

# Meta-analysis of the effect of proprioceptive exercise and theraband exercise on improving stability ankle in cases of chronic ankle instability (CAI) athletes

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## Abstract

**Received:**  
May 12, 2023

**Accepted:**  
June 15, 2023

**Online Published:**  
June 29, 2024

**Keywords:**  
Chronic ankle instability (CAI), meta analysis, proprioceptive exercise, theraband exercise.

Chronic Ankle Instability (CAI) is an injury to the lateral ligament complex that lasts more than 7 days. This study aims to analyze the effect of proprioceptive exercise and theraband exercise on increasing ankle stability in cases of chronic ankle instability (CAI) in athletes. The research method used in this research is systematic review and meta analysis carried out using PRISMA flow diagrams. Search for articles through journal databases including: PubMed, Science Direct, and Google Scoolar by selecting articles published in 2014-2024. The keywords used are "Chronic Ankle Instability" AND "(Proprioceptive OR Proprioceptive exercise)" AND "(Theraband OR Theraband Exercise)" AND "Stability" AND "Athlete". Inclusion criteria were full paper articles with a Randomized Controlled Trial (RCT) research method, the relationship measure used was the Mean SD, the intervention provided was Proprioceptive exercise and Theraband exercise, the research subjects had an age range of 12-45 years, and an athlete suffering from Chronic Ankle Instability (CAI). Eligible articles were analyzed using the Revman 5.3 application. The research results showed that the meta-analysis of 16 articles showed the results of Proprioceptive exercise (SMD= 1.10; 95% CI= 0.45 to 1.75; p= 0.00009) and Theraband Exercise (SMD= 1.05; 95% CI= 0.51 to 1.59; p= 0.0001). Thus, Proprioceptive exercise and Theraband Exercise have a significant effect on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes.

## Introduction

The ankle is an important part that plays a role in maintaining body balance when exercising or when carrying out daily activities. This makes the ankle one of the body locations that often experiences injury or damage (Hakim et al., 2022). In research by Ha et al. (2018), among patients who were athletes with ankle damage, 20% to 40% developed chronic ankle instability (CAI), which shows pain and instability of the ankle joint foot.

Athletes have a series of specific physiological characteristics and they are constantly faced with physical demands according to the required motor tasks, considering the various movements that must be practiced such as acceleration, deceleration, impulse, turning, sideways movement and jumping in a certain space so that they can cause injuries, especially to the lower extremities or ankle sprains (Silva et al. 2022).

Ankle sprain or Chronic Ankle Instability (CIA) is one of the most common injuries in sports and general activities (Lin et al., 2021; Al-Mohrej & Al-Kenani, 2016). Syafrianto (2017) in his research explained that in Indonesia, chronic ankle sprain injuries were the most frequent cases in athletes who took part in the DKI Jakarta PON regional training in 2012, namely 41.1% (Osborne & Esser, 2020). Nearly half (49.3%) of ankle sprains occur during sporting activities, including football and basketball in America (1.34 per 1,000 people). Around 31% to 40% of lateral ankle sprains can develop into chronic ankle injuries (Syafrianto et al., 2017).

Chronic Ankle Instability (CAI) is an injury to the lateral ligament complex that lasts more than 7 days. Injuries experienced with complaints of pain, chronic inflammation and instability in carrying out daily activities and sports caused by ligament weakness and decreased function including sensorimotor deficits

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ultimately lead to muscle weakness resulting in decreased postural tone and muscle strength and decreased proprioception, decreased flexibility and stability, and decreased balance (Calatayud et al., 2014).

One of the elements of physical condition in doing sports is balance. Balance can be interpreted as the body's ability to react to any changes which will ensure that the body's position remains stable and dynamic, whether static, such as in a still position, or dynamic, such as when performing locomotor movements. Because balance is so important in carrying out sports activities, training is needed to improve balance (Munawarah, 2019).

Chronic Ankle Instability (CAI) can occur due to overstretching of the lateral ankle ligament complex with inversion and plantar flexion which suddenly occurs when the foot does not rest perfectly on the floor/ground, which generally occurs on an uneven floor/ground surface. According to Farquhar (2013), factors that can facilitate the occurrence of Chronic Ankle Instability (CAI) are muscle weakness, especially the muscles around the ankle joint. Weakness or looseness of the ligaments in the ankle joint, poor balance ability, and uneven sports field surfaces, inappropriate shoes or footwear and daily activities such as working, exercising, walking and so on.

Alahmari et al. (2021) said that someone who experiences ankle instability is caused by reduced accuracy of proprioceptive signals from the ankle joint to carry out daily activities that require standing balance and to maintain overall body posture. Furthermore, Coelho-Oliveira et al. (2023) also stated that (CAI) can be caused by mechanical instability, functional instability or a combination of these two phenomena. Either mechanical instability can be caused by a specific insufficiency such as weakness, arthrokinematic changes, synovial inflammation, or degenerative changes. Functional instability is caused by a lack of neuromuscular control and proprioception. Thus, several implementations are needed which aim to improve balance and preventively improve existing factors. One thing that can improve functional balance is proprioceptive training (Siddaway & Hedges, 2019).

Proprioceptive training is an exercise designed to improve proprioception in ankle sprains. The proprioceptive mechanism for increasing stability, namely proprioception, describes afferent signals that move to the brain from receptors in the body that allow the brain to know where the body is. Proprioceptive input is provided to the brain via mechanoreceptors, vestibular receptors and visual receptors. Everything is

integrated into the central nervous system. Together these receptors stimulate efferent motor responses that produce appropriate body movements (Akre & Kumaresan, 2014). According to Syarfianto et al. (2021), proprioceptive training provides information about movement accuracy and muscle tissue reflexes to build dynamic stability in joints. Proprioceptive exercises train afferent neurons in an effort to increase the sense of movement in the joints and activate motor nerve function in the brain and activate the functional stability of the joints while maintaining it.

Han et al., (2015) said that ankle proprioception is an important component in maintaining balance, because it provides important information about adjusting the ankle position effectively in controlling balance. The result of research conducted by Yu & Kang (2022) show that ankle proprioceptive training can improve dynamic and static balance and is effective in preventing ankle injuries. A study conducted by Syarfianto et al. (2021) regarding the provision of strengthening exercises and proprioceptive exercises for functional ankle instability proves that proprioceptive exercises have a significant influence on improving the value of functional ankle stability. Furthermore, a study by Grueva-Pancheva et al. (2021) also proved that proprioceptive training improved the static and dynamic unilateral balance of patients with chronic ankle instability.

Apart from proprioceptive training, the use of media to help stabilize the body's mechanical balance in carrying out sports activities can also be done with exercise therapy using theraband exercise. Shanbei & Salekti (2018) theraband exercise is part of exercise therapy which plays a role in controlling the muscle nerves in the injured ankle and is one method of rehabilitation and prevention of ankle instability. The results of his research prove that theraband exercise significantly improves mechanical balance in cases of Chronic Ankle Instability (CAI).

Theraband is a device made from elastic rubber that functions as a loading medium to increase strength, mobility and range of motion (ROM) in one of the applications of exercise therapy. Theraband exercise aims to increase dynamic strength, endurance and muscle strength by using resistance that comes from external force. Theraband exercise in the form of isotonic exercises can help and improve muscle weakness caused by damage to the lateral ligament complex. Increased muscle strength is obtained by continuous training so that tonic muscle strength can increase capillary blood circulation which can increase phasic muscle strength which will result in additional

recruitment of motor units in the muscles which will activate the Golgi body so that the muscles will work optimally which ultimately forms stability, which is good for the ankle (Wulandari & Safitri, 2022).

Destya et al. (2020) stated that giving theraband exercise can increase strength which results in increased gamma-efferent activation. Elastic therabands have been shown to improve strength, mobility, and function and reduce joint pain. The results of his research prove that proprioception and theraband exercise can increase stability in basketball players who experience chronic ankle pain.

Various studies have been carried out to see the effect of proprioceptive exercise and theraband exercise on increasing stability in cases of Chronic Ankle Instability (CAI) in athletes, but the research results still do not show consistent results. In fact, in this way, experts in the physical field and sports players can further understand increasing ankle stability with these exercises to improve performance and achievement. Therefore, researchers are interested in further research by conducting a meta-analysis of the effect of proprioceptive exercise and theraband exercise on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes. Meta analysis is an epidemiological study that statistically combines data from primary research that discusses the same hypothesis to obtain quantitative summary results

The novelty of this research is using meta-analysis research with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) procedure to summarize the primary research involved. The aim of this research is to carry out a Meta analysis to examine the effect of proprioceptive exercise and theraband exercise on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes. The variable studied as an outcome of the intervention was an increase in ankle stability in athletes suffering from Chronic Ankle Instability (CAI). In this systematic review and Meta analysis, researchers involved research studies in all countries in the world using the randomized controlled trial (RCT) method. Reference management is needed as a digital library to help organize the articles that researchers want. The use of the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) diagram is used for transparency in the flow of information from collection to filtering articles. The picture is explained by starting with the flow of information through the collection, filtering, and eligibility of articles included in the systematic review using a graph adapted from the

Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) diagram developed by Moher, Liberati, Tetzlaff, Altman, and The PRISMA Group (Hadi et al., 2020).

The results of this meta-analysis may include more precise estimates of intervention effects or disease risk factors. So this meta-analysis research is useful for identifying more clearly the magnitude of proprioceptive exercise and theraband exercise in increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes.

## Methods

This research uses a systematic review, meta-analysis technique with data sourced from secondary data from databases obtained from previous studies. Make a summary of various journals specifically with the question asked in this research, namely the effect of proprioceptive exercise and theraband exercise on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes. There is no general agreement regarding the use of several articles as research samples regarding the last year of the article used, but in most studies that have been conducted by previous researchers using the last 3 to 10 years the article was published (Hadi et al., 2020). This research selects articles and presents several research results that are in accordance with the predetermined themes. The article that will be reviewed and is in accordance with the research topic is identifying more clearly the magnitude of proprioceptive exercise and theraband exercise in increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes. The data screening process will use Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA). The flow of information from the prism can be seen in the image below as follows.

## Results

The aim of this research is to find out which has a greater effect between proprioceptive exercise and theraband exercise on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes. After searching for articles, we obtained them from several systematic and comprehensive databases, including PubMed, Science Direct, and Google Scholar. Article searches were carried out using the keywords "Chronic Ankle Instability" and "Proprioceptive exercise" and "Theraband Exercise" and "Stability" and "Athlete".

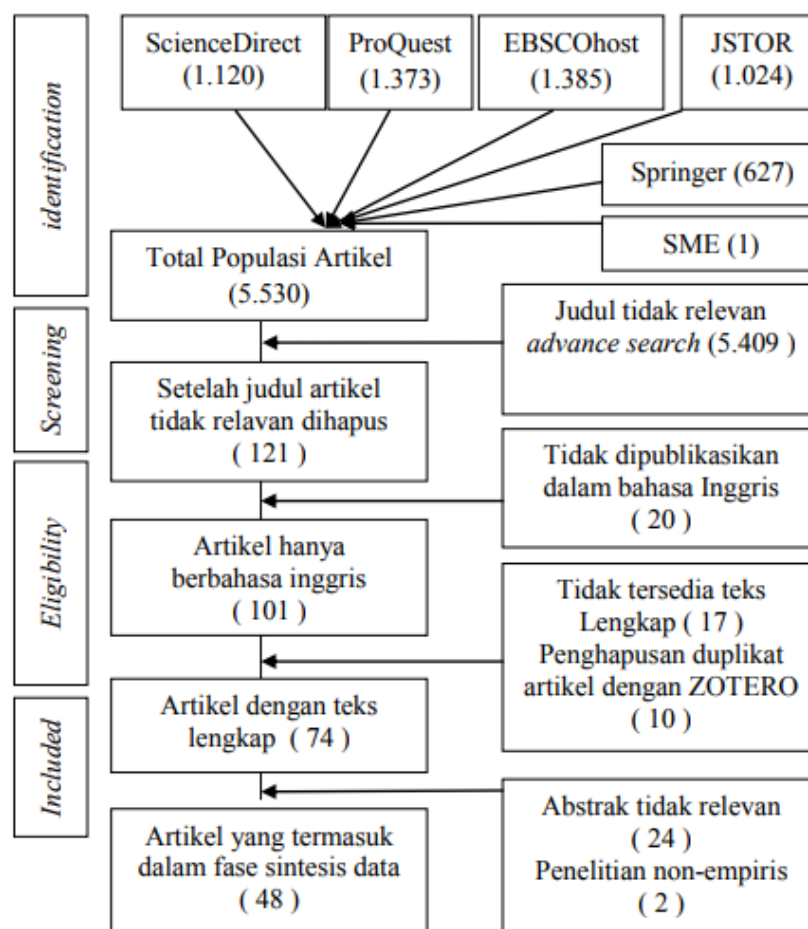


Figure 1. Article Screening Process.

The initial search process yielded results of 1649 articles, after the process of deleting published articles, 844 articles were obtained, of which 135 articles met the requirements for full text review. Articles that fall into the exclusion criteria are due to the following things:

After reviewing the full text of the article, it was found that the interventions from the study on Ankle chronic were not appropriate (non-proprioceptive exercise and theraband exercise).

The article is not appropriate, does not include the Mean SD value.

The outcome of the primary study does not match the expected criteria (not to increase stability).

After conducting an assessment, articles were found whose research subjects were not in the population of athletes who experienced chronic ankle instability.

The results of the articles that met the qualification requirements were reviewed again and 16 articles were found that met the quantitative requirements for Meta

analysis and were divided into 2 categories according to the independent variables, including:

1. Proprioceptive exercise, there are 8 articles
2. Theraband exercise, there are 8 articles

The article review process can be seen in Figure 2.

### Assessment of Research Quality

The research quality assessment is shown in table1 using the Critical Appraisal Skills Program (CASP). Each of the 11 questions was answered with the options: Yes, No and Not Clear.

Based on the study quality assessment using the Critical Appraisal Skills Program (CASP), 16 articles were included in the quantitative Meta analysis synthesis. There are 16 observational study articles as a source of Meta analysis of the influence of Proprioceptive Exercise and Theraband Exercise on Increasing Ankle Stability in Chronic Ankle Instability (CIA) Cases, namely.

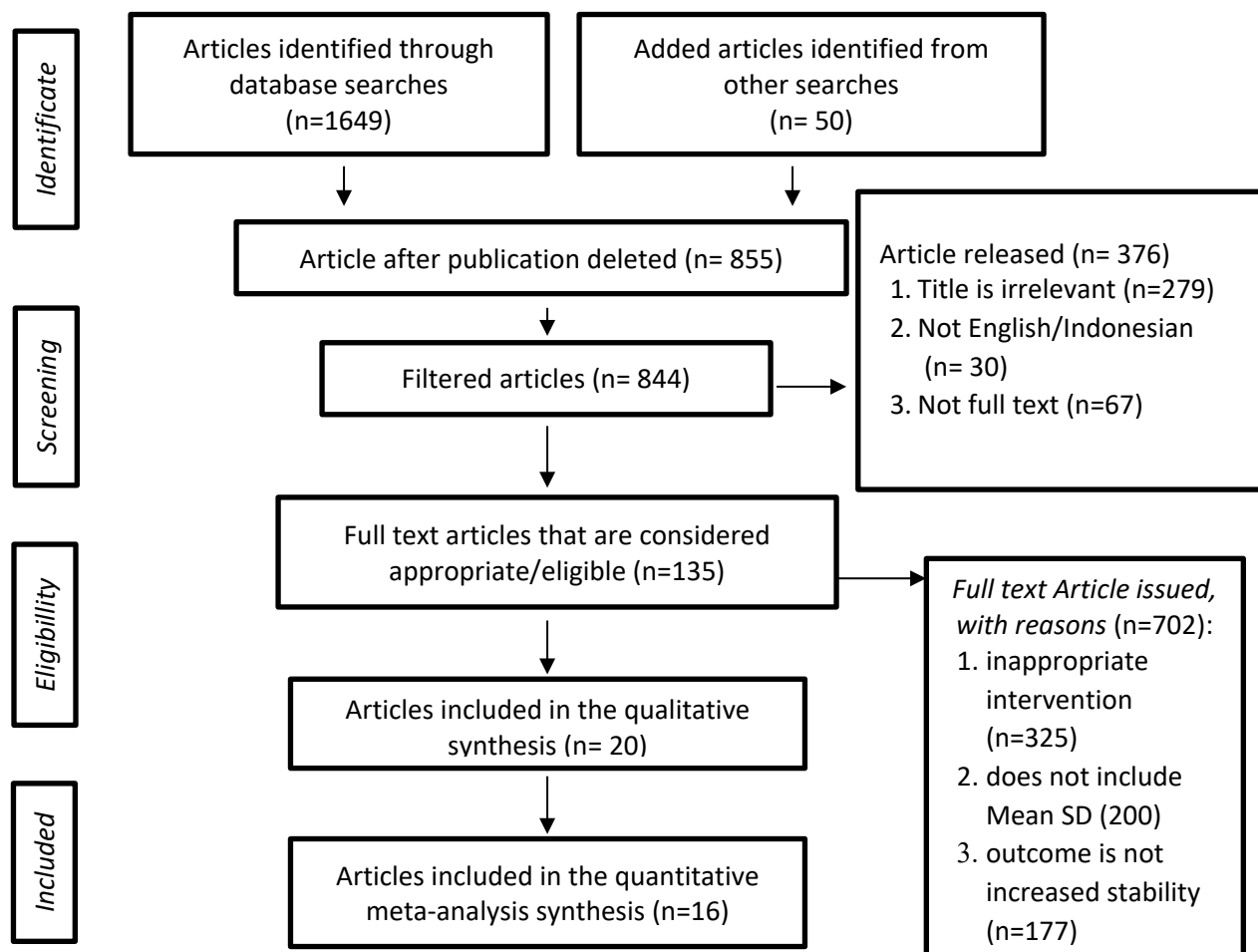


Figure 2. Prisma Flow Diagram.

Table 1

Research quality assessment.

Publications	1	2	3	4	5	6	7	8	9	10	11
Gidu et al. (2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Harry-Leite et al. (2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mudaliar & Dharmayat (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pinzón-Romero et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ribas et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Syafriyanto & Muchlis (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yoo et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zacharakis et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Aksen-Cengizhan et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cruz-diaz et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destya et al. (2020)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Sebianto et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spencer Cain et al. 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tabatabae et al. (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wang et al. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wang et al. (2022)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

**Table 2**

Proprioceptive Exercise (Summary Source).

No	Authors	Location	Sample Size	Intervention and Control	Outcome	Control		Intervention	
						Mean	SD	Mean	SD
1	Gidu et al. (2022)	Romania	96	I: Proprioceptive exercise C: No intervention	Increased ankle stability	4.37	7.45	8.57	1.98
2	Harry-Leite et al. (2022)	Portugal	40	I: Proprioceptive exercise C: No intervention	Increased ankle stability	4.92	1.84	5.33	1.80
3	Mudaliar & Dharmayat (2019)	India	45	I: Proprioceptive exercise C: No intervention	Increased ankle stability	27.2	1.7	29.22	0.9
4	Pinzón-Romero et al. (2018)	Colombia	58	I: Proprioceptive exercise C: No intervention	Increased ankle stability	5.21	4.32	5.24	4.65
5	Ribas et al. (2017)	Brazil	20	I: Proprioceptive exercise C: No intervention	Increased ankle stability	75.3	6.45	77.43	6.4
6	Syafriyanto & Muchlis (2020)	Indonesia	20	I: Proprioceptive exercise C: No Intervention	Increased ankle stability	20.7	1.41	25.65	1.13
7	Yoo et al. (2018)	South Korea	20	I: Proprioceptive exercise C: No intervention	Increased ankle stability	3.6	1.12	4.70	1.73
8	Zacharakis et al. (2020)	Greece	30	I: Proprioceptive exercise C: No intervention	Increased ankle stability	8.4	0.5	9.9	0.5

**Table 3**

Theraband training (Summary Source).

No	Authors	Location	Sample Size	Intervention and Control	Outcome	Control		Intervention	
						Mean	SD	Mean	SD
1	Aksen-Cengizhan et al. (2018)	Turkiye	22	I: Theraband training C: Swiss ball	Increased ankle stability	5.24	3.15	7.66	3.59
2	Cruz-diaz et al. (2015)	Spain	70	I: Theraband exercise C: No intervention	Increased ankle stability	81.06	1.24	83.42	3.72
3	Destya et al. (2020)	Indonesia	16	I: Latihan Proprioseptif dan theraband exercise C: Latihan proprioseptif dan antero posterior glide	Increased ankle stability	17.87	2.9	28	4.34
4	Sebianto et al. (2020)	Indonesia	20	I: Proprioceptive training with theraband C: Proprioceptive with wooble board	Increased ankle stability	6.6	5.03	13.80	10.30
5	Spencer Cain et al. 2020	USA	23	I: Theraband exercise C: No Intervention	Increased ankle stability	76.99	9.93	81.25	12.29
6	Tabatabae et al. (2019)	Iran	24	I: Theraband exercise C: No Intervention	Increased ankle stability	3.85	2.14	4.97	3.07
7	Wang et al. (2021)	China	54	I: Theraband training C: Proprioceptive exercise	Increased ankle stability	91.2	6.6	93.5	5.6
8	Wang et al. (2022)	China	52	I: Theraband training C: No intervention	Increased ankle stability	17.62	3.51	18.15	4.07

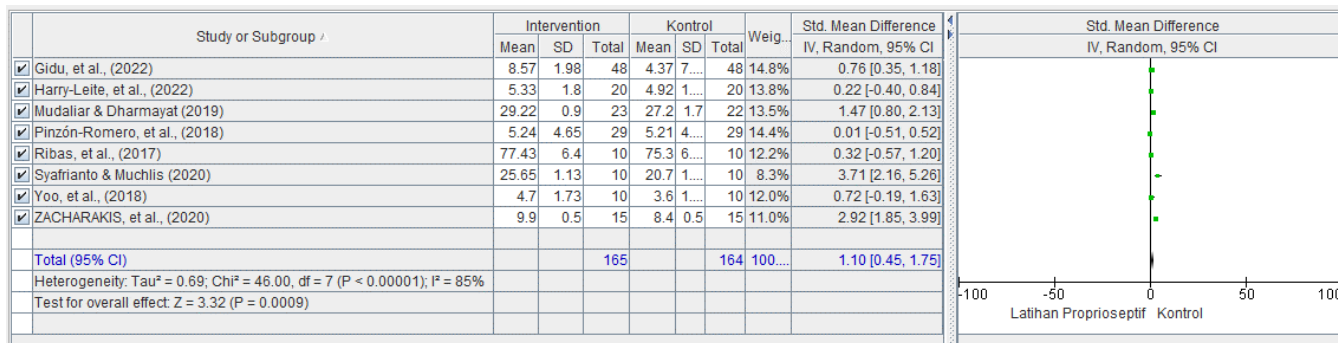


Figure 3. Forest plot Proprioceptive Exercise.

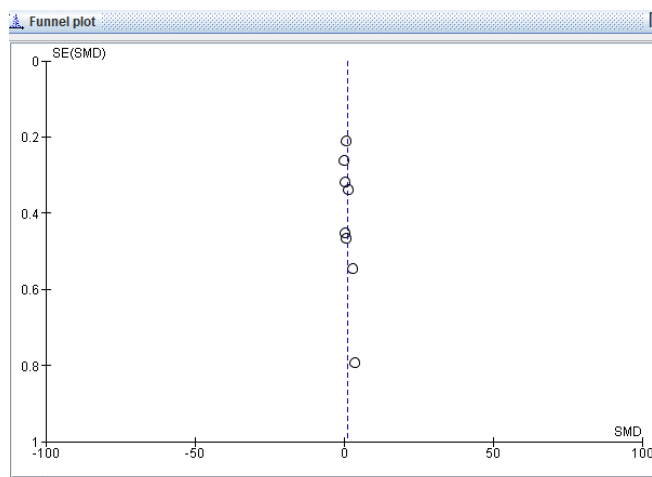


Figure 4. Funnel plot Propripseptive Exercise.

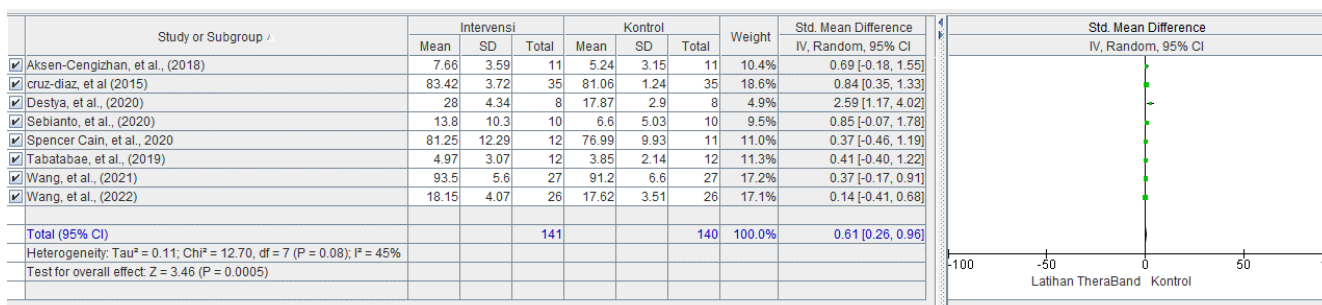


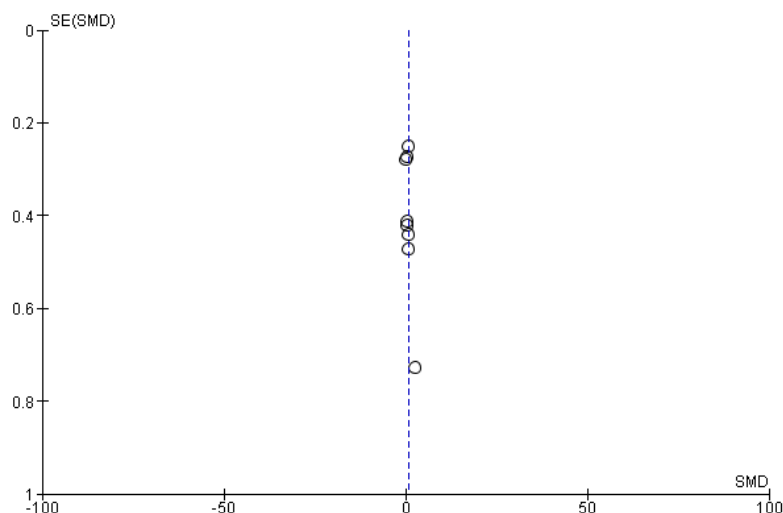
Figure 5. Forest Plot TheraBand Exercise.

Based on the results of the analysis in Figure 3, it can be seen that 8 articles have reported that proprioceptive exercise can increase ankle stability in cases of Chronic Ankle Instability (CAI) compared to other interventions or no intervention. Meanwhile, there is high heterogeneity between experiments ( $I^2 = 85\%$ ). The results of the analysis of proprioceptive exercise showed that 1.10 units had an effect on increasing ankle stability in cases of Chronic Ankle Instability compared to other interventions or no intervention and was statistically significant ( $p = 0.0009$ ).

A funnel plot is a plot that depicts the estimated effect size of each study against its estimate of precision, which is usually the standard error. Based on Figure 4, it shows that there is publication bias as indicated by the

asymmetrical distribution of the right and left plots, where the left plot appears to have a standard error between 0 and 0.6, while the right plot has a standard error between 0.4 and 1.

Based on the results of the analysis in Figure 5, it can be seen that there are 8 articles reporting that TheraBand exercise can increase ankle stability in cases of Chronic Ankle Instability (CAI) compared to other interventions or no intervention. Meanwhile, there is moderate heterogeneity between experiments ( $I^2 = 45\%$ ). The results of the analysis of TheraBand training showed that 0.61 units had an effect on increasing ankle stability in cases of Chronic Ankle Instability (CAI) compared to other interventions or no intervention and was statistically significant ( $p = 0.0005$ ).



**Figure 6.** Funnel Plot TheraBand Exercise.

Based on Figure 6, it shows that there is publication bias as indicated by the asymmetrical distribution of the right and left plots, where the left plot appears to have a standard error between 0 and 0.6, while the right plot has a standard error between 0.6 and 0.8.

## Discussion

Ankle sprain or Chronic Ankle Instability (CIA) is one of the most common injuries in sports and general activities (Lin et al., 2021; Al-Mohrej & Al-Kenani, 2016). Nearly half (49.3%) of ankle sprains occur during sporting activities (Herb & Hertel, 2014) and have high rates in American football and basketball (1.34 per 1,000 people) (Bhaskaran et al., 2018). Around 31% to 40% of lateral ankle sprains can develop into Chronic Ankle Instability (CIA) (Syafrianto et al., 2017). Chronic Ankle Instability (CIA) is an injury to the lateral ligament complex that lasts more than 7 days. Weakness in ligaments and decreased function, including sensorimotor deficits, can cause muscle weakness, resulting in reduced postural tone and muscle strength, as well as decreased stability and balance (Calatayud, 2014).

Factors that can facilitate the occurrence of Chronic Ankle Instability (CIA) can occur due to overstretching of the lateral ankle ligament complex with inversion and plantar flexion which suddenly occurs when the foot is not perfectly supported on the floor/ground, which generally occurs on the surface of the floor. According to Farquhar (2013) factors that can facilitate the occurrence of Chronic Ankle Instability (CIA) are muscle weakness, especially the muscles around the ankle joint. Weakness or looseness of the ligaments in

the ankle joint, poor balance ability, and uneven sports field surfaces, inappropriate shoes or footwear and daily activities such as working, exercising, walking and so on.

Coelho-Oliveira et al. (2023) stated that CAI can be caused by mechanical instability, functional instability or a combination of these two phenomena. Mechanical instability can be caused by specific insufficiency such as weakness, arthrokinematic changes, synovial inflammation, or degenerative changes. Functional instability is caused by a lack of neuromuscular control and proprioception, so it is necessary to pay attention to proprioception as an effort to prevent injury by improving balance. Symptoms of ankle instability include subjective feelings of ankle weakness, pain, swelling, spraining, and/or limitations in activities of daily living and sports participation. Chronic ankle instability can be caused by several different factors, including mechanical (joint laxity, altered kinematics, and degenerative or synovial changes in the talocrural joint cartilage) or functional (lack of proprioception, strength, or muscle control) disorders (Panhale & Chheda, 2020).

Mylsidayu et al. (2020) states that proprioception is the body's ability to sense movement, location and actions with the aim of preventing injury by increasing spatial awareness and balance. Continued by Destya et al. (2020) stated. Theraband exercise aims to increase dynamic strength, endurance and muscle strength by using resistance that comes from external force. Balance is the ability to maintain the nervous-muscular system in an efficient position or attitude when we move. Balance is also defined as an individual's ability to

maintain the projection of the center of the body on a supporting platform, whether standing, sitting, moving or walking (Munawarah, 2019). Ankle Stability is the ability of the body structure to maintain stability in various positions.

This research includes a systematic review and meta-analysis on the effect of proprioceptive and theraband training. The independent variables analyzed were proprioceptive exercise and theraband exercise. The dependent variable studied was increased ankle stability. The results of the primary study which carried out a systematic review and Meta analysis showed an epidemiological study design with a larger sample, different demographic characteristics from both developed and developing countries, thus providing a basis for concluding that proprioceptive exercise and theraband exercise have an effect on increasing ankle stability.

This research analyzes articles that use the Mean SD measure. The results of the systematic review and Meta analysis are presented in the form of a forest plot and funnel plot. A forest plot is a diagram that shows at glance information from each study examined in a Meta analysis and an estimate of the overall results (Murti, 2018). The forest plot also visually displays the amount of variation (heterogeneity) between study results. The funnel plot shows the relationship between the study effect size and the sample size or standard error of the effect size from the various studies studied (Murti, 2018). As explained in the research that I have carried out, the following results were obtained. 1) There are 8 research articles as a source for Meta analysis of the effect of proprioceptive exercise on increasing ankle stability in cases of Chronic Ankle Instability (CIA). The plot results show that proprioceptive exercise can increase ankle stability in cases of Chronic Ankle Instability (CIA) and it is significant (SMD= 1.10; 95% CI= 0.45 to 1.75; p= 0.00009). 2) There are 8 research articles as a source for meta analysis of the effect of theraband exercise on increasing ankle stability in cases of Chronic Ankle Instability (CIA). The plot results show that theraband exercise can increase ankle stability in cases of Chronic Ankle Instability (CIA) and is significant (SMD= 1.05; 95% CI= 0.51 to 1.59; p= 0.0001).

The results of this study are in line with research conducted by Yu & Kang (2022) showing that proprioceptive exercise on the ankle can improve dynamic and static balance and is effective in preventing ankle injuries. O'Driscoll & Delahunt (2021)

says that ankle proprioception is an important component in maintaining balance, because it provides important information about adjusting ankle position effectively in controlling balance. The proprioceptive mechanism for increasing stability is by drawing afferent signals that move to the brain from receptors in the body that allow the brain to know where the body is. Proprioceptive input is provided to the brain via mechanoreceptors, vestibular receptors and visual receptors. Everything is integrated into the central nervous system. Together these receptors stimulate efferent motor responses that produce appropriate body movements (Akre & Kumaresan, 2014). Research conducted by Syafrianto et al. (2017) showed that proprioceptive exercise for 3 sessions per week for 6 weeks can increase functional ankle stability in young figure skaters. Zaghlul et al. (2023) also proved in taekwondo athletes that proprioceptive exercise for 6 weeks influenced increased stability. The positive effects produced by proprioceptive exercise have basically also been proven in other sports such as football, basketball, skiing, handball, running Al-Mohrej & Al-Kenani (2016).

Zaghlul et al. (2023) explained that balance is the ability to move or maintain a posture in a standing position while maintaining weight so that a certain posture can be maintained. In particular, ankle strategies are important to provide stability for balance control and proprioceptive exercises have been shown to be effective in the prevention of recurrent ankle injuries. The research results of Zaghlul et al. (2023) suggest proprioceptive exercise to improve dynamic balance. Proprioceptive exercise can increase functional stability of the ankle in cases of functional ankle instability (Goulart et al., 2022). Acute ankle sprains can lead to decreased participation in sporting activities and overall performance of an athlete by causing decreased muscle strength, short-term loss of ankle range of motion, functional instability, and decreased proprioceptive input. Proprioception describes afferent signals traveling to the brain from receptors in the body that allow the brain to know where the body is in space. Proprioceptive exercise stimulates the activity of the muscles that act on the ankle, which helps increase stability in athletes (Yong, 2017).

Research conducted by Shashidharan & Selvan (2022) on the effect of proprioceptive exercise on balance in adolescent basketball players aged 13-14 years found that doing proprioceptive exercise for 8 weeks increased the balance score of basketball players. Proprioceptive balance training programs can benefit balance and have

a supportive effect on the technical skills of various sports. Proprioception is necessary to establish accurate, efficient, and coordinated efferent system responses to environmental demands. The ability to maintain balance while standing on one leg or both legs requires the integrity of the visual, vestibular, and nervous systems.

The stability of the ankle joint is very important when considering balance management. Ankle balance and proprioceptive abilities are both related to the level of competition in various sports. The proprioceptive ankle may be one of the important components contributing to balance control in sports, because during most sporting activities, the ankle complex is the only part of the body in contact with the ground. Ankle proprioception provides important information to enable adjustment of ankle position and upper body movement, to successfully perform the complex motor tasks required in elite sport (Kleffelgaard et al., 2017). Researchers argue that proprioceptive exercise can increase competitiveness and reduce the risk of injury if directed adequately, even when combined with strength training; it can increase the effectiveness of proprioceptive training. The effect of proprioceptive exercise on athletes is more effective if the training protocol lasts between 8 weeks and 12 weeks with a frequency of two sessions per week at 45 minutes per session (Gurevitch et al., 2018).

In research by Docherty et al. (2018) on the effect of Theraband exercise on the dynamic balance index of male basketball players who trained in 3 sessions for 8 weeks, it was found that resistance training using a theraband caused an increase in the stability index in the anterior-posterior axis, medial - lateral and overall axis. Theraband exercise can cause the function of nerve mechanisms provided from the spine to activate agonist muscles compared to antagonist muscles. Training using a theraband is effective in preventing sports injuries in maintaining proprioceptive sense of ankle receptors and improving nerve and muscle response in basketball players. Exercises using Theraband are often done because they are less susceptible to injury, have constant tension, and are easy to do by anyone, especially Theraband can freely control the intensity of the load, and are widely used in rehabilitation treatment for muscle strength training, sports trauma, and disability as it allows for customized training taking into account the individual's athletic abilities. In other words, strength training using theraband exercise offers a safe form of resistance so that the risk of injury is small, the cost is low, and is effective in increasing

muscle strength (Nagai et al., 2013).

The results of this study are in line with the results of research conducted by Wang, et al., (2020) which examined the effect of Isokinetic Strength and Theraband training to improve balance. The results of the research show that theraband exercise can improve body balance, but compared to isokinetic strength training, the effect of theraband on improving balance is not significant. Furthermore, Wiguna et al. (2016) said that the lack of training protocols could affect, training cycles or more frequent training might improve balance. Research conducted by Cruz-Diaz et al. (2015) states that theraband exercise can be used to prevent and rehabilitate chronic ankle pain. These physiological changes may result in more effective proprioceptive feedback, thereby improving ankle joint balance and mechanics.

Further research was conducted by Bonnel et al. (2020) which combined "Proprioceptive Exercises and Theraband Exercises to Improve Stability in Basketball Players Who Experience Chronic Ankle Sprain". The results of the study show that Proprioceptive and Theraband training can increase muscle development and improve neuromuscular control and also influence motor unit recruitment, selective activation of agonist muscles and their motor units, and coactivation of antagonists. The improvements that occurred were associated with muscle spindle sensitivity and afferent activation, indicating that force using the theraband effectively increased proprioceptive measures of balance.

Theraband exercise can increase strength which results in increased gamma-efferent activation. The spindle becomes more sensitive to instantaneous stretch, resulting in greater acuity in sensing joint position, and dynamic gamma efferent increases sensitivity to the rate of change in length. Theraband exercise has been proven to improve strength, mobility and function and reduce joint pain. Using theraband exercise can help increase ROM, reduce pain, nerve blockage, muscle function faster and increase performance in sports and all daily activities (Al-Mohrej & Al-Kenani, 2016). Prevention of chronic ankle sprain injuries requires special training to avoid re-injury because in general injuries that occur to the ankle are sprains. Through proprioceptive training and ankle muscle strengthening training with elastic resistance rubber, balance and neuromuscular control will improve resulting in a reduction in foot and ankle disability with the return of movement efficiency and

normal activities (Winter et al., 2015).

## Conclusion

Meta analysis conducted on 16 observational study articles from 3 continents consisting of 8 articles that researched proprioceptive exercise and 8 articles that researched theraband exercise, it can be concluded that proprioceptive exercise has a greater effect than theraband exercise in increasing ankle stability in cases of Chronic Ankle Instability (CAI) athletes with results from proprioceptive exercise of 1.10 units, significant value (SMD= 1.10; 95% CI= 0.45 to 1.75; p= 0.00009) and results from theraband exercise of 0.61 units, significant value (SMD= 1.05; 95% CI= 0.51 to 1.59; p= 0.0001).

The results of this meta-analysis research can be used as a reference and evaluation in preventing and minimizing the problem of decreased stability in the ankle, so as to reduce the incidence of Chronic Ankle Instability (CAI), especially in athletes. Apart from that, the results of this research can also be used as reference material in treating increased ankle stability due to Chronic Ankle Instability (CAI). Apart from that, the research has limitations in searching for articles. There are not many articles that analyze Proprioceptive exercise and Theraband Exercise variables on increasing ankle stability in cases of Chronic Ankle Instability (CAI) in athletes with an observational study design that includes the mean and standard deviation.

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