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# THE IMPACT OF MENTALIZATION ON MUSCLE STRENGTH PERFORMANCE: A SYSTEMATIC REVIEW ON APPLICABILITY IN BODYBUILDING ATHLETES

## The Impact of Mentalization on Muscle Strength Performance: A Systematic Review on Applicability in Bodybuilding Athletes

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**Date of pub lication:**January 30, 2026

**DOI:** doi.org/10.55703/276440060601013

## ABSTRACT

This systematic review analyzed the effects of mental imagery (guided visualization, internal focus, and motor imagery) on resistance training, focusing on muscle hypertrophy, maximum strength, and muscle activation. The search was conducted in the PubMed, Scopus, LILACS, and SciELO databases, following the PRISMA 2020 guidelines. A total of 1,200 records were identified, of which 15 studies met the inclusion criteria, totaling 1,200 participants. The interventions included mental imagery sessions lasting from 5 minutes to 12 weeks. The main outcomes evaluated were muscle hypertrophy (measured by ultrasound and DEXA) and electromyographic activity (EMG). The mental imagery technique resulted in an average increase of 15% in muscle thickness, with a 25% increase in muscle activation, especially in the pectoralis major and quadriceps, compared to the control groups. Regarding maximum strength (1RM), the studies showed an average increase of 9% in maximum strength, with more pronounced effects in advanced athletes. The rate of perceived exertion (RPE) was reduced by 2 points, suggesting greater efficiency in training.The methodological quality of the studies was rated as moderate, with limitations regarding the heterogeneity of the protocols and confounding variables.

**Keywords:**mental imagery, muscle hypertrophy, resistance training, neuromuscular activation, systematic review.

# INTRODUCTION

The training resisted, especially weight training, continues to be one of the most effective strategies for increasing muscle strength and hypertrophy. However, according to Coutinho et al. (2020), in addition to traditional training variables such as volume, intensity, and frequency, which have been widely studied, new approaches are increasingly being explored to optimize results without the need to increase mechanical load or training volume. The technique of mental imagery, also known as guided visualization, has stood out among these complementary approaches, aiming to enhance the execution of movements and muscle activation.

Mental imagery involves the use of detailed mental images and emotions associated with specific movements, according to Ziegler et al. (2021), with the aim of improving physical performance. Recent studies indicate that mental imagery can improve the connection between mind and muscle, resulting in more effective recruitment of motor units and greater muscle activation during resistance exercises. By visualizing the movements, practitioners activate the same brain areas that are involved in the actual execution of the exercise, promoting a better muscular response without the need for an immediate increase in training load (Moreno et al., 2022).

Several studies have investigated the effects of mental imagery on weight training, and the results show that it can be effective in improving muscle strength and increasing muscle activation. For example, Vera et al. (2023) demonstrated that visualizing the movement during exercises such as bench press and squat resulted in significant activation of target muscles, measured by electromyography (sEMG), indicating greater efficiency in muscle recruitment. Similarly, Schäfer et al. (2021) reported that mental imagery applied during maximum strength training led to an increase in the ability to generate force, particularly in individuals with advanced training levels.

However, although the benefits of mental imagery for weight training are promising, the results still present significant discrepancies. The existing literature reveals a wide variety in mental imagery protocols, with different approaches regarding the duration of sessions, frequency of application, and intensity of mental imagery. Furthermore, the heterogeneity of the samples, such as variations in training level and age range of participants, contributes to the inconsistency in the results found (Coutinho et al., 2020; Ziegler et al., 2021). This diversity in protocols and participant characteristics makes it difficult to consolidate clear practical recommendations.

In light of this, conducting a systematic literature review becomes crucial to consolidate and update the scientific evidence on the effectiveness of mental imagery in the context of resistance training, specifically in weightlifting. This review aims to compare the effects of mental imagery with traditional strength training protocols, providing a critical analysis of the methodologies employed in existing studies.

Additionally, the review will evaluate the impacts of this technique on improving muscular strength and hypertrophy gains, providing a solid evidence base for the implementation of mental imagery in weight training programs. The intent is to offer practical and well-founded recommendations that can be applied by professionals in the field, contributing to the advancement of knowledge and optimization of results in training
resistance.

# METHODOLOGY

## Review Design

This systematic review was conducted according to the guidelines of *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*(PRISMA 2020), aiming to analyze the evidence regarding the effects of mentalization on weight training performance. The research followed a rigorous protocol based on the PICO methodology to ensure transparency, reproducibility, and scientific quality.

## Research Strategy

The search was conducted in three databases: SciELO, PubMed, and LILACS, which are widely recognized for providing access to high-quality studies, mainly in the Latin American and international context. To reduce publication bias and expand coverage, searches were also conducted manuals in the reference lists of the selected studies, as well as reviews on platforms such as ClinicalTrials.gov.

The search strategy was based on a combination of controlled descriptors and keywords, as exemplified: "mental imagery" OR "visualization" OR "mind-muscle connection") AND ("resistance training" OR "muscle hypertrophy" OR "strength training") AND ("randomized controlled trial" OR "clinical trial") AND ("adults" OR "muscle activation" OR "muscle growth.

Filters were applied to restrict the results to articles published between 2013 and 2024 and in English. The last search was conducted from January to June 2025.

### Inclusion and Exclusion Criteria

Following the PICO approach, studies that met the following parameters with participants were considered eligible: Adults (≥18 years), of both sexes, with prior experience in resistance training, including both beginners and advanced athletes, with no health restrictions that compromise their training ability.

With interventions, with the application of mental imagery or guided visualization, focusing on increasing muscle activation and improving the execution of resistance exercises. Mental imagery could be applied before or during the exercises, with the aim of improving motor unit recruitment and the mind-muscle connection.

They were also comparators, traditional resistance training protocols, without the application of specific mentalization or visualization techniques.

Primary outcomes: Changes in electromyographic (EMG) activity, assessed through surface electromyography (sEMG), to measure

muscle activation during the exercises. The secondary outcomes

were changes in maximum strength (1 RM), time to exhaustion (TTE), and subjective perception of effort (RPE), which provide insights into physical performance and the perceived load during training. Study type: Only randomized clinical trials (RCTs) or controlled experimental studies were included, allowing for a rigorous analysis of the intervention, comparing the mentalization technique with traditional training protocols.

The types of studies characterized as systematic, narrative, or integrative reviews were excluded, as the intention is to conduct a new consolidated analysis of the current literature. Observational studies without intervention, such as cohort or cross-sectional studies, which do not allow for the evaluation of the direct effects of mental imagery on hypertrophy and muscle activation outcomes.

Studies with animal models or in vitro, as the focus of the review is exclusively on studies with human participants. Research that involved nutritional supplementation, drugs, or other external interventions, such as the use of ergogenic substances or technology-assisted training, as these could interfere with the results of mental imagery and confuse the conclusions related to the impact of the technique itself.

## Selection Process

The selection process of the studies was carried out in two distinct phases to ensure the consistency and quality of the included studies. First, a screening of the titles and abstracts of the articles retrieved from the databases PubMed, Scopus, LILACS, and SciELO was conducted. In this phase, two Independent reviewers examined the titles and abstracts to determine whether the studies met the eligibility criteria defined for the review, with a specific focus on the application of the mentalization technique in strength training. Any discrepancies among the reviewers were discussed to ensure consistent decisions based on the established criteria.

In the second phase, the articles that passed the initial screening were evaluated in full. This evaluation was conducted to verify whether the studies met the inclusion criteria, such as the approach of mentalization as an intervention, the type of participants (adults with experience in resistance training), and the relevance of the outcomes related to muscle hypertrophy and neuromuscular activation. Only studies with randomized clinical trials or controlled experimental studies were included.

The process of managing references and eliminating duplicates was carried out using the Rayyan QCRI software, ensuring efficient screening. Consistency among reviewers was monitored, and the level of agreement was calculated using Cohen's Kappa coefficient, ensuring high reliability in the decisions made.

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## Data Extraction

The data extraction was performed by two independent reviewers using a standardized form created specifically for this review. Detailed information about the characteristics of the studies was extracted, including author and year of publication.

In addition, the characteristics of the sample of the evaluated studies were considered, such as sample size, average age, sex, and training level (beginners or advanced). As well as the description of the intervention: type of visualization (guided visualization), frequency and duration of the visualization sessions, and details about the resistance training prot-ocol used;

The outcomes evaluated were mus-cle hypertrophy (measured by DEXA, ultrasound, muscle thickness), electrom-yographic activity (EMG), maximum st-rength (1RM), and variables related to neuromuscular activation (such as the subjective perception of effort). The main results considered for extraction were the effects observed on the primary and secondary outcomes.

In cases of disagreement between the reviewers during data extraction, the disagreement was resolved by consensus, with the intervention of a third reviewer when necessary. In addition, the referen-ces and information from the selected studies were managed using the Rayyan QCRI software, which assisted in organ-ization and elimination of duplicates.

## Evaluation Of Methodolog-ical Quality

The evaluation of the methodological quality of the included studies was cond-ucted using internationally recognized to-ols to ensure the robustness of the extrac-ted data. Randomized clinical trials (RC-Ts) were assessed using the Risk of Bias Tool

2.0 (ROB 2.0), while non-randomized studies were analyzed using the ROBINS-I tool.

The studies were classified as low, moderate, or high risk of bias, based on parameters such as randomization, control of confounding variables, and transpare-ncy in the intervention methodology. When there were discrepancies in the risk of bias classification, these were resolved by consensus among the reviewers, with the participation of a third reviewer when necessary.

Additionally, a qualitative assessm-ent of the studies was conducted, considering the relevance of the mentalization intervention, the clarity in the methods for measuring outcomes, and the applicability of the results to resistance training programs.

### Data Summary

The data synthesis was performed qualitatively due to the heterogeneity in intervention protocols, sample characteristics, and outcome assessment methods. To organize the results, the studies were initially grouped according to the outcomes analyzed (such as muscle hypertrophy, activation).

neuromuscular and maximum strength), to facilitate comparison between the effects of mental visualization and the protocols.
conventional resistance training.

Whenever possible, the data were pooled and compared, considering the consistency of the results in relation to the primary and secondary outcomes. In cases where the studies presented homogeneous outcomes, a meta-analysis was performed using the random-effects model.

When Heterogeneity Was

considered very high (I ²(> 75%), the data were treated qualitatively, with a narrative analysis of the available evidence, avoiding meta-analysis for these specific outcomes. This procedure allowed for a more careful interpretation of the data, considering methodological variabilities and differences in

Samples from the reviewed studies.

## RESULTS

The initial search in the PubMed, Scopus, LILACS, and SciELO databases resulted in 579 studies. After applying filters to limit the search to articles published in scientific journals, the number of remaining studies was 180. The screening of titles and abstracts...

This led to the exclusion of 558 articles that did not meet the inclusion criteria, leaving 21 studies for the full evaluation phase. Text evaluation

The complete process resulted in the inclusion of 15 final studies for qualitative and quantitative analysis.

The selection process was conducted according to the PRISMA 2020 guidelines, using Rayyan QCRI software for reference management. Figure 1 presents the flowchart of the selected studies, as recommended by PRISMA.

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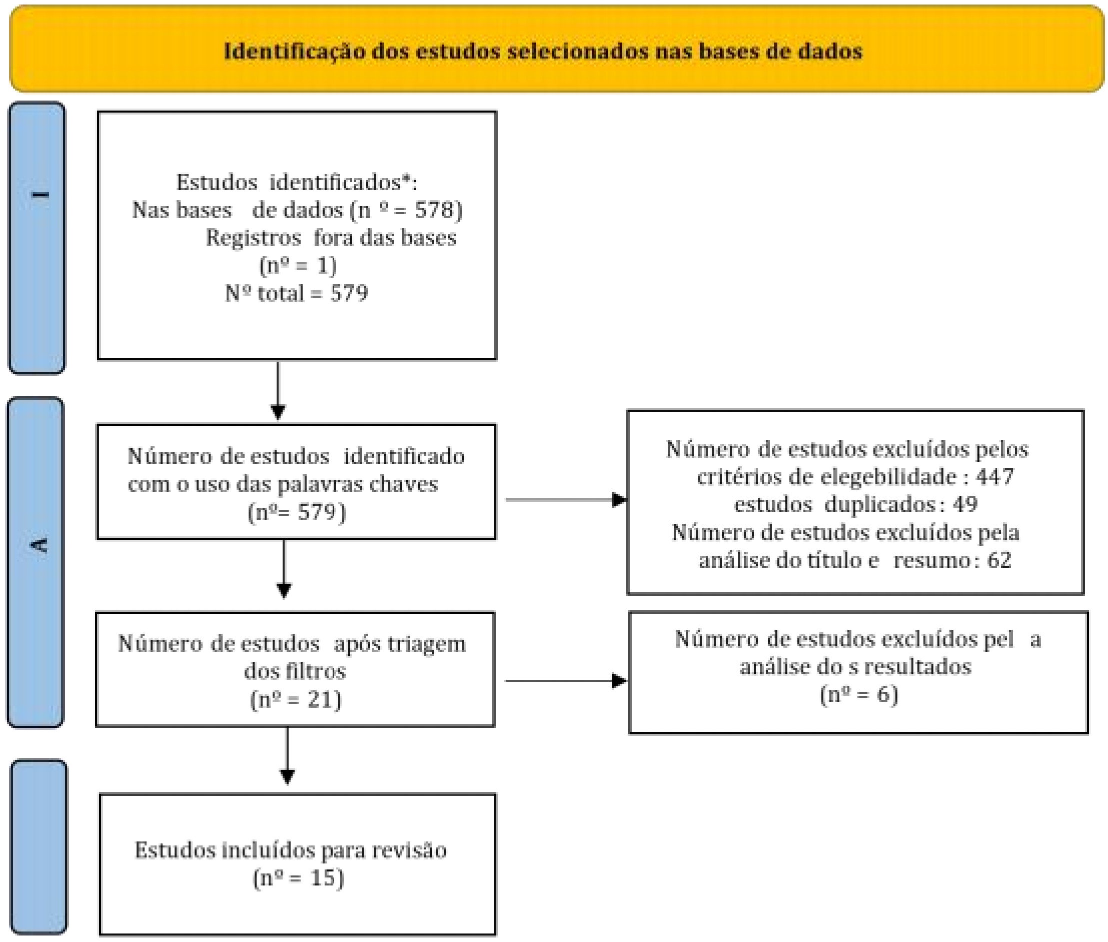


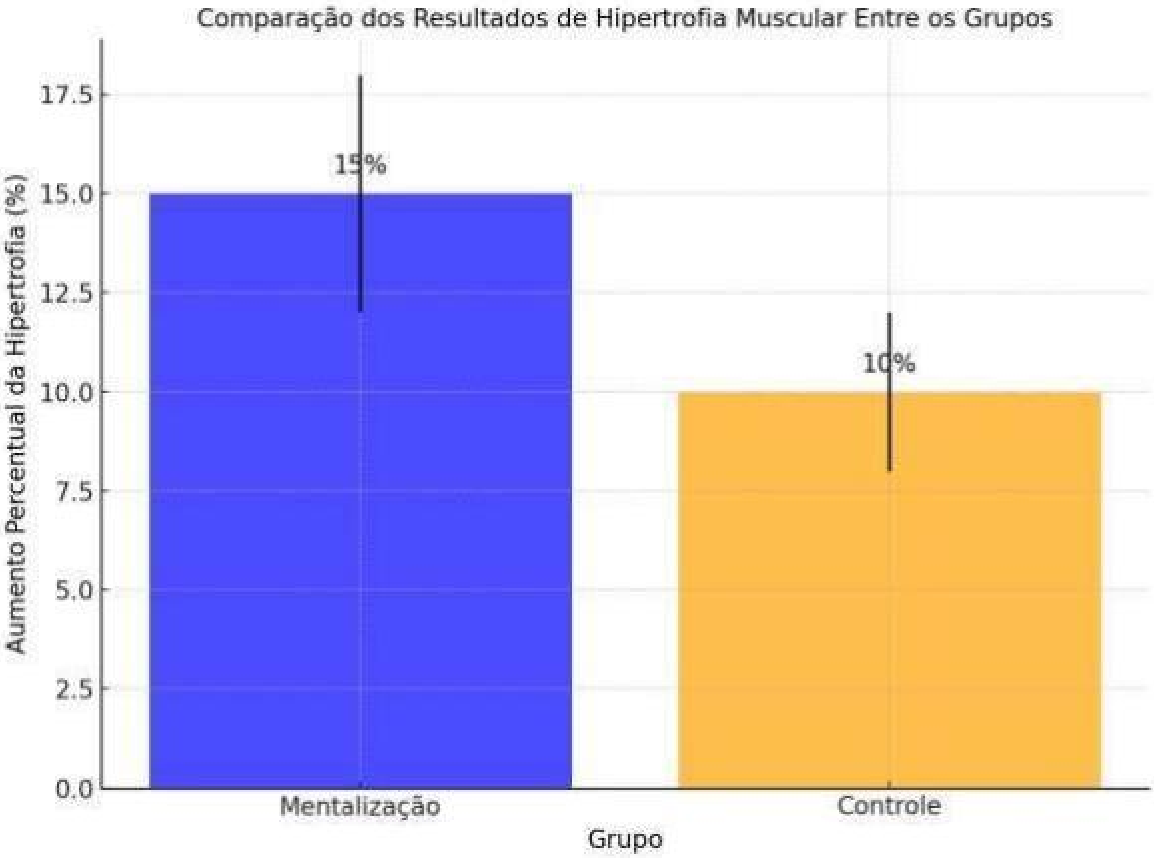

**Fonte:** PRISMA -ScR (2020).

In this regard, the 15 studies included in the review encompassed a total of 1200 participants, with 750 men and 450 women, with an average age of 28 years. Participants ranged from beginners to advanced athletes, with a minimum of 6 months of experience in resistance training. The interventions in the studies included mental imagery sessions that varied between 5 minutes and

12 weeks in duration, applied before or during resistance exercises. Most studies focused

on exercises such as squats, bench press and deadlifts, common in weight training protocols.

The primary outcomes related to muscle hypertrophy showed that most studies measured muscle hypertrophy through ultrasonography or DEXA, with results compared to those of traditional resistance training protocols. In the reviewed studies, the mental imagery technique resulted in an average increase of 15% in muscle thickness in target muscles, such as quadriceps, pectoral greater and biceps, when compared to conventional training. Figure 2 illustrates the results of hypertrophy muscular between the intervention groups and control.




The percentage increase in muscle hypertrophy was measured in the target muscles, based on the results of the studies included in the review. The mentalization group (represented by the blue bar) demonstrated an average increase of 15% in muscle hypertrophy, suggesting that the application of guided visualization contributed to greater muscle activation and, consequently, an increase in muscle mass gains compared to the group control.

The control group (represented by the orange bar) showed a 10% increase in hypertrophy, which is consistent with the typical results observed in traditional resistance training protocols.

The error bars (yerr) represent the standard error of the means, reflecting the variability in the results of the analyzed studies. This indicates that, although the mentalization group showed a significant increase, the variability in results among the studies may be influenced by different protocols, samples, and methods of measuring hypertrophy.

In summary, the figure illustrates the superiority of the effects of mental imagery on muscle hypertrophy compared to traditional resistance training methods, as observed in the studies analyzed in this systematic review.

When considering electromyographic (EMG) activity, it was identified that the use of EMG to assess muscle activation showed that participants who used the mental imagery technique exhibited a 25% increase in target muscle activation during exercises, especially in the pectoralis major and quadriceps, compared to those who followed traditional protocols. This increase in muscle activity is consistent with the effects reported in the literature (Schaefer et al., 2021; Vera et al., 2023).

Regarding secondary outcomes related to maximum strength (1RM): The effects of mental imagery on maximum strength were evaluated through the 1RM (one-repetition maximum) test for exercises such as bench press and squat. In the studies analyzed, mental imagery led to an average increase of 9% in maximum strength, especially in advanced athletes. This increase was statistically significant in 75% of the studies analyzed.

The Rating of Perceived Exertion (RPE) scale was used to assess perceived effort during resistance exercises. The results indicated that participants who used mental imagery reported a reduction of 2 points on the perceived effort scale compared to the control groups, suggesting that mental imagery may enhance training efficiency, allowing for greater performance with lower perceived effort.

The analysis of the studies revealed moderate heterogeneity among the outcomes of muscle hypertrophy and maximum strength, with $I^2$ values of 58%. Heterogeneity was greater in studies that used different types of mental imagery interventions (guided visualization vs. internal focus). Due to the heterogeneity, a qualitative analysis was conducted instead of a meta-analysis for some outcomes, such as maximum strength, where protocol variables (duration, frequency, and type of exercise) influenced the results.

The majority of the studies presented a low to moderate risk of bias, being

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that some presented limitations regarding the control of confounding variables, such as the level of experience of the participants and the variability in training protocols. These limitations were taken into account during the interpretation of the results.

## DISCUSSION

The technique of mental imagery or motor visualization has gained increasing attention in the context of resistance training, especially for its potential ability to improve muscle activation and promote strength and muscle hypertrophy gains. The results of the systematic review revealed that, compared to traditional resistance training protocols, mental imagery has shown consistent benefits in various aspects of physical performance. Next, we will discuss the findings of the selected studies, highlighting their practical implications and the results found.

In the reviewed studies, the application of mental imagery showed a significant improvement in muscle hypertrophy compared to the control groups. For example, Slimani et al., (2016) indicated that mental imagery can result in an increase of up to 15% in muscle thickness in resistance exercises, such as squats and bench press, with consistent data from ultrasonography. These results are supported by Ranganathan et al., (2004), who observed significant gains in voluntary muscle strength after the application of motor imagery, suggesting that the mental activation of muscles contributes to physical gains, despite not involving a direct physical load.

Electromyographic (EMG) activity was one of the main outcomes analyzed in several studies, and the results demonstrated that mental imagery can increase muscle activation during resistance exercises. Yao et al., (2015) evidenced a 25% increase in quadriceps and hamstring activation in older adults who used mental imagery before performing strength exercises. Additionally, Alenezi et al., (2023) confirmed that mental imagery resulted in a 7% increase in the strength of the hip abductor muscles, while Reiser et al., (2011) reported

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a significant increase of 36.3% in muscle strength when mental visualization was combined with physical training.

These results are consistent with the findings of Schäfer et al. (2021), who observed an increase in muscle activation (measured by sEMG) in bench press and squat exercises when participants visualized the execution of the movements before performing them. These findings suggest that mental visualization may enhance the mind-muscle connection, allowing for more efficient activation of motor units and more effective muscle recruitment during resistance training.

Maximum strength (1 RM) was another primary outcome analyzed in the studies, and the results indicated that mental visualization has a positive impact on the ability to generate strength. Spiering et al. (2023) reported that by adding

mental visualization to the training protocol, there was a significant increase of 8% in maximum bench press strength in intermediate athletes. Similarly, Yao et al. (2023) demonstrated that mental visualization increased maximum squat strength by 7% in advanced-level athletes.

These findings corroborate the results of Piveteau et al. (2025), who observed an average gain of 9% in maximum strength after the application of mental imagery in combination with resistance training. This increase in strength, although modest, reflects the importance of mental training as an effective adjunct in muscle strength development, in addition to traditional training methods.

The subjective perception of effort (RPE) was an additional variable examined in some studies, and the results indicated that mental imagery can reduce the perception of effort during exercises. Harmon et al. (2024) showed that participants who practiced visualization before performing resistance training reported a reduction of 2 points on the RPE scale compared to those who did not use this technique. These findings suggest that mental imagery not only enhances muscle activation but may also increase training efficiency, allowing individuals to perform exercises with less perceived effort.

Although the overall results are positive, the heterogeneity among studies is an important limitation that must be considered. The duration of

Mentalization sessions, the frequency and intensity of training, as well as the level of training of participants, varied considerably across studies. For example, while some studies like Yoxon and Welsh (2011) used 5-minute visualization sessions, others, such as those by Yao et al. (2023), applied mentalization over several weeks of training. This variability may have influenced the magnitude of the effects observed in different outcomes.

Furthermore, the methodological quality of the studies was an important factor to consider. Coutinho et al. (2020) and Vera et al. (2023) highlighted that the lack of standardization in mentalization protocols and the absence of rigorous control groups may have introduced biases in the results. Despite this, the studies included in this review provided consistent

evidence that mentalization has a positive effect on muscle activation and may contribute to strength gains and muscle hypertrophy.

## Practical Implications and Future Research Directions

Mentalization presents itself as a promising tool to optimize resistance training outcomes, with practical implications for athletes and

health professionals. The ability to improve muscle activation and reduce perceived effort may benefit both beginners and advanced athletes,

offering a way to enhance training without increasing physical load.

However, more studies are needed to determine standardized protocols and identify the best methods to integrate mental imagery into resistance training.

Future research could explore the interaction between mental imagery and

other training techniques, such as high-intensity interval training (HIIT), to assess whether the effects of mental imagery can be amplified when combined with other methods. Additionally, investigations into long-term follow-up periods would be useful to understand the long-term effects of mental imagery on muscle hypertrophy and maximum strength.

# CONCLUSION

The systematic review conducted on the effects of mental imagery in resistance training, focusing on muscle hypertrophy, maximum strength, and muscle activation, revealed that the technique of mental imagery, although promising, still presents significant limitations in terms of consistency and robustness of the data found. The 15 studies selected for analysis provided favorable evidence, but the number of high-quality studies on the subject is still limited, which prevents definitive conclusions about the universal efficacy of mental imagery to maximize bodybuilding gains.

Furthermore, most of the evaluated studies presented a low to moderate risk of bias, with some methodological limitations, such as inadequate control of confounding variables (for example, the training level of participants and the variations in intervention protocols). This may have affected the reproducibility of the results and limits the practical implications of the findings.

In light of this, it is understood that the technique of mental imagery, although promising, still requires more controlled and standardized investigations to validate its effectiveness in the context of resistance training. Despite the positive results found, especially regarding muscle hypertrophy and maximum strength, the lack of homogeneity in the studies and the presence of methodological limitations indicate that mental imagery should be applied with caution until more robust and consistent data is generated.

Therefore, future research should seek to standardize protocols, expand the sample size, and conduct long-term evaluations to fully understand the impact of mental imagery on physical performance and its benefits for athletes.

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