2025, Retos, 62, 232-242

Optimizing a resistance training program to increase muscle strength: a comprehensive planning approach - a systematic review

Optimización de un programa de entrenamiento de resistencia para aumentar la fuerza muscular: un enfoque de planificación integral - una revisión sistemática

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Abstract. Background: Muscle strength is an essential factor in maintaining one's health and quality of life. Resistance training programs have been known to be effective in improving muscle strength. However, their success can be affected by various factors, including exercise variety, volume, intensity, frequency, and duration. To optimize the effects of a resistance training program, a comprehensive planning approach is essential. Study Objective: This study aimed to conduct a systematic review of the literature to explore a comprehensive planning approach in optimizing resistance exercise programs to improve muscle strength. Materials and Methods: A systematic method was used to identify relevant studies from various scientific databases. Inclusion and exclusion criteria were established to select studies that fit the research objectives. Data from the selected studies were extracted and analyzed to evaluate the effectiveness and planning approaches used in resistance exercise programs. Results: The results of this systematic review indicate that a comprehensive planning approach, including individualization of the program, progressive and adaptive, integration of functional exercises, and periodic monitoring and evaluation, are critical factors in optimizing resistance exercise programs. Studies showed differences in the effectiveness of resistance training programs based on these factors.
Conclusion: By integrating a comprehensive planning approach, resistance exercise programs can be optimized to achieve maximal muscle strength gains. Practical implications of these findings include relevance to specific populations and application in the context of rehabilitation. Future research should focus more on understanding the interactions between these factors and explore more specific planning approaches to improve the effectiveness of resistance training programs.
Keywords: Resistance training program, Improving muscle strength, Comprehensive planning approach, Optimization of exercise program, Systematic literature review.

Resumen. Antecedentes: La fuerza muscular es un factor importante para mantener la salud y la calidad de vida. Se sabe que los programas de entrenamiento de resistencia son eficaces para mejorar la fuerza muscular. Sin embargo, su éxito puede verse afectado por diversos factores, como la variedad de ejercicios, el volumen, la intensidad, la frecuencia y la duración. Para optimizar los efectos de un programa de entrenamiento de resistencia, es esencial una planificación exhaustiva. Objetivos de la investigación: Este estudio tiene como objetivo realizar una revisión sistemática de la literatura para explorar un enfoque de planificación integral en la optimización de los programas de ejercicios de resistencia para mejorar la fuerza muscular. Materiales y métodos: Se utilizó un método sistemático para identificar estudios relevantes de diversas bases de datos científicas. Se establecieron criterios de inclusión y exclusión para seleccionar los estudios que se ajustaban a los objetivos de la investigación. Se extrajeron y analizaron los datos de los estudios seleccionados para evaluar la eficacia y los enfoques de planificación utilizados en los programas de entrenamiento de resistencia. Resultados: Los resultados de esta revisión sistemática sugieren que un enfoque de planificación integral, que incluya la individualización del programa, progresivo y adaptativo, la integración de ejercicios funcionales y el seguimiento y la evaluación periódicos, son factores importantes para optimizar los programas de ejercicios de resistencia. Los estudios mostraron diferencias en la eficacia de los programas de ejercicios de resistencia en función de estos factores.
Conclusiones: Mediante la integración de un enfoque de planificación integral, los programas de entrenamiento de resistencia pueden ser optimizados para lograr ganancias máximas de fuerza muscular. Las implicaciones prácticas de los hallazgos incluyen la relevancia para poblaciones específicas y la aplicación en el contexto de la rehabilitación. La investigación futura debería centrarse más en la comprensión de las interacciones entre estos factores y explorar enfoques de planificación más específicos para mejorar la eficacia de los programas de ejercicios de resistencia.
Palabras clave: Programa de entrenamiento de resistencia, Mejora de la fuerza muscular, Enfoque de planificación integral, Optimización del programa de ejercicios, Revisión sistemática de la literatura.

Fecha recepción: 15-04-24. Fecha de aceptación: 07-10-24
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Introduction

In this modern era, awareness of the importance of health and fitness has become a major focus for individuals from all walks of life. One integral component of health and fitness is muscular strength, which significantly impacts not only daily physical performance but also prevents injuries and supports optimal body function. Resistance training programs are becoming an effective method to improve muscle strength, and it is important to understand the factors that can optimize the effectiveness of such programs. Therefore, the main objective of this study was to conduct a systematic review of the existing literature to identify factors that influence muscle strength and design a comprehensive planning approach to optimize resistance training programs.

Increased muscle strength has a broad positive impact on human health and well-being. For example, studies have shown that optimal muscle strength can improve body balance and reduce the risk of falls, especially in the elderly

population (Pittaras et al., 2023). In addition, increased muscle strength can also improve cardiorespiratory function and enhance the body's ability to respond to physical stress (Miyamoto et al., 2016). Therefore, an in-depth understanding of the factors influencing muscle strength through resistance training programs is essential to support disease prevention efforts and improve quality of life.

Along with the development of science and technology, research on resistance exercise programs has become increasingly rich and complex. Recent research has highlighted the role of various factors, such as exercise variety, volume, intensity, frequency, and duration, in achieving optimal muscle strength gains (Sánchez Pastor et al., 2023). Studies by (Jiménez et al., 2019; Lee et al., 2014) suggest that exercise variety is a critical aspect in stimulating muscle adaptation, and therefore, designing exercise programs with sufficient diversity can accelerate the achievement of muscle strength goals.

In this context, a comprehensive planning approach is crucial to optimize resistance training programs. Individuals have different exercise needs and responses; therefore, an individually adaptable exercise program is essential. Research by (Wang et al., 2022) showed that individualizing an exercise program based on an individual's physical and functional characteristics can result in more significant improvements in muscle strength compared to a generic exercise program.

The relevance of this research is clear in the context of public health and the development of more effective exercise programs. By understanding the factors that influence muscle strength and designing comprehensive resistance training programs, we can provide better guidelines for health professionals, sports coaches, and individuals who want to improve their muscle strength. This aligns with the vision of the American College of Sports Medicine (ACSM), which emphasizes the importance of resistance training in improving the public's overall health (ACSM, 2009).

By detailing the problem and the importance of this study, the main objective of this systematic literature review was to collect, synthesize, and evaluate the existing scientific evidence. Through an in-depth literature analysis, this study aims to present a clearer view of what factors truly influence muscle strength and how comprehensive planning can optimize resistance training programs. As such, the results of this study are expected to make a valuable contribution to the development of theory and practice in the field of resistance exercise and public health as a whole.

Research methods

Inclusion and Exclusion Criteria

Inclusion Criteria

In this study, the researcher chose to include studies involving participants aged between 18 and 60, encompassing individuals with varying levels of fitness or baseline conditions. The main focus of the intervention was on studies that significantly explored the effect of resistance training on improving muscle strength. The researcher also considered including studies with experimental designs, observational studies, or controlled clinical trials, with a duration of intervention that allowed for analysis of long-term effects or sustainability.

Exclusion Criteria

Conversely, the exclusion criteria included studies that did not provide sufficient or relevant information regarding resistance exercise programs. Researchers also excluded studies with resistance training methods that differed significantly from the general standard or were too specific. Additionally, researchers excluded studies with irrelevant or inadequate control groups. Articles that were not available in a language that the researchers could understand, as well as studies that were only available in abstract form without full access to the full text, were also excluded. Researchers also avoided studies involving subjects with special medical conditions that could affect exercise outcomes, especially if these factors were not adequately explained or controlled.

Study Identification and Selection

The study identification and selection process began with developing a comprehensive literature search strategy. The search was conducted through reputable scientific databases with relevant keywords related to muscle strength and resistance training programs. Study selection was based on strict inclusion criteria, considering exercise type, duration, intensity, and relevance to the study objectives. In the selection, emphasis was placed on studies with a robust research design and consistent measurement methods. This process ensured that each included study met the established quality standards. Potential limitations or biases in each study were also carefully evaluated. The result was the selection of accurate and relevant studies, providing a solid foundation for the data synthesis required in this systematic review.

Data Collection

The data collection process in this study was carefully conducted to obtain relevant and quality information. The data collected included critical parameters related to resistance training programs and their effects on muscle strength. Data collection was done through a literature review of studies that met the inclusion criteria. Key information included the type of exercise used, exercise volume and intensity, frequency, and duration of exercise. Muscle strength data was also collected, including measurement methods and results recorded in the studies included in the systematic review. This process was conducted with attention to standardized methods and uniformity, ensuring that the data collected was reliable for in-depth analysis. Through this approach, maximum effort was made to provide a holistic understanding of the

effectiveness of resistance training programs in improving muscle strength.

Data Analysis

The data analysis, which followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, focused on synthesizing the findings from the identified and selected studies. First, the researcher collated the main findings relevant to the optimization of resistance training programs to improve muscle strength. Data on muscle strength, exercise variety, volume, intensity, frequency, and duration were extracted and carefully presented. Then, a quality assessment of the study was conducted based on the PRISMA criteria, providing insight into the reliability of the results. In addressing the heterogeneity of the data, the study implemented analysis methods appropriate to the nature of the data collected. An in-depth understanding of the variations between studies helped to detail the impact of resistance training programs on muscle strength. Through this approach, the data analysis resulted in an informative synthesis, by PRISMA guidelines, to ensure the quality and accuracy of this systematic review.

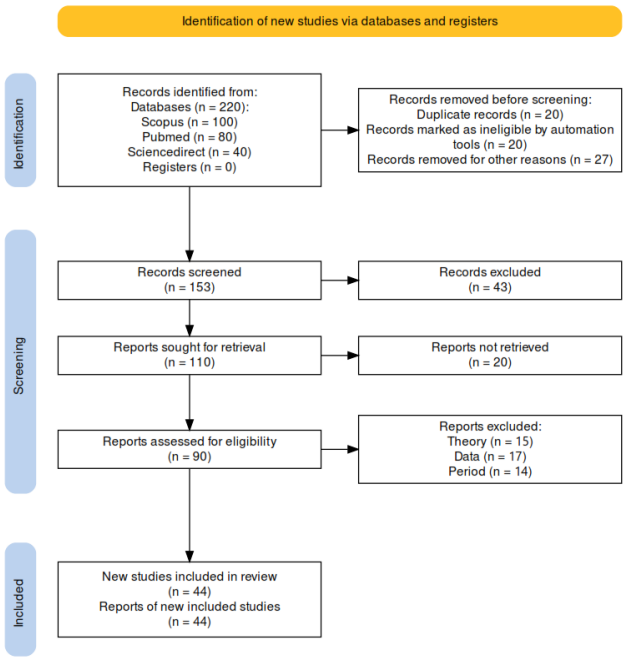

Figure 1. Article selection with PRISMA method

Literature review

Optimization of a Resistance Training Program

Exercise Variations

Exercise variety is one of the important aspects of designing an effective resistance training program to improve muscle strength. In this context, variety refers to the use of different types of exercises, be it using different weights, movements or training methods. This aims to provide a diverse stimulus to the muscles and prevent stagnant adaptations from occurring, which can hinder strength development. Thus, incorporating the right variety of exercises is key in designing an effective training program.

In a study conducted by (Aamann et al., 2020; Guizelini et al., 2018), it was found that the use of diverse exercise variations had a positive impact on increasing muscle strength in subjects undergoing a resistance training program. The results of this study suggest that the use of different types of exercises, including isometric exercises, eccentric contractions, and concentric contractions, can result in better muscle adaptation and significant increases in strength.

In addition, it is important to pay attention to variations in exercise intensity. A study by (Cuthbert et al., 2021) found that the use of exercise intensity variation in resistance programs had a significant impact on the development of muscle strength. They suggested that involving different levels of intensity, ranging from heavy to light exercise, can stimulate more effective muscle adaptation.

Exercise variation can also include the use of different tools and equipment in resistance training. According to (Encarnação et al., 2022), introducing tools such as dumbbells, barbells, kettlebells, and weight machines can provide different stimuli to the muscles, thus helping to accelerate overall muscle strength development.

In addition, changes in movement patterns and body positions can also be considered variations in training. For example, in squat training, variations such as squats with wider or narrower feet or squats with the weight in front of the body or behind the neck can provide different stimuli to the muscles of the legs and pelvis. This is also supported by (Fernandez Ortega & Hoyos Cuartas, 2020; Loenneke et al., 2019) in their research on the effects of variations in body position on muscle activation in resistance training.

In designing an effective resistance training program, it is important to consider exercise variation. By incorporating appropriate variations in exercise type, intensity, tools, and movement patterns, we can provide diverse stimuli to the muscles and promote optimal muscle strength development. This support from various scientific studies provides a strong basis for the successful implementation of exercise variation in resistance training programs.

Exercise Volume

Exercise volume is one key aspect in designing an effective resistance training program to improve muscle strength. It refers to the total amount of work performed in a single training session, including the number of sets, reps, and weights used. A deep understanding of exercise volume is necessary to optimize muscle response to an exercise stimulus.

In a study by (Schumann et al., 2022), it was found that there was a positive linear relationship between training volume and muscle strength gains in a variety of populations, including athletes, individuals training for general fitness, and elderly populations. This suggests that

increasing training volume tends to have a positive impact on muscle strength development. In this context, it is important to adjust the training volume according to the individual's goals and fitness level.

In addition, several studies have highlighted the importance of paying attention to the balance between training volume and recovery. One study conducted by (Rodrigues et al., 2023) found that too drastic an increase in training volume without adequate recovery can increase the risk of injury and overtraining. Therefore, in designing a resistance training program, it is important to consider not only the optimal training volume but also the appropriate recovery strategy.

In addition, research by (Nyberg et al., 2022; Orozco et al., 2021) highlighted the importance of exercise volume variation in achieving optimal muscle adaptation. They found that the use of exercise volume variation, such as changing the number of sets and reps from one training session to the next, can assist in avoiding stagnation in muscle strength development. Therefore, it is important to consider a dynamic approach in adjusting training volume according to individual needs.

In the context of selecting an appropriate training volume, it is also important to consider the principle of individualization. A study conducted by (Santana et al., 2021) showed that muscle response to exercise volume can vary significantly between individuals, depending on factors such as fitness level, age, and genetics. Therefore, in designing a resistance training program, it is important to consider the characteristics of individuals and adjust the exercise volume according to their needs and abilities.

Taking into account the findings of the various studies mentioned above, it can be concluded that training volume plays a crucial role in the optimization of resistance training programs to improve muscle strength. However, it is important to pay attention to the balance between optimal training volume and sufficient recovery, as well as take into account variations in training volume and the principle of individualization to achieve optimal results.

Exercise Intensity

Training intensity is one of the key factors in stimulating the physiological adaptations necessary to increase muscle strength. In the context of resistance training, intensity refers to how heavy the load lifted by the individual is. Proper intensity determination is essential to achieving optimal results in the development of muscle strength. According to (Baz-Valle et al., 2022), High exercise intensity has been shown to increase muscle strength and muscle mass in individuals involved in resistance exercise programs.

At higher levels of intensity, muscle fibre activation and motor unit recruitment increase, leading to greater stimulation for muscle growth and strength. A study published in the Journal of Clinical Medicine by (Magallanes et al., 2022; Morcillo-losa et al., 2024) showed that high-intensity exercise resulted in greater increases in muscle strength than lower-intensity exercise in regularly trained subjects.

However, it is important to note that optimal exercise intensity may vary based on individual fitness levels and goals. A study conducted by (Morcillo-losa et al., 2024) revealed that individualizing exercise intensity to meet the needs and abilities of the subject is a key factor in effectively increasing muscle strength.

In addition, changes in exercise intensity over time are also necessary to prevent plateauing or a decrease in physiological response to exercise. A review published in the journal Archives of Rehabilitation Research and Clinical Translation by (Rostron et al., 2021) emphasized that periodic resetting of exercise intensity is necessary to maintain an effective stimulus for muscle growth.

In practice, exercise intensity is usually measured as a percentage of a one-repetition maximum (1RM). However, other approaches, such as the use of subjective fatigue or feeling of effort, can also be used to determine appropriate training intensity. The use of subjective assessments such as RPE (Rating of Perceived Exertion) can be a valid alternative for establishing optimal exercise intensity in resistance programs.

In conclusion, exercise intensity is an important aspect of designing an effective resistance training program to increase muscle strength. By adjusting intensity according to individual needs and continuously monitoring physiological responses, optimal results in muscle strength development can be consistently achieved.

Exercise Frequency

Exercise frequency is one of the key aspects of planning an effective resistance training program. In this context, training frequency refers to how often a person performs resistance training in a given period, such as a week. The importance of proper training frequency greatly influences the results to be achieved in increasing muscle strength. Several important considerations need to be taken into account to determine the optimal training frequency.

One of the main considerations is the relationship between training frequency and muscle recovery rate. Studies by (Mangine et al., 2015) show that muscle recovery after resistance training takes varying amounts of time depending on the intensity and volume of exercise. Therefore, a training frequency that is too high without enough recovery time can result in overtraining and decreased performance. This shows the importance of taking the muscle recovery factor into account when planning the right training frequency.

In addition, muscle adaptation to resistance training also takes time. A study by (de Carvalho E Silva et al., 2022; Rebolledo-cobos et al., 2023) showed that an increase in muscle strength usually occurs within a few days after resistance training, but significant muscle building takes longer. Therefore, planning a training frequency that allows for optimal muscle adaptation is essential to achieving significant strength gains. Furthermore, it is also important

to take into account the principle of overload in planning training frequency. This principle states that in order to stimulate growth and increase muscle strength, exercises should provide a stimulus that exceeds the level normally encountered by the body. However, performing resistance training too frequently without enough time for recovery can hinder the body's ability to adapt and increase strength. Therefore, choosing a training frequency that allows for sufficient stimulus without sacrificing recovery is essential in planning an effective resistance training program.

Finally, in planning exercise frequency, it is also important to consider the fitness level and goals of the individual. Individuals with higher fitness levels may require a higher frequency of training to achieve significant strength gains. In addition, training goals should also be considered; for example, someone who wants to increase strength significantly may require a higher training frequency than someone who just wants to maintain existing strength.

In devising the optimal training frequency, factors such as muscle recovery, muscle adaptation, the principle of overload, and the individual's fitness level and goals must be considered. By taking all these into account, an effective resistance training program can be built to increase muscle strength significantly.

Exercise Duration

Exercise duration is one of the important factors to consider when designing an effective resistance training program to improve muscle strength. It relates not only to the length of the overall training session but also to the duration of each exercise or rep and the rest between sets. In the context of muscular strength development, a deep understanding of exercise duration can provide a more holistic view of the effectiveness of a resistance training program.

It is important to recognize that exercise duration significantly influences the stimulus provided to the muscle and the adaptation response that occurs. A study conducted by (Krzysztofik et al., 2019) showed that extending exercise duration by adding the number of reps in a set can increase muscle strength and muscle hypertrophy in resistance-trained individuals. This suggests that longer exercise durations may provide the additional stimulus needed to trigger optimal muscle adaptation.

In addition, there is evidence to suggest that shorter exercise durations with high intensity can also provide an effective stimulus to increase muscle strength. Research by (Aube et al., 2022) found that a resistance training program with a short training duration but high intensity was effective in increasing muscle strength in a training population. This suggests that factors such as exercise intensity can also influence muscle adaptation responses, even with shorter exercise durations.

However, no one training duration approach is suitable for all individuals or training goals. Individualization of exercise programs based on individual needs and abilities is key in designing effective exercise programs. A systematic review by (Valenzuela et al., 2023) highlighted the importance of adapting exercise duration according to an individual's fitness level, goals, and preferences to achieve optimal results. This emphasizes the need for a comprehensive approach to designing resistance training programs.

In addition, it is also important to pay attention to muscle recovery between exercise sets in a training session. The duration of rest between sets can also affect the stimulus provided to the muscles as well as the level of fatigue experienced by the individual. A study by (Grgic et al., 2017) showed that shorter rest durations between exercise sets tend to increase maximal muscle strength, while longer rest durations tend to increase exercise volume. Therefore, the rest duration between sets also needs to be carefully considered when designing an optimal resistance training program.

In conclusion, exercise duration is an important factor to consider when designing an effective resistance training program to increase muscle strength. Determining the right exercise duration should take into account various factors such as exercise goals, exercise intensity, and individual fitness levels. With a comprehensive approach and individualization of the exercise program, the duration of exercise can be adjusted to provide an optimal stimulus for the development of muscle strength.

Comprehensive Planning Approach

A comprehensive planning approach in resistance training programs is critical to achieving significant and sustained improvements in muscle strength. This involves strategies considering various essential factors, such as individualization, progressivity, functional integration, and periodic monitoring and evaluation.

Individualization of exercise programs includes the introduction and adjustment of programs based on individual characteristics such as age, gender, physical fitness level, and injury history. A study by (Grgic et al., 2018) highlighted the importance of exercise program individualization in achieving optimal muscle strength gains. They found that exercise programs tailored to individual needs produce more significant improvements than generic exercise programs.

A comprehensive planning approach also includes aspects of progressivity and adaptability in the exercise program. This involves gradually increasing the training load or exercise complexity to ensure continued muscle adaptation. A study conducted by (Morcillo-Losa et al., 2024) showed that a progressive increase in exercise intensity is a crucial factor in triggering physiological responses that allow for significant increases in muscle strength.

Integrating functional exercises into resistance training programs is an essential strategy in a comprehensive planning approach. Functional training allows for strength development that is more relevant to daily activities or individual-specific goals. According to (Xiao et al., 2021),

the integration of functional exercises can improve the transfer of strength from training to real situations, thereby increasing the overall effectiveness of the exercise program.

A comprehensive planning approach also involves regularly monitoring and evaluating the individual's progress throughout the exercise program. This allows for identifying changes that occur and necessary adjustments in the exercise program. A study (Ohiichuk, 2022) highlighted the importance of regular monitoring and evaluation in ensuring the effectiveness and safety of resistance exercise programs.

By applying a comprehensive planning approach that includes individualization, progressivity, functional integration, and periodic monitoring and evaluation, resistance training programs can be optimized to achieve maximum muscle strength gains. This approach allows for proper adjustments according to individual needs and ensures the exercise program is effective and safe in the long run.

Periodic Monitoring and Evaluation

Monitoring progress during a resistance training program is critical to ensuring its effectiveness. Through systematic monitoring, trainers can evaluate whether the exercise program delivers the desired results or needs adjustment. Monitoring progress is critical for determining the effectiveness of a resistance training program and for making necessary adjustments to ensure continued progress and minimize the risk of overtraining or injury (Muñoz-López et al., 2021).

It is essential to choose the proper evaluation method to measure improvements in muscle strength accurately. Evaluation methods that can be used include the one-rep maximal (1RM) test, muscle thickness measurement, and tools such as dynamometers. Various methods, such as one-repetition maximum (1RM) testing, muscle thickness measurements, and dynamometry, are commonly used to assess muscle strength and size changes following resistance training interventions.

Periodic evaluation allows the trainer to adjust the training program according to the individual's development. By looking at the evaluation results, trainers can identify areas that need improvement or adjustment in the exercise program. Regular evaluation allows for adjustments to the resistance training program based on individual progress, ensuring that the program remains challenging and effective (Alizadeh et al., 2023).

In addition, progress monitoring also helps in avoiding potential injuries or fatigue caused by overtraining. By noticing signs of fatigue or excessive strain, coaches can reset the program to ensure adequate recovery. Regular monitoring of progress also aids in preventing potential injuries or overtraining by recognizing signs of fatigue or excessive strain and adjusting the program accordingly to ensure adequate recovery. With regular monitoring and evaluation, resistance training programs can be appropriately adjusted to ensure the effective and safe achievement of muscle strength goals for the individual performing them.

Recovery and Restoration

Recovery and recuperation play a vital role in ensuring the effectiveness and success of a resistance training program. Recovery is the process by which the body recovers from exercise-induced stress and adapts to the stimulus. During the recovery phase, muscles repair themselves and become more robust, so it is essential to ensure sufficient time between training sessions for optimal recovery. Research has shown that adequate recovery between training sessions can improve physical performance and reduce the risk of injury in athletes (Cunha et al., 2023).

Effective recovery can be achieved through various strategies, including active rest, massage and proper nutritional care. Active rest, such as light walking or stretching, can help increase muscle blood flow and reduce muscle stiffness after exercise. In addition, massage can help reduce muscle tension, increase blood flow, and speed up the removal of metabolic waste products from the muscles. It can also provide a relaxing effect that aids in the recovery process.

Proper nutrition also plays a vital role in the recovery process. Adequate protein, carbohydrates, and fats are needed to repair muscle tissue, replace lost glycogen, and provide the energy needed for recovery. Supplements such as whey protein or BCAAs (branched-chain amino acids) also help accelerate recovery. As evidence, a study found that protein consumption after resistance training can increase muscle protein synthesis and accelerate muscle recovery (Joanisse et al., 2021).

In addition, paying attention to other factors that can affect the recovery process, including adequate sleep and stress management, is essential. Quality sleep is when the body does most of its repair and regeneration, including forming new muscles. Lack of sleep can disrupt the recovery process and hinder muscle growth. Therefore, it is essential to prioritize adequate sleep in a recovery program. Sufficient sleep is critical to ensuring optimal recovery and improved athlete performance.

Finally, stress management can also significantly impact the recovery process. Chronic stress can lead to elevated levels of stress hormones such as cortisol, which can hinder muscle recovery and affect athlete performance. Therefore, relaxation techniques such as meditation, yoga, or deep breathing can help reduce stress and improve recovery effectiveness. A study found that relaxation techniques such as meditation effectively reduce cortisol levels and improve physical and mental recovery (Jones et al., 2014).

With these aspects in mind, it is essential to note that recovery is integral to an effective resistance training program. Proper recovery strategies will help ensure muscles recover properly, increase strength, and reduce the risk of injury.

Progression and the Role of Psychological Factors

Progression is a critical concept in designing an effective resistance training program. It refers to the constant increase in load, volume, or intensity of exercises to promote continued muscle growth and development. The body is constantly exposed to a new and increasing stimulus through progressivity, forcing the muscles to adapt and grow stronger.

In a study by (Zouita et al., 2023), continuous progressivity in resistance training programs can result in significant improvements in muscle strength and athletic performance. They highlighted the importance of gradually increasing training loads to achieve higher strength levels.

Progression applies not only to load increases but also to training volume and intensity. They suggest gradual training volume or intensity increases are also essential to stimulate optimal muscle growth.

Psychological factors, such as motivation, goals, and self-confidence, have a significant role in the success of a resistance training program. High motivation can increase exercise consistency and the likelihood of achieving desired results. In addition, clear goals can provide additional direction and motivation to maintain dedication to the exercise program.

A study (Weakley et al., 2023) found that individuals with high motivation tend to progress better in resistance exercise programs. The study emphasized the importance of paying attention to this psychological aspect in designing an effective exercise program.

Furthermore, (Collins et al., 2019) revealed that high self-confidence can help individuals overcome obstacles and achieve better results in resistance training. They suggested that building self-confidence through slight, measurable achievements can improve exercise motivation and performance.

Considering the role of progressivity and psychological factors in resistance training programs, trainers or instructors need to design programs that consider not only the physical aspects but also the physical and psychological aspects that can affect exercise motivation and consistency. This holistic approach can significantly increase the likelihood of achieving optimal results in improving muscle strength.

Results and discussion

In the results and discussion section, we summarize the main findings from our systematic literature review related to optimizing resistance training programs to improve muscle strength. Through an in-depth analysis of scientific studies, we identified significant patterns and trends in the influence of various training factors on improving muscle strength. We will describe the differences and similarities between the evaluated exercise programs and illustrate their practical implications in a clinical context, particularly in rehabilitation and developing more effective exercise guidelines. The discussion will also include the application of the exercise programs in special populations and recommendations for further research. As such, this discussion will provide healthcare practitioners and researchers with insight into how to design more optimal resistance exercise programs to increase muscle strength and improve overall health.

Table 1.
Research findings

Findings	One of the supporting Journals of Systematic Review	Explanation
Exercise Variations	(Baz-Valle et al., 2022)	Findings suggest that resistance training programs that include various exercise types, including weight training, bodyweight training, and functional training, tend to be more effective in improving muscle strength than programs that use only one type of exercise.
Exercise Volume and Intensity	(Lai et al., 2023)	Training programs emphasising higher volume and intensity tend to provide better results in increasing muscle strength than lighter or less intense training programs.
Frequency and Duration of Exercise	(Chang et al., 2022)	There is a correlation between the frequency and duration of training and the increase in muscle strength. An exercise program that is performed regularly and has adequate duration is overall more effective in achieving increased muscle strength.
Individualization and Progressivity	(Manojlović et al., 2021)	Exercise programs tailored to individual needs and abilities and designed to increase in difficulty progressively often result in more significant increases in muscle strength.
Functional Exercise Integration	(Endo et al., 2020)	Integration of functional exercises that mimic everyday movements or the specific demands of a particular sport or physical activity can help optimise muscle strength in a more holistic and relevant manner.

Differences and Similarities of Exercise Programs

The differences and similarities of resistance training programs evaluated in a systematic review of the literature revealed a variety of approaches used to improve muscle strength. In this analysis, several differences and similarities were found that may affect the effectiveness of the exercise programs. One significant difference was in terms of exercise variety. Some exercise programs emphasize variation in the types of exercises performed, including isometric, isotonic and isokinetic exercises, while others may focus more on more specific resistance exercises or functional movements. These variations may affect muscle adaptations differently and produce varying results in strength gains.

Furthermore, training volume and intensity vary significantly between programs. Some programs may

emphasize high volume with a greater number of sets and reps, while others may opt for a higher intensity approach with heavier weights but lower volume. This affects the body's physiological response and the level of fatigue experienced by the subject during exercise.

In addition, factors such as frequency and duration of exercise may also vary between programs. Some studies show the benefits of training with a high frequency but shorter duration, while others emphasize the importance of less frequent but more prolonged training. This reflects differences in periodization and recovery strategies between programmes.

Despite the significant differences, the training programs also have some striking similarities. One is the progressive approach integrated into the exercise design, where the training load gradually increases according to the subject's strength improvement. This reflects the basic principles of effective muscle strength development.

In addition, many exercise programs emphasize individualization, where the exercise program is tailored to the subject's physical condition, goals, and abilities. This approach considers individual variability in response to resistance training and ensures that the exercise program meets the subject's needs.

Healthcare practitioners can develop a more targeted and practical approach to improving muscle strength in diverse populations by understanding the differences and similarities between resistance exercise programs.

1. Implications for Clinical Practice

The results of this systematic review show crucial implications for clinical practice. They can guide healthcare practitioners in designing effective resistance exercise programs that suit individual needs. Based on the key findings of the analyzed studies, a comprehensive planning approach significantly improves muscle strength.

First, clinical practitioners can use these findings to design resistance exercise programs tailored to the needs and characteristics of their clients. By considering factors such as exercise variety, volume, intensity, frequency, and duration, practitioners can tailor exercise programs to achieve optimal results according to individual goals and health conditions.

In addition, understanding the differences and similarities between the various resistance exercise programs evaluated in this study can assist clinical practitioners in selecting an exercise strategy that best suits their clients' conditions and preferences. For example, for rehabilitation patients with certain injuries, functional exercises that emphasize specific movements may be more effective for optimal recovery.

The clinical practice implications of this systematic review also apply to rehabilitation. Clinical practitioners can use this information to develop more effective and targeted rehabilitation programs, with attention to adapting exercises to meet the needs of individuals with physical or medical restrictions. This will help speed up patients' recovery processes and improve their quality of life. By paying attention to the recommendations from this study, clinical practitioners can also integrate the principles of resistance exercise program optimization into their daily practice. This includes program individualization, planned and adaptive progressions, integration of functional exercises, and periodic monitoring and evaluation to ensure program effectiveness and safety.

Overall, the results of this systematic review provide valuable insights for clinical practitioners in designing and implementing resistance exercise programs that can effectively and safely improve muscle strength for various client populations, both in the context of rehabilitation and general health.

In order to improve muscle strength through resistance training programs, a comprehensive planning approach is critical. Through a systematic review of the literature, we identified some key findings. Exercise variety, volume, intensity, frequency and duration all play an essential role in achieving optimal results. There were also significant differences and similarities in the exercise programs evaluated, highlighting the importance of program individualization. The clinical implications of these findings are significant, especially in the context of rehabilitation. Healthcare practitioners can accelerate patients' recovery and improve outcomes by adopting optimized resistance exercise programs.

Clinical practitioners should consider the identified optimization principles in their exercise program design, their characteristics, and specific goals. In addition, we encourage the development of more population-specific exercise guidelines, such as athletes or rehabilitation patients, to ensure that the suggested exercise programs effectively meet their needs. For researchers, we recommend continuing to explore areas of research that are still poorly understood, such as exercise adaptation for special populations or the development of more accurate evaluation methods. By continuing to deepen our understanding of the optimization of resistance training programs, we can optimize their benefits in improving muscle strength and general health.

Conclusion

In conclusion, this study illustrates the importance of optimizing resistance training programs to improve muscle strength through a comprehensive planning approach. Based on the systematic review conducted, factors such as exercise variety, volume, intensity, frequency, and duration significantly influence the effectiveness of resistance training programs. An approach that pays attention to program individualization, progressivity, adaptability, and functional exercise integration proved to be the key to achieving optimal results.

The practical implications of these findings are highly relevant in the context of resistance exercise program development, especially in rehabilitation and health. Individualization of exercise programs considers each

individual's unique needs, while a progressive and adaptive approach ensures a sustained increase in muscle strength. The integration of functional training is also essential in improving the transfer of strength to daily activities.

Nonetheless, this study also recognizes some weaknesses and limitations. One of these concerns is the limited data available in the literature included in this systematic review. Some studies may have weaker methodology or limitations in the population studied, which may affect the generalizability of the findings.

Further studies are needed in future research to explore the factors that influence the success of resistance exercise programs, including the effects of long-term interventions and the interactions between various exercise variables. Improvements in research methodology, including more robust study designs and the use of more representative samples, are also needed to increase the confidence of this study's results.

Thus, this study concludes that optimizing resistance exercise programs requires a holistic and evidence-based approach. By paying attention to the factors that have been identified and taking steps to address existing limitations, this study hopes to make a valuable contribution to improving our understanding of how to maximize muscle strength through effective and efficient resistance training.

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