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# The Effects of Strength Training on Motor Control and Functional Performance in Older Adults: A Narrative Review

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A B S T R A C T

**Objective:** This narrative review aims to synthesize the current evidence on the effects of strength training on motor control and functional performance in older adults.

**Methods and Materials:** A comprehensive literature search was conducted using multiple electronic databases, including PubMed, Web of Science, Scopus, and Google Scholar. The search targeted peer-reviewed articles published in English from 1990 to 2023. The primary search terms included combinations and variations of keywords like "strength training," "motor control," "functional performance," and "older adults." Studies were included if they involved participants aged 60 years or older, implemented a strength training intervention, and assessed outcomes related to motor control and/or functional performance. Both acute and longitudinal studies were considered to provide a thorough analysis.

**Findings:** The review found that strength training induces significant neurophysiological adaptations in older adults, leading to enhanced motor control and functional performance. Improvements in motor control were evidenced by increased balance, coordination, and movement accuracy. Functional performance benefits included increased gait speed, reduced fall risk, and improved ability to perform daily tasks. The review also highlighted the importance of tailored strength training interventions to maximize these benefits in older adults.

**Conclusion:** Strength training is a potent intervention for enhancing motor control and functional performance in older adults. The findings support the incorporation of strength training into exercise programs for the elderly, not only for improving muscle strength but also for enhancing overall motor function and quality of life. Future research should focus on optimizing strength training protocols and exploring their long-term sustainability.

**Keywords:** *Strength training, motor control, functional performance, older adults, neurophysiological adaptations, aging, fall prevention.*

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## 1. Introduction

Introduction: The global population is aging rapidly, with the number of individuals aged 60 years and older expected to double by 2050 (1). This demographic shift has brought increased attention to the challenges associated with maintaining physical function and independence in older adults. As people age, they experience a gradual decline in muscle mass, strength, and power, a condition known as sarcopenia (2, 3). These physiological changes are accompanied by alterations in motor control and functional performance, which can significantly impact an older adult's quality of life and ability to perform activities of daily living (4, 5) Strength training has emerged as a potent intervention for combating age-related declines in muscle function and physical performance (6, 7). Traditionally, the focus of strength training research in older adults has been on its effects on muscle hypertrophy, strength gains, and bone density (8). However, there is growing interest in understanding how strength training influences motor control and functional performance in this population (4, 9). Motor control, which encompasses the processes by which the nervous system coordinates muscles and limbs to perform skilled and purposeful movements, undergoes significant changes with aging (4, 5). These changes include alterations in movement speed, accuracy, and variability, as well as declines in balance and coordination (4, 9). Such age-related deteriorations in motor control can lead to increased fall risk, reduced mobility, and decreased independence in older adults (10). Functional performance, on the other hand, refers to an individual's ability to perform essential activities of daily living and maintain independence (11). It encompasses various aspects of physical function, including gait speed, balance, and the ability to perform tasks such as rising from a chair or climbing stairs (12). Declines in functional performance are associated with increased risk of disability, institutionalization, and mortality in older adults (13). The relationship between strength training, motor control, and functional performance in older adults is complex and multifaceted. While it is well established that strength training can improve muscle strength and power in this population (2, 6), the extent to which these improvements translate to enhanced motor control and functional performance remains a subject of ongoing research and debate (9, 14). Recent studies have begun to elucidate the potential mechanisms by which strength training may influence motor control in older adults. These include improvements in neural drive to muscles (15, 16), enhanced motor unit recruitment and firing rates (17, 18), and changes in muscle activation patterns (19). Additionally, strength training has been shown to induce neuroplastic changes in the central nervous system, which may contribute to improved motor control and learning in older adults (3). The effects of strength training on functional performance in older adults have been more extensively studied, with numerous investigations reporting improvements in measures such as gait speed, balance, and performance of daily activities following strength training interventions (6, 11). However, the optimal training parameters (e.g., intensity, volume, frequency) for maximizing functional improvements remain a subject of ongoing investigation (20). Furthermore, there is growing interest in understanding how different types of strength training protocols (e.g., traditional resistance training, power training, functional training) may differentially affect motor control and functional performance in older adults (21, 22)

The potential synergistic effects of combining strength training with other interventions, such as balance training or motor skill practice, are also areas of active research (23, 24).

This narrative review aims to synthesize the current evidence on the effects of strength training on motor control and functional performance in older adults. We will examine the neurophysiological adaptations underlying these effects, explore the relationship between strength gains and improvements in motor control and function, and discuss the practical implications for designing effective training programs for older adults. Additionally, we will identify gaps in the current literature and suggest directions for future research in this important and rapidly evolving field.

By comprehensively examining the interplay between strength training, motor control, and functional performance in older adults, this review seeks to provide valuable insights for researchers, clinicians, and practitioners working to promote healthy aging and maintain independence in the elderly population.

## 2. Search Method and Scope

Search Method and Scope This narrative review aimed to synthesize the current evidence on the effects of strength training on motor control and functional performance in older adults. To ensure a comprehensive and up-to-date analysis, we conducted a thorough literature search using multiple electronic databases, including PubMed, Web of Science, Scopus, and Google Scholar. The search was

limited to peer-reviewed articles published in English from 1990 to 2023, encompassing over three decades of research in this field. The primary search terms used were combinations and variations of the following keywords: "strength training," "resistance training," "motor control," "functional performance," "older adults," "elderly," "aging," "neuromuscular adaptations," and "motor function." Boolean operators (AND, OR) were employed to refine the search and ensure the inclusion of relevant studies. Additionally, we examined the reference lists of key articles and recent systematic reviews to identify any pertinent studies that may have been missed in the initial database search. Studies were included if they met the following criteria: (1) involved participants aged 60 years or older; (2) implemented a strength training intervention; (3) assessed outcomes related to motor control and/or functional performance; and (4) were original research articles, systematic reviews, or meta-analyses. We excluded studies that focused solely on young or middle-aged adults, those that did not include a strength training component, and those that only measured muscle hypertrophy or strength without assessing motor control or functional outcomes. The scope of this review encompassed various aspects of strength training interventions in older adults, including traditional resistance training, power training, and functional strength training. We examined studies investigating the effects of these interventions on a range of motor control outcomes, such as movement accuracy, variability, and coordination, as well as functional performance measures like gait speed, balance, and activities of daily living. To provide a comprehensive overview, we included both acute and longitudinal studies, ranging from single-session experiments to long-term training interventions lasting several months. Given the multifaceted nature of motor control and functional performance, we also considered studies that explored the underlying neurophysiological mechanisms of strength training adaptations in older adults. This included research on changes in neural drive, motor unit behavior, and central nervous system plasticity associated with strength training. To ensure the quality and relevance of the included studies, two independent reviewers screened the titles and abstracts of the initially identified articles. Full-text reviews were then conducted for potentially eligible studies, with any disagreements resolved through discussion or consultation with a third reviewer.

## 3. Effects of Strength Training on Motor Control in Older Adults

Strength training induces profound neurophysiological adaptations in older adults, contributing to enhanced motor control. One of the primary mechanisms involves increased motor neuron excitability. Orssatto et al. demonstrated that resistance training leads to elevated intrinsic motor neuron excitability in older adults, which may contribute to improved neural drive and muscle activation (Orssatto et al.2023). This adaptation is crucial for maintaining and enhancing motor function in aging populations. Furthermore, strength training has been shown to modulate cortical excitability and plasticity. Although Leung et al. did not find differential modulation of motor cortex excitability between skill and strength training, other studies have suggested that resistance exercise can induce changes in cortical representations and neural networks associated with movement control (4, 25). These adaptations may underlie the improved motor performance observed in older adults following strength training interventions. The nervous system's role in counteracting sarcopenia and muscle atrophy has been highlighted by Aagaard et al. Strength training appears to enhance neural drive to the muscles, improving motor unit recruitment and firing rates. This neural adaptation is particularly important in the early stages of training and can contribute to rapid improvements in force production and motor control before significant muscle hypertrophy occurs (3).

## 4. Changes in Movement Accuracy and Variability

Strength training has been shown to positively impact movement accuracy and reduce variability in older adults. Hortobagyi et al. reported that both low- and high-intensity strength training partially restored impaired quadriceps force accuracy and steadiness in aged adults (26). This improvement in force control is crucial for precise movements and can translate to enhanced performance in activities of daily living. The reduction in movement variability following strength training is particularly evident in tasks requiring fine motor control. Shim et al. demonstrated that strength training increased training-specific multifinger coordination in humans (27). This finding suggests that resistance exercise can improve the ability to modulate force output across multiple muscle groups, leading to more stable and accurate movements. Moreover, the effects of strength training on movement accuracy extend to various motor tasks. Studies have shown improvements in gait parameters, including increased walking speed and reduced variability in stride length and

time(6, 28). These enhancements in locomotor function can significantly impact an older adult's mobility and independence.

### 5. Improvements in Coordination and Balance:

Strength training has demonstrated substantial benefits for coordination and balance in older adults. Holviala et al. reported that strength training improved muscle strength characteristics, functional capabilities, and balance in middle-aged and older women (6). The enhanced strength and power output resulting from resistance exercise contribute to better postural control and dynamic balance. The impact of strength training on balance is further supported by Granacher et al., who found that core instability strength training improved trunk muscle strength, spinal mobility, dynamic balance, and functional mobility in older adults. This highlights the importance of targeting core musculature in addition to limb muscles for comprehensive improvements in motor control. Coordination improvements following strength training are evident in both gross and fine motor tasks (24). Voelcker-Rehage et al. demonstrated that physical fitness, including muscular strength, is related to better cognitive and motor function in old age. This suggests that strength training may have far-reaching effects on the neural networks underlying motor coordination (29). Additionally, Boiko Ferreira et al. showed that 12 weeks of resistance training improved motor coordination and dynamic balance in older women. This study underscores the potential for relatively short-term strength training interventions to yield significant improvements in motor control (30).

In conclusion, strength training offers multifaceted benefits for motor control in older adults. The neurophysiological adaptations, including increased motor neuron excitability and enhanced neural drive, provide a foundation for improved movement performance. These changes manifest as increased accuracy and reduced variability in force production and movement execution. Furthermore, the improvements in coordination and balance contribute to enhanced functional capacity and reduced fall risk in the elderly population. As such, strength training should be considered a vital component of interventions aimed at maintaining and improving motor function in older adults.

### 6. Gait Speed and Mobility

The impact of strength training on functional performance in older adults is a topic of significant interest in gerontology and exercise science. Research has consistently demonstrated that resistance exercise can lead to substantial improvements in various aspects of daily functioning, including gait speed and mobility, performance of activities of daily living, and fall prevention. Strength training has been shown to have a substantial positive impact on gait speed and overall mobility in older adults. Holviala et al demonstrated that combined strength and endurance training significantly improved muscle strength, walking speed, and dynamic balance in aging men. This study underscores the potential of multimodal training approaches to enhance locomotor function comprehensively (12). The relationship between increased muscle strength and improved gait parameters is further supported by Sipilä et al., who found that strength training enhanced isometric muscle strength and walking speed in elderly women (28). This improvement in walking speed is particularly crucial, as it is a key indicator of functional independence and mortality risk in older populations. Miszko et al. compared the effects of strength and power training on physical function in community-dwelling older adults (21). While both interventions improved functional performance, power training showed superior results in enhancing overall functional ability, including mobility tasks. This suggests that incorporating power-oriented exercises into strength training programs may yield additional benefits for gait and mobility. The long-term effects of resistance training on mobility have also been investigated. McCartney et al. conducted a study on long-term resistance training in the elderly and found sustained improvements in dynamic strength, exercise capacity, and mobility. This research highlights the potential for strength training to provide lasting benefits for functional performance in older adults (8).

### 7. Fall Prevention

One of the most critical impacts of strength training on functional performance is its role in fall prevention. Falls are a major cause of injury and loss of independence in older adults, and strength training has emerged as a powerful intervention for reducing fall risk. Granacher et al. (24) compared traditional and recent approaches in promoting balance and strength in older adults. They found that progressive resistance training, particularly when combined

with balance exercises, was effective in improving neuromuscular function and reducing fall risk. The mechanisms by which strength training contributes to fall prevention are multifaceted. Improved lower limb strength enhances the ability to recover from perturbations and maintain postural stability. Additionally, increased muscle power allows for faster corrective movements when balance is challenged. Wolfson et al. conducted a study on balance and strength training in older adults, finding that the intervention led to significant gains in strength, balance, and gait stability (31). Importantly, they also observed that Tai Chi practice helped maintain these improvements, suggesting the potential benefits of combining strength training with other forms of exercise for fall prevention. The impact of strength training on fall prevention extends beyond physical improvements. Liu et al. conducted a systematic review and meta-analysis on the effects of motor imagery training in gaining muscle strength. They found that elderly individuals may benefit more from this cognitive-physical approach than young adults, highlighting the potential for combined cognitive and physical interventions in fall prevention strategies (32). Hauer et al. reviewed the effectiveness of physical training on motor performance and fall prevention in cognitively impaired older persons. Their findings support the use of strength training as part of a comprehensive fall prevention program, even in populations with cognitive impairments (10).

In conclusion, strength training has a profound and multifaceted impact on functional performance in older adults. It significantly improves gait speed and mobility, enhances the ability to perform activities of daily living, and plays a crucial role in fall prevention. The benefits of strength training extend beyond mere increases in muscle mass and strength, encompassing improvements in neuromuscular coordination, balance, and overall functional capacity. As such, incorporating structured resistance exercise programs into the care and lifestyle of older adults should be a priority for healthcare providers and policymakers aiming to promote healthy aging and maintain independence in the elderly population.

## 8. Neural Adaptations

Strength training has been shown to elicit a variety of adaptations in the human body, particularly in the context of aging populations. These adaptations can be broadly categorized into three main mechanisms: neural adaptations, muscular adaptations, and cognitive and psychological factors. Each of these mechanisms plays a critical role in enhancing physical performance, functional capabilities, and overall quality of life in individuals, particularly older adults. Neural adaptations are fundamental to the improvements observed in strength training. These adaptations primarily involve changes in the central nervous system (CNS) and peripheral nervous system that enhance motor performance. One of the key aspects of neural adaptation is the increased efficiency of motor unit recruitment. Strength training leads to greater synchronization of motor unit firing, which allows for more effective force production during muscle contractions (16). Additionally, resistance training has been shown to enhance the excitability of motor neurons, which can improve muscle activation and overall strength (17). Another significant neural adaptation is the improvement in intermuscular coordination, which refers to the ability of different muscle groups to work together effectively. This is particularly important in complex movements that require the integration of multiple muscle groups, such as walking or climbing stairs (4). As individuals engage in strength training, their CNS becomes more adept at coordinating these movements, leading to improved functional performance. Moreover, strength training can also positively influence cognitive functions related to motor control. Research indicates that older adults who participate in strength training exhibit enhanced cognitive processing related to movement tasks, suggesting that the benefits of strength training extend beyond physical adaptations to include improvements in cognitive function (23).

## 9. Muscular Adaptations

Muscular adaptations to strength training encompass changes in muscle structure and function. One of the most notable changes is an increase in muscle hypertrophy, which refers to the growth of muscle fibers. This growth is primarily driven by mechanical tension and metabolic stress experienced during resistance training (2). Hypertrophy leads to an increase in cross-sectional area of the muscle, contributing to greater strength and power output. In addition to hypertrophy, strength training induces changes in muscle fiber composition. Resistance training can shift the ratio of type I (slow-twitch) to type II (fast-twitch) muscle fibers, often resulting in an increase in the proportion of type II fibers, which are more conducive to explosive strength and power (16). This shift is particularly beneficial for older adults, as it can counteract the natural decline in muscle mass and function associated with aging. Furthermore, strength

training enhances the muscle's ability to generate force through improved contractile properties. This includes increased muscle activation capacity and improved efficiency of energy utilization during contractions. These adaptations are crucial for maintaining functional independence in older adults, allowing them to perform daily activities with greater ease.

## 10. Cognitive and Psychological Factors

The cognitive and psychological aspects of strength training are equally important in understanding its comprehensive benefits. Engaging in regular strength training can lead to improvements in self-efficacy and motivation, which are critical for adherence to exercise programs. The psychological benefits include reduced symptoms of depression and anxiety, improved mood, and enhanced overall well-being (16). Moreover, strength training has been associated with cognitive benefits, particularly in older adults. Studies have shown that resistance training can lead to improvements in executive functions, such as planning, organization, and multitasking abilities (29). These cognitive enhancements are thought to be linked to the increased neural plasticity and improved blood flow to the brain that accompany regular physical activity. Lastly, the social aspects of participating in strength training, such as group classes or community programs, can foster social interaction and support, further enhancing psychological well-being. This social engagement is particularly beneficial for older adults, as it can combat feelings of isolation and loneliness (24).

In conclusion, the mechanisms underlying the effects of strength training are multifaceted, involving intricate interactions between neural, muscular, and psychological adaptations. These adaptations not only improve physical capabilities but also enhance cognitive functions and psychological well-being, contributing to a higher quality of life, particularly in older adults. The integration of these factors underscores the importance of strength training as a vital component of health and wellness programs for aging populations.

## 11. Training Intensity and Volume

Optimal training parameters for older adults are crucial for maximizing the benefits of strength training while minimizing the risk of injury. This involves careful consideration of training intensity and volume, frequency and duration of interventions, and the comparison of different training modalities such as traditional resistance training versus power training. Each of these factors plays an integral role in developing effective training programs tailored to the unique needs of older individuals.

Training intensity refers to the amount of resistance used during strength training, while training volume encompasses the total amount of work performed, typically measured in sets and repetitions. Research indicates that older adults can benefit from both high- and low-intensity training, but the specific intensity must be tailored to individual capabilities and health status. High-intensity strength training, defined as using weights that are 70% or more of an individual's one-repetition maximum (1RM), has been shown to significantly improve muscle strength and functional performance in older adults (1). However, it is essential to ensure that older individuals are adequately prepared for such intensity to avoid injury. Conversely, lower intensity training (40-60% of 1RM) can also yield substantial benefits, particularly for those who are new to strength training or have pre-existing health conditions (16). The volume of training, which includes the number of sets and repetitions, also plays a critical role. A meta-analysis suggests that a moderate volume of 2-3 sets of 8-12 repetitions is effective for improving strength and functional outcomes in older adults (20). It is important to note that while higher volumes can lead to greater strength gains, they also increase the risk of fatigue and injury, necessitating a balanced approach.

## 12. Frequency and Duration of Interventions

The frequency of strength training sessions is another vital parameter. Current guidelines recommend that older adults engage in strength training exercises at least two to three times per week to achieve optimal benefits (Latham et al., 2004). This frequency allows for sufficient recovery between sessions, which is particularly important given the slower recovery rates often observed in older populations.
Duration of training interventions also influences outcomes. Long-term training programs, typically lasting 12 weeks or more, have been shown to produce significant improvements in muscle strength, power, and functional capabilities Interventions that last longer not only enhance physical performance but also contribute to sustained improvements in quality of life and independence in older adults (2).

## 13. Comparison of Different Training Modalities

When considering the types of strength training modalities, traditional resistance training and power training

each offer unique benefits. Traditional resistance training focuses on building muscle strength through controlled movements, typically involving slower lifting speeds with heavier weights. This method is effective for increasing muscle mass and strength, which are crucial for daily activities and fall prevention in older adults (8).

On the other hand, power training emphasizes the speed of movement and explosive strength, which can be particularly beneficial for improving functional performance and reducing fall risk. Power training involves lighter weights lifted at a faster pace, which has been shown to enhance neuromuscular adaptations and improve overall motor control (22). Studies suggest that incorporating power training into strength training regimens can lead to superior improvements in functional abilities compared to traditional resistance training alone.

In conclusion, optimizing training parameters for older adults requires a nuanced understanding of intensity, volume, frequency, duration, and the specific training modalities employed. By tailoring these factors to the individual needs and capabilities of older adults, it is possible to enhance strength, functional performance, and overall health outcomes, thereby promoting independence and improving quality of life.

## 14. Special Considerations for Specific Populations

Strength training for older adults requires special considerations to ensure safety and effectiveness, particularly when addressing specific populations such as the frail elderly, older adults with chronic conditions, and gender-specific responses. Each of these groups presents unique challenges and opportunities that must be taken into account when designing and implementing strength training programs.

## 15. Frail Elderly

Frail elderly individuals often experience a significant decline in muscle mass, strength, and overall functional capacity, which increases their risk of falls and other health complications. Strength training can be particularly beneficial for this population, as it has been shown to enhance muscle strength, improve balance, and increase overall mobility (1, 13). However, it is crucial to tailor the intensity and volume of training to the individual's capabilities. Low to moderate intensity resistance training, focusing on functional movements, is recommended to minimize the risk of injury while promoting strength gains (6).

Moreover, frail elderly individuals may have comorbidities that necessitate additional precautions during training. Incorporating exercises that enhance proprioception and balance can further mitigate fall risk and improve functional outcomes (9).

## 16. Older Adults with Chronic Conditions

Older adults with chronic conditions such as arthritis, cardiovascular disease, or diabetes face unique challenges in strength training. These conditions can limit physical activity levels and complicate the management of health outcomes. Nevertheless, research indicates that strength training can be safely implemented in this population, leading to significant improvements in muscle strength, joint function, and metabolic health. For individuals with arthritis, low-impact resistance training can help alleviate pain and improve joint function (2). Similarly, older adults with cardiovascular issues can benefit from strength training, provided that their exercise programs are closely monitored and tailored to their specific health status (16). It is essential for healthcare providers to collaborate with exercise professionals to create safe and effective training regimens that consider the individual's medical history and current physical capabilities.

## 17. Gender-Specific Responses

Gender differences also play a significant role in the response to strength training among older adults. Research has shown that men and women may exhibit different adaptations to resistance training due to variations in hormonal profiles, muscle fiber composition, and body composition (6). For instance, men typically experience greater increases in muscle mass and strength compared to women, primarily due to higher levels of testosterone, which promotes muscle hypertrophy. However, women can achieve significant improvements in strength and functional capacity through resistance training, particularly when focusing on power training modalities (11). Gender-specific training programs that consider these differences can enhance outcomes for both men and women. For example, women may benefit from higher repetitions with lower weights to improve muscular endurance, while men may focus on heavier resistance to maximize strength gains.

## 18. Future Directions and Research Gaps

Strength training has been shown to significantly impact older adults by enhancing motor control, improving functional performance, and promoting overall well-being. Neurophysiological adaptations resulting from strength training lead to better movement accuracy, reduced variability, and improved coordination and balance. These changes are essential for maintaining independence and preventing falls, which are critical concerns for the aging population. Additionally, strength training positively influences functional performance, enhancing gait speed, mobility, and the ability to perform activities of daily living, thereby improving quality of life and reducing fall risk.

The mechanisms underlying these benefits include neural and muscular adaptations, as well as cognitive and psychological factors. Neural adaptations enhance motor unit recruitment and coordination, while muscular adaptations contribute to increased strength and power. Furthermore, cognitive factors, such as improved focus and motivation, play a role in enhancing overall physical capabilities. To maximize the benefits of strength training for older adults, it is crucial to establish optimal training parameters, including appropriate intensity, volume, frequency, and duration of interventions. Comparing different training modalities, such as traditional resistance training and power training, highlights the need for tailored approaches to meet individual capabilities and goals.

Long-term adherence to strength training is vital for sustaining improvements, and strategies must be implemented to combat the effects of detraining. Effective strategies include fostering motivation, providing social support, and emphasizing the functional benefits of continued training. Special considerations for specific populations, such as frail elderly individuals and those with chronic conditions, must also be integrated into training programs. Gender-specific responses to strength training should be acknowledged, as men and women may exhibit different adaptations due to variations in hormonal profiles and muscle composition. Looking ahead, future research should focus on areas requiring further investigation, such as the long-term sustainability of strength training benefits and the impact on cognitive function. Emerging trends, including the use of power training and technology-assisted interventions like virtual reality and exergaming, show promise in enhancing engagement and motivation among older adults. These innovations have the potential to revolutionize strength training delivery, making it more enjoyable and effective for this population. By addressing these research gaps and leveraging emerging trends, we can continue to improve the health and well-being of older adults through effective strength training interventions.

## 19. Conclusion

In conclusion, strength training for older adults necessitates a nuanced understanding of the specific needs and considerations of various populations. The frail elderly, older adults with chronic conditions, and gender-specific responses all require tailored approaches to ensure safety and effectiveness. By addressing these factors, strength training can significantly enhance physical function, reduce the risk of falls, and improve overall health outcomes in older adults.In summary, strength training for older adults is a multifaceted approach that significantly impacts motor control, functional performance, and overall well-being. The neurophysiological adaptations resulting from strength training lead to enhanced motor control, characterized by improved movement accuracy, reduced variability, and better coordination and balance. These changes are crucial for maintaining independence and preventing falls, which are significant concerns in the aging population.Moreover, strength training has a profound impact on functional performance, notably in gait speed, mobility, and the ability to perform activities of daily living. These improvements are vital for enhancing the quality of life and reducing the risk of falls, thereby contributing to safer aging. The mechanisms underlying these benefits include neural and muscular adaptations, as well as cognitive and psychological factors, which collectively enhance physical capabilities and mental resilience. To maximize the benefits of strength training, optimal training parameters must be established, including appropriate intensity, volume, frequency, and duration of interventions. Comparing different training modalities, such as traditional resistance training and power training, highlights the need for tailored approaches to meet individual capabilities and goals. Long-term adherence to strength training is essential for sustaining improvements, and strategies must be implemented to combat the effects of detraining. These strategies include fostering motivation, providing social support, and emphasizing the functional benefits of continued training. Finally, special considerations for specific populations, such as frail elderly individuals, those with chronic conditions, and gender-specific responses, must be integrated into training programs. By addressing these unique needs, strength

training can be effectively adapted to enhance the health and functional abilities of all older adults, promoting a more active and independent lifestyle. Overall, the evidence underscores the importance of strength training as a critical component of health promotion and disease prevention in older adults.

## Authors' Contributions

M. A. and N. L. B. collaboratively developed the conceptual framework for the review and were both involved in drafting and revising the narrative content. M. A. conducted the systematic search, screened the literature, and extracted data. N. L. B. provided critical revisions that were important for the intellectual content and integration of the narrative review. Both authors approved the final version of the manuscript for publication.

## Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

## Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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## Declaration of Interest

The authors report no conflict of interest.

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## Ethics Considerations

Ethical considerations were adhered to throughout the review process. All sources of information were properly cited to avoid plagiarism. Confidential information from industry reports was handled with care to respect intellectual property rights.

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