

Exercise Interventions for Sarcopenia in Older Adults: Effects on Muscle Strength and Physical Function

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Abstract

Sarcopenia is an age-related syndrome characterized by progressive decline in skeletal muscle mass, muscle strength, and physical function, which can significantly affect the independent living ability and quality of life of older adults. With population aging, sarcopenia has become an important health issue in geriatric medicine. Exercise intervention is considered one of the most effective non-pharmacological strategies for preventing and managing sarcopenia because it can stimulate muscle adaptation, improve neuromuscular function, and enhance daily activity capacity. Different exercise modalities, including resistance exercise, aerobic exercise, balance training, traditional Chinese exercises, and combined exercise programs, have shown positive effects on muscle strength and physical performance in older adults with sarcopenia. Resistance exercise can promote muscle protein synthesis and improve indicators such as handgrip strength and gait speed, while multimodal exercise programs may provide additional benefits by simultaneously improving muscle function, balance, and mobility. However, differences in exercise intensity, intervention duration, individual health status, and adherence may influence clinical outcomes. This article discusses the characteristics of sarcopenia in older adults, the mechanisms of exercise intervention, the effects of different exercise modalities on muscle strength and physical function, and the challenges in clinical application, aiming to provide theoretical support for the development of individualized exercise strategies for sarcopenia management.

Keywords: Sarcopenia, older adults, exercise intervention, muscle strength, physical function, resistance training

1. Introduction

Sarcopenia is a progressive skeletal muscle disorder associated with aging, characterized by reductions in muscle mass, muscle strength, and physical performance. Unlike simple muscle volume reduction, sarcopenia involves functional impairment of the entire neuromuscular system, including decreased muscle contraction ability, reduced mobility, impaired balance, and increased risk of falls. As

muscle function gradually declines, older adults may experience difficulties in walking, climbing stairs, carrying objects, and performing daily activities, which can further reduce independence and increase the risk of disability.

The occurrence of sarcopenia is closely related to multiple physiological changes during aging. Aging can lead to reduced muscle protein synthesis, increased muscle fiber loss, impaired neuromuscular junction function, chronic low-

grade inflammation, hormonal changes, and decreased physical activity. These factors interact with each other, resulting in continuous deterioration of muscle structure and function. When muscle decline exceeds the compensatory ability of the body, older adults may develop significant functional limitations and increased vulnerability to adverse health outcomes.

In clinical practice, sarcopenia assessment mainly focuses on three aspects: muscle strength, muscle quantity, and physical performance. Handgrip strength, gait speed, chair stand tests, and appendicular skeletal muscle mass index are commonly used indicators for evaluating sarcopenia. Among these indicators, muscle strength and physical function have received increasing attention because they are closely associated with daily living ability and fall risk. Maintaining muscle strength is not only important for preventing physical disability but also contributes to improving overall health status and quality of life.

Compared with pharmacological interventions, exercise intervention has advantages including safety, accessibility, and broad applicability. Exercise can directly stimulate skeletal muscle adaptation, improve neuromuscular coordination, enhance functional capacity, and help older adults maintain active lifestyles. Existing studies have demonstrated that exercise interventions can improve muscle strength and physical performance in older adults with sarcopenia, although the effectiveness varies depending on exercise type, intensity, frequency, and duration (Huang et al., 2026).

At present, resistance exercise is widely recognized as an important intervention approach for sarcopenia. By applying mechanical stimulation to skeletal muscles, resistance training promotes muscle adaptation and improves muscle strength. However, sarcopenia is not only a problem of muscle loss but also involves balance impairment, reduced mobility, and decreased ability to participate in daily activities. Therefore, exercise programs focusing solely on muscle strength may not fully meet the comprehensive needs of older adults. Multicomponent exercise strategies combining resistance training, balance training, aerobic exercise, and functional training have gradually attracted attention.

This article focuses on the effects of exercise interventions on muscle strength and physical

function in older adults with sarcopenia. By analyzing the characteristics of sarcopenia, the physiological mechanisms of exercise intervention, and the clinical value of different exercise approaches, this article aims to explore suitable exercise strategies for improving functional outcomes and supporting the long-term management of sarcopenia.

2. Overview of Sarcopenia in Older Adults

2.1 Characteristics and Clinical Manifestations of Sarcopenia

Sarcopenia is a complex aging-related condition involving gradual deterioration of skeletal muscle structure and function. The disease process is not limited to a decrease in muscle mass but is more closely related to the decline in muscle strength and physical performance. Older adults with sarcopenia may initially show reduced exercise capacity, fatigue, and slower movement speed. As the condition progresses, symptoms such as difficulty walking independently, frequent falls, and reduced ability to perform daily activities may occur.

The decline of muscle strength often appears earlier than obvious muscle mass reduction. This phenomenon indicates that muscle quality, neuromuscular coordination, and functional efficiency are important components in sarcopenia development. An older adult may maintain relatively stable body weight while still experiencing reduced muscle function due to increased fat infiltration and decreased muscle quality.

The clinical consequences of sarcopenia are extensive. Reduced muscle strength can affect balance control and mobility, increasing the possibility of falls and fall-related injuries. Long-term functional decline may lead to decreased participation in social activities, reduced quality of life, and increased dependence on caregivers. Therefore, early identification and intervention are essential for delaying disease progression.

2.2 Factors Influencing the Development of Sarcopenia

The development of sarcopenia is influenced by aging-related physiological changes and various external factors. Physical inactivity is considered one of the most important modifiable risk factors. With aging, many individuals reduce daily physical activity because of chronic disease, pain, or decreased confidence in movement. Long-term inactivity reduces mechanical stimulation of

skeletal muscle, leading to decreased muscle protein synthesis and accelerated muscle loss.

Nutritional status also plays an important role. Insufficient protein intake, inadequate energy consumption, and micronutrient deficiencies may weaken the ability of skeletal muscle to maintain normal structure and function. Older adults often face problems such as decreased appetite, digestive dysfunction, and dietary imbalance, which may further aggravate muscle decline.

Chronic diseases, including diabetes, cardiovascular disease, and inflammatory disorders, may also accelerate sarcopenia progression. These conditions can influence muscle metabolism through inflammation, oxidative stress, and reduced physical activity. In addition, psychological factors such as depression and fear of falling may cause older adults to avoid exercise, creating a cycle of reduced activity and further muscle deterioration.

Therefore, sarcopenia management requires not only attention to muscle itself but also consideration of lifestyle, nutrition, disease status, and functional ability. Exercise intervention provides a practical approach because it can simultaneously influence muscle function, mobility, and overall physical activity levels.

3. Mechanisms of Exercise Interventions in Sarcopenia

Exercise intervention is considered an effective strategy for delaying sarcopenia progression because it can regulate skeletal muscle metabolism, improve neuromuscular function, and enhance functional capacity. Unlike passive nutritional supplementation or simple lifestyle adjustments, exercise provides mechanical stimulation and physiological adaptation through repeated muscle activation. The beneficial effects of exercise on sarcopenia are not limited to increasing muscle size but also include improving muscle quality, coordination ability, balance control, and daily activity performance.

3.1 Promotion of Muscle Protein Synthesis and Improvement of Muscle Quality

Skeletal muscle is a dynamic tissue that maintains structural stability through continuous balance between protein synthesis and protein degradation. During aging, anabolic resistance gradually develops, meaning that skeletal muscle

responds less effectively to nutritional intake and physical stimulation. This condition contributes to reduced muscle regeneration ability and accelerates muscle loss.

Exercise, especially resistance exercise, can provide mechanical loading to skeletal muscle and activate adaptive responses. Appropriate mechanical stimulation promotes muscle protein synthesis, enhances the function of muscle fibers, and improves muscle strength. Resistance training does not simply increase muscle volume but can also improve muscle quality by increasing the functional efficiency of existing muscle tissue.

The improvement of muscle strength is particularly important in sarcopenia management. Some older adults may not show significant changes in muscle mass after exercise intervention but demonstrate improvements in grip strength, walking ability, and daily activity performance. This suggests that functional improvement depends not only on muscle quantity but also on neuromuscular adaptation and movement efficiency.

Recent evidence indicates that different exercise types may have different effects on sarcopenia-related outcomes. A systematic review and network meta-analysis involving older adults with sarcopenia showed that moderate-intensity resistance training produced relatively clear improvements in handgrip strength, although no single exercise program demonstrated superiority across all functional indicators (Huang et al., 2026). Therefore, exercise prescription should consider the specific functional problems of individuals rather than pursuing muscle mass improvement alone.

3.2 Enhancement of Neuromuscular Coordination and Physical Function

Aging-related muscle decline is accompanied by deterioration of the nervous system, including reduced motor unit recruitment, impaired coordination between nerves and muscles, and slower response ability. These changes contribute to decreased movement stability and increased risk of falls.

Exercise can improve communication between the nervous system and skeletal muscles through repeated movement practice. Resistance exercise enhances the ability of muscles to generate force, while balance training and functional exercise improve postural control and movement coordination. These adaptations help older

adults perform daily activities more safely.

Physical function is a key indicator reflecting the clinical significance of sarcopenia. Indicators such as gait speed, chair stand ability, timed up-and-go test performance, and short physical performance battery scores are closely related to independent living ability. Exercise interventions targeting these functions can help older adults maintain mobility and reduce dependence.

Research on traditional Chinese exercises has also demonstrated potential benefits for functional improvement in older adults with sarcopenia. A systematic review and meta-analysis found that traditional exercises were associated with improvements in handgrip strength, appendicular skeletal muscle mass index, gait speed, timed up-and-go performance, and other physical function indicators (Ma et al., 2026). These findings suggest that exercise forms emphasizing controlled movement, balance, and coordination may provide additional functional benefits beyond muscle strengthening.

3.3 Regulation of Inflammation and Metabolic Function

Aging is often accompanied by chronic low-grade inflammation, which may negatively affect skeletal muscle metabolism. Increased inflammatory activity can interfere with muscle protein synthesis, accelerate muscle degradation, and contribute to the development of sarcopenia. In addition, metabolic disorders such as insulin resistance may further affect muscle health.

Regular exercise can regulate metabolic processes and improve the internal environment of skeletal muscle. Physical activity enhances glucose utilization, improves insulin sensitivity, and promotes mitochondrial function. These effects are particularly important because metabolic abnormalities frequently coexist with muscle decline in older adults.

Exercise may also influence body composition by reducing excessive fat accumulation and maintaining lean tissue. Since sarcopenia is often accompanied by increased fat infiltration within skeletal muscle, improving body composition can contribute to better muscle function. Therefore, exercise intervention should not only focus on increasing muscle size but also aim to improve overall metabolic health.

3.4 Influence of Exercise Adherence and Individualized Prescription

Although exercise has demonstrated positive

effects on sarcopenia, the actual outcomes depend greatly on whether older adults can maintain long-term participation. Aging-related physical limitations, chronic diseases, fear of falling, and insufficient motivation may reduce exercise adherence.

A suitable exercise program should consider individual differences in baseline physical condition, disease status, functional limitations, and exercise experience. Excessive exercise intensity may increase injury risk, whereas insufficient stimulation may fail to produce meaningful adaptation. Therefore, gradual progression and individualized adjustment are important principles in sarcopenia exercise management.

Recent studies have emphasized that exercise dose and modality both influence intervention outcomes. Different targets, such as improving grip strength, walking ability, or balance, may require different exercise strategies. Research on exercise dose has suggested that exercise volume and type should be considered together when designing interventions for older adults with sarcopenia (Bai, P., Xiong, Q., & Wu, T., 2026). This indicates that effective exercise management requires a balance between scientific planning and practical feasibility.

4. Effects of Resistance Exercise on Muscle Strength and Physical Function

4.1 Role of Resistance Exercise in Sarcopenia Management

Resistance exercise is one of the most widely studied exercise modalities for sarcopenia. It refers to repeated muscle contraction against external resistance, including weight training, elastic band exercises, and resistance-based functional movements. Because skeletal muscle responds directly to mechanical loading, resistance exercise has become a core strategy for improving muscle function in older adults.

The main advantage of resistance exercise is its ability to stimulate muscle adaptation. Through repeated resistance stimulation, muscle fibers gradually enhance force production capacity, improving muscle strength and movement efficiency. Compared with simple aerobic activities, resistance exercise provides stronger stimulation for muscle maintenance and functional improvement.

The effectiveness of resistance exercise is closely related to training intensity, frequency, and

duration. Moderate-intensity resistance training is commonly used in older adults because it can provide sufficient stimulation while maintaining safety. However, exercise intensity should be adjusted according to individual health status, especially for older adults with cardiovascular disease, joint disorders, or severe functional limitations.

4.2 Effects on Muscle Strength

Muscle strength decline is one of the most important features of sarcopenia and is strongly associated with disability risk. Among various evaluation indicators, handgrip strength is frequently used because it is simple, reproducible, and closely related to overall physical function.

Resistance exercise can effectively improve handgrip strength by increasing muscle activation and enhancing neuromuscular adaptation. A systematic review and network meta-analysis of exercise interventions in older adults with sarcopenia found that moderate-intensity resistance training showed relatively significant improvement in handgrip strength compared with routine care, suggesting its potential value in clinical management (Huang, J. H., Ge, S. Y., Dong, L., & Xu, G. H., 2026).

However, improvement in muscle strength does not depend only on increasing resistance intensity. Exercise consistency and correct movement patterns are equally important. For older adults, especially those with reduced mobility, excessive emphasis on high-intensity training may reduce adherence and increase the possibility of injury. Therefore, safe and sustainable resistance exercise programs may provide greater long-term benefits.

4.3 Effects on Physical Performance

Although increasing muscle strength is an important goal, improving physical performance is often more meaningful in clinical practice. Older adults with sarcopenia frequently experience difficulties in walking, standing from a chair, and maintaining balance. Therefore, exercise interventions should focus on whether functional ability improves.

Resistance exercise can improve lower limb strength, which contributes to better walking ability and mobility. Stronger lower limb muscles help older adults complete daily activities such as climbing stairs and transferring between sitting and standing positions.

Evidence from systematic reviews suggests that exercise interventions can improve physical performance indicators in older adults with sarcopenia. A comprehensive analysis of randomized controlled trials showed that physical exercise was superior to control conditions in improving muscle strength and physical performance, with resistance exercise demonstrating advantages in increasing skeletal muscle mass (Lucio et al., 2026). These findings support the important role of resistance training in sarcopenia management.

However, resistance exercise alone may not fully address balance impairment and mobility limitations. Since sarcopenia involves multiple functional problems, combining resistance training with balance and functional exercises may produce more comprehensive effects.

5. Effects of Other Exercise Modalities on Sarcopenia Management

Although resistance exercise is regarded as a fundamental approach for improving muscle strength in older adults with sarcopenia, other forms of exercise also play important roles in maintaining physical function. Sarcopenia is a multidimensional condition involving muscle strength decline, impaired balance, reduced mobility, and decreased ability to perform daily activities. Therefore, exercise strategies that incorporate different movement patterns may provide more comprehensive benefits.

5.1 Aerobic Exercise and Functional Improvement

Aerobic exercise mainly improves cardiovascular endurance and metabolic capacity through continuous rhythmic movement. Common forms include walking, cycling, and low-intensity endurance activities. Compared with resistance exercise, aerobic exercise provides relatively weaker stimulation for muscle hypertrophy but has advantages in improving cardiopulmonary function, energy metabolism, and overall activity tolerance.

For older adults with sarcopenia, aerobic exercise may indirectly support muscle health by increasing daily activity levels and reducing sedentary behavior. Long-term inactivity is an important contributor to muscle decline, and aerobic exercise can encourage older adults to maintain regular movement habits. Improved endurance may also allow individuals to participate in resistance training and functional activities more effectively.

However, aerobic exercise alone may have limited effects on increasing muscle strength. Since sarcopenia is strongly associated with loss of muscle force, aerobic exercise is generally considered more suitable as part of a comprehensive exercise program rather than a replacement for resistance training.

5.2 Balance and Functional Training

Balance impairment is one of the important consequences of sarcopenia. Reduced muscle strength, slower neuromuscular responses, and impaired postural control increase the risk of falls among older adults. Therefore, balance training has important clinical value in sarcopenia management.

Balance exercises include single-leg standing, movement coordination training, and functional tasks involving changes in body position. These exercises can improve postural stability and movement confidence. For older adults who have already experienced falls or fear of falling, balance training may help reduce activity avoidance and encourage participation in daily activities.

Functional training focuses on movements closely related to daily life, such as chair rising, walking changes, stair climbing, and carrying objects. Compared with isolated muscle training, functional exercises emphasize the practical application of improved muscle strength. This approach may better translate physiological improvements into enhanced independence.

The combination of resistance training and functional exercises is particularly suitable for older adults because it addresses both muscle capacity and real-life movement requirements. Improving the ability to perform daily activities is often the ultimate goal of sarcopenia intervention.

5.3 Traditional Chinese Exercises and Their Potential Value

Traditional Chinese exercises, including Tai Chi and other slow, controlled movement practices, have attracted increasing attention in sarcopenia management. These exercises usually involve continuous movements, weight transfer, lower limb control, and coordination between breathing and body movement. Their characteristics make them suitable for older adults with relatively low exercise tolerance.

Compared with high-intensity exercise, traditional exercises have advantages in safety

and accessibility. Many older adults are more willing to participate in these forms of exercise because the movements are relatively gentle and can be adapted according to individual ability.

Evidence from recent studies suggests that traditional Chinese exercises may improve muscle strength and physical function in older adults with sarcopenia. A systematic review and meta-analysis showed that traditional Chinese exercises were associated with improvements in handgrip strength, appendicular skeletal muscle mass index, gait speed, timed up-and-go test performance, and other functional indicators (Ma et al., 2026). These findings indicate that traditional exercises may provide benefits not only through muscle activation but also through improved balance and movement coordination.

The mechanism of traditional exercises may involve repeated weight shifting, lower limb muscle engagement, and enhanced neuromuscular control. Although the increase in muscle mass may be less pronounced compared with resistance training, improvements in balance and mobility may contribute significantly to reducing functional decline.

5.4 Digital Health-Based Exercise Interventions

With the development of digital health technology, exercise interventions delivered through digital platforms have become a new approach for sarcopenia management. Digital interventions may include online exercise guidance, mobile applications, remote supervision, and wearable device monitoring.

Digital exercise programs can overcome some limitations of traditional face-to-face interventions, such as limited medical resources, transportation difficulties, and insufficient supervision. For older adults living in the community, digital platforms may improve access to structured exercise programs.

Recent evidence indicates that digital health-based exercise interventions may improve muscle strength, balance ability, walking performance, and physical function among older adults with sarcopenia. A systematic review of randomized controlled trials found potential improvements in muscle mass, muscle strength, balance, walking ability, and physical function following digital exercise interventions, although the certainty of evidence varied across outcomes (Xu, J., Li, S., Yang, X., & Mao, D., 2026).

Despite these advantages, digital exercise

interventions also face challenges. Some older adults may have limited familiarity with digital devices, and remote exercise lacks direct physical correction from professionals. Therefore, digital approaches may be more effective when combined with professional guidance and individualized adjustment.

6. Combined Exercise and Comprehensive Intervention Strategies

6.1 Importance of Multimodal Exercise Programs

Sarcopenia involves multiple physiological systems, meaning that a single exercise modality may not completely address all clinical problems. Muscle strength, endurance, balance, mobility, and psychological confidence are interconnected aspects of functional health. Therefore, combined exercise strategies have gradually become an important direction in sarcopenia management.

A comprehensive exercise program usually combines resistance training with aerobic exercise, balance training, and functional activities. Resistance training provides direct muscle stimulation, while aerobic exercise improves endurance and metabolic function. Balance and functional training help transform increased muscle capacity into improved daily performance.

Compared with isolated exercise, multimodal programs may better reflect the complex needs of older adults. For example, an older person may improve muscle strength through resistance training but still have difficulty walking safely due to balance problems. Adding balance and mobility exercises can help overcome this limitation.

6.2 Exercise Combined with Nutritional Intervention

Muscle maintenance depends not only on physical stimulation but also on adequate nutritional support. Protein intake provides essential amino acids required for muscle protein synthesis, while exercise enhances the utilization of these nutrients.

In older adults with sarcopenia, exercise combined with nutritional strategies may produce greater benefits than either approach alone. A systematic review of exercise effects in older adults with sarcopenia indicated that the combination of physical exercise and nutritional supplementation showed greater benefits for muscle mass and strength compared with single interventions, although the evidence certainty varied (Lucio et al., 2026).

From a clinical perspective, exercise and nutrition should be considered complementary rather than independent strategies. Exercise creates the stimulus for muscle adaptation, while appropriate nutritional support provides the necessary materials for repair and growth. The combination may be particularly important for older adults with insufficient protein intake or increased nutritional risk.

6.3 Individualized Exercise Prescription

Although exercise has demonstrated positive effects in sarcopenia management, there is no universally applicable exercise program for all older adults. Differences in age, baseline muscle function, chronic disease status, previous exercise experience, and personal preferences can influence intervention outcomes.

For older adults with mild muscle decline, moderate resistance training combined with regular physical activity may be sufficient to maintain function. For individuals with more severe functional impairment, exercise should begin with lower-intensity activities focusing on safety, balance, and gradual progression.

Exercise prescription should include appropriate selection of exercise type, intensity, frequency, and duration. Excessively demanding programs may decrease adherence, whereas insufficient stimulation may fail to produce meaningful adaptation. Therefore, the most effective exercise program is not necessarily the most intensive one but the one that can be safely performed and maintained over time.

Recent research on exercise dose has emphasized that different outcomes may require different training strategies. Improvements in handgrip strength and mobility may respond differently to exercise modality and dose, suggesting that exercise planning should consider specific clinical goals (Bai, P., Xiong, Q., & Wu, T., 2026). This provides support for individualized management rather than standardized exercise recommendations.

7. Challenges and Future Directions of Exercise Intervention

7.1 Challenges in Exercise Implementation for Older Adults with Sarcopenia

Although exercise intervention has demonstrated positive effects in improving muscle strength and physical function, its application in older adults with sarcopenia still faces several practical challenges. The

effectiveness of exercise depends not only on physiological responses but also on individual participation, long-term adherence, and the feasibility of intervention programs in real-life settings.

One major challenge is the heterogeneity of older adults with sarcopenia. Aging populations differ significantly in physical condition, disease burden, nutritional status, and functional ability. Some older adults may only experience mild muscle weakness, while others may already have severe mobility limitations or multiple chronic diseases. Applying the same exercise program to all individuals may result in insufficient effectiveness for some people and excessive burden for others.

Therefore, exercise intervention requires comprehensive assessment before implementation. Evaluations of muscle strength, physical performance, balance ability, daily activity level, and health status can help determine suitable exercise strategies. For older adults with severe functional impairment, initial intervention may need to focus on basic mobility training and safety improvement rather than directly introducing intensive resistance exercise.

Another challenge is maintaining long-term exercise adherence. Unlike short-term clinical interventions, sarcopenia management requires continuous lifestyle adjustment. Many older adults discontinue exercise because of fatigue, lack of motivation, fear of injury, or insufficient understanding of exercise benefits. Even when exercise produces measurable improvements, these effects may gradually decline if regular participation cannot be maintained.

Improving adherence requires not only designing appropriate exercise programs but also providing psychological and social support. Family involvement, professional guidance, group exercise environments, and regular feedback may encourage older adults to maintain exercise habits. Exercise should be integrated into daily life rather than considered a temporary treatment measure.

7.2 Limitations of Current Evidence

Although numerous studies have explored exercise interventions for sarcopenia, several limitations remain. First, differences exist among studies regarding diagnostic criteria, participant characteristics, exercise protocols, and outcome measurements. Sarcopenia definitions have developed over time, and different studies may

use different standards to identify affected individuals. These differences may influence comparisons between studies.

Second, exercise programs vary considerably in terms of intensity, frequency, duration, and supervision methods. Some studies focus on resistance training, while others evaluate combined exercise programs or traditional exercises. Because intervention designs are not completely consistent, determining the optimal exercise prescription remains difficult.

Third, many existing studies focus mainly on short-term outcomes. Improvements in muscle strength and physical function can often be observed after several weeks or months of intervention, but whether these benefits can be maintained over several years requires further investigation. Long-term adherence and sustainability are particularly important because sarcopenia is a chronic aging-related condition.

In addition, some studies include relatively small sample sizes or specific populations, limiting the generalizability of findings. Older adults living in communities, nursing facilities, and hospitals may have different exercise needs and responses. Future research should pay greater attention to diverse populations and real-world application environments.

7.3 Future Directions of Exercise Intervention

Future sarcopenia management may focus on developing more precise and personalized exercise strategies. Instead of simply recommending general exercise, clinicians may need to consider individual characteristics and identify the most suitable exercise combination for each older adult.

One important direction is the integration of exercise assessment and monitoring technologies. Wearable devices, digital health platforms, and remote supervision systems may provide continuous information about exercise performance and physical changes. These approaches may improve intervention accuracy and help older adults maintain participation.

Digital health-based exercise interventions have already shown potential in sarcopenia management. Current evidence suggests that digital programs may improve muscle strength, balance ability, and physical function, although further studies are needed to determine the optimal methods of delivery and supervision (Xu, J., Li, S., Yang, X., & Mao, D., 2026). In the

future, combining digital technology with professional guidance may provide a more accessible approach for community-based sarcopenia management.

Another important direction is the development of multimodal intervention systems. Since sarcopenia involves muscle decline, metabolic changes, nutritional problems, and functional impairment, exercise alone may not fully address all aspects of the condition. Combining exercise with nutritional management, health education, and fall prevention strategies may provide more comprehensive benefits.

The relationship between exercise and specific clinical outcomes also requires further exploration. Different individuals may have different primary problems, such as reduced muscle strength, poor balance, slow walking speed, or decreased independence. Future exercise prescriptions may become increasingly outcome-oriented, selecting specific training approaches according to individual functional limitations.

8. Conclusion

Sarcopenia is an important age-related condition characterized by progressive decline in skeletal muscle function and reduced physical performance. The deterioration of muscle strength and mobility can significantly affect the independence and quality of life of older adults. Exercise intervention provides an effective and practical strategy for delaying sarcopenia progression because it can stimulate muscle adaptation, improve neuromuscular coordination, and enhance functional ability.

Among different exercise modalities, resistance exercise plays a central role in improving muscle strength and supporting muscle function. Other approaches, including aerobic exercise, balance training, traditional Chinese exercises, and digital health-based exercise programs, also contribute to improving physical performance and maintaining active lifestyles. Combined exercise strategies may provide broader benefits by addressing multiple functional problems associated with sarcopenia.

However, exercise intervention should not be understood as a standardized program suitable for all older adults. Individual differences in physical condition, disease status, exercise capacity, and personal preferences require individualized exercise prescription. Future clinical practice should further integrate exercise

assessment, nutritional management, digital technology, and long-term health support to improve the effectiveness and sustainability of sarcopenia intervention.

Through appropriate exercise strategies, older adults with sarcopenia may achieve improvements not only in muscle strength and physical function but also in maintaining independence and improving overall quality of life.

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