



Research Progress on the Application of Exercise Rehabilitation in Older Adults with Sarcopenia

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Abstract. With the acceleration of global population aging, sarcopenia, a common geriatric syndrome, has seen its prevalence rise continuously, emerging as a major public health issue threatening the health and quality of life of the elderly. Exercise rehabilitation, offering low cost, high efficacy, and multi-system benefits, is recognized as a core strategy for sarcopenia prevention and management. This paper systematically reviews recent research on exercise rehabilitation in older adults with sarcopenia. It summarizes the clinical diagnostic approaches for sarcopenia, the intervention mechanisms and clinical evidence of various exercise modalities, and the effects of exercise rehabilitation on improving muscle mass, strength, and physical performance, aiming to provide a scientific basis for the comprehensive management of sarcopenia in the elderly.

Keywords: Sarcopenia; Older adults; Exercise rehabilitation; Muscle strength.

With global aging accelerating, sarcopenia has become a major geriatric concern due to its high prevalence and severe functional impairment. It is a progressive skeletal muscle disorder characterized by loss of muscle mass, strength, and physical performance ^[1]. Prevalence reaches 32.2% among older adults abroad, affecting over 50 million people^[2], with a projected 500 million globally by 2050 ^[3]. In China, prevalence ranges from 5.6% to 14.3%, rising rapidly with age ^[4].

Sarcopenia increases risks of falls, fractures, disability, and mortality from cardiovascular and respiratory diseases. Current interventions mainly rely on nutrition and exercise, with pharmacological treatments still under development. Guidelines consistently emphasize the crucial role of exercise rehabilitation ^[5], which offers low cost, high safety, and multi-system benefits. This paper systematically reviews recent research on exercise rehabilitation in older adults with sarcopenia, aiming to refine the rehabilitation system and support healthy aging strategies within a life-course perspective..

1 Literature Search Strategy:

This narrative review systematically synthesizes research on exercise rehabilitation in older adults with sarcopenia. Literature searches were conducted in PubMed, Web of Science, CNKI, and Wanfang Data (January 2000 – February 15, 2026), using

a combination of MeSH and free-text terms. Chinese search terms: “肌少症/肌肉减少症/骨骼肌减少症” AND “老年/老年人/高龄” AND “运动/运动康复/运动干预/运动训练” OR “抗阻训练/力量训练/渐进性抗阻” OR “有氧运动/耐力训练” OR “传统功法/太极拳/八段锦/易筋经/五禽戏” OR “全身振动训练/振动训练” OR “血流限制训练/加压训练” OR “多组分运动/综合运动干预”. English search terms: (“sarcopenia” OR “sarcopenic”) AND (“older adults” OR “elderly” OR “aging” OR “aged”) AND (“exercise” OR “exercise rehabilitation” OR “physical activity” OR “physical exercise”) OR (“resistance training” OR “strength training” OR “progressive resistance”) OR (“aerobic exercise” OR “endurance training”) OR (“traditional Chinese exercise” OR “Tai Chi” OR “Baduanjin” OR “Yijinjing” OR “Qigong”) OR (“whole body vibration” OR “vibration training”) OR (“blood flow restriction” OR “kaatsu”) OR (“multicomponent exercise” OR “combined exercise”).

Inclusion criteria: (1) older adults (≥ 60 years) diagnosed with sarcopenia; (2) single or combined exercise interventions (with/without nutrition); (3) outcomes including muscle mass, strength, or physical performance; (4) study types: RCTs, quasi-experimental studies, prospective cohort studies, consensus statements, clinical guidelines, systematic reviews/meta-analyses, and high-quality narrative reviews. Exclusion criteria: animal studies, conference abstracts, unavailable full text, non-English/Chinese publications.

Two researchers independently screened literature; disagreements were resolved by discussion. Due to heterogeneity in interventions, outcomes, and assessment methods, thematic synthesis (not meta-analysis) was used to integrate evidence.e.

2 Clinical Diagnosis of Sarcopenia

Diagnosis of sarcopenia requires comprehensive assessment of muscle mass, strength, and physical performance. Guidelines vary in tools and cut-off points.

For muscle mass: CT/MRI are gold standards but costly, mainly for research. DXA is preferred for clinical use due to accuracy and operability. BIA is portable and non-invasive, widely used for community screening^[6]. The 2024 Chinese guidelines recommend BIA for community screening.

For muscle strength: grip strength test is simple and prognostic. AWGS cut-off points for weakness: <28 kg (men), <18 kg (women). The five-time chair stand test (≥ 12 seconds) indicates weakness, especially for those with hand dysfunction^[7].

For physical performance: common tools include 6-meter gait speed, SPPB, and TUG. AWGS and Chinese consensus use gait speed <1.0 m/s as declining performance^[2]. SPPB score <9 also indicates decline^[8].

In conclusion, sarcopenia diagnosis should use a multi-dimensional strategy integrating muscle mass, strength, and physical function to improve accuracy and applicability.

3 Application of Different Exercise Rehabilitation Modalities in the Treatment of Older Adults with Sarcopenia

3.1 Aerobic Exercise

Aerobic exercise, a rhythmic activity improving cardiorespiratory fitness, is favored by the elderly. It improves cardiorespiratory fitness and muscle mass ^[9] in sarcopenia patients, and enhances muscle function by remodeling contractile properties at the fiber level ^[10]. Mechanisms include reducing intramuscular fat infiltration, increasing mitochondrial enzyme activity and optimizing mitochondrial quality control, and maintaining neuromuscular system integrity to counteract denervation ^[11].

Recent evidence supports aerobic exercise in sarcopenia. Lipka et al. found that a 12-week high-intensity intermittent Nordic walking program (3 sessions/week, 57-63 min/session, 50%-70% HRmax) in sarcopenic women (60-79 years) significantly increased appendicular lean mass, skeletal muscle index, lower limb strength, and improved TUG performance ^[13]. Wang LZ et al. reported that 8-week moderate-intensity aerobic exercise (3 sessions/week, 40 min/session) in obese sarcopenic older adults increased skeletal muscle mass and decreased fat mass, BMI, and visceral fat area ^[13]. Wang L et al. observed improvements in grip strength, skeletal muscle mass index, thigh circumference, and 6-minute walk distance after a 12-week aerobic exercise intervention in hospitalized elderly sarcopenia patients ^[14].

Prescription guidelines recommend 4-5 times/week, >150 minutes weekly, at 40%-70% HRR or RPE 11-14. Sessions start at 5-10 minutes, progressing to 15-30 minutes ^[15].

3.2 Resistance Training

Resistance training (RT), involving muscle contraction against external resistance, is the cornerstone for sarcopenia, superior to aerobic training, whole-body vibration, and electrical stimulation for inducing muscle hypertrophy ^[16]. Mechanisms: promoting muscle protein synthesis via signaling pathways (e.g., enhancing leucine sensitivity); neural adaptations initially (increased motor unit recruitment, coordination); long-term stimulation of contractile protein synthesis, increased fiber cross-sectional area, and satellite cell activation, counteracting muscle loss ^[17].

Clinical evidence: Pereira et al. found 12-week progressive RT (2 sessions/week) plus nutrition reduced sarcopenia prevalence from 35.14% to 0% in community older adults (mean 69.1), improving grip strength, chair stand, TUG ^[18]. A meta-analysis (24 RCTs, 951 participants) confirmed RT improves grip strength, gait speed, knee extension strength, TUG ^[19]. Polo-Ferrero et al. reported improved physical performance (five-time chair stand, TUG) and body composition after 32 weeks of high-speed RT in women >65 with low muscle strength ^[20]. A Dutch protocol for frail older adults outlines 12-week, twice-weekly progressive RT (20%-80% 1RM) targeting muscle mass, strength, and function ^[21].

In practice, RT uses elastic bands, dumbbells, or body weight. Optimal strength gains at 70%-85% 1RM; beginners start at 40%-60% 1RM. Frequency: 2-3 times/week with ≥ 48 hours rest, focusing on major muscle groups, especially lower limb and core.

3.3 Vibration Training

Vibration training involves standing on a vibrating platform, activating muscle spindles and stretch reflexes, causing rhythmic contractions ^[32]. This low-load passive method suits sarcopenic elderly with joint pain or low strength. Mechanisms: proprioceptive input activates high-threshold motor units ^[23]; mechanical stress may activate IGF-1/PI3K/AKT pathway, promoting synthesis and inhibiting FOXO-mediated degradation ^[24]; improves microcirculation and potentially counteracts denervation via neuromuscular junction effects ^[25].

Clinical studies: Zhuang et al. found 12 weeks of whole-body vibration (3/week, 12 Hz, 2-4 mm amplitude) in sarcopenic older adults improved appendicular skeletal muscle index, knee extension strength, gait speed, SPPB, IGF-1, and growth hormone ^[26]. Zhu et al. reported superior gains in skeletal muscle index, grip strength, and 6-minute walk distance when combining 6 weeks of vibration with blood flow restriction vs. conventional rehab ^[27]. Huang S et al. observed improved chair stand time and Berg Balance Scale after adding whole-body vibration (5/week for 12 weeks) to standard care ^[28].

Optimal parameters: high-frequency (30-40 Hz), low-amplitude (1-2 mm) for strength and gait; dynamic postures (e.g., mini-squats) preferred. Typical regimen: 2-3 times/week, 15-30 minutes, a well-tolerated alternative for frail individuals unable to do traditional RT.

3.4 Traditional Chinese Exercises

Traditional Chinese exercises (TCEs) like Tai Chi, Baduanjin, and Wuqinxi integrate movement, breathing, and meditation. Their slow, low-impact nature suits frail older adults or those with balance issues.

TCEs have multi-targeted mechanisms: neuromuscularly, slow controlled movements enhance motor unit recruitment and coordination, activating lower limb and core muscles ^[29]; metabolically, sustained isometric contractions help maintain protein balance ^[30]; systemically, deep diaphragmatic breathing reduces chronic low-grade inflammation ^[31].

Evidence: Yang S found Tai Chi and Baduanjin improved grip strength and gait speed versus controls, though muscle mass and ADL improvements were not significant ^[32]. Zhu et al. showed 12 weeks of Yijinjing significantly enhanced muscle strength in sarcopenic older adults ^[33].

TCEs are safe, accessible, require no equipment, and promote social engagement. Recommended protocols: 3-5 sessions/week, 40-60 minutes each, for ≥ 12 weeks, tailored to individual capabilities. Notably, TCEs improve muscle strength but have limited effect on muscle mass; combining them with resistance training and nutritional support may be optimal for comprehensive management.

3.5 Combined Training

Combined training (CT) integrates two or more exercise modalities, most commonly resistance training with aerobic, balance, flexibility, or coordination exercises ^[34]. Unlike single-modality approaches, CT aims to concurrently improve muscle

strength, cardiorespiratory fitness, balance, and physical function, better addressing multifaceted decline and fall risk in older adults [35].

Evidence is accumulating. A network meta-analysis by Qiu et al. on sarcopenic obesity found multi-component training most effective for body composition (reducing body fat %) and significantly enhanced grip strength, 30-second chair stand, and gait speed [36]. Lu et al. concluded CT significantly improves knee extension strength, gait speed, and TUG time in sarcopenic older adults [35]. The “Vivifrail” program from Spain prescribes individualized combinations of resistance, balance, aerobic, and flexibility exercises based on functional capacity [34]. A Korean study using twice-weekly, 60-minute group CT (30 min RT + 20 min aerobic at 50%-70% $\text{VO}_{2\text{max}}$) reported improved gait speed, SPPB, and grip strength after 12 weeks [37]. A 24-week RCT by Guo H et al. found that CT improved L3 skeletal muscle area more than strength training alone or control, suggesting integrating TCEs with modern RT is promising [38].

Current guidelines recommend CT frequency of 2-3 times/week, intensity progressively adjusted to baseline function, with emphasis on proper technique and safety under professional supervision.

4 Conclusion

Sarcopenia predicts functional decline and poor outcomes in the elderly, making it a key target for healthy aging. Exercise rehabilitation is central to its management, but evidence quality varies. Different exercise modalities affect muscle mass, strength, and function differently, yet standardized prescriptions for varying functional levels are lacking. Optimal dose-response relationships remain unclear, requiring more research on intervention duration, frequency, and intensity. Most studies focus on single modalities, with limited exploration of combined exercises. Traditional exercises show promise, but their integration with modern sports medicine needs more rigorous trials. Future research should prioritize multi-center, long-term RCTs to establish individualized exercise prescriptions. Investigating molecular mechanisms may support precision rehabilitation. Integrating modern and traditional exercises can develop population-specific models. Additionally, combining exercise with nutritional support and cognitive training is needed for comprehensive sarcopenia management.

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