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Effects of Exercise Interventions Systematic on Physical Function in Patients with Sarcopenia a Systematic Review Based on AWGS Criteria

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Abstract

Sarcopenia is characterized by progressive loss of skeletal muscle mass and strength associated with aging, leading to decreased physical function and reduced quality of life. This systematic review aimed to comprehensively evaluate the effects of various exercise interventions on muscle mass, strength, and physical function in patients diagnosed with sarcopenia according to the Asian Working Group for Sarcopenia(AWGS) criteria. A systematic literature search of PubMed, Embase, and Cochrane identified 54,604 studies, of which seven randomized controlled trials(RCTs) were analyzed using the ACSM FITT-VP principle. The review found that low-to-moderate intensity aerobic and resistance exercises performed 3–5 times per week for 60 min resulted in significant improvements in muscle mass, strength, and physical function. Notably, combined exercise interventions that integrated aerobic and resistance training yielded the greatest benefits. However, the limited number of included studies and heterogeneity in the intervention protocols suggest the need for larger, more objective, and reliable future research.

Keywords: *Sarcopenia, Exercise, Physical Performance, Asian Working Group For Sarcopenia(AWGS), Exercise Intervention.*

Introduction

Sarcopenia is a complex condition characterized by the progressive loss of skeletal muscle mass and strength owing to aging, resulting in impaired physical function and reduced quality of life. The major contributing factors include chronic diseases, lifestyle factors, hormonal changes, increased inflammatory cytokines, mitochondrial dysfunction, and alterations in protein synthesis and degradation capacity[1,2]. Sarcopenia has emerged as a significant global public health issue with varying prevalence rates across countries. In Europe[3], the prevalence among individuals aged 60 years and older ranges from 10% to 27%, whereas in Asian countries, it ranges from 13.8% to 21.3%, depending on the diagnostic criteria and population characteristics[4]. In Korea, the prevalence among the older people is approximately 10.25%, and the proportion of the elderly population is expected to increase to 40% by 2050[5].

The impact of sarcopenia on physical function and quality of life in older adults is predominantly negative. Decreased muscle strength and physical function increase the risk of falls, fractures, and disability; hinder activities of daily living; and increase dependence on medical and nursing care, thereby raising social costs[6]. Numerous previous studies have reported a relationship between sarcopenia and physical function, commonly manifesting as reduced gait speed, decreased grip strength, and an overall decline in physical performance, which in turn affects disability, hospitalization, and mortality rates[7].

Various exercise interventions such as aerobic, resistance, combined, balance, and stretching exercises have been proposed to manage sarcopenia [8,9,10,11,12,13,14,15]. Aerobic exercise(AE) enhances cardiopulmonary endurance, increases fatigue thresholds, and improves the activities of daily living [8,13,14]. Resistance exercise(RE) promotes muscle protein synthesis and increases muscle fiber size and number, effectively enhancing muscle strength[9,13,14]. Combined exercise(CE), which

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integrates AE and RE, offers complementary benefits for sarcopenia management and physical function improvement[10,13,14]. Balance exercise(BE) reduces the risk of falls and improves postural stability and functional independence, particularly in older adults with sarcopenia[11,13]. Stretching exercise(SE) maintains and improves joint range of motion, alleviates muscle stiffness, and contributes to injury prevention[12].

According to previous studies[8,9,10,11,12,13,14] and guidelines[15], each exercise intervention comprehensively improves physical function and prevents functional decline. The Asian Working Group for Sarcopenia(AWGS) has developed specific criteria for diagnosing sarcopenia, considering the body composition and health status of Asian populations. The 2014 AWGS criteria used dual X-ray absorptiometry and bioimpedance analysis to measure muscle mass, handgrip strength for muscle strength, and gait speed for physical performance, presenting population-specific cutoff values[16]. In 2019, the guidelines were updated to emphasize early detection and intervention, further refining the diagnostic process[17].

Table 1. Guidelines For Exercise Interventions for Older Adults (ACSM)[15]

FITT	Aerobic Exercise	Resistance Exercise	Balance Exercise	Stretching Exercise
Frequency	≥5 days/week for moderate intensity or ≥3 days/week for vigorous intensity; a combination of both on 3-5 days/week	≥2 days/week	≥2-3 days/week.	≥2 days/week
Intensity	Moderate (5-6 on a scale of 0-10) to vigorous (7-8 on a scale of 0-10)	Light intensity (40%-50% 1-RM*) for beginners, progressing to moderate/vigorous (60%-80% 1-RM); moderate (5-6 on a scale of 0-10) to vigorous (7-8); Power training: light to moderate loading (30%–60% of 1-RM)	Effective intensity not determined	Stretch to the point of tightness or slight discomfort
Time	30-60 min/day for moderate intensity or 20-30 min/day for vigorous intensity; can be accumulated throughout the day	Progressive weight training: 8–10 exercises involving the major muscle groups; ≥1 set of 10–15 repetitions for beginners; progress to 1–3 sets of 8–12 repetitions for each exercise Power training: 6–10 repetitions with high velocity	≥ 20-30 min/day as needed	Hold stretch for 30–60 s
Type	Activities that do not cause excessive orthopedic stress (e.g., walking, water exercise, cycling).	Weight training or bodyweight exercises targeting major muscle groups	Exercise skills exercises (e.g., balance, agility), multi-faceted activities (e.g., tai chi, yoga); recommended for older adults at risk for falls	Slow movements ending in static stretches rather than ballistic movements

*1-RM: one repetition maximum

Comparative studies have shown differences in body composition between Asian and Western populations; Asians generally have lower muscle mass and higher fat mass relative to body size. Genetic factors, muscle fiber composition, hormonal responses, and metabolic rates also influence sarcopenia, necessitating tailored diagnostic criteria and intervention strategies[18,19].

This study systematically analyzed the effects of exercise interventions on the physical function of patients with sarcopenia based on the AWGS criteria to provide empirical evidence for developing optimized exercise programs for Asian populations. The long-term goal is to promote health and improve quality of life in aging societies.

Materials and Methods

Search Strategies

To ensure transparency and reliability, the study protocol was registered in PROSPERO(CRD42024558296). A systematic literature search was conducted up to April 2025 in the core databases PubMed, Embase, and Cochrane Library, according to the NLM COSI(Core, Standard, Ideal) models [20]. Main search terms included "Sarcopenia" AND "Exercise" OR "Resistance Training" OR "Circuit-Based Exercise" OR "Postural Balance" OR "Muscle Stretching Exercises" AND "physical functional performance," along with relevant natural language terms. The search was limited to randomized controlled trials(RCTs) and studies using AWGS diagnostic criteria.

Study Selection

Studies retrieved from the core databases were de-duplicated using EndNote[21]. Following the PRISMA 2020 checklist[22], two reviewers(Ha and An) independently screened the titles and abstracts, with eligible studies undergoing full-text assessment. Disagreements were resolved through discussions with a third reviewer. Data extraction was performed by Ha and cross-checked by An, and manuscript preparation was finalized through consensus. Inclusion criteria were set according to PICOS:population(P) diagnosed with sarcopenia based on the AWGS 2014 or 2019[13,14]; intervention (I) - exercise interventions for sarcopenia; comparison (C) - control groups receiving exercise or other interventions; outcomes (O) - physical function indicators; and study design(S) - RCTs. The exclusion criteria were non-Asian populations, non-English articles, studies published before 2014, animal studies, and non-RCTs.

Quality Assessment

Two reviewers independently assessed the risk of bias using the Physiotherapy Evidence Database(PEDro) scale[23], which comprises 10 items evaluating random allocation, allocation concealment, baseline comparability, therapist blinding, subject blinding, assessor blinding, intention-to-treat analysis, adequate follow-up, between-group statistical comparisons, and point estimates with variability.

Data Extraction

Data from the included studies were organized according to the American College of Sports Medicine(ACSM) FITT-VP principles (frequency, intensity, time, type, volume, and progression)[15]. The effects on physical function were statistically analyzed using the assessment tools employed in each study.

Results

Search and Selection of Studies

A total of 54,604 studies were identified from core databases(PubMed, Embase, and Cochrane Library), of which 203 met the AWGS diagnostic criteria(PubMed, n=66; Embase, n=27; Cochrane, n=110). Following the PRISMA 2020 guidelines, title/abstract screening and full-text review yielded seven RCTs for final inclusion(Figure 1). The mean PEDro score(Table 2) was 6.3, indicating moderate to high methodological quality. Most studies satisfied random allocation and assessor blinding, but allocation concealment, subject blinding, and therapist blinding were not met.

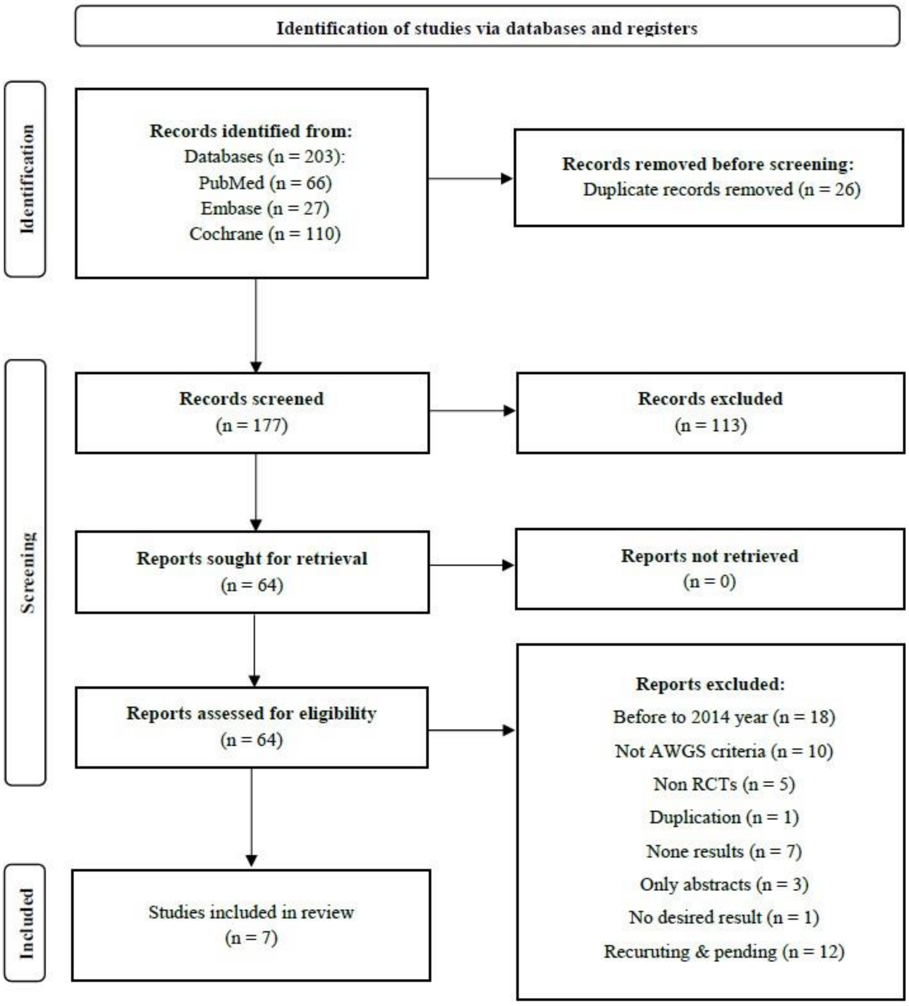

Figure 1. PRISMA Flow Diagram.

Table 2. Quality Assessment

Study	eligibility criteria	Random Allocation	Concealed Allocation	Baseline Similarity	Blinding (Subjects)	Blinding (Therapists)	Blinding (Assessors)	Follow-up of>85%	Intention-to Treat Analysis	Comparison Between Groups	Point Estimates and Variability	Quality Score (0-10)
Yoshimura, Y. et al (2018)	Y	1	0	1	0	0	1	1	1	1	1	7
Takeuchi, I. et al (2018)	Y	1	0	1	0	0	1	1	1	1	1	7
Zhu, L. et al (2019)	Y	1	0	1	0	0	1	0	1	1	1	6
Yuenyongchaiwat, K. & Akekawatchai, C. (2022)	Y	1	0	1	0	0	1	1	1	1	1	7
Tokuda, Y. & Mori, H. (2023)	Y	1	1	1	0	0	1	1	0	1	1	7
Chaovarin, C. et al (2023)	Y	1	0	1	0	0	0	1	1	1	1	6
He, S. et al (2024)	Y	1	0	1	0	0	0	0	0	1	1	4

Characteristics of Included Studies

This systematic review included seven RCTs targeting Asian patients with sarcopenia. All the studies wereorganized according to the ACSM FITT-VP principles [15]. Key findings: all studies were conducted in Asian countries(Japan, China, and Thailand) in hospitals or community settings. The participants included two studies on post-stroke sarcopenia, four on sarcopenia, and one on sarcopenia owing to hemodialysis. The diagnostic criteria included the AWGS 2014(three studies), AWGS 2016(one study), and AWGS 2019(three studies). Interventions were categorized as single(one study, RE) or combined(six studies, AE, RE, and BE). Intervention duration ranged from 8 to 24 weeks(mean

12.6 weeks), with an exercise frequency of 3–5 times per week, low-to-moderate intensity, and sessions of up to 60 min. Exercise progression was individualized, and most studies included nutritional supplementation.Outcomes were assessed using muscle mass(BMI, SMI, and ASM), strength(HGS and leg extension), and physical function(GS, 5-STST, FIM-motor, PA, and inspiratory capacity). Most studies reported statistically significant improvements($p<0.05$). Specifically, studies using AWGS 2014 criteria showed increases in SMI by 0.32 kg/m²(95% CI: 0.18–0.46) and grip strength by 2.1 kg(95% CI: 1.4–2.8), whereas those using AWGS 2019 reported greater improvements in gait speed(0.15 m/s, 95% CI: 0.09–0.21, $p<0.05$). This review confirms the effectiveness of various exercise interventions in improving physical function in patients with sarcopenia and provides important foundational data for clinical exercise prescription (Table 3).

Discussion

This review confirms that CE interventions are effective in improving physical function in patients diagnosed with sarcopenia according to the AWGS criteria. In the seven RCTs analyzed, low-to-moderate-intensity exercise performed 3–5 times per week for 60 min led to significant improvements in muscle mass, strength, and physical function. These findings are consistent with those of previous studies. Kemmler et al.(2020) demonstrated that high-intensity RE significantly increased muscle strength(36.5%) and bone mineral density(4.2%) in elderly men with osteoporosis and sarcopenia. Muscle mass in the exercise group increased by 0.25 kg/m², whereas the control group showed a decrease of 0.08 kg/m²($p<0.001$), and maximal dynamic strength increased by 481N in the exercise group but decreased by 26N in the control group($p<0.001$)[31]. Similarly, Otsuka et al.(2022) reported that 24 weeks of high-intensity RE increased muscle mass by 8.5% and strength by 20.3%, confirming significant effects on muscle quantity and quality($p<0.005$)[32]. Liu et al.(2020) found in a meta-analysis that CE increased muscle strength by 23.7% and reduced body fat by 6.2%($p<0.01$), with mixed training(MT) also showing significant effects(SMD 0.62, 95% CI: 0.29–0.95, $p=0.0002$)[33]. Mende et al.(2022) confirmed that machine-based RE was effective in improving functional performance in older adults with sarcopenia, with the chair-stand test showing significant results (SMD -0.92, 95% CI: -1.11 to -0.73, $p<0.00001$)[34].

Conversely, Liu et al.(2020) found that the effect of CE was not as large as expected, with no statistically

Table 3.Studies in the Review

Authors (year)	Study design (Nation)	Participants			Intervention								Outcomes
		Num. and Age (age, Mean ± SD)	Char. (Settings)	DC	TD(wk)	Frequenc/wk	Intensity	Time/session	Type	Volume	Progression	Combination	
Yoshimura, Y. et al (2019)[24]	RCT (Japan)	· Total(n=44) · IG(n=21, 80.8±7.1) · CG(n=23, 78.9±6.3)	post stroke (Hospital)	AWGS 2014	8 wk	5 days/wk	1RM 20~30%	20 min/set	· Low intensity RE : STSe · WME : leg press, leg curl, leg extension	100 min/wk	Gradually increase	LEAA Suppl, RRP	· FIM-motor: *P* <0.045(IG↑)* · SMI: *P* <0.041(IG↑)* · HGS: *P* <0.002(IG↑)*
Takeuchi, I. et al (2019)[25]	RCT (Japan)	· Total(n=68) · IG(n=35, 78.8±5.1) · CG(n=33, 80.9±7.3)	post stroke (Hospital)	AWGS 2014	8 wk	5 days/wk	1RM 20~30%	10 repetitions/set	· Low intensity RE : STSe · WME : leg press, leg curl, leg extension	· Low intensity RE : max 10 repetitions/set · WME : none	Gradually increase	BCAA & vitamin D Suppl, RRP	· MC: *P* <0.033(IG↑)* · HGS: *P* <0.041(IG↑)* · BMI: *P* <0.035(IG↑)* · FIM-motor: *P* < 0.177
Zhu, L. et al (2019)[26]	RCT (China)	· Total(n=113) · WC(n=37, 72.2±6.6) · Ex(n=40, 74.5±7.1) · ExS(n=36, 74.8±6.9)	Sarcopenia (Community)	AWGS 2014	12 wk	· 3 days/wk : 2 days group : 1 day home	Monitoring & Adjustment (Qualified Coach)	· Wu & Cd : 5~10 min/set · RE : 20~30 min/set · AE : 20 min/set · HE : relearning/set	· Wu & Cd · RE : band exercise on chair · AE · HE	180min/wk	Adjustment (qualified coach)	ExS: nutrition Suppl (Ensure NutriVigor)	· GS: *P* <0.602 · LM: *P* <0.015(ExS↑)* · ASM/height²: *P* <0.025(ExS↑)* · HGS: *P* <0.094 · Leg ext.: *P* <0.0001(Ex, ExS↑)* · 5-Chair stand: *P* <0.004(Ex, ExS ↑)* · 6MWT: *P* <0.796 · PASE: *P* <0.026(Ex, ExS↑)* · LADL impairments: *P* <0.055
Yuenyongchaiwat, K. & Akekawatchai, C. (2022)[27]	RCT (Thailand)	· Total(n=60) · IG(n=30, 69.23±6.71) · CG(n=30, 71.93±5.19)	Sarcopenia (Community)	AWGS 2019	12 wk	· Walking : 5 days/wk · RE : 2 days/wk	Moderate	· Walking : ≥7,500 steps/1 day	· Walking · RE : Band exercise	· Walking : ≥37,500 steps/wk	Gradually increase	none	· SMI: *P* <0.825 · HGS: *P* <0.001(IG↑)* · GS: *P* <0.004(IG↑)* · MIP: *P* <0.001(IG↑)* · Walking: *P* <0.020(IG↑)* · PA: *P* <0.001(IG↑)*
Tokuda, Y. & Mori, H. (2023)[28]	RCT (Japan)	· Total(n=54) · RE(n=15, 75.8±2.23) · RE+EAA(n=15, 78.0± 1.48) · RE+EAA+TCC (n=16, 78.65±2.45)	Sarcopenia (Hospital)	AWGS 2019	24 wk	2 days/wk	RPE 13	· Warm up : 20 min/set · RE : 40 min/set	· Warm up · RE : Band exercise : free weight	120 min/wk	RPE 13	EAA & TCC Suppl	· SMM: *P* <0.010(RE+EAA+TCC ↑)* · HGS: *P* <0.798 · Leg ext.: *P* <0.680 · GS: *P* <0.180 · Physical QOL: *P* <0.964
Chaovarin, C. et al (2024)[29]	RCT (Thailand)	· Total(n=53) · IG(n=26, 56±9.81) · CG(n=27, 49.5±11.05)	hemodialysis (Hospital)	AWGS 2019	12 wk	3days/wk	1RM 30~50%	three sets/session of hemodialysis	· RE : sand back(leg)	· <1RM 85% : avoid muscular injury	Gradual increase of 30-50% every 4 weeks	none	· ASM: *P* <0.001(IG↑)* · RLV: *P* <0.001(IG↑)* · LLV: *P* <0.001(IG↑)* · LDS: *P* <0.001(IG↑)* · 5-STST: *P* <0.001(IG↑)* · Body weight: *P* <0.037(IG↑)*
He, S. et al (2024)[30]	RCT (China)	· Total(n=94) · SDSG(n=34, 67.76±5.47) · STG(n=30, 66.87±3.84) · CG(n=30, 65.42±3.97)	Sarcopenia (Community)	AWGS 2016	24 wk	· 3 days/wk : SDSG, STG · more ex./wk : CG	Varies intensity (every 3 sessions)	· 8wk/3 session : SDSG, STG	· RE : U/E & L/E 5types : SDSG, STG · Yijinjing ex. : SDSG · RE+Yijinjing ex. : SDSG · General activity : CG	none	Gradually increase	· nurse education · protein intake : CG	· SMA: *P* <0.05(SDSG, STG↑)* · SMD: *P* <0.05(SDSG, STG↑)* · RSMI: *P* <0.05(SDSG, STG↑)* · MFI: *P* >0.05(CG↑)* · HGS: *P* <0.05(SDSG, STG↑)*

*****: p<0.05, **RCT**: Randomized Controlled Trial, **IG**: Intervention Group, **CG**:Controll Group, **Char.**: Charcteristics, **DC**: Diagnostic Criteria, **AWGS**: Asian Working Group for Sarcopenia, **TD(wk)**: Total Duration(week), **1RM**: 1 Repetition Maximum, **RE**: Resistance Exercise, **STSe**: Sit To Stand Exercise, **WME**: Weight Machine Exercise, **LEAA**: Leucine-Enriched Amino Acid, **BCAA**: Branched-Chain Amino Acids, **Suppl.**: Supplementation, **RRP**: Recovery Rehabilitation Program, **FIM**: Functional Independence Measure, **SMI**: Skeletal Muscle Index, **HGS**: Hand Grip Strength, **MCC**: Mean Calf Circumference, **Wu & Cd**: Warmup & Cool down, **AE**: Aerobic Exercise, **HE**: Home Exercise, **WC**: Waitlist Control, Ex: Exercsie alone, **ExS**: Combined program and nutrition Supplement, **GS**: Gait Speed, **LM**: Lower limb Muscle mass, **ASM**: Apendicular Skeletal Muscle mass, **Leg ext.**: Leg extension, **5CS**: 5-Chair Stand, **6MWT**: 6-Minute Walk Test, **PASE**: Physical Activity Scale for the Elderly, **LADL**: Lnstrumental Activities of Daily Living, **MIP**: Maximal Inspiratory Pressure, **PA**: Physical Activity, **MET**: Metabolic Equivalent, **EAA**: Essential Amino Acid, **TCC**: Tea CateChin, **SMM**: Skeletal Muscle Mass, **QOL**: Quality-Of-Life, **RLV**: Right Leg Volume, **LLV**: Left Leg Volume, **LDS**: Leg Dynamometer Strength, **5-STST**: 5-Sit To Stand Test, **SDSG**: Self-Determined Sequence exercise program Group, **STG**: Strength Training Group, **Yijinjing ex.**: A traditional Chinese health promotion exercise consisting of 12 movements., **SMA**: Skeletal Muscle Area, **SMD**: Skeletal Muscle Density, **RSMI**: Relative Skeletal Muscle mass Index, **MFI**: Muscle Fat Infiltration.

significant difference in the chair-stand test between the CE and control groups(SMD 0.11, 95% CI: -0.36 to 0.57, p=0.65)[33]. This suggests that the effectiveness of CE is limited under certain conditions or in specific populations. Overall, recent studies indicated that AE and RE are effective in patients with sarcopenia, with CE yielding the greatest effects. These results provide important evidence for the optimal exercise prescription for Asian patients with sarcopenia, although caution is warranted, as the effects may not be consistent across all conditions.

This study has several limitations. First, generalizability is limited as most participants were from East Asia. Second, there is a lack of research on the long-term sustainability of the intervention effects. Third, the concurrent effects of nutritional supplementation were not controlled. Fourth, as a systematic review, the results were derived from qualitative analysis. Future research should include multicenter studies across diverse Asian regions to develop standardized exercise protocols. The significance of this review lies in systematically demonstrating the effects of exercise interventions based on the AWGS diagnostic criteria and providing foundational data for establishing tailored rehabilitation programs for older Asians with sarcopenia.

Conclusion

This systematic review demonstrates that structured CE interventions integrating low to moderate intensity aerobic and resistance training, performed 3–5 times per week for 60 minutes, significantly enhance muscle mass, strength, and physical function in Asian patients diagnosed with sarcopenia under the AWGS criteria. The synergistic effects of aerobic exercise, which improves cardiopulmonary endurance, and resistance training, which stimulates muscle protein synthesis, appear to be critical for addressing the multifactorial pathophysiology of sarcopenia, particularly in populations with inherently lower baseline muscle mass. These findings are consistent with global evidence supporting resistance training as a cornerstone of sarcopenia management, but they also highlight the amplified benefits of multimodal approaches tailored to Asian physiological profiles. However, the concurrent use of nutritional supplementation in the majority of the included studies complicates the isolation of exercise-specific effects, necessitating stricter controls in future trials. As the global prevalence of sarcopenia escalates, this evidence base provides a critical roadmap for mitigating disability burdens and fostering healthy ageing trajectories.

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