



Position statement: Evidence-Based Exercise Guidelines for Sarcopenia in Older Adults: Insights from the Korean Working Group on Sarcopenia

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Background: Sarcopenia is a geriatric muscle disease characterized by the loss of muscle mass, strength, and physical function. To better reflect the unique characteristics of sarcopenia in Korean older adults, the Korean Working Group on Sarcopenia (KWGS) developed a diagnostic algorithm, including a new category of "functional sarcopenia." This study aimed to establish evidence-based exercise guidelines tailored to the KWGS framework. **Methods:** A multidisciplinary expert committee conducted a systematic review of randomized controlled trials (RCTs) published between 2000 and 2024 to assess exercise interventions according to exercise interventions by FITT (frequency, intensity, time, type) principles. Five key questions were developed, focusing on optimizing exercise modalities to improve muscle mass, strength, and physical performance in older adults with or without sarcopenia. **Results:** A total of 42 RCTs met the inclusion criteria. Resistance training was most effective for improving muscle mass and strength, while combined resistance and aerobic exercise is most effective for enhancing physical function. The guideline recommends individualized exercise prescriptions based on sarcopenia subtypes and specific functional deficits, supported by evidence grades and levels. **Conclusion:** This is the first Korean evidence-based exercise guideline developed within the KWGS algorithm, offering clinical and community practitioners specific, actionable strategies for preventing and managing sarcopenia. It supports tailored interventions using FITT principles aligned with individual goals and sarcopenia classification.

Key Words: Sarcopenia, Guidelines, Lean body mass, Muscle strength, Physical fitness

INTRODUCTION

Sarcopenia is a geriatric muscle disease characterized by age-related declines in muscle mass, strength, and physical function.^{1,2)} The World Health Organization officially recognized sarcopenia as a disease in 2016 with the assignment of an ICD-10-CM code (M62.84), acknowledging its significant clinical implications and healthcare burden.³⁾ The guideline for sarcopenia diagnosis vary across different global institutions, including the European Working Group on Sarcopenia in Older People,²⁾ International Working Group on Sarcopenia, and the Asian Working Group for Sarcopenia.¹⁾ These variations reflect both methodological differences and population-specific considerations, including ethnic differences in body composition, lifestyle factors, and cultural contexts relevant to physical activity patterns.

To address the unique characteristics of sarcopenia in the Korean population, the Korean Working Group on Sarcopenia (KWGS) developed a tailored algorithm for evaluating sarcopenia.⁴⁾ The newly introduced concept of “functional sarcopenia” highlights individuals with low muscle strength and poor physical performance but without significant muscle mass loss, aligning sarcopenia more closely with frailty. The KWGS algorithm incorporates the assessments of appendicular skeletal muscle mass (ASM), muscle strength, and physical performance to classify sarcopenia.⁴⁾

Based on this classification, sarcopenia is defined as loss of muscle mass with muscle weakness or reduced physical performance, whereas “severe sarcopenia” involves both weakness and impaired performance. Functional sarcopenia, which affects older adults, requires targeted intervention.^{4,5)} Given these classifications, exercise programs should be tailored to each subtype’s specific deficits. However, existing studies lack structured, outcome-based exercise guidelines aligned with the KWGS framework, making it unclear how to optimize interventions for different types of sarcopenia.^{4,5)} Furthermore, the heterogeneity in methodology, intervention protocols, and outcome measures across existing literature creates significant challenges for clinicians and exercise specialists attempting to translate research findings into evidence-based practice for the Korean elderly population.

Therefore, the Korea Society of Sarcopenia develops and proposes evidence-based exercise program guidelines tailored to the KWGS algorithm to address the distinct functional impairments associated with different sarcopenia classifications. Our approach integrates systematic evidence synthesis with expert consensus methodology to formulate practical, comprehensive, and culturally appropriate exercise recommendations that consider the physiological, functional, and psychosocial aspects of sarcopenia management among Korean older adults. By establishing these guidelines,

we seek to standardize exercise prescription and facilitate targeted interventions that optimize functional outcomes and quality of life in this vulnerable population.

MATERIALS AND METHODS

Guidelines have been developed to provide a systematic approach to exercise for the prevention and improvement of sarcopenia in older adults or individuals with sarcopenia. To create these exercise guidelines, the Korea Society of Sarcopenia formed a collaborative development committee (special exercise committee) consisting of a multi-disciplinary and multi-institutional group of experts, including exercise physiologists, field exercise specialists, internists, and orthopedic surgeons. The committee members were selected based on their expertise in sarcopenia research, clinical experience with geriatric populations, and specialized knowledge in exercise science, ensuring comprehensive coverage of all aspects relevant to sarcopenia management. The guideline development process consisted of the following 10 steps: (1) formation of a development committee; (2) topic selection; (3) review of published guidelines; (4) development plan; (5) selection of key questions (KQs); (6) search for evidence; (7) appraisal and quality appraisal; (8) synthesis; (9) formulation of recommendations and establishment of recommendation grades; and (10) committee consensus and external review. This methodological framework adheres to the principles of evidence-based medicine.

Selection of KQs

The committee reviewed position statements published by the European Working Group on Sarcopenia in Older People,²⁾ the Asian Working Group for Sarcopenia,¹⁾ and the Korean Working Group on Sarcopenia⁴⁾ to establish the KQs. The committee selected the five most appropriate KQs based on a review of other position statements considering their national context and clinical importance ([Supplementary Table S1](#)). Through an iterative consensus process, the committee prioritized questions that addressed critical gaps in current practice and were most relevant to the Korean healthcare context. The KQs included elements of a typical exercise prescription, including FITT (frequency, intensity, time, and type).

Data Sources and Search Strategy

To answer the KQs, an extensive literature search was conducted using a systematic review of evidence identified through online databases, such as PubMed of the US National Library of Medicine, ScienceDirect of Elsevier, and Springer Link of Springer Nature. Only data from randomized controlled trial (RCT) published between January 1, 2000, and May 31, 2024, were considered. The

keywords used for the literature search are described in the Supplementary Materials ([Supplementary Table S2](#)). In the review stage, the committee used the Participants, Intervention, Comparison, Outcomes, Time, Setting, and Study Design (PICOTS-SD) framework to determine the scope of inclusion in the literature for the use of systematic review methods. Specifically, we included studies with participants aged ≥ 60 years with or at risk of sarcopenia; interventions involving structured exercise programs; comparisons with control groups receiving usual care, health education, or no intervention; outcomes measuring changes in muscle mass, strength, or physical performance; timeframes of at least 6 weeks; settings in both clinical and community contexts; and randomized controlled trial study designs. Among the 1,314,218 duplicate studies were excluded using EndNote (Clarivate Analytics, Philadelphia, PA, USA), yielding 36,528 relevant articles. The initially selected articles were further reduced to 335 of the most relevant papers, of which 42 were finally selected, excluding those with no sarcopenia or age < 60 years (65 cases), no RCT design (26 cases), exercise not included in the intervention program (154 cases), not written in English (11 cases), and others (37 cases) ([Fig. 1](#)). The selected papers were experimental papers with a randomized controlled trial design and clear PICOTS-SD, which provided evidence-based rec-

ommendations for the KQs selected by the committee.

Risk of Bias Assessment

The articles selected for review were assessed for quality by two independent reviewers using the Cochrane Collaboration tool to measure the risk of bias. Prior to the formal assessment, the reviewers underwent standardized training and consensus in the use of the Cochrane risk of bias tool to ensure consistency in evaluation. Any conflicts were discussed among the reviewers and then confirmed and finalized. Quality items included potential randomization process bias, deviations from intended intervention bias, missing outcome data bias, outcome measurement bias, and selection of reported result bias. The reviewers evaluated each item as “low risk,” “high risk,” or “unclear risk.” Each domain was assessed according to the specific criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions (Version 6.3, 2022), with detailed justifications documented for each judgment. [Supplementary Figs. S1 and S2](#) show the results of the risk of bias evaluation for each study by domain. Of the 42 studies, 36 used appropriate methods to generate the allocation sequence, and all applied adequate methods of allocation concealment. The risk of bias was unclear in the remaining six studies owing to insufficient information regarding allocation concealment. The risk of deviation from the intended interventions was low in 30 studies and unclear in 12 studies. The risk of bias owing to missing outcome data was low in 39 studies and unclear in three studies. Outcome measures were appropriate, and the data were unlikely to have been influenced by knowledge of the intervention received. However, two studies did not provide sufficient information. The risk of selection bias among the reported results was low in 34 studies, unclear in 7, and high in 1. Overall, the general risk of bias was low-to-moderate in the included studies.

Procedures for Conclusive Selection and Formulation of Guidelines

Following a review of the evidence from the selected literature, the committee reviewed the capability of applying the guidelines for each KQ by summarizing the contents of the selected evidence as a response to the KQ. The committee employed a structured consensus development method, combining elements of the Delphi technique and nominal group process, to systematically integrate empirical evidence with clinical expertise. Comments from committee members were subsequently collected and recommendations were completed. Based on the applicability review, ratings were provided for the type, strength, and grade of the evidence. The rate of evidence was categorized into four levels ([Supplementary Table S3](#)), and the recommendation grade was established ac-

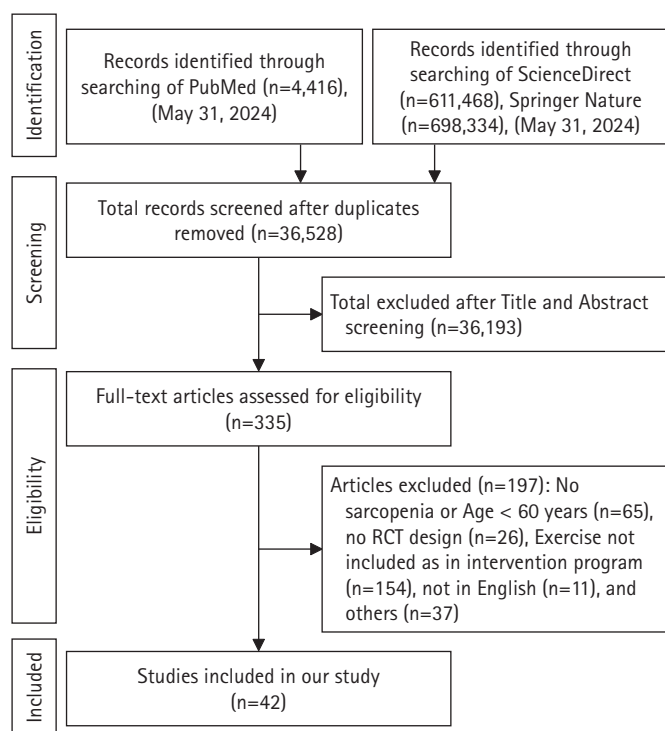


Fig. 1. Flowchart illustrating the systematic literature search methodology and selection process for developing evidence-based exercise guidelines for patients with sarcopenia. Literature sources included PubMed from the National Library of Medicine (NLM), ScienceDirect (Elsevier), and Springer Link (Springer Nature).

cording to the committee's consensus, with a principle of $\geq 80\%$ (Supplementary Table S4).

RESULTS

This study systematically reviewed the existing literature to identify the most effective FITT principle for increasing muscle mass, strength, and overall physical performance, with the goal of providing evidence-based exercise program guidelines based on the KWGS algorithm. The systematic review yielded 42 RCT that met

our inclusion criteria, providing robust evidence for formulating exercise recommendations tailored to different sarcopenia subtype. We have summarized our findings below based on the five KQs that we developed.

KQ1. What types of exercise are effective for each of muscle mass, muscle strength, and physical performance?

First, we summarized the FITT principle of exercises that improved muscle mass based on previous research (Table 1).⁶⁻²⁵ Resistance training is the most recommended type of exercise for im-

Table 1. Distinct FITT principles for improving muscle mass, muscle strength, and physical function in older adults with and without sarcopenia

	Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Muscle mass	Heo and Jee ⁹⁾ , 2024	OA (n = 81) CBSP	A: Low-intensity strength exercise B: Moderate-intensity C: High-intensity D: Control	For 12 weeks, 3 times/week	6–12 RMs	50 min/day	Resistance exercise; weight machine-based training	B&C: ↑ Thigh muscle mass
	Balachandran et al. ¹⁰⁾ , 2023	OA (n = 21) CBSP	A: Strength training B: Health education	15 weeks, 3 days/week	6–8 RPE (0–10 scale) 12–15 reps, 1–2 min rest between sets, 2–3 sets RPE < 6	N/A	Resistance exercise; weight machine, 4 lower & 5 upper body exercise	A: ↑ D3-creatine (D3Cr) muscle mass and DEXA appendicular lean mass increased
	Madrid et al. ⁸⁾ , 2023	OA (n = 55) CBSP	A: Weight loss (WL) with aerobic training (AT) B: WL with resistance training (RT) C: Diet-induced WL	18 months, 4 days/week	AT: 12–14 on the Borg RPE scale RT: 10–12 reps, 75% of 1RM, 3 sets, 4 days/week, progressive overload	45 min	AT: Walking RT: Resistance exercise; upper and lower body machine-based exercise	B > A or C: ↔ better preserved muscle area and improved muscle quality
	Kemmler et al. ⁷⁾ , 2021	OA with obesity (n = 43) CBSP	A: High-intensity resistance exercise (HIT-RT) B: Control	18 months, 2 sessions/week	60%–85% 1RM	N/A	Dynamic resistance exercise; weight machine-based training (12–14 exercise/session)	A: ↑ Lean body mass, metabolic syndrome maker, total and abdominal body fat rate
	Ghasemikaram et al. ⁶⁾ , 2021	OA (n = 43) CBSP	A: HIT-RT B: Control	18 months, 2 days/week	65%–85% 1RM	N/A	Resistance exercise; weight machine-based training (12–14 exercise/session)	A: ↑ Increased muscle quality
	Sheshadri et al. ¹¹⁾ , 2020	Dialysis patients (aged 53–66; n = 54) HBP	A: Intervention group B: Control group	6 months, daily	N/A	N/A	Aerobic exercise; walking	A: ↑ Total body muscle mass, average daily steps, fat & BMI
	Yamada et al. ¹²⁾ , 2015	OA (n = 227) HBP	A: Walking and nutrition B: Walking C: Control	6 months, daily	N/A	N/A	Walking; walked with an ankle weight (0.5 kg) at their own discretion	A&B: ↑ Skeletal muscle mass index, IGF-1, and 25(OH)D

(Continued on the next page)

Table 1. Continued

	Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Muscle strength	Kemmler et al. ¹⁷ , 2020	OM with osteopenia/osteoporosis (n = 43) CBSP	A: HIT-RT exercise B: Control	For 8–12 weeks, 2 times/week	1–10 RM	N/A	Weight training (18 exercise) (add vitamin D, Ca, protein)	A: ↑ Hip/leg extensor strength, skeletal muscle mass
	Sáez de Asteasu et al. ²⁰ , 2020	Acutely hospitalized OA (n = 370) CBSP	A: Exercise intervention (n = 185) B: Control (n = 185)	5–7 days, 2 session/day	30%–60% of 1RM	20 min/day	Multicomponent exercise training (resistance, balance, and walking training exercises)	A: ↑ Knee extension, hip flexion, 1RM of leg press/chest press, knee extension & muscle power
	Vitale et al. ¹⁸ , 2020	OA (aged 60–80; n = 14) HBP	A: Resistance exercise B: Control	For 24 weeks, 4 times/week	Body weight or 500 mL bottle	5 min warm 45 min main 5 min cool	RT	A: ↑ Chair-stand test, thigh cross-sectional area, total fat mass
	Dong et al. ¹⁴ , 2019	Maintenance hemodialysis with sarcopenia (n = 45) CBSP	A: Resistance exercise B: Control	For 12 weeks, 3 times/week	Lower limb: own body weight Upper limb: elastic ball	1–2 hr	Body weight exercise with ball	A: ↑ Physical activity status (maximum grip strength, daily pace, and physical activity level)
	Cebrià I Iranzo et al. ¹⁵ , 2018	OA with sarcopenia (n = 37) CBSP	A: Respiratory muscle training (RMT, n = 9) B: Peripheral muscle training (PMT, n = 11) C: Control (n = 17)	For 12 weeks, 3 times/week	RMT: 40%–60% of maximum static inspiratory pressure PMT: 40%–60% of maximal isometric muscles strength	PMT: about 40 min/day	RT with dumbbells and ankle/wrist weight	B > C: ↑ Knee extension B > A, C: ↑ Arm flexion strength A, B > C: ↑ Maximal inspiratory pressure, maximum expiratory pressure, maximal voluntary ventilation
	Chen et al. ¹³ , 2018	OW with sarcopenia (n = 33) CBSP	A: Kettlebell training B: Control	For 8 weeks, 2 times/week	60%–70% of 1RM	60 min/day	Kettlebell training (11 movements)	A: ↑ Left and right handgrip strength, back strength
	Tsuzuku et al. ¹⁹ , 2018	OA without experience in RT participated (n = 88) Comb H&C	A: Slow movement resistance training (SRT-BW) B: Control	For 12 weeks, every day	Body weight serving as the load	Approximately 15 min	3 different exercises, eccentric and concentric (spending 4 s on each movement)	A: ↑ Knee extension and hip flexion strength, thigh muscle thickness
	Rondanelli et al. ¹⁶ , 2016	OA with sarcopenic (n = 130) CBSP	A: Physical activity+Dietary supplement (n = 69), Dietary (whey protein, and vitamin D mixture) B: Placebo (n = 61)	For 12 weeks, 5 times/week	Strengthening exercise: ≤ 8 reps, maintained at Borg RPE scale 12–14	20 min/day	RT, balance+gait training. Dietary (whey protein, and vitamin D mixture)	A: ↑ Handgrip strength, fat free mass, relative skeletal muscle mass

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Table 1. Continued

	Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
	Hassan et al. ²¹⁾ , 2016	Residents of nursing care facilities (n = 42) CBSP	A: Exercise (n = 21) B: Control (n = 21)	For 6 months, 2 times/week	Comfortably complete 10 reps/3 sets or by increasing reps with the same load to 15 reps/3 sets	1 hr/day	RT and balance training	A: ↑ Grip strength, ↓ BMI
Physical function	Bernabei et al. ²²⁾ , 2022	OA with physical frailty and sarcopenia (n = 1,549) CBSP	A: Multicomponent intervention B: Control	2 times weekly, 4 times/week, 36 months	Moderate intensity physical activity	N/A	Aerobic, strength, flexibility, and balance	A: ↑ SPPB, HGS, Appendicular lean mass
	Yuenyongchaiwat et al. ²⁴⁾ , 2022	OA with sarcopenia (n = 60) HBP	A: Walking+Band exercise (n = 28) B: Routine daily (n = 29)	For 12 weeks, 5 times/week	N/A	N/A	Walking ≥ 7,500 steps/day + Theraband resistance exercise	A: ↔ SMI, ↑ HGS, Gait speed
	Lee et al. ²⁵⁾ , 2021	OW diagnosed with OSA (n = 27) CBSP	A: Elastic band resistance exercise B: Control	A: 3 times/week, 12 weeks	A: Band color and resistance increased by 25%	55 min/session	Resistance (elastic band exercise), balance & functional exercise	A: ↑ Physical function (timed up and go test), balance (single leg stance) B: No change
	Kim et al. ²³⁾ , 2013	Community-dwelling Japanese OW with sarcopenia (n = 128) CBSP	A: Exercise (Ex) and tea catechin supplementation (TC) group (n = 32) B: Ex group (n = 32) C: TC group (n = 32) D: Health education group (n = 32)	A & B: 2 times/week, 3 months	Moderate intensity (Borg RPE scale of 12–14)	60 min/session	Resistance (elastic band exercise), balance & gait training	A: ↑ Muscle mass, ↑ walking speed B: ↑ Walking speed A & D: ↑ Functional fitness (TUG)

FITT, frequency-intensity-time-type; CBSP, center-based supervised programs; HBP, home-based programs; Comb H&C, combined home and center-based programs; OA, older adults; OM, older men; OW, older women; RPE, rate of perceived exertion; 1RM, one-repetition maximum; reps, repetitions; OSA, osteosarcopenic adiposity; DEXA, dual-energy X-ray absorptiometry; IGF-1, insulin-like growth factor-1; BMI, body mass index; SMI, skeletal muscle mass index; HGS, handgrip strength; TUG, timed up & go test; ↑, significantly improved; ↓, not improved; ↔, no change; N/A, not applicable.

proving muscle mass in older adults with and without sarcopenia. Two studies that used high-intensity resistance training (HIT-RT) twice weekly for 18 months, with weights set at 60%–85% of one-repetition maximum (1RM) over 12–14 exercises per session, significantly improved lean body mass, metabolic syndrome markers, and muscle quality in the intervention group.^{6,7)} Madrid et al.⁸⁾ compared weight loss with aerobic training, resistance training, and diet-induced weight loss over 18 months. The resistance training group had better preserved muscle area and improved muscle quality than the other groups. Heo and Jee⁹⁾ investigated low-, moderate-, and high-intensity resistance exercises in older adults for 12 weeks. Moderate- and high-intensity exercise groups showed increased thigh muscle mass. Balachandran et al.¹⁰⁾ con-

ducted a strength training program over 15 weeks, finding significant increases in D3-creatine muscle mass and dual-energy X-ray absorptiometry assessed appendicular lean mass. It has also been reported that aerobic exercise coupled with resistance training can help improve muscle mass. Sheshadri et al.¹¹⁾ focused on dialysis patients, implementing a daily aerobic exercise program for 6 months, leading to increases in total body muscle mass, daily steps, and reductions in fat and body mass index (BMI). Another study examined the effects of walking exercise with nutritional support in older adults over 6 months.¹²⁾ Both walking groups showed improvements in skeletal muscle mass index (SMI), insulin-like growth factor-1 (IGF-1), and vitamin D (25(OH)D) levels.

Previous studies have recommended resistance exercise for im-

proving muscle strength in older adults (Table 1). Nine trials examined the effects of various exercise modalities on muscle function in older adults with and without sarcopenia, with intervention durations ranging from 8 weeks to 6 months. Chen et al.¹³⁾ observed that older women with sarcopenia who underwent kettlebell training twice weekly for 12 weeks at 60%–70% of 1RM experienced significant gains in handgrip and back strength. Similarly, Dong et al.¹⁴⁾ found that patients with sarcopenia undergoing hemodialysis and engaging in bodyweight exercises with a ball three times a week for 12 weeks showed improvements in grip strength, daily walking pace, and overall physical activity levels. Cebria I Iranzo et al.¹⁵⁾ reported that older adults with sarcopenia who engaged in resistance training with dumbbells three times weekly for 12 weeks demonstrated enhanced knee extension and arm flexion strength. Rondanelli et al.¹⁶⁾ evaluated a group that received a combination of physical activity and dietary supplements (whey protein and vitamin D) five times a week for 12 weeks. They found an increase in handgrip strength and skeletal muscle mass compared to those in the control group. Kemmler et al.¹⁷⁾ conducted a HIT-RT study in older men with osteosarcopenia, showing improvements in leg strength and muscle mass after 8–12 weeks of HIT-RT combined with vitamin D and protein supplements. Resistance exercise has positive effects on muscle strength and function in older adults without sarcopenia. Vitale et al.¹⁸⁾ demonstrated improvements in chair-stand test scores and thigh muscle cross-sectional area in participants performing bodyweight exercises or using small weights four times a week over 24 weeks. Tsuzuku et al.¹⁹⁾ reported that slow-movement resistance training with body weight led to significant gains in knee extension, hip flexion strength, and thigh thickness compared with the control group. In addition, multicomponent exercise programs combining resistance, balance, and walking exercises can further improve muscle strength and power. For example, Saez de Asteasu et al.²⁰⁾ conducted a study with hospitalized patients and found significant increases in 1RM strength in leg and chest press exercises after multicomponent training sessions held twice daily for 5–7 days. Hassan et al.²¹⁾ showed that nursing home residents improved grip strength and reduced BMI with a twice-weekly resistance and balance training program over 6 months.

Table 1 summarizes the FITT principles for improving physical function. Bernabei et al.²²⁾ investigated the effects of a multicomponent exercise intervention over 36 months in 1,549 older adults with physical frailty and sarcopenia. Participants in the intervention group, who participated in moderate-intensity aerobic exercise, strength training, flexibility training, and balance exercises twice a week at a community center and four times a week at home, showed significant improvements in short physical perfor-

mance battery scores, grip strength, and appendicular muscle mass compared to the control group. The combined effects of exercise and tea catechin supplementation were evaluated in 128 community-dwelling older women with sarcopenia over a 3-month period. Participants in the exercise and tea catechin groups showed improvements in muscle mass and walking speed, whereas those in the exercise-only group (exercise) showed significant improvements in walking speed.²³⁾ The study included 57 older adults with sarcopenia who performed home-based resistance exercises using elastic bands and walked > 7,500 steps daily for 12 weeks. The exercise group showed significant improvements in hand strength and walking speed while maintaining their SMI.²⁴⁾ Lee et al.²⁵⁾ examined the effects of resistance, balance, and functional training in 27 postmenopausal women with osteoporosis for 12 weeks. The exercise group performed progressively higher-intensity elastic band exercises three times a week, and their physical function (timed up-and-go [TUG] test) and balance (single-leg stance) improved.

KQ2. What is the most effective way of applying exercises to improve muscle strength and physical performance?

Table 2 presents the findings of various studies that evaluated the effects of exercise interventions on muscle strength and physical function in older adults.^{26–32)} Each study included different groups of participants, including those with and without sarcopenia, and different types of exercises, frequencies, intensities, and durations. Three studies recommended resistance training to improve muscle strength and physical function. Seo et al.²⁶⁾ focused on resistance training using elastic bands in older adults with sarcopenia conducted three times a week for 16 weeks. The results revealed improvements in functional fitness, grip strength, and isometric muscle strength. Resistance training, including elastic band exercises three times per week for 12 weeks, resulted in significant improvements in lower extremity function, including body fat mass, handgrip strength, leg strength, TUG scores, and gait speed.^{27,28)} Exercises to improve strength and physical performance are characterized by combined strength training and aerobic exercise. Villareal et al.²⁹⁾ examined combinations of weight, aerobic, and resistance training in obese older adults over 26 weeks and found that the exercise groups experienced improvements in physical performance, body weight, VO₂ peak, and strength, with specific benefits varying by exercise type. Jung et al.³⁰⁾ implemented a circuit-training program in older women with sarcopenia, showing gains in body composition (BMI, fat-free mass, and fat mass), muscle mass, strength, and balance after 12 weeks of training.

Table 2. FITT principle to improve muscle strength and physical function in older adults with and without sarcopenia

Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Valdes-Badilla et al. ²⁸⁾ , 2023	OW (n = 44) CBSP	A: Elastic band B: Group-based dance	3 times/week, 12 weeks	A: 5-8 OMNI-RES B: Moderate to vigorous	A, B: 60 min	A: Elastic band (upper and lower limbs) B: Performed dances	A > B: ↑ Fat-free mass, HGS, leg strength, TUG, walking speed
Seo et.al. ²⁶⁾ , 2021	OA with sarcopenia (n = 22) CBSP	A: Resistance training B: Control	3 times/week, 16 weeks	4–8 OMNI-RES	60 min	Weight-based elastic band resistance training	A: ↑ Functional fitness, grip strength, isometric muscle strength
Zhu et al. ³¹⁾ , 2019	OA with sarcopenia (n = 113) CBSP	A: Exercise B: Exercise & nutrition C: Control	Twice a week, 12 weeks	Not specified low intensity	90 min	Resistance (Thera bands) + aerobic exercise	A & B: ↑ Strength, 5-CST
Jung et.al. ³⁰⁾ , 2019	OW with sarcopenia (n = 26) CBSP	A: Exercise B: Control	3 times/week, 12 weeks	60%–80% of HRR	25–75 min	Circuit training (exercise consisted 10 movements)	A: ↑ BMI, free fat mass, & fat mass, muscle mass & strength, ↑ Balance
Grosicki et al. ²⁷⁾ , 2019	Mobility limited OA (n = 70) CBSP	A: Progressive resistance training B: Home-based flexibility	3 times/week, 12 weeks	80% of 1RM	2–3 sets of 10–12 reps	Progressive resistance exercise	A: ↑ Torque capacity, SPPB, ↑ Lower extremity function
Villareal et al. ²⁹⁾ , 2017	Obese OA (n = 160) CBSP	A: Aerobic training B: Resistance training C: Aerobic+resistance training) D: Control	3 times/week, 26 weeks	A: 65%–85% of peak HR B: 65% of 1RM	A&B: 60–90 min B: 1–2 sets of 8–12 reps	Resistance training, Aerobic exercise	A & B & C: ↑ Physical performance test, ↑ Body weight A & C: ↑ VO ₂ peak B & C: ↑ Strength
Englund et al. ³²⁾ , 2017	Mobility limited and vitamin D insufficient OA (n = 149) CBSP	A: Physical activity+placebo B: Physical activity+nutritional supplement	3 times/week, 6 months	Somewhat hard	30 min aerobic and 20 min strength	Walking, lower extremity strength exercise, balance and flexibility	A & B: ↑ Muscle strength, ↑ Body composition, thigh composition B: ↑ Intermuscular fat, muscle density

FITT, frequency-intensity-time-type; CBSP, center-based supervised programs; OW, older women; OA, older adults; OMNI-RES, OMNI Perceived Exertion Scale for Resistance Exercise; HRR, heart rate reserve; RM, repetition maximum; HR, heart rate; HGS, handgrip strength; TUG, timed up & go test; 5-CST, five times chair and stand test; ↑, significantly improved; ↓, not improved.

KQ3. What exercises are effective for improving both muscle mass and strength?

Table 3 shows a study that evaluated exercise methods that are effective for enhancing muscle mass and muscle strength.^{7,33,34)} Resistance training effectively enhances muscle mass and strength in older adults with and without sarcopenia. In sarcopenic older adults, moderate-to-high-intensity machine-based resistance exercises improved grip strength and leg extension strength over durations of 12 weeks to 18 months, with sessions lasting 30–50 minutes, 2–3 times per week, at intensities of 65%–85% of 1RM.^{7,33)}

Kemmler et al.⁷⁾ noted a more pronounced decline in muscle mass and strength after an 18-month resistance training period during detraining than in controls. In healthy older adults without sarcopenia, low-intensity (20% maximal power) eccentric ergometer resistance training for 20 minutes twice a week over 12 weeks also effectively improved muscle mass and strength.³⁴⁾ Resistance exercises ranging from low- to high-intensity, including eccentric ergometer- and machine-based training up to 85% of 1RM, consistently improved muscle mass, grip strength, and leg strength.^{7,33)} Both sarcopenic and healthy older adults should typically perform

Table 3. FITT principle to improve muscle mass and muscle strength in older adults with and without sarcopenia

Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Kemmler et al. ⁷⁾ , 2021	OM with osteosarcopenia (n = 43) CBSP	A: High intensity resistance training (n = 21) B: Control group (n = 22)	18 months (2 days/week)	65–85% of 1RM	1–3 sets of 8–15 reps	Resistance training	A: ↑ Skeletal muscle mass changes, ↑ Hip-/leg-extensor strength
Lichtenberg et al. ³³⁾ , 2019	OM (n = 40) CBSP	A: High intensity-RT (n = 19) B: Control (n = 21)	28 weeks (2 days/week)	65%–80% of 1RM	1–2 sets of 8–15 reps	Resistance training	A: ↑ SMMI, ↑ HGS
Mueller et al. ³⁴⁾ , 2009	OA (n = 62)	A: Conventional resistance training (n = 23)	12 weeks	A: 75% of 1RM	A: 20-min exercise (3 sets of 10 reps)	A: Resistance training	A: ↑ Thigh muscle mass
	CBSP	B: Eccentric ergometer training (n = 23) C: Cognitive training (n = 16)	(2 days/week)	B: 20% Maximal power output	B: 20-min exercise	B: Eccentric muscle endurance training	B: ↑ Muscle mass, ↑ Maximal isometric leg extension strength

FITT, frequency-intensity-time-type; CBSP, center-based supervised programs; OM, older men; OA, older adults; RM, repetition maximum; SMMI, skeletal muscle mass index; HGS, handgrip strength; ↑, significantly improved; ↓, not improved.

resistance training for 50–60 minutes per session, with gradual increases in time for those with sarcopenia. For optimal gains in muscle mass and strength, resistance training at 50%–85% of 1RM or rate of perceived exertion (RPE) 12–16, for 30–60 minutes per session, at least twice a week for 12 weeks, is recommended. Long-term progressive training is particularly beneficial for individuals with sarcopenia.

KQ4. What types of exercises are effective for improving both muscle mass and physical performance?

Table 4 presents a study that evaluates exercise methods effective in improving muscle mass and physical function.^{35–38)} Both resistance and aerobic exercises are effective in enhancing muscle mass and physical function in older adults with sarcopenia and Parkinson's disease. Sixteen trials examined the effects of various exercise modalities, often paired with nutritional supplementation, in older adults with and without sarcopenia. Monti et al.³⁵⁾ reported that a 2-year, thrice-weekly multicomponent program for sarcopenic adults, including aerobic, resistance, and balance exercises, maintained muscle architecture and neuromuscular junction (NMJ) stability, with greater physical performance improvements than controls. Liao et al.^{36,37)} showed that elastic band resistance exercises in adults with sarcopenia and obesity improved muscle mass, physical capacity, balance, body composition, and quality of life. Kim et al.³⁸⁾ examined older adults with Parkinson's disease, showing that high-intensity interval training three times a week for 24 weeks improved lean muscle mass, ASM mass, and walking distance, while moderate-intensity continuous training improved chair-stand test performance. For optimal improvements in muscle

mass and physical function, resistance training should be performed twice weekly for at least 12 weeks at an exertion level of 12–14 on the Borg RPE scale using body weight or elastic bands. Aerobic activities such as walking and cycling at moderate intensity (60% of the maximum aerobic power) are recommended three times weekly for 60 minutes over 24 weeks for older adults with sarcopenia and Parkinson's disease.

KQ5. What exercises are effective for improving overall muscle mass, strength, and physical performance?

Table 5 summarizes research evaluating the effectiveness of various exercise interventions on muscle mass, strength, and physical function.^{39–46)} Both resistance and aerobic exercises have been shown to be effective in improving muscle mass, strength, and physical function in older adults with and without sarcopenia. In older adults with sarcopenia, moderate- to high-intensity resistance exercise using elastic bands or body weight, even when guided by personal subjective measures, such as RPE, leads to significant improvements in muscle mass and strength as measured by grip strength, leg press, and physical function as assessed by gait speed.^{39,40)} These improvements were observed with an exercise duration of at least 8 weeks, typically extending to ≥ 12 weeks, when exercise was performed for at least 30 minutes per day, typically 60 minutes, 2–3 times per week.⁴¹⁾ In healthy older adults without sarcopenia, the effects were observed at varying levels for each FITT principle. In resistance exercises, improvements in lean mass, grip strength, and physical functions such as muscle power, gait speed, and balance have been demonstrated across various intensities. These range from bodyweight exercises such as squats and medi-

Table 4. FITT principle to improve muscle mass and physical function in older adults with and without sarcopenia

Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Monti et al. ³⁵⁾ , 2023	OA diagnosed with sarcopenia (n = 45) Comb H&C	A: Multicomponent intervention B: Control	A: 3 times/week, 2 years	Not specified, moderate intensity	60 min/session	Aerobic (walking, cycling), Resistance (strength training), Balance	B: ↓ Muscle architecture, NMJ stability A: maintain muscle architecture, NMJ stability A > B: ↑ Physical performance
Kim et al. ³⁸⁾ , 2023	OA with Parkinson's disease (n = 30) CBSP	A: High-intensity interval training B: Moderate-intensity continuous training C: Control	A, B: 3 times/week, 24 weeks	A: 60% max aerobic power, intervals lasting 30–50 s, 1-min resting interval B: 50% VO _{2peak}	A, B: 40–60 min/session	Aerobic (cycling), Calisthenics (chair squats, chair split squats, seated dorsi flexion, standing calf raises)	A: ↑ Lean leg muscle mass, ASM mass, ASM index, 6-min walking distance, 30-second chair-stand test score B: ↑ 30-second chair-stand test score only
Liao et al. ³⁶⁾ , 2018	OA diagnosed with sarcopenic obesity (n = 56) CBSP	A: Elastic band resistance exercise B: Control	A: 3 times/week, 12 weeks	Moderate intensity (Borg RPE scale of 13)	55 min/session	Resistance (elastic band exercise)	A: ↑ Muscle mass, physical capacity (functional forward reach, gait speed, timed up and go, and timed chair rise, Balance (single leg stance), quality of life, muscle quality)
Liao et al. ³⁷⁾ , 2017	OW diagnosed with sarcopenic obesity (n = 46) CBSP	A: Elastic band resistance exercise B: Control	A: 3 times a week, 12 weeks	Moderate intensity (Borg RPE scale of 13)	55 min/session	Resistance (elastic band exercise)	A: ↑ Body composition (fat-free mass, leg lean mass, total fat mass, body fat percent), ↑ Physical capacity (gait speed, timed up and go, timed chair rise), ↑ Balance (single leg stance), ↑ Muscle quality, ↑ Sarcopenia and physical difficulty

FITT, frequency-intensity-time-type; Comb H&C, combined home and center-based programs; CBSP, center-based supervised programs; OA, older adults; OW, older women; RPE, rate of perceived exertion; NMJ, neuromuscular junction; ASM, appendicular skeletal muscle; ↑, significantly improved; ↓, not improved.

um-intensity exercises using elastic bands to power training at intensities of up to 80% of 1RM.^{41,42)} Among the FITT elements, there was no difference in the exercise frequency between healthy older adults and those with sarcopenia. However, the exercise time for healthy older adults was generally > 1 hour per day, indicating that they can sustain longer exercise sessions than those with sarcopenia.⁴³⁾ Healthy older adults typically engaged in combined exercises that included resistance training along with various aerobic activities such as walking and bench stepping.⁴⁴⁻⁴⁶⁾

DISCUSSION

This study aimed to provide evidence-based exercise program guidelines for older adults with and without sarcopenia using the KWGS algorithm. The KWGS has established specific criteria for diagnosing sarcopenia, severe sarcopenia, and functional sarcope-

nia with a focus on muscle mass, muscle strength, and physical performance. To our knowledge, our guidelines are the first in Korea to specifically present the methods and effects of various types of exercises for the prevention and treatment of sarcopenia based on the KWGS. This represents a significant advancement in the clinical management of sarcopenia, as it addresses the gap between diagnostic classification and therapeutic intervention by providing specific exercise prescriptions tailored to the KWGS framework. This guideline identifies effective exercise methods for improving muscle mass, strength, and physical function separately or in combination and presents their effectiveness based on their level of evidence and grade of recommendation.

Comprehensive Exercise Recommendations Based on FITT Principles

Table 6 summarizes the final exercise guidelines based on the

Table 5. FITT principle to improve muscle mass, strength and physical function in older adults with and without sarcopenia

Study, year	Participants	Groups	Frequency	Intensity	Time	Type	Main findings
Osuka et al. ³⁹⁾ , 2021	OA with sarcopenia (n = 156)	A: Exercise+HMB (n = 39)	12 weeks,	12–14 of RPE	60 min/day	Resistance training	A: ↑ SMI, ↑ HGS, knee extensor strength & hip adductor strength, ↑ Gait speed, TUG & 5-CST
	CBSP	B: Exercise+Placebo (n = 39)	2 days/week				
		C: Education+HMB (n = 39)					
		D: Education+Placebo (n = 39)					
Saengrui et al. ⁴²⁾ , 2021	OA (n = 80)	A: Simple resistance intervention group (n = 40)	For 12 weeks, 3 times/week	N/A	30 min/day	Resistance training (squat, heel lift, and thigh raising)	A: ↑ SMI, ↑ HGS, ↔ Gait speed
	HBP	B: Control group (n = 40)					
Baggen et al. ⁴⁴⁾ , 2019	OW (n = 45)	A: Training group (n = 24)	12 weeks,	60% of 1RM	40 min/day	Bench stepping exercise	A: ↑ Muscle volume, ↑ Knee extensors, ↑ SPPB, 5-CST & 10m walk
	CBSP	B: Control group (n = 21)	3 days/week				
Mafi et al. ⁴¹⁾ , 2019	OM with sarcopenia (n = 68)	A: Resistance	8 weeks	60%–80% RM	40 min/day	Resistance training	A: ↑ Muscle mass, Muscle strength (leg press & chest press), ↑ TUG
	CBSP	B: Epicatechin					
		C: Resistance exercise+Epicatechin					
		D: Placebo					
Carvalho et al. ⁴³⁾ , 2019	Obese OM (n = 40)	A: Obese dynapenic type 1 (n = 21)	12 weeks,	80% 1RM	75 min/day	Mixed power training	A: ↑ Lean mass, ↑ Gait speed, TUG, stair and balance & Lower limb muscle power
	CBSP	B: Obese dynapenic type 2 (n = 18)	3 days/week				
Piastra et al. ⁴⁰⁾ , 2018	OW with sarcopenia (n = 66)	A: Muscle reinforcement training	Twice a week, 36 weeks	N/A	60 min	Resistance training	A: ↑ Muscle mass, muscle strength, ↑ Static balance
	CBSP	B: Postural training					
Chan et al. ⁴⁵⁾ , 2018	Patients with high fracture risk of ≥ 50 years (n = 110)	A: Integrated care	3 times/week, 12 weeks	N/A	60 min	Resistance, aerobic, and flexibility	A & B: ↑ Fat free mass, ↑ Muscle strength, ↑ Physical performance
	CBSP	B: Low extremities exercise					
Kemmler et al. ⁴⁶⁾ , 2010	OW (n = 246)	A: Multi-purpose exercise	18 month,	65%–70% of 1RM	60 min	Resistance, aerobic, balance, and flexibility	A: ↑ Body composition and functional ability
	CBSP	B: Control	2 days/week	50%–60% of HRmax			

FITT, frequency-intensity-time-type; HBP, home-based program; CBSP, center-based supervised programs; OA, older adults; OW, older women; OM, older men; HMB, β -hydroxy- β -methylbutyrate; RPE, rate of perceived exertion; RM, repetition maximum; HR, heart rate; SMI, skeletal muscle mass index; HGS, handgrip strength; TUG, time up- and go; 5-CST, five times chair and stand test; ↑, significantly improved; ↓, not improved; ↔, no change; N/A, not applicable.

FITT principle for improving and preventing sarcopenia in older adults with and without sarcopenia. To enhance muscle mass, resistance training should be performed more than three times a week for 24 weeks at moderate or high intensity (60%–80% 1RM). Each session should include 10–15 repetitions per machine for 2–3 sets, lasting at least 30 minutes, using machines or free weights. This guideline is substantiated by level I evidence with a grade of A. For augmenting muscle strength, resistance training

should occur more than twice a week for 12 weeks, at a moderate or higher intensity (40%–60% 1RM). Each session should last at least 20 minutes and use machines or free weights, as supported by level I evidence and grade A. The results showed that it is effective to combine resistance training and aerobic exercise to improve physical function. Resistance training was performed at least twice a week for 12 weeks at moderate or high intensity for at least 20 minutes per session. In addition, aerobic exercise (e.g., walking),

Table 6. Exercise guideline based on FITT principle for improving sarcopenia

Modality	Frequency	Intensity	Time	Type	Evidence	Grade
Muscle mass					I	A
Resistance	Over 3 times/week, 24 weeks	Moderate or higher (60%–80% 1RM)	At least 30 min ^{a)}	Various resistance ^{b)}		
Muscle strength					I	A
Resistance	Over 2 times/week, 12 weeks	Moderate or higher (40%–60% 1RM)	At least 20 min	Various resistance		
Physical function					II	B
Resistance	Over 2 times/week, 12 weeks	Moderate or higher (40%–60% 1RM)	At least 20 min	Various resistance		
Aerobic ^{c)}	3–5 times/week, 12 weeks	Moderate or higher	At least 30–50 min	Walking		
Muscle mass & Muscle strength					II	B
Resistance	Over 3 times/week, 24 weeks	Moderate or higher (60%–80% 1RM)	At least 30 min	Various resistance		
Muscle mass & Physical function					I	A
Resistance	Over 3 times/week, 24 weeks	Moderate or higher (60%–80% 1RM)	At least 30 min	Various resistance		
Aerobic ^{c)}	3–5 times/week, 12 weeks	Moderate or higher	At least 30–50 min	Walking		
Muscle strength & Physical function					I	A
Resistance	Over 2 times/week, 12 weeks	Moderate or higher (40%–60% 1RM)	At least 20 min	Various resistance		
Aerobic ^{c)}	3–5 times/week, 12 weeks	Moderate or higher	At least 30–50 min	Walking		
Muscle mass, Muscle strength, & Physical function					I	A
Resistance	Over 3 times/week, 24 weeks	Moderate or higher (60%–80% 1RM)	At least 30 min	Various resistance		
Aerobic ^{c)}	3–5 times/week, 12 weeks	Moderate or higher	At least 30–50 min	Walking		

^{a)}Time is needed at least 30 min for each machine 10–15 repetition, 2–3 sets.

^{b)}Various resistance exercise is allowed elastic band and/or machine and/or free weight resistance exercise.

^{c)}Aerobic exercise is recommended in addition to resistance exercise.

performed 3–5 times a week for 12 weeks at moderate or high intensity for at least 30–50 minutes, improved physical function. This recommendation is supported by level II evidence of grade B.

Physiological Basis for Resistance Training Recommendations

Our review results suggest that resistance training is recommended to improve muscle mass and strength. After 3–6 months of proper resistance training, muscle strength increased by an average of 40%–150%, depending on the individual's characteristics and the intensity of the program; the total lean body mass increased by 1–3 kg, and the muscle fiber area increased by 10%–30%.^{47,48)} Therefore, even in old age, adaptations to muscle loading can induce neural, metabolic, and structural changes in the muscles, which help compensate for strength loss and age-related atrophy.⁴⁹⁾ Resistance training is widely recommended to improve muscle mass, strength, and physical function; however, each has differences in the FITT. Muscle mass training requires longer periods (24 weeks) and higher weekly frequencies to reflect the time required to achieve significant muscle hypertrophy in older adults. In contrast,

strength and physical function may improve in a shorter period (12 weeks) with lower-frequency sessions. A slight difference was observed in intensity. Muscle growth requires considerable mechanical tension; therefore, resistance training requires a higher intensity (60%–80% of 1RM). However, the intensity (40%–60% of 1RM) for enhancing muscle strength is slightly lower than the intensity required to improve muscle mass, suggesting that it is beneficial for improving muscle strength. Muscle hypertrophy depends on muscle protein synthesis (MPS), and muscles grow through the damage and regeneration of muscle fibers; therefore, repetitive stimulation over a long period of time is required.^{50,51)} High-intensity training is required to produce sufficient mechanical tension. This tension activates the mammalian target of rapamycin (mTOR) signaling pathway, which is important for promoting MPS and satellite cell activation.⁵²⁾ This is important for older adults as they have anabolic resistance, a state in which MPS is less responsive to exercise stimuli. In addition, increases in muscle mass require the activation of fast-twitch (Type II) fibers, which are activated during high-intensity exercise and have a higher potential for increasing

muscle size.⁵³⁾ In addition, muscle strength improvement depends on the efficient activation of both the fast and slow muscles and mainly on neurological adaptation, and therefore, it can be effective even in a relatively short period of time and at a slightly lower intensity.⁵⁴⁾

Rationale for Combined Exercise Approaches

The difference between exercise to improve physical function and exercise to increase muscle mass and strength is the combined approach of resistance training and aerobic exercise such as walking, which involves the entire body. It is well known that aerobic exercise can help prevent the loss of essential physical abilities, such as muscle strength, mobility, balance, and endurance, which are necessary for older adults to safely carry out daily activities.^{55,55)} Moreover, it was found that combining aerobic exercise with resistance exercises had more benefits than a single exercise,⁵⁷⁻⁵⁹⁾ and such combined exercise had a more significant effect on the physical performance of older adults than single exercise.^{58,60)} This is because combined exercises engage more factors involved in physical performance, resulting in more comprehensive and effective outcomes than single exercises.⁶¹⁾

Integrated Approach for Comprehensive Sarcopenia Management

Finally, a combined approach of resistance and aerobic exercise is recommended to increase muscle mass and improve strength and physical function. Resistance training should be performed 3–5 times per week for 12 weeks at moderate to vigorous intensity (60%–80% of 1RM) for a minimum of 30 minutes per session. Additionally, aerobic exercise, such as walking, is recommended at least three times per week for 12 weeks, with each session lasting 30–50 minutes in total (Level I, Grade A). According to a previous review, although the level of evidence for resistance training alone in improving muscle mass, strength, and physical performance in older adults with sarcopenia is moderate, the strongest evidence supports combined or multimodal training programs that include resistance training, aerobic exercise, and balance.⁶²⁾ Additionally, the frequency of resistance training in this review ranged from a minimum of 2 days to a maximum of 5 days, with most studies recommending 3 days per week.⁶²⁾ The intensity of resistance training ranged from 20%–79% of 1RM.⁶²⁾ In another previous study, the intensity ranged from 40%–80% of 1RM or a somewhat difficult¹²⁻¹⁴⁾ RPE in frail older adults.⁶³⁾ Aerobic exercise was performed 2–5 times per week as part of a multicomponent exercise intervention.⁶²⁾ For older adults with sarcopenia, the intensity of aerobic exercise ranged from 50%–70% of the maximum heart rate or corresponded to an RPE of 7–17.⁶²⁾ This is consistent with the American College of Sports Medicine/American Heart Association

guidelines, which recommend moderate- to vigorous-intensity aerobic exercises for older adults.⁶⁴⁾ The international exercise recommendations for older adults include moderate-to-high-intensity resistance and power training 2–3 times a week to prevent frailty and sarcopenia.⁶⁵⁾

In addition to combined exercise modalities, several studies included in this review incorporated nutritional supplementation—such as protein, amino acids, or vitamin D—in conjunction with physical training. Rather than considering nutrition as a confounding variable, we acknowledge that these multimodal interventions closely reflect current clinical practices in sarcopenia management. Accumulating evidence suggests that the co-administration of exercise and targeted nutritional support may exert synergistic effects by enhancing MPS, modulating anabolic pathways, and facilitating neuromuscular adaptation.⁶⁶⁾ This study emphasizes the clinical importance of an integrated approach that combines nutritional strategies with exercise prescriptions to optimize improvements in muscle mass, strength, and physical function.

Clinical Implications and Future Directions

This guideline provides the first evidence-based exercise recommendation in Korea based on the KWGS algorithm for older adults with and without sarcopenia. This highlights the importance of tailoring exercise programs according to specific goals such as muscle mass, strength, or physical function by adjusting the FITT principles. Resistance training is central to improving muscle mass and strength, whereas a combination of resistance and aerobic exercises is the most effective for enhancing physical function. The alignment of exercise prescriptions with the KWGS diagnostic categories enables clinicians to develop targeted interventions based on individual sarcopenia phenotypes (sarcopenia, severe sarcopenia, or functional sarcopenia), potentially improving therapeutic efficiency and patient outcomes (Fig. 2). These findings support the implementation of structured goal-specific exercise interventions in clinical and community settings to prevent and manage sarcopenia in older adults.

This study has several limitations. It included randomized controlled trials conducted in both community and clinical settings, and therefore, participant homogeneity may have been disrupted. Participants recruited from these different environments are likely to differ in baseline health status, prevalence of comorbidities, degree of physical frailty, and responsiveness to exercise interventions. Such heterogeneity may have influenced the observed outcomes and limited the internal consistency of the evidence base. Nevertheless, to ensure the relevance of the findings to the Korean context, we adopted the sarcopenia diagnostic algorithm proposed by the KWGS, which reflects the unique characteristics of the Ko-

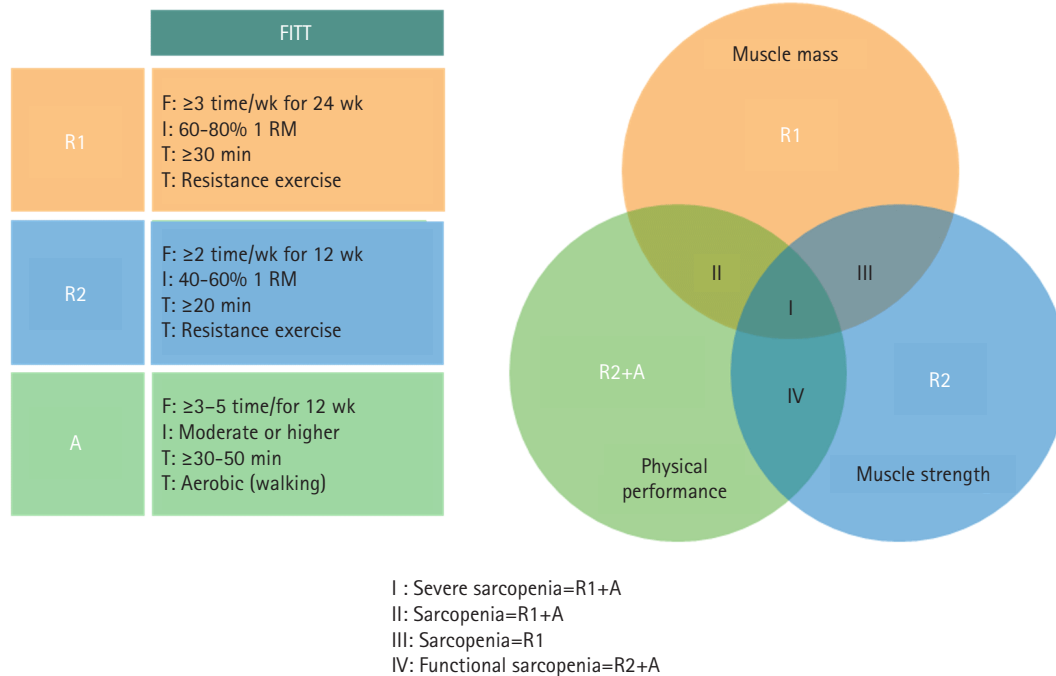


Fig. 2. Algorithm for exercise prescription based on FITT for improving sarcopenia. R1 indicates resistance exercise type 1; R2, resistance exercise type 2; A, aerobic exercise. FITT, frequency- intensity-time-type; 1RM, one-repetition maximum.

rean older population. In line with this approach, we intentionally included both community-based and clinically recruited populations to better represent the heterogeneity encountered in real-world practice. This strategy aims to ensure that the exercise recommendations are applicable not only to healthy older adults living independently but also to vulnerable individuals receiving clinical care. By doing so, we enhance the generalizability and external validity of the findings across diverse healthcare settings.

Future research should focus on optimizing exercise protocols for specific sarcopenia subtypes, evaluating the cost-effectiveness of these interventions in various healthcare settings, and investigating the integration of digital health technologies to enhance adherence and monitoring. Additionally, exploring the interactions between exercise and nutritional interventions, particularly protein supplementation and vitamin D, may provide insights into synergistic approaches for comprehensive sarcopenia management in the Korean elderly population.

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CONFLICT OF INTEREST

No conflicts of interest relevant to this article were reported.

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AUTHOR CONTRIBUTIONS

Conceptualization, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Data curation, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Funding acquisition, HP; Investigation, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Methodology, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Project administration, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Supervision, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK; Writing-original draft, SB, SK, CK; Writing-review & editing, SB, SK, CHK, JSK, JHK, SKL, SKM, SL, JIY, DYK, HP, CK.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via <https://doi.org/10.4235/agmr.25.0052>.

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