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Systematic Review

ASSOBRAFIR clinical practice guidelines in cardiovascular physical therapy: Exercise-based interventions in outpatient rehabilitation programs for heart failure[☆]

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ABSTRACT

Background: Exercise training is a core component of cardiovascular rehabilitation programs for patients with heart failure (HF). In Brazil, physical therapists frequently deliver rehabilitation interventions. Given heart failure clinical management advancements and varied rehabilitation approaches, standardizing exercise training within cardiovascular rehabilitation programs is essential.
Objective: To provide evidence-based recommendations for structuring exercise training (ET) in outpatient cardiovascular rehabilitation with HF, whether with preserved or reduced left ventricular ejection fraction.
Methods: The Guideline Panel followed the principles of the Guidelines International Network (GIN) and the Appraisal of Guidelines for Research & Evaluation (AGREE-II) to ensure methodological rigor. The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach was used to assess the certainty of evidence (CoE) and to formulate recommendations for key questions regarding supervised ET in clinically stable outpatients with HF. Treatment effects were assessed through meta-analyses of randomized clinical trials published since 2009.
Results: The Guideline Panel suggests: 1. High-intensity interval training and moderate-intensity continuous training are equivalent (conditional recommendation [CoR], low CoE); 2. Moderate-intensity resistance training is more effective than low-intensity resistance training (CoR, very low CoE); 3. High-intensity inspiratory muscle training (IMT) is more effective than low-intensity IMT (CoR, very low CoE); 4a. Neuromuscular electrical stimulation (NMES) is more effective than NMES placebo or usual activities (CoR, low CoE). 4b. NMES, in addition to aerobic training, is not more effective than aerobic training alone (CoR, low CoE).
Conclusion: These recommendations provide valuable guidance for delivering exercise-based interventions to outpatient cardiovascular rehabilitation programs in heart failure patients.

Introduction

Heart failure (HF) is a clinical syndrome characterized by signs and/or symptoms caused by a functional or structural cardiac abnormality associated with elevated natriuretic peptide levels and/or evidence of pulmonary or systemic congestion.[1] This syndrome represents a growing public health concern, with varying prevalence and incidence across countries.[2] In 2019, HF caused nearly 13 % of Brazilian Unified Health System hospitalizations, significantly burdening the healthcare system and resulting in 115 deaths per 1 million inhabitants.[3] Heart failure is classified into three phenotypes based on left ventricular ejection fraction (LVEF): (i) preserved (HFpEF; LVEF $\geq$ 50 %), (ii) reduced (HFrEF; LVEF $\leq$ 40 %), and (iii), mildly reduced (HFmrEF; LVEF 41–49 %).[4]

Cardiovascular rehabilitation is a multifaceted, comprehensive intervention that includes core components such as patient education, nutritional counseling, psychosocial support, personalized patient assessment, medication optimization, and exercise training. It is considered the standard of care for secondary prevention of cardiovascular diseases.[5,6] Exercise training, prescribed and supervised by exercise specialists such as physical therapists,[7,8] encompasses various modalities, is safe, relatively low-cost, and is well-established for individuals with stable HF receiving optimal medical therapy.[9–11]

Exercise-based cardiovascular rehabilitation programs enhance exercise tolerance, improve health-related quality of life (QoL), and reduce hospital readmissions and mortality, regardless of program duration.[12–14] To maximize outcomes, exercise programs should follow the FITT-VP principles: Frequency, Intensity, Time, Type, Volume, and Progression.[15,16] Furthermore, for effective and safe supervised exercise training, physical therapists must personalize prescriptions by adhering to the principles of specificity, overload, and reversibility.[17]

In Brazil, heart failure is the most prevalent cardiovascular disease in cardiovascular rehabilitation programs, although its prevalence varies regionally.[18] Brazilian cardiovascular rehabilitation centers show significant discrepancies in implementing core components, ranging from 8.3 % (vocational counseling) to 100 % (physical exercise). Other core components are present in 25 % to 96 % of centers. Furthermore, participation rates remain very low (1 % to 3 %).[18]

Recent advances in heart failure treatment and exercise programs have led to diverse exercise-based rehabilitation approaches. Therefore, this guideline provides evidence-based recommendations from studies over the last 15 years to standardize exercise training within in cardiovascular rehabilitation for individuals with heart failure.[7,8] Intended for physical therapists in cardiovascular rehabilitation, this guideline focuses on aerobic, resistance, and inspiratory muscle training (IMT), typically physical therapist-supervised.[7,8] Neuromuscular electrical stimulation (NMES) is also discussed, both as a standalone or combined

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intervention.

METHODS

Protocol and enrollment

This guideline followed Appraisal of Guidelines for Research & Evaluation II (AGREE-II) recommendations and the Guideline International Network (GIN) principles.[19,20] The panel used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach[21] and the Evidence to Decision (EtD) Framework to develop, rate, and assess the certainty of evidence (CoE) for recommendations. The ASSOBRAFIR General Executive Board endorsed the proposal for the ASSOBRAFIR Clinical Practice Guidelines in Cardiovascular Physical Therapy.

Panel composition and stakeholder involvement

A multidisciplinary panel of 33 professionals developed these guidelines, including: ASSOBRAFIR General Executive Board, management committee, eight voting members, a methodology team, and an executive committee. The General Executive Board, management committee, and methodology team did not influence systematic reviews or recommendations. The executive committee, composed of 20 experts in systematic reviews and meta-analyses, was selected through a public process. The panel comprised physical therapists, university faculty, and scientists with cardiovascular rehabilitation expertise; all holding equal voting rights. Supplementary Materials – Methods Section lists participants, affiliations, roles, and conflict of interest declarations (Table S1).

Panelists reported patient preferences and values in the recommendations when applicable. While intended for physical therapists caring for people with HF within cardiovascular rehabilitation programs, patient-friendly materials, and feedback will be provided post-publication. Future updates will incorporate patient perspectives more effectively.

Guideline scope and PICO framework

This guideline focuses on exercise-based interventions in cardiovascular rehabilitation programs for outpatients with heart failure. The management committee chairs formulated initial PICO questions, which panelists refined and prioritized by voting. Outcomes for each PICO were ranked using GRADE methodology as 'critical' (7–9), 'important' (4–6), or 'of limited importance' (1–3).[22] Four structured research questions are detailed with comprehensive methods outlined in the Supplementary Materials (Table S2).

Evidence synthesis and systematic review

An information specialist designed a comprehensive search strategy, guided by PICO questions and validated by the management and executive committee (Tables S3-S6). Databases searched include Medline/PubMed, EMBASE, Scopus, Web of Science, CENTRAL via Cochrane Library, and LILACS, alongside hand-searched journals and conference abstracts. Only English-language randomized clinical trials (RCTs) with defined inclusion/exclusion criteria were included.

The Covidence platform[23] was used for duplicate screening and extraction. This process also applied to the revised Cochrane Risk of Bias tool for RCTs (RoB 2.0)[24] and Note assessments. Two independent reviewers assessed search results in two stages: title/abstract evaluation, then full-text and bibliography review. For each PICO, two independent reviewers extracted data using a standardized Covidence spreadsheet (Table S7). The executive committee evaluated study quality using the RoB 2.0.[24] Discrepancies were resolved by consensus or a third reviewer.

Evidence summaries and formulation of recommendations

The management committee prepared evidence summaries for each PICO question, detailing study designs, populations, interventions, effect estimates, and CoE. During online meetings, the panel formulated recommendations using the EtD framework, emphasizing the population perspective. Consensus on each recommendation's direction, strength, and qualifications required at least 80 % panel approval.

Interpretation of strong and conditional recommendations

Following the GRADE framework, a "strong" recommendation indicates a clear patient preference for the approach, requiring substantial justification for deviation. A "weak" or "conditional" recommendation suggests varied patient acceptance due to differing values, preferences, and resources, allowing for individualized practice.[25,26] Comments accompanying each recommendation are integral for accurate interpretation. Recommendations balance health benefits and potential harms, guiding cardiovascular rehabilitation to minimize risks and maximize well-being.

Manuscript preparation

The managment committee organized working groups to summarize the evidence and formulate a final recommendation for each PICO question. All voting members approved the manuscript's final draft.

Document review

The ASSOBRAFIR Scientific Board and the General Coordination of Scientific Documents reviewed the manuscript prior to peer review and publication.

Dissemination and implementation tool

The guidelines will be disseminated via social media and ASSOBRAFIR events. These events will also facilitate consultation forums for regional implementation, with results presented at subsequent meetings for monitoring and auditing.

Editorial independence

It was prepared following the Brazilian Journal of Physical Therapy submission guidelines and underwent independent evaluation, including external peer review.

Funding and updating

ASSOBRAFIR covered all guideline expenses and facilitated member involvement, with no industry participation. All management committee and voting members disclosed potential financial, intellectual, and personal conflicts of interest. ASSOBRAFIR will reassess the guideline in three years for potential updates.

Results

The Task Force developed five conditional clinical practice recommendations (Table 1). For comprehensive details on the methods, CoE, and EtD frameworks, please refer to the Supplemental Material – Results Section. The forest plots and evidence profiles provide additional insights into the included evidence. Table S8 summarizes the key research priorities for future trials.

Recommendation PICO 1 – aerobic training (AT)

The guideline panel suggested that supervised high-intensity interval

Table 1
Summary of recommendations.

Clinical question (PICO)	Recommendation	Strength and CoE
[1] Is high-intensity interval aerobic physical training carried out under supervision (I) more effective than continuous or moderate-intensity interval aerobic physical training, carried out under supervision (C), on functional capacity, major cardiovascular events, lean mass body and quality of life (O) of patients with heart failure, participants in outpatient training programs (P)?	The guideline panel suggests supervised HIIT or MICT as therapeutic options for outpatients with HFpEF and HFrEF in cardiovascular rehabilitation programs.	Conditional recommendation; Low CoE.
[2] Is supervised moderate or high-intensity interval peripheral resistance training (I) more effective than other modalities of supervised peripheral resistance training (C) on peripheral muscle function, functional capacity, major cardiovascular events, lean body mass, and quality of life (O) in patients with heart failure participating in outpatient training programs (P)?	The guideline panel suggests that supervised moderate-intensity resistance training is more effective than low-intensity resistance training for outpatients with HFrEF in cardiovascular rehabilitation programs.	Conditional recommendation; Very low CoE.
[3] Is high-intensity inspiratory muscle training (IMT), applied with linear pressure loading devices (I) more effective than other types of IMT (C) on ventilatory muscle function, peripheral muscle function, functional capacity, events major cardiovascular diseases and the quality of life (O) of patients with heart failure, participating in outpatient training programs (P)?	The guideline panel suggests that high-intensity IMT is more effective than low-intensity IMT for improving inspiratory muscle strength and endurance training for outpatients with heart failure in cardiovascular rehabilitation programs.	Conditional recommendation; Very low CoE.
[4] Is supervised neuromuscular electrical stimulation (NMES), alone or associated with physical exercise (aerobic or peripheral resistance) (I), more effective than physical exercise, placebo NMES or control (no intervention) (C) on functional capacity, peripheral muscle function, major cardiovascular events, lean body mass and quality of life (O) of patients with heart failure participating in outpatient training programs (P)?	a) The guideline panel suggests that NMES, in addition to supervised aerobic training, is not more effective than aerobic training alone for outpatients with heart failure in cardiovascular rehabilitation programs. b) The guideline panel suggests that isolated NMES, under supervision, is more effective than NMES placebo or usual activities for outpatients with heart failure in cardiovascular rehabilitation programs.	Conditional recommendation; Low CoE. Conditional recommendation; Low CoE.

training (HIIT) or moderate-intensity continuous training (MICT) shall be considered as therapeutic options for patients with HFrEF and HFpEF in cardiovascular programs (conditional recommendation – CoR, low CoE).

Summary of the evidence

Out of 3042 references, 22 eligible studies were included in the review. Considering the entire population, after 4 to 12 weeks of treatment, supervised HIIT increased peak oxygen uptake (VO_2peak) by 1.17 $ml.kg^{-1}.min^{-1}$ (95 %CI 0.45 to 1.89; $p = 0.0015$; low CoE) more than the control group (MICT). Subgroup analysis revealed consistent VO_2peak improvements in HFrEF patients, with no significant difference between groups in the two HFpEF studies. Another subgroup analysis based on treatment duration (shorter or longer than 12 weeks), compared with the entire study population, showed that interventions lasting ≥ 12 weeks led to an additional VO_2peak increase of 1.07 $ml\cdot kg^{-1}\cdot min^{-1}$ (95 % CI: 0.30 to 1.84), with no significant differences observed for shorter interventions. The exclusion of the two studies involving patients with HFpEF did not alter the results.

Regarding 6-minute walk distance (6MWD), the six included studies indicated a significant increase in distance covered after 6 to 12 weeks of supervised HIIT, with an additional increase of 20.3 m compared to the MICT group (95 %CI 6.37 to 34.23; $p = 0.0043$; moderate CoE). However, considering a minimum important difference (MID) of 37 m, the result was precise but did not reach the clinically meaningful threshold. The studies did not include patients with HFpEF.

For the outcome of functional capacity, measured as workload, supervised HIIT showed no difference compared to the MICT group after 6 to 12 weeks of treatment (very low CoE). Additionally, no significant changes were observed in the sub-analysis considering patients with HFrEF or HFpEF.

After 12 weeks of treatment, supervised HIIT led to a significant improvement in QoL, assessed by the Minnesota Living with Heart Failure Questionnaire (MHFLQ), with a −3.93-point greater improvement compared to the MICT group (95 %CI −5.88 to −1.98; $p < 0.0001$; moderate CoE). However, no significant differences were observed using the Short Form 36 (SF-36) or the Kansas City Cardiomyopathy Questionnaire (KCCQ) tools (very low CoE).

Only one study provided data on major cardiovascular events,[27] showing no differences during the 12-week intervention. From weeks 13 to 52 of follow-up, there was a possible trend toward more hospital admissions due to cardiovascular events in the HIIT group ($n = 19/82$) compared to the MICT group ($n = 8/73$), likely due to fewer hospitalizations for worsening HF in the latter group.

Justification

Aerobic training is an essential component in the rehabilitation of patients with heart failure.[28–31] Given the demonstrated benefits of both MICT and HIIT,[32] evaluating whether one modality is superior to the other is crucial.

The panel unanimously issued a conditional recommendation for both interventions, primarily due to "trivial" desirable effects and low overall CoE. Undesirable effects remain unknown, and the balance of effects was evenly split. Most studies had a high risk of bias, raising concerns about intervention efficacy. While VO_2peak showed a significant point estimate benefit, its lower CI suggested only a trivial effect compared to the MID. Similarly, the 6MWD result did not meet the expected clinical impact.

Other EtD criteria and implementation considerations

The panel determined that the resources required would involve negligible costs and savings. Acceptability was rated as variable, and the feasibility of implementation was unanimously supported.

Recommendation PICO 2 – resistance training (RT)

The guideline panel suggested that supervised moderate-intensity RT is more effective than low-intensity RT for outpatients with HFrEF in cardiovascular rehabilitation programs (CoR, very low CoE).

Summary of the evidence

Out of 1043 references, 14 studies were selected for full-text evaluation, with only one meeting the eligibility criteria for analysis. After 15 weeks of treatment, supervised moderate-intensity RT (assessed by peripheral muscle strength in the dip, leg press, and pulldown) in patients with heart failure showed significant differences in strength only for the pulldown exercise in those with HFrEF (MD 4.70 kg; 95 %CI 1.62 to 7.78; $p = 0.003$; low CoE), compared to low-intensity RT.

For VO_2peak, no differences were found between RT intensities in the overall or subgroup analyses. However, regarding the 6MWD, there was a difference favoring moderate-intensity RT in HFrEF patients (MD 22.2 m; 95 %CI 6.48 to 37.92; $p = 0.006$) and in the total group (MD 15.67 m; 95 %CI 4.11 to 27.22; $p = 0.008$; moderate CoE), compared to low-intensity RT.

In terms of QoL, as assessed by MHFLQ, patients with HFmrEF showed significantly greater improvement with supervised low-intensity RT compared to moderate-intensity RT (MD 21.21 points; 95 % CI 5.44 to 36.98; $p = 0.008$; very low CoE). No evidence regarding major cardiovascular events was reported in the analyzed study.

Justification

RT has been included in the recommendations for patients with heart failure.[33–35] Combining RT with AT leads to more substantial increments in cardiorespiratory fitness and muscle[17,33–37] However, assessing whether moderate-intensity RT is superior to low-intensity RT in this population is important. Only one study met eligibility, showing a moderate overall risk of bias. The panel judged desirable effects small and unanimously voted for a conditional recommendation with very low CoE, ranging from very low to moderate across outcomes.

Other EtD criteria and implementation considerations

The panel judged that the resources required would involve negligible costs and savings. Furthermore, there was insufficient evidence to consider potential adverse effects (only one study[36] was assessed, showing no statistically significant differences). The intervention's acceptability was rated as variable, yet the panel unanimously judged it feasible to implement. Consequently, the balance of desirable and undesirable effects favors the intervention.

Recommendation PICO 3 – inspiratory muscle training (IMT)

The guideline panel suggested that high-intensity IMT (Hi-IMT) is more effective than low-intensity (Li-IMT) for improving inspiratory muscle strength and endurance for outpatients with HF in cardiovascular rehabilitation programs (conditional recommendation, very low CoE).

Summary of the evidence

Out of 577 references, only one was deemed eligible. The selected study, included in the meta-analysis, measured MIP in cmH_2O as a percentage (%MIP) and showed an improvement in %MIP when comparing Hi-IMT to sham (Li-IMT) (MD: 17.4 percentage points [pp]; 95 %CI 1.97 to 32.83; $p = 0.03$). Furthermore, the endurance of the Hi-IMT group showed significant gains compared to the control (MD: 19 pp; 95 %CI 7.6 to 30.4, $p = 0.001$). However, lower bounds of both 95 %CI include the possibility of a trivial effect.

Justification

The topic is justified by IMT's crucial role in heart failure patient rehabilitation, considering its pathophysiology and proven benefits across modalities.[38–41] Assessing if one IMT intensity or modality is superior, or if IMT is more effective than other interventions, is essential.

The panel mostly voted for a conditional recommendation favoring intervention. Desirable effects were rated as moderate, while undesirable effects were unanimously deemed trivial, leading to a likely favorable balance of effects. However, the overall CoE was very low, based on only one study with low to moderate CoE for the two outcomes and a moderate risk of bias. Furthermore, the intervention and outcomes differed substantially from typical studies (IMT with linear pressure load; MIP [cmH_2O]), leading to potential interpretation bias due to the atypical method and outcome measurement used.

Other EtD criteria and implementation considerations

The panel unanimously agreed that implementing the interventions incurred moderate costs. However, varying intensity costs are negligible, as different IMT protocols use the same equipment. The intervention was deemed acceptable and feasible: physical therapists, after two hours of specific training, could integrate IMT into rehabilitation programs. This met legal requirements without significant cost increases and yielded effective outcomes for most participants in a relatively short period.

Recommendation PICO 4 – neuromuscular electrical stimulation (NMES)

The guideline panel suggested that:

1. NMES, in addition to supervised AT, is not more effective than AT alone for outpatients with heart failure in cardiovascular rehabilitation programs (conditional recommendation, low CoE).
2. Isolated NMES, under supervision, is more effective than NMES placebo or usual activities for outpatients with heart failure in cardiovascular rehabilitation programs (conditional recommendation, low CoE).

Summary of the evidence

Out of 6082 screened references, 13 eligible studies were included in our analysis. Only one study included patients with implantable cardiac devices, with no adverse events reported. Five studies did not communicate this information.

In the meta-analysis comparing NMES vs. NMES placebo or usual activities, the NMES group showed an increase of 53.18 m in the 6MWD (95 %CI: 29.02 to 77.33; low CoE). Additionally, NMES increased the 6MWD only when performed five times/week or in more than 30 sessions (MD: 46.73 m; 95 % CI: 15.6 to 77.85; low CoE). Subgroup analysis based on LVEF showed a significant increase in 6MWD for patients with HFpEF (MD: 51.8 m; 95 %CI: 34.69 to 68.92; low CoE) but not those with HFrEF. One study found AT to be more effective than NMES (−15.3 m; 95 % CI: −26.69 to −3.91; low CoE),[42] while another study observed no difference between NMES combined with AT and AT alone.[43]

For VO_2peak, no difference was observed between NMES and NMES placebo or usual activities, including in the subgroup analysis of patients with HFrEF who performed more than 30 NMES sessions (low CoE). Only one study with HFpEF patients and less than 30 NMES sessions vs. NMES placebo or usual activities showed a difference (1.07 m; 95 %CI: 0.24 to 1.9). However, the lower CI limit suggested a trivial effect.[44] No difference was observed between NMES and AT or NMES combined with AT vs. AT alone (low CoE).

Regarding peripheral muscle strength, no difference was observed between NMES vs. NMES placebo or usual activities (low CoE), nor in the single study comparing NMES combined with AT vs. AT alone.[43]

Regarding health-related QoL (based on MLHFQ), NMES improved this outcome compared to NMES placebo or usual activities (MD: −14.31; 95 % CI: −22.33 to −6.30; low CoE). Subgroup analysis of patients with HFpEF also showed improvement (MD: −17.40; 95 %CI: −26.21 to −8.59; very low CoE), which was not observed in studies involving patients with HFrEF. No differences were observed between NMES combined with AT and AT alone. One study used the Kansas City Cardiomyopathy Questionnaire and found that NMES improved health-related QoL compared to placebo.[45]

Only one study compared NMES vs. NMES placebo in terms of mortality and hospital readmission, finding no difference in survival with cardiac death as the primary outcome.[43] However, the NMES group had significantly lower hospital readmission rates both before (HR: 0.40; 95 %CI: 0.21 to −0.78, $p = 0.007$) and after adjusting for main prognostic factors such as age, sex, and baseline ejection fraction (HR: 0.22, 95 %CI: 0.10 to 0.46, $p < 0.001$). In the univariate Cox proportional hazards model, NMES patients showed a 55 % lower risk for the combined outcome than the placebo group.

Justification

NMES is widely used for the rehabilitation of patients with muscle weakness.[46,47] For heart failure patients, it's crucial to determine if NMES is more effective than placebo, usual care, or AT. Additionally, assessing if combining NMES with exercise yields superior results compared to exercise alone is critical.

The panel unanimously gave a conditional recommendation for NMES in the first scenario, and for either NMES or comparison in the second (see subtopic: '4.1 Recommendation'), considering factors like CoE, which ranged from very low to low. The panel's overall CoE judgment was unanimously low. Most included studies (9/13) had a moderate risk of bias. The balance of effects "probably favored the intervention" when comparing NMES to placebo or usual activity, but "neither favored the intervention nor the comparison" for NMES vs. AT, or NMES combined with AT vs. AT.

Other EtD criteria and implementation considerations

The panel concluded that NMES requires moderate resources, including additional equipment, electrodes, and hygiene costs, despite no direct evidence. Undesirable effects were deemed trivial. Finally, NMES was considered acceptable and feasible, particularly for individuals unable to participate in other ET interventions.

Discussion

Given the substantial impact of heart failure and the pivotal role of physical therapists in patient management, this Clinical Practice Guideline was formulated to provide evidence-based recommendations for outpatient care via physical therapy interventions, aiming to optimize patient outcomes and enhance cardiovascular rehabilitation quality. Recommendations for AT, RT, IMT, and NMES are based on varying evidence levels and CoE. Supervised HIIT and MICT are suggested for chronic heart failure, albeit with low CoE and conditional recommendation. Despite very low CoE, moderate-intensity RT is preferred over low-intensity RT for HFrEF patients. Hi-IMT is suggested for significant improvement in MIP and endurance compared to Li-IMT, despite conditional recommendation and very low CoE. NMES demonstrates potential benefits in enhancing 6MWD, yet lacks significant effects on VO_2peak and muscle strength, carrying a conditional recommendation with low CoE.

AT provides significant benefits for patients with heart failure. An analysis of 22 studies found that supervised HIIT notably improved VO_2peak, especially in patients with HFrEF, with an additional increase of 1.17 $mL.kg^{-1}.min^{-1}$ compared to the MICT after 4–12 weeks. Both HIIT and MICT increased VO_2peak beyond the MID (1 $mL.kg^{-1}.min^{-1}$),[48] highlighting the significant impact of AT. A previous meta-analysis also compared HIIT and MICT in heart failure patients, showing that HIIT led to a greater VO_2peak gain.[49] However, when only studies with isocaloric protocols were compared, there was no difference between the interventions. Thus, caloric expenditure appears to be an important determinant for the VO_2peak gain in heart failure patients.[50] This challenges the assumption that HIIT is inherently superior, emphasizing individualized prescription.

Cardiometabolic benefits of AT include enhanced insulin sensitivity, reduced inflammation, decreased abdominal fat, improved vascular function, enhanced lipid metabolism, improved skeletal muscle function, and modest improvements in left ventricular function.[51–53] Evidence indicates improvement in the 6MWD after 6 to 12 weeks of supervised HIIT, with a 20.3-meter greater improvement than MICT; however, this increase was lower than the MID of 37 m.[54] QoL also improved after 12 weeks of HIIT, although CoE ranged from low to moderate. Given the limited evidence, modality choice should consider patient preferences, clinical judgment, and resource availability. As a general recommendation, HIIT should be initiated after a few weeks of MICT, once normal physiological responses to moderate-intensity exercise are confirmed, to ensure safe progression. As patients advance, MICT and HIIT can also be alternated.

Supervised moderate-intensity RT is more effective than low-intensity training for patients with HFrEF, resulting in a conditional recommendation based on very low CoE. Only one of the 14 eligible studies provided a comprehensive analysis, showing significant improvement in peripheral muscle strength and the 6MWD. Resistance training enhances the strength and endurance in both lower and upper extremities, improved cardiorespiratory fitness (VO_2peak increase of 2.6 $mL\cdot kg^{-1}\cdot min^{-1}$), increases 6MWD by 49.9 m, and improves overall QoL,[33,55] emphasizing its potential benefits despite the low CoE. The increase in 6MWD exceeds the MID of 37 m, for heart failure patients.[54] Moreover, it is noteworthy that patients with acute coronary syndrome and reduced lower extremity muscle strength have an increased risk of developing HF.[56] Furthermore, although another guideline[57] suggests an RT prescription for stable HFrEF patients, including 2–3 sets per muscle group at 60–80 % 1-repetition maximum (RM), we found insufficient evidence to support 60–80 % 1RM RT prescriptions, underscoring the need for RCTs in this area.

IMT is recommended for patients with heart failure, with Hi-IMT proving more effective than Li-IMT in increasing MIP. Supported by low CoE, one study showed significant improvements in MIP and respiratory muscle endurance after Hi-IMT (twice a day, seven days a week, for four weeks). Hi-IMT improved MIP by 57.2 % compared to 25.9 % in a lower-intensity group, and endurance improvement was 72.7 % versus 18.2 %.[58] This demonstrates that IMT using a maximal 10RM approach is feasible, well-tolerated, effective, and safe for heart failure patients. Hi-IMT enhances inspiratory muscle strength and endurance, making it an efficient therapeutic strategy. IMT targets structural and metabolic changes in muscle fibers that contribute to dyspnea, poor QoL, and poor prognosis.[59,60] It also offers an alternative for those unable or unwilling to participate in traditional cardiovascular rehabilitation programs.[38,61] IMT benefits are observed across different intensities, with higher intensities providing more significant improvements in less time. Incorporating IMT into AT programs leads to additional improvements in MIP and QoL.[41]

Regarding feasibility, two studies[62,63] reported drop-out rates of 21.4 % and 15.9 %, respectively, with patients showing good acceptance, no discomfort or intolerance, and no adverse effects during IMT.[57]

The recommendation for NMES in patients with heart failure is conditional, with ongoing debates about its efficacy. An analysis of 13 studies showed NMES, alone or with physical exercise, benefits 6MWD and QoL. The NMES group increased 6MWD by 53.1 m compared to the placebo, exceeding the MID of 37 m[54] NMES improved QoL by reducing the score by 14.3 points, greater than the MID by 7.1 points.[29] No significant difference in VO_2peak and muscle strength was observed between the NMES and placebo groups. Some studies suggest NMES for NYHA Class II/III heart failure patients to improve performance in 6MWD, short physical performance battery (SPPB), and 5-repetition sit-to-stand test[46,64,65] and muscle strength[66] However, other studies show that NMES significantly enhances VO_2peak and 6MWD, with effects comparable to exercise-based interventions.[41,67,68] The panel acknowledged NMES's negligible costs and healthcare savings.

A key strength of this guideline is its foundation on systematic reviews of RCTs, backed by a rigorous and structured search strategy, minimizing selection bias compared to guidelines relying on previously selected studies.

Conclusion

These clinical practice recommendations offer valuable guidance for managing outpatients with heart failure through exercise interventions in cardiovascular rehabilitation programs. These findings underscore the importance of personalized interventions in heart failure management and highlight the need for further high-quality research to strengthen the evidence supporting these recommendations. Clinicians are encouraged to adopt these recommendations to improve patient outcomes, while researchers are urged to address evidence gaps to support future guidelines.

Declaration of competing interest

The authors declare no conflicts of interest. No external funding influenced the content or recommendations of this guideline, which were developed independently based on current evidence.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.bjpt.2025.101260.

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