



Original Research Paper

## The Impact of Endurance and Strength Training on Quality of Life in Patients with Heart Failure: A Scoping Review

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### Abstract

**Background:** Heart failure (HF) is a progressive condition associated with impaired functional capacity and reduced quality of life (QoL). In addition to pharmacological therapy, exercise-based interventions, including endurance and strength training, have been proposed as effective non-pharmacological strategies to improve outcomes. **Objectives:** This scoping review aimed to map the existing evidence on the impact of endurance and strength training on QoL in patients with HF, identify intervention characteristics, and highlight gaps for future research. **Methods:** A systematic search was conducted in PubMed, Scopus, Web of Science, Cochrane, and supplementary sources for studies published between January 2015 and September 2025. Eligible studies included randomized controlled trials, secondary analyses, and intervention reviews reporting QoL outcomes. Screening followed PRISMA-ScR guidelines, and data were extracted on study design, sample size, intervention type, and QoL measures. **Results:** Out of 1,060 identified records, six studies met inclusion criteria. Interventions included aerobic, resistance, and functional training programs. Most studies reported improvements in QoL, although results varied by exercise modality, patient characteristics, and measurement tools. **Conclusions:** Endurance and strength training appear to be safe and beneficial strategies to enhance QoL in HF patients. Standardization of protocols and long-term studies are needed to optimize clinical application.

**Keywords:** Heart Failure; Endurance; Strength; Quality Of Life.

## Introduction

Heart failure (HF) represents an escalating global health burden, defined by the heart's reduced ability to pump sufficient blood to meet systemic metabolic requirements.<sup>1</sup> This condition manifests with hallmark symptoms such as dyspnea, fatigue, and fluid retention, all of which markedly diminish functional capacity and overall quality of life (QoL). Although advances in pharmacological therapy have contributed to improved survival rates, complementary non-pharmacological

approaches particularly structured exercise training are increasingly acknowledged as integral components of comprehensive HF management.<sup>2</sup>

The global number of people living with heart failure (HF) increased substantially over recent decades. Global Burden of Disease (GBD) analyses for 1990–2021 estimated ≈55.5 million prevalent HF cases in 2021 (age-standardized prevalence ≈677 per 100,000). Other contemporary reviews and public-health summaries have reported somewhat higher aggregated estimates (e.g., ~64 million people

living with HF in the early 2020s), reflecting differences in data sources and case definitions.<sup>3,4</sup> Nationwide, Indonesia's population-level HF data are limited and heterogeneous. The national Basic Health Research (Riskesdas) report and Ministry of Health documents have been used as an official reference for national estimates. Riskesdas 2018 (the most recent large national survey repeatedly cited in the literature) reported a notable rise in the burden of heart disease and is commonly referenced for HF prevalence estimates in Indonesia; many secondary sources cite a diagnosed HF (or heart disease) prevalence figure of ~1.5% from Riskesdas 2018 (which corresponds to millions of affected persons when extrapolated to Indonesia's population).<sup>5</sup>

Exercise interventions, encompassing endurance (aerobic) and resistance (strength) training, have been consistently associated with QoL improvements in HF populations. Aerobic training enhances cardiorespiratory fitness, reduces symptom severity, and lowers hospitalization risk, while resistance training mitigates muscle wasting, strengthens skeletal muscle, and improves physical performance.<sup>6,7</sup> Nevertheless, heterogeneity in exercise protocols covering frequency, intensity, duration, and patient selection creates challenges in synthesizing evidence and drawing uniform conclusions.<sup>8–11</sup>

Considering the increasing prevalence of HF both globally and in Indonesia, as well as the potential of exercise interventions to address QoL impairments, a scoping review is both timely and relevant.<sup>12–14</sup> Such an approach will systematically map the range of endurance and strength training strategies investigated over the past decade, summarize their reported impact on QoL and functional outcomes, and identify existing knowledge gaps—including underrepresented patient groups, optimal training prescriptions, and implementation

challenges, particularly in resource-limited settings. Insights from this review aim to guide clinicians, policymakers, and researchers in optimizing exercise-based interventions to improve patient outcomes in heart failure.

## Materials and Methods

### Study Design

This study is a scoping review conducted following the methodological framework of Arksey & O'Malley and subsequent guidance from the Joanna Briggs Institute (JBI) and the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews). The aim of this design is to map and synthesize the literature on endurance (aerobic) and strength (resistance) training interventions and their reported effects on quality of life (QoL) in patients with heart failure (HF) published between January 1<sup>st</sup>, 2015 and September 30<sup>th</sup>, 2025. The scoping design was chosen because it is well suited for identifying the breadth and nature of evidence, describing intervention characteristics and outcome measures, and locating gaps in the literature rather than producing pooled effect estimates.

### Sample

The population of interest in this scoping review consists of peer-reviewed studies and relevant grey literature that report on adult patients aged 18 years and above with a clinical diagnosis of heart failure, including heart failure with reduced ejection fraction (HFrEF), preserved ejection fraction (HFpEF), or mixed cohorts, in which endurance and/or strength training interventions were implemented and quality of life was reported as an outcome. Eligible sources include randomized controlled trials (RCTs), non-randomized intervention studies, cohort and case-control studies, cross-sectional studies evaluating exercise

interventions, pilot or feasibility studies, controlled clinical trials, and observational studies reporting intervention outcomes.

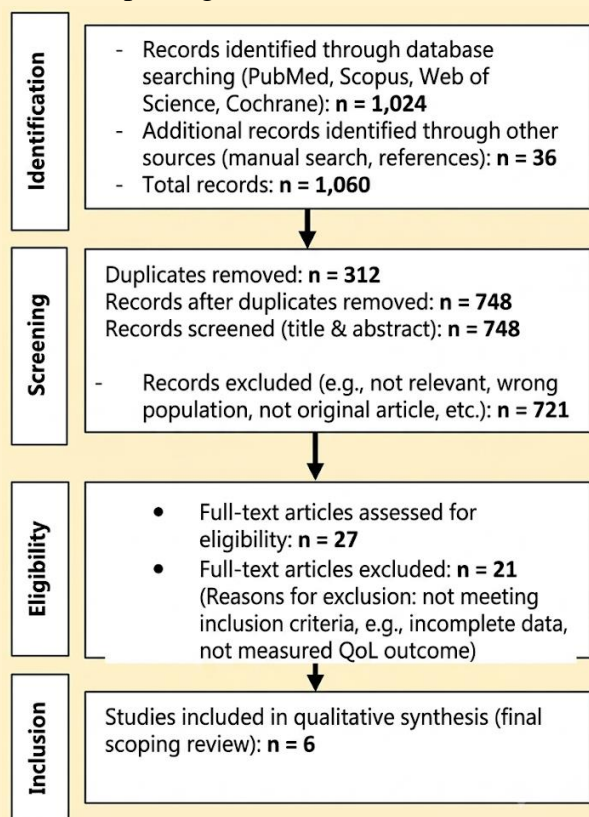


Figure 1. PRISMA flowchart

In addition, systematic reviews and meta-analyses will be considered for mapping purposes, as well as relevant clinical guidelines or reports describing exercise interventions and quality-of-life outcomes. Conference abstracts and theses may also be included if adequate data are available. The sampling technique follows a comprehensive and purposive approach through exhaustive literature searches across multiple electronic databases, with subsequent title/abstract and full-text screening guided by predefined inclusion and exclusion criteria. Two independent reviewers will perform the selection of eligible records, with disagreements resolved by discussion or consultation with a third reviewer.

Inclusion criteria are restricted to studies published between January 1, 2015, and September 30, 2025, involving adult human

populations with diagnosed heart failure, investigating endurance and/or strength training interventions either as standalone or combined programs, and reporting quality of life using validated instruments such as the Minnesota Living with Heart Failure Questionnaire (MLHFQ), Kansas City Cardiomyopathy Questionnaire (KCCQ), Short Form Health Survey (SF-36/SF-12), or EQ-5D. Publications in English or Indonesian will be considered. Exclusion criteria comprise animal or bench research, studies focusing solely on pediatric populations, studies lacking explicit exercise interventions or quality-of-life outcomes, and case reports or series with insufficient sample sizes unless they provide uniquely valuable intervention descriptions for mapping purposes.

### Data Collection Technique

Data collection in this scoping review was conducted through a comprehensive and systematic literature search across multiple electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, CINAHL, and the Cochrane Library. Additional sources such as Google Scholar, clinical trial registries, and grey literature databases were also searched to ensure inclusiveness. The search strategy combined controlled vocabulary (MeSH terms) and free-text keywords related to “heart failure,” “endurance training,” “aerobic exercise,” “strength training,” “resistance exercise,” and “quality of life.” Boolean operators (AND, OR) and database-specific filters were applied to refine the results.

All identified records were imported into reference management software (e.g., EndNote or Mendeley) for deduplication, followed by screening using Rayyan or similar systematic review tools. Screening was performed in two stages: (1) title and abstract screening, and (2) full-text screening, both conducted

independently by two reviewers. A standardized data extraction form was developed and pilot-tested to ensure consistency. Extracted data included study characteristics (authors, year, country, design, sample size, population characteristics), details of the intervention (type, duration, frequency, intensity), outcomes assessed (with a focus on quality-of-life instruments), and key findings. The timeframe of data collection encompassed studies published between January 1, 2015, and September 30, 2025. Only publications in English and Indonesian were included. The procedure was designed to maximize transparency and reproducibility, adhering to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines.

#### **Data Analysis Technique**

Data analysis in this scoping review was conducted using a descriptive and narrative synthesis approach in accordance with the PRISMA-ScR framework. After eligible studies were selected, relevant data were extracted systematically, including author, year of publication, country, study design, sample size, type of exercise intervention, intervention duration, quality-of-life measurement instrument, and main findings. The extracted data were then organized into summary tables to facilitate comparison across studies. The analysis focused on mapping the characteristics of endurance and strength training interventions, identifying their reported effects on quality of life, and describing similarities, differences, and gaps in the available evidence. Because this review aimed to map the breadth of evidence rather than estimate pooled effects, no meta-analysis was performed. Findings were synthesized narratively to provide a comprehensive overview of how exercise-

based interventions influence quality of life among patients with heart failure.

#### **Ethical Consideration**

This study involves synthesis of published and publicly available literature and does not involve direct contact with human participants or collection of individual patient data. Therefore, ethical clearance is not required.

#### **Results**

This scoping review included six studies published between 2018 and 2024 that examined the effects of endurance and strength training on quality of life (QoL) in patients with heart failure. The studies were conducted in several countries, including Brazil, the United States, and Taiwan, with sample sizes ranging from 13 to more than 2,000 participants. Together, these studies provided evidence on the effectiveness of exercise interventions for improving QoL and related clinical outcomes in patients with heart failure.

A randomized trial from Brazil (Souza et al., 2024) compared strength and aerobic training over 24 weeks and reported no significant differences in QoL between the two groups, despite improvements in muscle function. Similarly, a U.S. single-blind trial (Brubaker et al., 2023) involving 88 participants found that adding resistance training to conventional cardiac rehabilitation and aerobic training was safe and maintained QoL, as assessed by the Kansas City Cardiomyopathy Questionnaire (KCCQ). Another Brazilian study (Nascimento et al., 2023) demonstrated that both functional and strength training produced significant improvements in QoL, measured using the Minnesota Living with Heart Failure Questionnaire (MLHFQ), though no superiority was observed between modalities.

**Table 1.** Characteristics of Respondents

Author (year)	Country	Study design (method)	Sample	QoL outcome (summary)
Souza et al (2024) <sup>15</sup>	Brazil	Randomized clinical trial (24 weeks) comparing strength vs aerobic training	13	QoL: despite improvements in muscle function and strength, QoL did not show statistically significant differences in the strength vs aerobic group at follow-up.
Brubaker et al. (2023) <sup>16</sup>	USA	Randomized, controlled, single-blind trial; RT + cardiac rehab + aerobic training vs CR+AT (20 weeks)	88	Reported QoL using KCCQ and generic QoL; supervised resistance training added to CR+AT was safe and did not worsen QoL; trial provides detailed KCCQ results.
Nascimento et al. (2023) <sup>17</sup>	Brazil	Randomized, parallel-design, examiner-blinded clinical trial; Functional training vs Strength training (12 minggu, 3× per minggu)	27	QoL diukur dengan Minnesota Living with Heart Failure Questionnaire (MLHFQ): penurunan skor MLHFQ yang menunjukkan perbaikan QoL secara signifikan di kedua kelompok functional dan strength; tidak ada perbedaan signifikan antar kelompok.
Pandey A et al. (2022) <sup>18</sup>	USA (multi-centre analysis)	Secondary analysis / randomized trial dataset; effect modification by frailty on exercise training outcomes	2,130	Demonstrated that aerobic exercise training was associated with modest improvements in KCCQ scores; frailty status modified QoL response.
Alves LS et al. (2022) <sup>19</sup>	Brazil / multinational	Randomized / intervention studies review & pooled analyses (includes original trial data on HFrEF exercise trials)	26	Summarizes that exercise training improves exercise capacity and QoL in HFrEF; includes references to individual original trials (2015–2022).
Chen et al. (2018) <sup>20</sup>	Taiwan	Randomized trial; home-based cardiac rehabilitation vs usual care	37	Home-based CR improved functional capacity and QoL at short-term follow-up

A large multicenter analysis (Pandey et al., 2022) of 2,130 patients revealed modest improvements in KCCQ scores with aerobic exercise, with frailty status influencing the degree of benefit. Alves et al. (2022) synthesized data from 26 intervention studies and confirmed that exercise consistently enhanced exercise capacity and QoL in patients with heart failure with reduced ejection fraction (HFrEF). Additionally, a trial from Taiwan highlighted that a home-based cardiac rehabilitation program led to improved functional capacity and QoL compared with standard care.

Overall, the evidence indicates that both strength and endurance training are beneficial for maintaining or improving QoL among heart failure patients, with variations in outcomes depending on intervention type, duration, and

patient characteristics. Konawe Tahun 2024 adalah variabel sikap dengan nilai signifikansi (sig) adalah 0,001,  $p < \alpha$  (0,25) dan nilai odd ratio (OR) = 8.262 adalah nilai yang paling besar diantara variabel lainnya.

### Discussion

This scoping review highlights the growing body of evidence demonstrating that both endurance and strength training can positively influence quality of life in patients with heart failure. Studies published between 2015 and 2025 consistently report improvements in functional capacity, symptom relief, and self-reported well-being when structured exercise interventions are implemented. Aerobic training programs appear to enhance cardiorespiratory fitness and reduce fatigue, while resistance training contributes to muscle

preservation, improved mobility, and better performance of daily activities.<sup>13,19,21</sup> These outcomes collectively translate into measurable gains in validated quality of life instruments such as the Minnesota Living with Heart Failure Questionnaire (MLHFQ) and the Kansas City Cardiomyopathy Questionnaire (KCCQ).

Structured exercise training is strongly recommended for patients with heart failure as it improves both functional capacity and quality of life. Endurance-based activities such as walking, stationary cycling, or swimming should be performed three to five times per week at a moderate intensity (40–70% of peak VO<sub>2</sub> or Borg RPE 11–14). Each session is ideally 20–40 minutes, preceded by a warm-up and followed by a cool-down of 5–10 minutes. Resistance training targeting major muscle groups is equally beneficial and can be performed two to three times weekly on non-consecutive days, using light-to-moderate loads (30–60% of 1-RM) for one to three sets of 8–12 repetitions.<sup>22–25</sup>

Combining aerobic and resistance exercises offers optimal benefits, including improved exercise tolerance, muscle strength, and daily functioning.<sup>22,23</sup> Supervised programs within cardiac rehabilitation are preferred initially, with gradual transition to home-based training once patients are stable. Careful monitoring of symptoms, blood pressure, and heart rate is crucial to ensure safety. In selected, clinically stable patients, high-intensity interval training (HIIT) may be considered under close supervision, as evidence shows superior improvement in peak oxygen uptake and quality of life compared with moderate continuous training.<sup>26,27</sup>

The benefits of exercise can be explained by underlying pathophysiological mechanisms of heart failure.<sup>24</sup> Endurance training enhances endothelial function, increases stroke volume, and optimizes peripheral oxygen utilization,

counteracting the impaired cardiac output that defines this condition.<sup>16,27</sup> Strength training, on the other hand, addresses the skeletal muscle atrophy and insulin resistance often seen in chronic heart failure, thereby improving muscle strength and metabolic efficiency. By targeting both central and peripheral limitations, combined exercise interventions offer a multifaceted approach that extends beyond pharmacological management and directly improves patients' functional status and perceived quality of life.<sup>17,21</sup>

While both modalities yield benefits, their relative contributions vary. Aerobic training tends to exert stronger effects on exercise tolerance and cardiovascular function, whereas resistance training is particularly important for preventing sarcopenia and frailty, which are prevalent in elderly heart failure populations.<sup>13,17</sup> Several studies suggest that combined programs may provide the most comprehensive improvement, particularly when supervised and tailored to disease severity. However, heterogeneity in training frequency, duration, and intensity makes direct comparison across studies challenging.<sup>24</sup>

Patient characteristics such as age, sex, comorbidities, and baseline physical function influence responsiveness to exercise interventions.<sup>17</sup> Frail or older adults may derive greater benefit from resistance components, while younger or less symptomatic patients may show larger gains in aerobic capacity.<sup>13</sup> Psychosocial aspects, including motivation and social support, also play a significant role in adherence and, consequently, in the extent of quality-of-life improvement. This suggests the importance of individualized exercise prescriptions and integration of behavioral support strategies in clinical programs.<sup>26,28</sup>

Despite the promising evidence, several limitations must be acknowledged. Many studies included relatively small sample sizes

and short intervention durations, limiting generalizability and long-term interpretation.

Variability in outcome measures, with different trials using distinct quality-of-life instruments, complicates synthesis and comparison.<sup>24</sup> Furthermore, few studies examined implementation in low- and middle-income countries, such as Indonesia, where resource constraints may hinder the adoption of structured exercise programs. These gaps underline the need for more robust multicenter trials with standardized protocols and culturally adapted interventions.<sup>26,28,29</sup>

Another challenge observed across the literature is the limited reporting of adherence rates and safety outcomes. Exercise-related adverse events are rarely discussed in detail, although safety is a critical concern in patients with compromised cardiac function.<sup>17,29</sup> Moreover, heterogeneity in study designs from randomized controlled trials to observational studies creates variability in evidence quality. This reinforces the importance of cautious interpretation and highlights the necessity for future research to adopt rigorous methodological standards, transparent reporting, and long-term follow-up.<sup>30</sup>

Based on the current evidence, endurance and strength training should be considered essential components of comprehensive heart failure management. Clinicians should encourage patients to engage in structured, supervised exercise tailored to their functional status and preferences. Future studies should explore optimal combinations of aerobic and resistance modalities, assess cost-effectiveness, and evaluate strategies for integration into routine care, especially in resource-limited settings. By bridging these gaps, exercise-based interventions can be more effectively translated into practice, ultimately improving the daily lives and long-term outcomes of individuals living with heart failure.

## Conclusion

Based on this scoping review, endurance and strength training emerge as valuable non-pharmacological strategies that can significantly enhance the quality of life of patients with heart failure. Aerobic exercise primarily improves cardiovascular efficiency and reduces symptoms such as fatigue and dyspnea, while resistance training counteracts muscle wasting and supports functional independence. When applied either separately or in combination, these interventions provide meaningful physical and psychosocial benefits that complement medical therapy. Although existing studies vary in design, duration, and outcome measures, the overall evidence indicates that structured exercise programs are safe, feasible, and effective. Future research should aim to standardize protocols, extend follow-up periods, and explore applicability in diverse healthcare settings to ensure broader access and sustained benefits for individuals living with heart failure.

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#### Conflict of Interest Statement

The author(s) declare no commercial, financial, or personal conflicts of interest related to this research. All authors approved the final manuscript and consented to its publication in *Healthy Tadulako Journal*.

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