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Review article

Relationship Between Exercise Training and Quality of Life in Heart Failure Patients

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Abstract

Background*:** Heart failure (HF) is a growing disease that affects up to 6.5 million Americans and greatly contributes to the rising expense of health care. HF affects almost 23 million individuals worldwide. Exercise training increased patients' quality of life (QoL) and may be connected with lower morbidity and mortality. ***Aim*:** To assess the association between exercise training and QoL in HF patients. ***Methods: We examined databases from 2008 to 2019 for research that looked at the association between exercise training and QoL in HF patients. For the analysis, eight controlled studies that met the inclusion criteria were chosen. The study's characteristics as well as data on QoL in HF patients, exercise training, and aerobic capacity were extracted and examined. ***Results***: The investigation showed a more positive effect of the training exercise on patients' QoL after heart failure. **Conclusion**: Regular 30-minute exercise training three times a week for eight weeks is an effective strategy to improve all QoL aspects in individuals with chronic heart failure caused by various etiologies. These exercises had to be modified based on the patients' age and functional capacity.

Keywords: Heart failure, Exercise, Quality of life, Morbidity

العلاقة بين التدريب على التمارين الرياضية ونوعية الحياة لدى مرضى قصور القلب

الخلاصة

الخلفية: قصور القلب (HF) هو مرض متنام يصيب ما يصل إلى 6.5 مليون أمريكي ويساهم بشكل كبير في ارتفاع نفقات الرعاية الصحية. يؤثر HF على ما يقرب من 23 مليون فرد في جميع أنحاء العالم. أدى التدريب على التمارين الرياضية إلى تحسين نوعية حياة المرضى (QoL) وقد يكون مرتبطا بانخفاض معدلات الاعتلال والوفيات. **الهدف**: تقييم العلاقة بين التدريب على التمارين الرياضية وجودة الحياة لدى مرضى قصور القلب. **الأساليب**: فحصنا قواعد البيانات من 2008 إلى 2019 للبحث في طبيعة العلاقة بين التدريب على التمرين وجودة الحياة في مرضى قور عضلة القلب. بالنسبة للتحليل، تم اختيار ثماني دراسات خاضعة للرقابة استوفت معايير الإدراج. تم استخراج وفحص خصائص الدراسة وكذلك البيانات المتعلقة بجودة الحياة لدى مرضى قصور القلب والتدريب على التمارين الرياضية والقدرة اجراء تمارين الرياضة الهوائية. **النتائج**: أظهر نتائج البحث في الدوريات تأثيرا أكثر إيجابية لممارسة التدريب الرياضي على جودة الحياة لدى المرضى بعد قصور القلب. **الاستنتاج**: يعد التدريب المنتظم لمدة 30 دقيقة ثلاث مرات في الأسبوع لمدة ثمانية أسابيع استراتيجية فعالة لتحسين جميع جوانب جودة الحياة لدى الأفراد الذين يعانون من قصور القلب المزمن الناجم عن مسببات مختلفة. كان لا بد من تعديل هذه التمارين بناء على عمر المرضى وقدرتهم الوظيفية.

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INTRODUCTION

Heart failure (HF) affects 23 million individuals worldwide, including 6.5 million in the United States, and increases health-care expenditures [1-3]. Every year, nearly 960,000 new cases of HF are discovered, with annual treatment expenditures exceeding $30 billion. After a diagnosis of HF, the 5-year survival rate is 40-50 percent [4]. Despite therapeutic advances, HF remains a leading cause of hospitalization, with symptomatic patients having a one-year mortality rate of roughly 45%. Dyspnea and tiredness impair a patient's social and physical functioning, as well as their quality of life. Ejection fraction and cardiac output have a weak correlation with a patient's ability to exercise, indicating that factors other than the central circulation are at work [5]. In individuals with heart failure, exercise training may reduce morbidity and increase survival; it also reduces mortality, hospitalizations, and chronic illness risk [6,7]. Physical activity increases aerobic capacity and autonomic equilibrium [8]. The core of non-pharmaceutical HF treatment is moderate exercise, which is well tolerated by the majority of individuals with HF and does not impede exercise adherence [6]. However, the benefits of fitness training on mental disorders and QoL are largely unknown. The relationship between exercise capacity, mood, and QoL differs depending on the study design. Variations between studies are likely due to the heterogeneity of HF populations, variations in exercise prescriptions (e.g., intensity and progression), and use of different measures of exercise ability, depressive symptoms, and QoL. Several studies have shown that exercise training increases exercise capacity and cardiorespiratory fitness and improves QoL [9].

Research question

Is there a relationship between exercise training and quality of life for patients with heart failure?

Heart failure

The term heart failure is frequently used to describe a progressive heart ailment. It is a clinical disorder that results from a structural or functional variation in cardiac function that impairs the ventricle's capacity to load or pump blood. It is caused by a range of cardiovascular illnesses, although it can be initiated by some common cardiac abnormalities that result in lessened contraction (systole) or filling (diastole), or both. Significant cardiac dysfunction always precedes the onset of heart failure symptoms [10,11,12].

Classification of Heart Failure

Systolic heart failure

In general, systolic HF is characterized by a decrease in myocardial contractility and an ejection fraction of less than 40%. A normal heart pumps around 65% of the blood in the ventricle at the end of a diastole. In systolic HF, the ejection fraction decreases gradually as myocardial dysfunction increases [13]. Reduction in the total amount of blood pumped from the ventricle, which stimulates the sympathetic nervous system to produce adrenaline and norepinephrine, characterizes systolic HF. The purpose of this initial response is to preserve the failing myocardium, but the continued response results in the loss of β1-adrenergic receptor sites (down regulation) and further damage to heart muscle cells [11]. Systolic dysfunction is typically caused by conditions that impair the heart's contractile performance (e.g., ischemic heart disease and cardiomyopathy), create a volume overload (e.g., valvular insufficiency and anemia), or generate a pressure overload (e.g., hypertension and valvular stenosis) on the heart. The amount of systolic ventricular dysfunction can be estimated by assessing cardiac output, ejection fraction, and left-sided heart failure symptoms, particularly pulmonary congestion [13].

Diastolic heart failure

Diastolic HF is caused by a persistently high workload on the heart, which responds by enlarging myocardial cells (i.e., ventricular hypertrophy and altered heart muscle function). These alterations result in a decrease in ventricular filling, which increases ventricular pressure and decreases blood volume. This will result in decreased blood volume in the ventricles and cardiac output. Low output and high ventricular filling pressures result in the same neurohormonal responses as systolic heart failure [11], in addition to conditions that restrict expansion of the ventricle (e.g., pericardial effusion, constrictive pericarditis), increase wall thickness and diminish chamber size (e.g., myocardial hypertrophy), and those that delay diastolic relaxation contribute to diastolic dysfunction (e.g., aging, IHD). Aging is frequently accompanied by a delay in the resting of the heart's muscles during diastole, such that diastolic filling begins when the ventricle is rigid and difficult to extend to receive greater volume. The same delay occurs in cardiac ischemia, which is caused by a lack of energy to inhibit the formation of consistency between actin and myosin filaments and to transport Ca^{++} back into the sarcoplasmic reticulum [13].

Left-sided heart failure

During a contraction, the left ventricle must generate a particular amount of force in order to evacuate blood through the aortic valve. The term for this force is "afterload." The pressure within the aorta and arteries serves as resistance and affects the force necessary to open the aortic valve and pump blood into the aorta. The term for this pressure is peripheral vascular resistance (PVR). Hypertension is one of the leading causes of left-sided HF because it elevates arterial

Class I	No limitation of physical activity. Ordinary physical activity does not cause undue breathlessness, fatigue, or palpitations.
Class II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary physical activity results in undue breathlessness, fatigue, or palpitations.
Class IV	Unable to carry on any physical activity without discomfort. Symptoms at rest can be present. If any physical activity is undertaken, discomfort is increased.

Table 1: Classification of Heart Failure Based on Severity of Symptoms and Physical Activity

pressure. When aortic pressure rises, the left ventricle must work harder to push blood into the aorta. The increasing effort leads the left ventricle to deteriorate and eventually fail over time [14]. Blood backs up from the left ventricle into the left atrium and ultimately into the four pulmonary veins and lungs in left-sided HF. This causes fluid to migrate first into the interstitium and subsequently into the alveoli, increasing pulmonary pressure. Because it inhibits gas exchange across the alveolar capillary membrane, alveolar edema is more severe. The decreased oxygenation of the blood leaving the lungs may cause shortness of breath and cyanosis. Fluid accumulation in the lungs is known as acute pulmonary edema, which requires immediate medical attention [14].

Right-sided heart failure

Conditions causing right-sided HF increase the right ventricle's workload. Either they raise the necessary contractile force or necessitate the pumping of extra blood volume (preload). Left-sided HF is the primary contributor of right-sided HF. When the left side of the heart fails, fluid backs up into the lungs, increasing pulmonary pressure. This increased fluid and pressure in the pulmonary artery and lungs requires the right ventricle to continuously pump blood. This increased stress eventually leads to its failure [14]. When the right ventricle becomes hypertrophied or fails due to elevated pulmonary pressure, the condition is known as corpulmonale. When the right ventricle fails, it does not empty normally, causing a backflow of blood into the systemic blood arteries. As the right ventricle fills with blood, the right atrial and systemic venous blood volumes increase. In a 45-degree upright position, the jugular veins of the neck, which are ordinarily not visible, become dilated and visible. The peripheral tissues may develop edema, and the abdominal organs may swell. Anorexia, nausea, and abdominal pain result from fluid accumulation in the gastrointestinal (GI) tract. As the condition worsens, blood accumulates in the hepatic veins and the liver swells (hepatomegaly). This liver congestion also produces abdominal pain in the upper right quadrant and inhibits liver function. In addition to causing splenomegaly, systemic venous congestion also causes splenomegaly [14]. As shown in Table 1, HF is classified according to the severity of symptoms and physical limits during exertion [15,16].

Exercise

Physical activity is connected to health advantages. Inactivity remains a threat to public health. This more sedentary lifestyle is hazardous to the individual and may be costly, as it has been connected to an increase in cases of cardiovascular diseases [17]. Numerous studies link HF activities to enhanced physiology and QoL. It generally requires significant effort and is brief in duration. The optimal exercise is anaerobic and low in oxygen. In conventional exercises, muscle activity is categorized by the predominant type of contraction [18].

Quality of life (QoL)

The World Health Organization (WHO) defines quality of life as "a person's perception of their life circumstances in relation to their goals, aspirations, standards, and concerns." QoL elements include wealth, employment, physical and mental health, education, recreation and leisure time, social belonging, religious beliefs, safety, security, and freedom [19,20]. QoL encompasses globalization, healthcare, politics, and employment [20]. This concept implies that life quality is a subjective evaluation based on cultural, social, and environmental circumstances. There is no correlation between QoL and "health state," "lifestyle," "life satisfaction," or "mental condition" or "well-being." Because the WHO concept of QoL focuses on the "perceived" quality of life of respondents, it is not intended to evaluate symptoms, illnesses, or conditions, nor disability as objectively determined, but rather the perceived effects of disease and health treatments on the individual's QoL. The WHOQoL examines a person's health perception, psychosocial standing, and other aspects of life [21].

Theoretical background

Nursing is the science of restoring patients' lives as quickly as feasible. This responsibility is fulfilled by the implementation of the nursing philosophy, which is discussed in several nursing theories. Patients with heart failure were required to regularly use the training activities in their social environment. Therefore, Orem's self-care theory is one of the theories that exemplifies the function of the nurse in the management of patients who are unable of caring for themselves, even with family support. When the patient or family cannot give the essential care, there is a need for self-care that a nurse can meet. The general theory is composed of three interrelated theories are:

- Theory of self-care,
- Theory of self-care deficit,
- The theory of nursing systems.

The researcher uses these sub-classes because of the following:

1. The patients are required to manage their health deviation requisites through regular exercise training.
2. The nurse must act for or on behalf of another, guiding and directing the patients, offering physical or psychological support for patients, developing and maintaining an environment that encourages personal growth, and teaching, in order to fulfill their duty in assisting the patients.
3. The nurse needs to use the partially compensatory system and the supportive-educative system to help the patients maintain their self-care behaviors.

These reasons illustrating the researcher's decision in using this theory.

Application of the self-care theory

The application of the self-care theory is done through nursing process. The researcher can follow the following steps:

***Assessment*:** through the assessment step, the researcher assesses the patients for their demographic and clinical data because this data affects the interventional program. For patients with heart failure, demographics such as age, gender, levels of education, occupation, and economic status; and clinical data such as duration of disease, type of heart failure, degree of physical limitation, comorbidities, and heart failure-related complications affect the selection of the type and degree of intensity of the training exercises.

Nursing diagnosis: The nursing diagnosis is a clinical decision about the actual or potential patient's responses to health or illness. Nursing diagnosis necessitated the use of synthesis and analysis skills. For patients with heart failure, the following nursing diagnoses can be formulated:

- Impaired physical performance due to inability to carry out daily activities caused by dyspnea.

- Impaired QoL due to physical and psychological problems associated with heart failure.

Planning and outcome identification: During the planning step, the researcher uses the modifiable exercises training to improve patients' physical capacity and their quality of life.

Implementation: During implementation step, the researcher executes the intervention program formulated in the planning step.

Evaluation: During the evaluation, the researcher compares the patients' physical capacity and QoL after application of the exercises compared with what is suspected outcomes which is formulated in the planning step.

METHODS

This project is a combination of a focused literature review and a thematic analysis of articles that highlight the lived experience of insufficient QoL care for individuals with HF. One of the authors searched the Cumulative Index to Nursing and Allied Health Literature, Medline, and PubMed for health-related bibliographic information. We were able to simultaneously search all three databases for several keyword combinations using the search function. Combinations of HF and congestive heart failure included exercise, training, and quality of life. Due to the inability of the simultaneous search to include the fourth database, Social Services Abstracts, a separate search was run using the same key terms. In the second phase, the citation results from the four databases were integrated. The third phase consisted of a thorough evaluation of writers and titles, as well as the removal of non-English titles and merely commentary articles. Additionally, we excluded papers published prior to 2008 in order to prioritize more recent research. Two of the authors evaluated the abstracts of the citations that resulted in the fourth phase and selected studies that focused on the impact of HF care on the quality of life as perceived by the patient. The inclusion or exclusion of a journal from the social work literature was determined by examining the names of the journals in which these publications were published. After completing the bibliographic database, the fifth and last stage was to examine the full-text versions of the publications in order to identify and compile themes regarding the lived experience of HF that were evident in the research results portions of each article. The eligible articles are listed in Table 2.

RESULTS AND DISCUSSION

Heart failure is a terrible catastrophe that affects all aspects of human existence. Patients' QoL is negatively impacted by a range of health issues and consequences caused by HF. The research of the influence of training on the QoL of HF patients is an essential topic since exercise training is utilized to improve the physical and mental health of those patients. It enhances their standard of living. In 2008, Bocalini *et al*. investigated the effects of exercise training on the functional ability and QoL of individuals with various types of heart failure. They investigated 56 people with HF, which were allocated into two groups (trained and untrained groups). In comparison to the untrained group, their results demonstrate that functional ability and QoL are enhanced in the trained group following exercise training [22].

Table 2: Synthesis Matrix for Literature Review

Author Name	Title	Year	Design	Conclusion
Bocalini *et al*. 2008 [22]	Physical exercise improves the functional capacity and quality of life in patients with heart failure	2008	Prospective, randomized, controlled study	Guided and monitored physical exercise is safe and has the potential to improve functional capacity and quality of life in heart failure patients with multiple etiologies.
Piepoli, 2013 [23]	Exercise training in chronic heart failure: mechanisms and therapies	2012	Systematic review of literature	Regular exercise training is associated with improved quality of life and survival in healthy individuals and in cardiovascular disease patients.
Bahramnezhad, *et al*., 2013 [24]	Exercise and Quality of Life in Patients with Chronic Heart Failure	2013	Cross-sectional study	Results showed a positive effect of exercise on quality of life in patients with heart failure.
Chrysohoou *et al*., 2014 [9]	High intensity, interval exercise improves quality of life of patients with chronic heart failure: a randomized controlled trial	2014	A randomized controlled trial	High intensity, systematic aerobic training, could be strongly encouraged in CHF patients, since it improves QoL, by favorably modifying their fitness level.
Dehkordi and Far, 2015 [25]	Effect of Exercise Training on the Quality of Life and Echocardiography Parameter of Systolic Function in Patients With Chronic Heart Failure: a Randomized Trial	2015	Quasi-experimental study (Experimental and control groups)	Exercise program increases ejection fraction and quality of life in chronic heart failure patients, associated with management of disease by health team.
Nolte *et al*., 2015 [26]	Effects of exercise training on different quality of life dimensions in heart failure with preserved ejection fraction: the Ex-DHF-P trial	2015	Prospective, multicenter, randomized, controlled trial	Structured supervised exercise training performed in HFpEF positively affects general health perceptions, improves patients' emotional status and social dimensions of QoL, and reduces symptoms of depression. ET should be considered for improving QoL in patients with HFpEF.
Slimani *et al*., 2018 [27]	The Effects of Physical Training on Quality of Life, Aerobic Capacity, and Cardiac Function in Older Patients With Heart Failure: A Meta-Analysis	2018	Randomized controlled trials	The present meta-analysis showed that physical training has positive effects on QoL, aerobic capacity, and cardiac function in older patients with HF.
Taylor *et al*., 2019 [28]	Impact of Exercise Rehabilitation on Exercise Capacity and Quality-of-Life in Heart Failure	2019	Systematic Review and Meta-analysis of Individual Participant Data (PRISMA-IPD)	These results, based on an IPD meta-analysis of randomized trials, confirm the benefit of ExCR on HRQoL and exercise capacity and support the Class I recommendation of current international clinical guidelines that ExCR should be offered to all HF patients.

Similarly, Piepoli (2012) focused on the effect of exercise training on the QoL of patients with chronic HF during the study. He did a review of the relevant literature and discovered that training activities can be employed as a rehabilitation technique for individuals with chronic HF and have a positive impact on the QoL of these patients [23]. In addition, in the field of non-experimental research, Bahramnezhad *et al*. did a cross-sectional study to examine the influence of exercise on the QoL among 160 cases of medically stable patients with chronic HF, who were allocated into two equal groups (experimental and control groups). They were engaged in exercise training for 30 minutes, three times per week, for eight weeks (poly striding). The workouts have not been performed for six months after eight weeks. The results indicate that exercise had a good influence on the QoL of the patients, but the lack of continuity did not improve the patients' overall QoL compared to their state prior to exercise [24]. In addition, Chrysohoou *et al*. (2014) investigated whether high-intensity interval exercise improves QoL in patients with chronic HF in a randomized controlled trial to evaluate the effect of high-intensity interval exercise on QoL and depression status in patients with chronic HF [9]. They mentioned the strength and limitations of evaluating patients with systolic HF, as the measurement of QoL is a very difficult task, especially among HF patients. Due to the wide heterogeneity in clinical characteristics and origin of HF, only patients suffering from ischemic heart disease or dilated cardiomyopathy were enrolled (even with an implanted defibrillator or cardiac resynchronization system), while a few patients with severe chronic obstructive pulmonary disease or sleep apnea were included. They conclude that application of a combined high-intensity interval exercise program in patients with systolic HF of ischemic or idiopathic origin appears to offer substantial beneficial effects on several hemodynamic and clinical factors and particularly on QoL markers, improving the ability to perform daily activities, even in terminally ill patients, although the beneficial effect was limited in elderly patients. Dehkordi and Far (2015) investigated the effect of exercise on the QoL of patients with HF from the perspective of the diagnostic ECG procedure. They studied the effect of exercise training on the QoL and echocardiography parameter of systolic function in patients with chronic HF in a randomized clinical trial [25]. They perform the study on 66 male and female patients with chronic HF who were randomly allocated into two 33-person experimental and control groups. The patients in the experimental group participated in three exercise sessions each week for twenty-four weeks. A QoL questionnaire and echocardiography

were utilized to collect data. The data were analyzed using a paired and independent t-test. In the experimental group, left ventricular diameter (LV-ESD, LV-EDD) and ejection percent were significantly different at the end of the exercise program compared to 24 weeks later in the control group. Physical performance, activity limitation following physical issues, energy and weariness, social performance, physical discomfort, and public health all differed significantly between the two groups ($P < 0.05$ for all). They suggest that exercise programs improve ejection fraction and QoL in individuals with chronic HF, which is connected with illness management by a healthcare team. The QoL of patients involves numerous dimensions (physical, psychological, levels of independence, social, and environmental dimensions). Consequently, the study of these dimensions and the influence of exercise on these dimensions is likewise a crucial topic. In 2015, Nolte et al. investigated the impact of exercise training on many parameters of QoL in patients with maintained ejection fraction and HF. They discovered that systematic, supervised exercise training in HF with poor ejection fraction improves patients' emotional status and social dimensions of QoL, and lowers depressive symptoms, and consider exercise training to improve QoL in patients with HF with poor ejection fraction [26]. In a meta-analysis, Slimani *et al*. (2018) examined the benefits of physical exercise on the QoL, aerobic capacity, and cardiac function of HF patients aged 65 and older. They demonstrated that physical activity improves QoL, aerobic capacity, and heart function in older individuals with HF. When creating physical training programs to enhance QoL and aerobic capacity in elderly patients with heart failure, practitioners should consider both training volume and manner [27]. Taylor *et al*. also investigated the effect of exercise rehabilitation on exercise capacity and QoL in HF. They support the Class I recommendation of current international clinical guidelines that exercise should be performed by all patients with HF [28]. According to the studies cited previously, exercising for 30 minutes three times per week for eight weeks is an effective way to improve the QoL of patients by increasing their functional capacity, individual survival, ejection fraction, health perception, emotional status, social status, aerobic capacity, and heart functions [28]. In addition, exercise relieves the symptoms of psychological disorders, particularly depression [22-24,9,25-28]. Although exercise training is useful in enhancing the QoL of patients, these effects are depending on the intensity, nature, and duration of the exercise regimen. The demographic and clinical characteristics of the patients are also significant factors that may affect the efficacy of these workouts. Consequently, exercise training should be completed consistently without interruption [24]. Moreover, high intensity fitness training is contraindicated for elderly patients [9]. Therefore, aerobic exercise is an alternate training modality for the elderly to enhance their quality of life [27].

Conclusion

Patients with chronic heart failure caused by a variety of etiologies can enhance their quality of life across all dimensions by engaging in regular exercise for 30 minutes, three times per week, for eight weeks. These exercise training programs must be modified according to the age group and functional capabilities of the patients.

Conflict of interests

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