



## Effective Strategies for Physical Activity Adherence in Heart Failure Patients: An Umbrella Review

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### Abstract

**Background:** Despite the importance of physical activity in heart failure treatment, physical activity adherence in heart failure patients is low. The purpose of this umbrella review was to obtain the best strategies for enhancing physical activity adherence among HF patients.

**Methods:** Databases were investigated from 2010 to Jan 2022. The full text of the papers was investigated in terms of inclusion and exclusion criteria. Eventually, out of 74 relevant papers, 7-review study with 20977 patients were eligible and included in the study.

**Results:** Five key effective approaches were identified in two subsets for enhancing physical activity adherence as follows: 1) exercise-based approaches including 1.1) Exergames, whereby the extent of adherence to exergames was between 84 and 98%. 1.2) Tele-rehabilitation with 70%-100% adherence the intervention groups 1.3) Tai chi and Qigong practices (TQPs), whereby the exercise adherence in TQP groups was 67-100%, 2. Theoretical-behavioral approaches 2.1) approaches based on behavioral and psychological theories, which were a combination of an exercise program alongside a behavior modification intervention, 2.2) Self-efficacy.

**Conclusion:** Approaches that are based on exercise alongside behavioral and theoretical interventions could enhance physical activity adherence among HF patients. It is suggested to evaluate mix methods of exercise-based approaches and theoretical-behavioral approaches mentioned in this study in future clinical trial studies. Use of capacity of TR programs improve to physical activity adherence should receive more attention.

**Keywords:** Patient adherence; Heart failure; Review; Physical activity; Exercise



## Introduction

Heart failure (HF) is one of the most common cardiovascular diseases worldwide (1). Globally there are more than 37 million patients with HF diagnosis. Heart failure as an important burden on global healthcare services negatively affects quality of life, life expectancy, and healthcare costs of the patient. In HF patients, one-year mortality has been reported 24.1% and the one-year rehospitalization rate as 31.9%. The general clinical management of HF patients demands about \$70 billion of healthcare costs worldwide. In addition, the future trends of incidence and prevalence of HF over the future decades would increase because of interaction effect of several causes mostly resulting from aging population and unhealthy lifestyle (2).

Heart failure is one of the major challenges in healthcare systems of all countries. The American Heart Association has reported that cardiovascular disease is responsible for 22% of mortalities per year. In Iran, heart failure is the most common cause of hospitalization at hospital, as in every 100,000 Iranian people, around 3700 suffer from heart failure (3). The one-year mortality rate of HF in Iran has been 32% (4). Physical activity is the central core of the heart failure rehabilitation program; currently it is recommended alongside pharmacotherapy for heart failure. The benefits of physical activity in HF (including improving the capacity of tolerating physical activity, quality of life, and reducing frequent hospitalizations) have been widely confirmed (5). Physical activity is one of the important therapeutic aspects in HF patients. Nevertheless, the adherence of HF patients to physical activity is low whether in daily life or in rehabilitation programs (6, 7). In this regard, 40-91% of HF patients do not participate in regular exercise (8).

Although physical activity and physical rehabilitation programs in HF patients lead to significant outcomes, evidence has shown that few numbers of these patients participate in physical activity programs (9). Lack of adherence to treatment regimens has remained a major challenge to

healthcare systems. (10-13). The strategies to increase adherence to physical activity in these patients can improve the symptoms and outcomes of the disease, and help in preventing hospitalization at hospital and aggravation of symptoms (14). Adherence to exercise programs can result in enhanced quality of life, reduced mortality of cardiovascular patients in the end, decreased frequent hospitalizations (15, 16). As well as improved cardiac functioning (17). There are several reviews of different strategies for increasing adherence to physical activity in heart failure patients (2, 18). As the number of systematic reviews increases, the next necessary step to provide the evidence needed by health care decision makers is to conduct reviews of existing systematic reviews and evidence summaries. Clinicians and policy makers are faced with a large number of review studies in a specific work area (19). Therefore, umbrella reviews are needed for integrating and extracting results from multiple reviews (20).

This umbrella review was designed and performed to achieve the best and most effective strategies for enhancing physical activity adherence among HF patients.

## Methods

This study is an umbrella review. It has been performed based on the protocol of Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA 2009) (21).

### *Research question*

What are the effective strategies for empowering HF patients in adherence to physical activity?

### *Inclusion and exclusion criteria*

Following standard approaches for evidence analysis, the inclusion criteria were determined using PICOS criteria. 1) Population (Inclusion criteria: Patients with HF above 18 yr old, Exclusion criteria: Studies that had not focused on HF patients).

2) Intervention (Inclusion criteria: Effective interventions for empowering HF patients in adherence to physical activity included interventions at hospital, out of hospital and clinic were of selected, Exclusion criteria: Studies that do not include a relevant intervention.). 3) Comparison: (Inclusion criteria: Increased adherence to instructions on physical activity and exercise. Exclusion criteria: Reviews that included non-clinical trial studies and qualitative studies were excluded). 4) Outcome: (Inclusion criteria: increased adherence to instructions on physical activity and exercise. Exclusion criteria: Studies that do not report a relevant outcome.) 5) Study: (Inclusion criteria: Systematic reviews, meta-analysis, and the reviews that included different types of clinical trial studies were incorporated in the analysis. The included studies met two mandatory criteria of Database of Abstracts of Reviewers of Effects (DARE). Exclusion criteria: Reviews that included non-clinical trial studies and qualitative studies were excluded (22, 23). Finally, review articles in English language from 2010 to Jan 2022, with above inclusion criteria and focus on adherence of physical activity in heart failure and effective strategies were selected for this study. It was not included abstracts, primary studies, withdrawn/retracted publications and dissertations.

### **Search strategy**

Systematic search was performed from 2010 to Jan 2022 by two independent trained individuals (SA & SM) across databases of PubMed, Scopus, Web of Science, ProQuest, Google Scholar, Medline, and Science Direct using keywords based on mesh keywords and other words from review related literature consist of “patient Adherence, heart failure, review, physical activity, exercise” and by applying the MESH standard action (OR, NOT and AND) operators in proper places.

Patients’ adherence and heart failure and review and physical activity with alternative key words (e.g., “physical activity” OR “exercise”). The words within a component were separated using “OR”, “AND” operator. MESH search terms: #1: (patients’ adherence) and (heart failure); #2: (patients’ adherence) and (heart failure) and (physical

activity); #3: (patients’ adherence) and (heart failure) and (exercise) or (physical activity) and (review), #4(patients adherence) and (heart failure) and (physical activity) and (review) not (exercise); #5: #1 & #2 & #3 & #4.

### **Screening, data extraction, and quality assessment (risk of bias)**

The initial screening of the titles and abstracts as well as full text of papers were performed frequently by two independent researchers using EndNote. To select articles, full texts of studies and abstracts independently to qualify were screened based on PRISMA checklist (2009) by 2 reviewers (SA & SR). Any discrepancy about articles qualify was resolved through discussion between the reviewers, and in case of disagreement it was resolved through discussion with a third person (HK).

In order to Quality appraisal of included systematic reviews, AMSTAR2 was employed. AMSTAR2 has a total of 16 items that include questions related to the use of PICO, review registration, study inclusion criteria, search strategy, search and data extraction, included and excluded studies, evaluation of methodological quality, received funding, meta-analysis model, heterogeneity between included studies, and publication bias. Answers in each item are “yes”, “no”, “cannot answer” and “not applicable”. “Yes” is the only answer that earns a point. The maximum score is 16. If less than 40% of the cases are satisfactory, the quality is low, between 40% and 80% of the cases are satisfactory, the quality is average. At least 80% of cases are satisfactory, the quality is high (24). The results of quality assessment of review articles are shown in Table 1.

### **Data synthesis**

The heterogeneity of interventions and outcome measures made it impossible to combine the results in one analysis and meta-analysis. Hence, using summary tables to present the extracted data and a narrative approach was conducted to review the selected articles. The narrative synthesis is based on the extracted data it was prepared by the first reviewer (SA) and reviewed by the 2nd, 3d,

and 4th reviewers (SR or SM & AH). Any differences were resolved by consensus discussion. It was chaired by the 5th referee (HK) and the 5th referee made the final decision.

## Results

The full text of papers was explored regarding inclusion and exclusion criteria and eventually out of 74 relevant papers, 7 review studies with 20977 patients qualifying the inclusion criteria were included. From the initial search, 49599 articles were retrieved from the databases. After first screening, 30716 publications were eliminated due to not relevant and duplication. After accurate abstract and title screening, during two stages 74 articles remained. After reading articles with full text, of 74 articles that remaining, only 7 full-text were relevant for inclusion and analysis. Exclusion articles with full text consist of 24 not a review article, 26 article not focused on physical activity, 7 article not focused on heart failure and 9 article too wide ranging related to Comprehensive chronic diseases management. The number of papers and method of selection based on PRISMA 2009 are provided in Fig. 1.

The demographics characteristics of the systematic reviews were summarized descriptively in Table 2. A summary of studies presenting the strategies for enhancing physical activity, the adherence, and their outcomes is presented in Table 3. These strategies have been introduced based on the best and most effective strategies for increasing adherence to physical activity in heart failure based on review studies result consist of only clinical trial studies.

Based on the obtained results, the extracted strategies were classified as follows:

### Exercise-based approaches

#### Exergames

The results of review study regarding application of exergames in HF, platforms of exergames in studies are safe and viable, and none of them has reported side effects. The extent of adherence to exergames was between 84% and 98%. The participants reported improved balance and quality of life, improved cognitive function, and enjoyment of the game after the exercise. Exergames helped them to experience a greater sense of relationship with family members especially their grandchildren (29).

**Table 1:** Result of the quality assessment of reviews using the AMSTAR 2 checklist

Reference	AMSTAR 2 items																Quality of Article
	Q <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>	Q <sub>4</sub>	Q <sub>5</sub>	Q <sub>6</sub>	Q <sub>7</sub>	Q <sub>8</sub>	Q <sub>9</sub>	Q <sub>10</sub>	Q <sub>11</sub>	Q <sub>12</sub>	Q <sub>13</sub>	Q <sub>14</sub>	Q <sub>15</sub>	Q <sub>16</sub>	
(25)	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	81% HQ
(26)	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	87% HQ
(27)	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	87% HQ
(28)	1	0	1	1	0	0	0	1	1	0	n/a	n/a	0	1	0	1	44% MQ
(14)	1	1	1	1	1	1	1	1	1	0	n/a	n/a	1	1	0	1	75% MQ
(29)	1	1	1	1	1	0	1	1	0	1	n/a	n/a	0	1	0	1	63% MQ
(16)	1	1	1	1	1	1	1	1	1	1	n/a	n/a	0	1	0	1	75% MQ

MQ: moderate quality; HQ: high quality; Yes: 1; NO: 0; n/a: not applicable

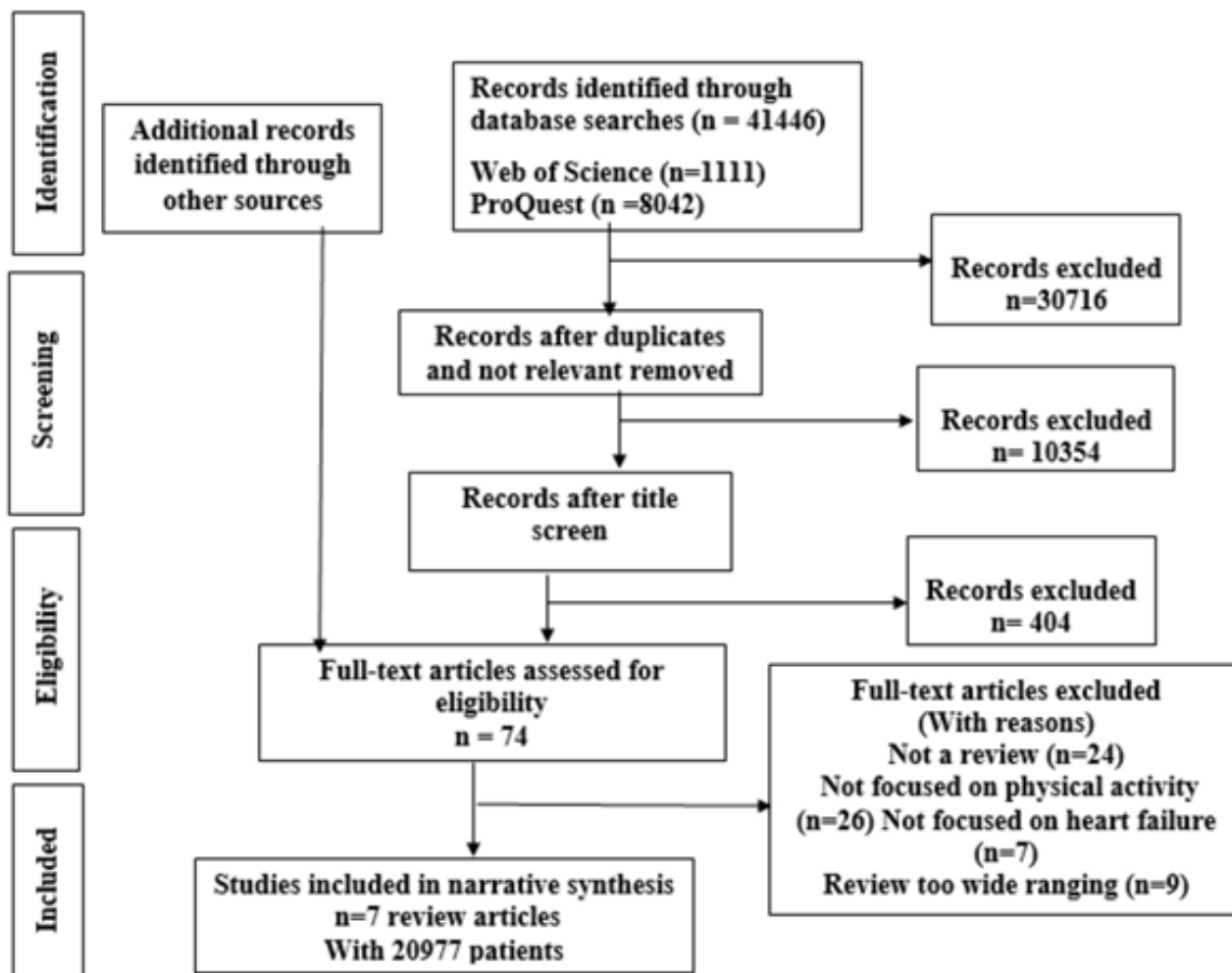


Fig. 1: The PRISMA flow diagram of selected studies

Table 2: Characteristics of included review studies and their sample

Reference	Country	population (M/F)	Mean age (year)	Type of studies In reviews	Number of patients	Number of studies
(25)	Portugal	--	--	RCT/CCT	2226	17
(26)	UK	69.49%M	66	RCT	6277	21
(27)	China	59M	65	RCT/CCT	2465	33
(28)	USA	72%M	57.42	RCT	5763	21
(14)	Iran	71%M	65	RCT/CCT	704	12
(29)	Sweden	46%F	74	Pre-post/ RCT	311	11
(16)	UK	25%F	68	RCT	3231	11

### *Tele-rehabilitation*

The results of review study by Cavalheiro et al (2021) regarding the effect of TR programs in HF indicated that TR was effective in improving the functional capacity of HF patients in the six-minute walk-test (6mw) (Mean Difference (MD) 15.86; CI 95% [7.23; 24.49]; I<sup>2</sup> = 74%) and peak aerobic capacity results (MD 1.85; CI 95% [0.16; 3.53]; I<sup>2</sup> = 93%). Furthermore, it could enhance the quality of life of patients. In these cases, the extent of adherence in the intervention group ranged from 70% to 100%. In four studies, adherence has been considered as presence in more than 80% of sessions, which ranged from 71% to 95% in the intervention group. None of the studies reported major side effects associated with TR, and interventions were considered safe. The minor complications were limited (25).

### *Tai Chi and Qigong Practices (TQPs):*

The results of review study by Chen et al. (2020) indicated that based on moderate level evidence, addition of TQP (Tai Chi and Qigong practices) as compared to routine managements (RMs) was associated with a considerable statistical improvement in the quality of life and exercise capacity in CHF patients. In addition, the evidence of clinical studies indicated that (with low confidence interval) TQPs may have similar rehabilitation effects to general aerobic exercises in comparison to RMs alone. The advantages of TQP outweighed those of general exercise in improving quality of life (MD:-9.18). TQPs plus RM in comparison to RM alone improved VO<sub>2</sub>peak (MD: 1.24 mL/kg/min, 95% CI, 0.91 to 1.57; I<sup>2</sup> = 0%) and 6-min walking distance (6MWD) (MD: 59.63 meters, 95% CI, 43.35 to 75.90 I<sup>2</sup> = 88%). (34) No side effects associated with TQPs were found in the included studies, and very few patients left the exercises in TQP group. The extent of persistence in TQP groups ranged from 67% to almost 100% (27).

### *Theoretical-behavioral approaches*

#### *Behavioral approaches and approaches combined with theories:*

The results of review study indicated that there is moderate evidence on supporting an exercise program along with behavioral change intervention presented by a physiotherapist in a center-based or group-based setting, and it was more effective than other approaches including exercise alone. Combination of an exercise program alongside behavioral change intervention was effective (SMD=1.26, 95% CI (0.26 to 2.26), *P*<0.05). Center-based interventions (SMD=0.98, 95% CI (0.35 to 1.62) and group-based interventions (SMD=0.89, 95% CI (0.29 to 1.50) by physiotherapist (SMD=0.84, 95% CI (0.03) were considerably effective. Moderate evidence was observed regarding effectiveness of an exercise program alongside behavioral change intervention presented by physiotherapist in a group-based and center-based setting (26). Social support can be one of the ways of enhancing exercise self-efficacy, whereby others can act as potential facilitators of exercise (16). In the results of review, briefly, the facilities-based programs showed adherence of 50%-91.8%. Combination of several theories for establishing unique interventions could be useful for resolving the various known obstacles against adherence (28).

#### *Self-efficacy*

The results of review study regarding application of self-efficacy in adherence to exercise among each of patients indicated that there was a positive relationship between self-efficacy and initiating as well as sustaining exercise in HF especially within the short-term. Successful performance strategies adapted from self-efficacy theory for promoting exercise have been used in most papers reviewed by Rajati (14).

**Table 3:** A summary of studies presenting the strategies for enhancing physical activity

<i>Reference</i>	<i>Intervention(s)</i>	<i>Summary of results</i>	<i>Type of review</i>
(25)	Most TR programs were a combination of aerobic exercises (Walking , cycling) and regular contact (1-2 phone contact) per week by the healthcare team	Adherence in the intervention groups was between 70 and 100%,	Systematic Review & Meta-analysis
(26)	Aerobic and sitting resistance training and exercises, Tele-rehabilitation at home, personalized health intervention, training self-care, home Walking, cognitive-behavior therapy, internet-based multidisciplinary program	Combination of an exercise program alongside behavior change intervention was effective some effective interventions: behavior change, graded tasks, behavioral exercise, planning, goal setting	Meta-Analysis
(27)	Rcts where the intervention group would receive types of Qigong practice	Exercise cessation of patients was low in TQP groups. Adherence to TQP was good. The extent of persistence in TQP groups ranged from 67 to almost 100%.6MWD	Systematic Review & Meta-analysis
(28)	Phone conversation, contact with exercise coach, audiovisual tapes group support, exercise websites, feedback, exercise equipment such as treadmill or exercise bike at home	The extent of adherence to exercise ranged from 38 to 99% varying over time	Review
(29)	Nintendo Wii, exercise bike, cyber cycling with walking virtual competitors on treadmill, running exergame platform, IREX VR system Sony playstation Eye Toy system at home, clinic, or hospital	Satisfaction with exercise, increased balance and willingness to interact, improved cognitive function one study 84% adherence with not major side effects, increased energy with gameplay and better physical, social, and psychological well-being	Scoping review
(14)	Identifying barriers determining goals, planning, self-controlling symptoms and activity, correcting the risk factor / self-care, feedback and problem-solving, role models, gradual increase in exercise, group sessions	In ten studies, physical activity and self-efficacy of patients were elevated in the intervention group. In four studies, the total physical activity level did not increase significantly.	Systematic review
(16)	Home Walking assessment, goal setting, feedback and problem-solving, phone support, motivational interviewing, aerobic, cardiac rehabilitation under Tele-monitoring at home, internet training interventions and feedback through email	Short-term outcomes, home intervention as well as motivational interviewing, progressive exercise program and electronic health self-management led to greater exercise adherence.	Systematic review

## Discussion

In this study, five key effective approaches were identified in two subsets for improving adherence to physical activity. Meanwhile, methods of adherence measurement were very diverse. Considering

differences of individuals in terms of conditions including physical and psychological health status, individual, economic, social, and cultural differences, and more importantly different reasons for lack of adherence to physical activity), we have not mentioned any priority for the methods. Each of

the mentioned approaches can be effective if they are chosen and implemented in line with the person's conditions.

*1. Tele-rehabilitation:* Tele-rehabilitation (TR) has been defined as providing rehabilitation services through information communication and technology, which includes services including assessment, prevention, treatment, education, and counseling through weekly feedback, suitable exercise program in line with the patient status is presented. (30-32). Tele-rehabilitation was superior over usual care (UC) without cardiac rehabilitation (CR) in improving the functional capacity of HF patients. Further research and more standardized protocols are required for improving the evidence on the effectiveness, safety, and cost-effectiveness of TR (25). This is especially important for today's world, since COVID-19 pandemic has attracted the attention to Tele-rehabilitation and accelerated use it because of the limitations in use of rehabilitation sessions. Hence, usage of Tele-rehabilitation would be a part of clinical performance in the future, since the pandemic has clarified the need of using novel approaches for rehabilitation among patients with chronic disease (18).

*2. Self-efficacy:* Self-efficacy refers to understanding or judging the ability of accomplishing a special goal. Self-efficacy affects the manner of thinking, emotions, development of motivation, and action of individuals (33, 34). Self-efficacy is considered as an important behavioral predictor, since it functions as an independent factor from activity skills of the person (35). Self-efficacy has a considerable effect on doing exercise in patients with HF. In addition, all four sources of self-efficacy are important in developing exercise and maintaining exercise behaviors among HF patients. Nevertheless, there is lack of evidence for assessing which type of strategy is more suitable in this process (14). Some interventions based on theoretical frameworks and motivational interviewing can be helpful. Dealing with self-efficacy with regard to exercise may be another useful area that should receive attention in this regard (16).

*3. TQPs:* Tai chi and Qigong practices (TQPs) usually involve slow coordinated movements with

meditation and well-adjusted respiratory techniques performed at any place, time, with absolutely no specialized equipment and within the shortest time. TQPs considering no need to special equipment, low costs, and various physical advantages, may be a promising rehabilitation treatment as complementary to conventional pharmacotherapy or as an alternative to typical exercises. These exercises can be considered in combination with cardiac rehabilitation programs for CHF patients especially in household settings (27). These results are in line with the findings of previous systematic review (36). TQP results in useful outcomes in exercise capacity for CHF patients.

*4. Exergame:* Exergaming can be defined as performing a videogame through complete movements of the body for controlling action on the screen. It requires a player to consume a considerably higher energy in comparison to rest levels. Exergame commercial platforms have advantages such as being relatively inexpensive. Healthcare providers have reported that use of an exergame commercial platform would provide targeted and significant opportunities for enhancing the wellbeing of elderly and disabled clients in geriatric healthcare. This investigation has been a first step for examining the possibility of using an exergame platform for helping HF patient to adopt a more active lifestyle, though further studies are required in older adults, performing this game would increase the heart rate and oxygen uptake in comparison to rest time, and may facilitate promoting light to moderate physical activity. One of the advantages of exergames is that it presents an option for patients to perform physical activity at their home (37-39). The results of a review study indicated that performing exergames in comparison to rest and low mobility computer games led to higher energy expenditure (29).

*5. Behavioral approaches:* Adherence to exercise necessitates the person to develop long-term behavioral changes in them. Studies that involve theory-based interventions and present multiple behavioral change techniques are more effective than the interventions that do not combine such strategies. Long-term adherence to exercise entails de-



velopment of behavioral changes, and interventions should be created based on behavioral theories that have been successful in establishing positive behavioral changes (28). Center-based approaches and group-based approaches by a physiotherapist were significantly associated with effectiveness. An exercise program along with a behavioral change intervention provided by a physiotherapist in a group-based or center-based setting may be suitable for enhancing physical activity in heart failure. Group-based interventions can contribute to behavioral change through social comparison and changes in the norm-related beliefs about health-associated behaviors and group member identity (26). Assessment of HF symptoms (such as fatigue or sleep problems) as well as symptom management strategies through phone intervention could lead to enhanced patient self-efficacy in communicative intervention in comparison to the standard care group (35). Further, interventions based on integrating all four sources of self-efficacy may be useful for enhancing adherence to exercise in the end (40). Motivational strategies such as goal setting, positive reinforcement, and problem solving as a part of sources of enhancing self-efficacy for exercise may be effective in the short run (41).

Clinical and research implications:

Heart failure is a complex syndrome that causes many movement restrictions for people and makes it difficult for therapists to provide a single activity strategy (16). Physical activity adherence is influenced by several variables that can be modified and controlled by researchers and professionals (42). This study presents the most up-to-date and effective strategies from among numerous review studies and various solutions. Clinicians and health policy makers can use these effective strategies for increasing adherence to physical activity and preparation of physical activity guidelines for HF patients.

### **Limitations**

The present study includes a collection of the most up-to-date and effective evidence based on clinical studies about strategies for enhancing physical ac-

tivity adherence in HF patients. In the selected review studies, different interventions and outcome measures were used to assess adherence to physical activity, which made meta-analysis impossible. Moreover, in studies, little attention had been paid to cultural, economic and social differences and its possible effects on adherence to physical activity. This limitations and gap in studies highlights the necessity of conducting further clinical studies in this regard in order to provide a more precise understanding of these issues.

### **Conclusion**

Exercise-based approaches in a gradual way alongside behavioral intervention and providing two-sided feedback (service provider and receiver) would enhance physical activity adherence among HF patients and give a sense of support to these patients. Future clinical trial studies evaluate mixed methods of exercise-based approaches and theoretical-behavioral approaches mentioned in this study, and examine the effect of feedback as well as social supports. Heart failure is a complex clinical syndrome causing the person to experience a set of symptoms. Heart failure patients are the elderly, who in addition to heart failure may also suffer from other comorbidities including arthritis, diabetes, hypertension, etc. Since TR programs have the capacity to integrate other approaches into them, the person and healthcare system can use different types of approaches extracted in this study in the form of TR depending on the individual conditions.

### **Journalism Ethics considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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## Conflicts of interest

There is no conflict of interest in this paper.

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