# Effects of a home walking exercise program on functional status and symptoms in heart failure

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**Background** Hospital-based exercise programs using a bicycle ergometer or a combination of exercise modalities have shown positive benefits in heart failure, but may not be readily accessible to many patients. Thus, we sought to evaluate the effects of a 12-week home walking exercise program on functional status and symptoms in patients with heart failure.

**Methods** A randomized controlled trial comparing a 12-week progressive home walking exercise program (n = 42) to a "usual activity" control group (n = 37) was conducted in patients with heart failure (78 [99%] male; mean age 62.6 ± 10.6 years; ejection fraction 27% ± 8.8%; 63 [80%] New York Heart Association class II; 15[20%] New York Heart Association class III–IV) from a Veterans Affairs medical center and a university-affiliated medical center. Functional status (peak oxygen consumption via cardiopulmonary exercise testing, 6-minute walk test, the Heart Failure Functional Status Inventory), and symptoms (Dyspnea-Fatigue Index score with a postglobal rating of symptoms) were measured at baseline and 12 weeks.

**Results** No adverse events related to exercise training occurred. Overall mean compliance to training was 74 ± 37%. Peak oxygen consumption and the Heart Failure Functional Status Inventory were unchanged with training. Compared to the usual activity group, the training group had significantly longer walking distances measured by the 6-minute walk test (1264 ± 255 vs 1337 ± 272 feet, $P = .001$), and improved postglobal rating of symptoms ($P = .03$).

**Conclusion** In patients with heart failure, a progressive home walking exercise program is acceptable, increases walking distance, and decreases global rating of symptoms. (Am Heart J 2004;147:339–46.)

**See related Editorial on page 190.**

Numerous exercise training programs have been evaluated in patients with heart failure (HF).[1–16] Hospital-based training programs have accounted for the majority of reported studies, only 1 of which included a high-intensity walking program as a sole exercise modality.[3] Three investigators have reported on home-based exercise programs,[1,2,17] only 1 of which involved walking exercise that was combined with resistance training.[2] To date, the effects of a low-intensity walking exercise program on functional status and symptomatology in patients with HF has not been studied.

The purpose of the present study was to determine the effects of a low-intensity, progressive, 12-week home walking exercise (HWE) program on the primary end point of functional status (which include exercise capacity and functional performance) and secondary end point of symptoms (dyspnea and fatigue) in patients with HF.

## Methods

### Study Population

Subjects were recruited from a Veterans Affairs medical center and a university-affiliated medical center. Primary care providers and cardiologists were responsible for clinical management of HF patients. Inclusion criteria were: New York Heart Association class II–IV, left ventricular ejection fraction (LVEF) ≤ 40% and HF duration ≥ 3 months. Exclusion criteria were: myocardial infarction (MI) or recurrent angina within 3 months; orthopedic, neurologic, or pulmonary conditions limiting exercise; peak expiratory flow rate < 50%, uncorrected peripheral vascular disease; stenotic valvular disease; uncontrolled ventricular tachyarrhythmias; current involvement in an exercise program; and/or cognitive impair-

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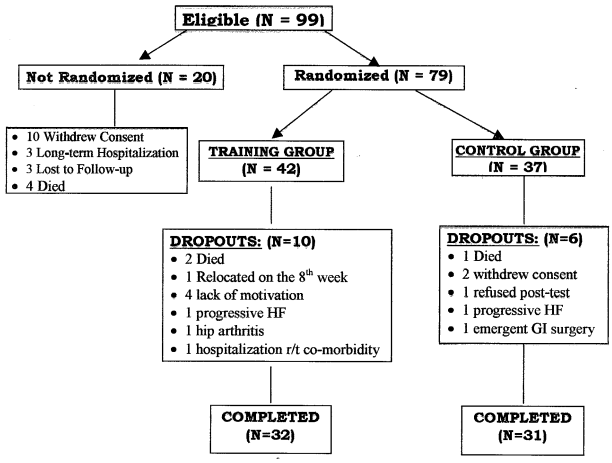
**Figure 1**




Patients screened, consented, randomized, and completed.

ment defined by a mini-mental state score $< 20$. An enrollment summary is shown in Figure 1.

## Study design

The study was a prospective, randomized controlled trial. Hospital institutional review boards approved the protocol, and all patients gave written informed consent.

After completion of baseline testing, patients were randomized into 2 groups. For 12 weeks, the training group (n = 42) underwent HWE training and the control group (n = 37) underwent "usual activity." Patients in both groups received a pedometer, a small device anchored to a patient's lower leg and calibrated to his/her stride to record time and distance walked (ie, number of steps and miles). Nurse home visits (conducted weekly for the first 6 weeks and biweekly in the last 6 weeks) were performed solely to clarify questions about the experimental protocol and reinforce assigned physical activity. During the study, medical regimens were kept stable except for diuretic dosage and temporary medication changes during hospitalization or emergency room visits.

**Training group.** Home walking exercise was once a day, 5 days per week, with an exercise duration and intensity initiated at 10 minutes and 40% maximal heart rate (HR) and progressively increased up to 60 minutes and 65% maximal HR in the last 6 weeks of the program, respectively. Patients were instructed to: 1) wear the pedometer for the walking exercise and immediately record walking data, and 2) reset the pedometer (after the walking exercise) and record all-day data before bedtime. Thus, walking pedometer data (5 d/wk) plus all-day pedometer data (daily) were provided for validity check of the intervention. During each home visit, the nurse 1) provided a weekly walking prescription including duration, frequency, and intensity (percentage of maximal HR method), 2) walked with the patient to evaluate exercise tolerance and validate self-reported protocol compliance, 3) conducted a brief physical assessment immediately before and after walking exercise, and 4) reviewed pedometer data and counseled patient about incomplete data.

**Control group.** Patients in the "usual activity" group were instructed to maintain their normal daily activities and asked not to begin a regular exercise program. Patients were asked to provide only the all-day pedometer data. During each home visit, the nurse 1) obtained vital signs and performed a brief physical assessment, 2) reinforced maintenance of daily activities, and 3) reviewed all-day pedometer data.

## Instruments

At baseline and at 3 months, all subjects underwent testing for the primary end point of functional status via 1) cardiopulmonary exercise test (CPX), 2) 6-minute walk test (6-MWT) and 3) Heart Failure Functional Status Inventory (HFFSI), and the secondary end point of symptomatology via the Dyspnea-Fatigue Index with global rating of symptoms.

**Cardiopulmonary exercise test.** Exercise capacity was evaluated using a symptom-limited ramp CPX test with gas exchange analysis. The method available was an electronically braked cycle ergometer (Sensormedics 800S). All CPX personnel were blinded to patient assignment. On an upright position, the patient underwent 3 minutes rest, 3 minutes unloaded pedaling, exercise-phase pedaling at 60 rpm, and 2 minutes recovery pedaling at 40 rpm. During the exercise phase, work rate was increased at 10 W/min in a ramp pattern up to symptom-limited maximum. Every 2 minutes, 12-lead electrocardiogram (ECG), blood pressure (BP), and oxygen saturation were recorded. Exercise was terminated due to: 1) patient's request, 2) ECG changes associated with myocardial ischemia (ST-segment depression $> 2$ mm), 3) systolic BP $> 200$ mm Hg, 4) diastolic BP $> 100$ mm Hg, and 5) physical exhaustion, dyspnea, or calf/thigh pain.

Gas exchange measurements were obtained breath-by-breath using a metabolic cart (Sensormedics $V_{max}$ 29). Gas analyzers were calibrated immediately before each patient's test. Peak oxygen consumption ($Vo_2$) was determined as the highest 10-second average value of $Vo_2$ observed over the last 30 seconds of exercise.[4] Ventilatory threshold (VT) was defined as the $Vo_2$ before the systematic increase in ventilatory equivalent for oxygen ($Ve/Vo_2$) without concomitant increase in ventilatory equivalent for carbon dioxide ($Ve/Vco_2$) (ventilatory equivalent method).[5,6,18]

**Six-minute walk test.** To measure functional performance, patients were asked to walk in a corridor from end to end at their own pace while attempting to cover as much ground as possible in the allotted period of 6 minutes.[19] Research assistants performed the 6-MWT and were not blinded to group assignment. To assure reliability and validity: 1) instructions were scripted and given immediately prior to the test, 2) the principal investigator randomly checked for proper use of the script, and 3) research assistants were not allowed to talk to the patient during the test. In 10% of the sample, test-retest reliability yielded a correlation of .92 ($P = .01$).

**Heart Failure Functional Status Inventory.** This is a 25-item self-administered questionnaire that quantifies the patient's assessment of overall functional status.[20] In each item, patients indicate whether they can perform a particular activity of daily living (ADL) (with a corresponding metabolic equivalent assignment) by answering "yes," "yes, but only slowly," or "no, I can't do this." If the response is "yes, but

**Table I.** Baseline demographic and clinical characteristics (n = 79)

| Variables | Training group (n = 42) | Control group (n = 37) | P |
|---|---|---|---|
| Male/female | 42/0 (100/0) | 36/1 (97/3) | .95 |
| Race | | | |
| White | 24 (57) | 13 (35) | |
| Black | 13 (31) | 19 (51) | .13 |
| Latin | 5 (12) | 4 (11) | |
| Asian | 0 | 1 (3) | |
| Age (y) | 63.8 ± 10.1 | 61.3 ± 11.1 | .31 |
| BMI (kg/m$^2$) | 30.1 ± 6.4 | 28.8 ± 6.1 | .34 |
| Type of cardiomyopathy | | | |
| Ischemic | 23 (57) | 16 (43) | .28 |
| Nonischemic | 19 (43) | 21 (57) | |
| NYHA | | | |
| Class II | 32 (76) | 31 (84) | |
| Class III/IV | 9 (24) | 6 (16) | .43 |
| LVEF (%) | 29.1 ± 8.5 | 24.7 ± 8.8 | .03* |
| Heart failure duration (m) | 37.4 ± 33.8 | 41.3 ± 49.7 | .68 |
| Peak expiratory flow (%) | 76.4 ± 23.8 | 80.5 ± 22.4 | .44 |
| Medications | | | |
| Diuretics | 40 (95) | 33 (89) | .56 |
| ACE inhibitors | 35 (83) | 32 (87) | .32 |
| Angiotensin receptor blocker II | 4 (10) | 2 (5) | .77 |
| Nitrates | 13 (31) | 10 (27) | .70 |
| β-Blockers | 16 (38) | 14 (38) | .98 |
| Digoxin | 28 (67) | 24 (65) | .87 |
| Risk factors | | | |
| SPYH (y) | 24.7 ± 26.8 | 25.9 ± 34.3 | .86 |
| Alcohol history | 33 (79) | 34 (92) | .18 |
| Cocaine history | 6 (14) | 9 (24) | .28 |
| IVDU history | 0 (0) | 4 (11) | .09 |
| Hypertension | 32 (76) | 27 (73) | .74 |
| Diabetes | 17 (41) | 11 (30) | .32 |
| Arthritis | 18 (43) | 12 (32) | .34 |

Values are given as mean ± SD or n (%). *BMI,* Body mass index; *NYHA,* New York Heart Association; *LVEF,* Left ventricular ejection fraction; *SPYH,* smoking pack year history; *IVDU,* intravenous drug use.
*$P < .05$.

only slowly" or "no, I can't do this," then the patient identifies the major symptom that limited activity (ie, dyspnea, fatigue, etc.). Test-retest reliability of HFFSI yielded a correlation of .92 ($P = .01$).

**Dyspnea-Fatigue Index.** This is a self-administered, 5-point Likert scale instrument measuring the magnitude of each component: the specific dyspnea-provoking task, the pace with which the task is performed, and the patient's general functional capacity.[21] At the end of the 12-week program, patients were asked to provide a global rating of individual improvement in which a higher score indicated worse functioning, from 1 = "much better" to 5 = "worse" than before the study. In 10% of the sample, test-retest reliability was .87 ($P = .03$).

## Compliance to exercise training

From the walking pedometer data, overall mean compliance for the 12-week program was the sum of the average weekly compliance rates divided by 12. Average weekly compliance rate was calculated as:

$$\%\ \text{weekly compliance} = \frac{\text{actual walking time (min)}}{\text{prescribed walking time (min)}} \times 100$$

## Statistical analyses

The $\chi^2$ statistic and the independent $t$ test were used to evaluate differences in baseline characteristics. Using a critical effect size of .76 with power set at .80 and $\alpha$ set at .05, a sample size of 30 in each group was calculated on the primary end point of functional status.[1] To account for the lower effect size of the HWE program and patient dropout, sample size was increased in each group by 20%. Outcome variables were compared between groups using repeated-measures analysis of variance with an intention to treat approach (ie, every attempt was made to measure outcome data at withdrawal or baseline measures were imputed for missing post-test data).[22] Significantly different baseline variables were used as covariates in the multivariate analysis (Tables I and II). The total pedometer distance in miles between groups was compared using Student $t$ test. Data were expressed as mean ± SD. Statistical significance was set at $P <$

**Table II.** Baseline cardiorespiratory responses between groups (n = 79)

| | Training group (n = 42) | Control group (n = 37) | *P* |
|---|---|---|---|
| Rest | | | |
| HR (beats/min) | 77.6 ± 15.1 | 77.1 ± 16.1 | .89 |
| RPP (beats/min × mm Hg) | 9165.7 ± 2109.3 | 9067.8 ± 1888.7 | .83 |
| Peak | | | |
| Ve (L/min) | 54.3 ± 12.4 | 53.4 ± 11.5 | .76 |
| $VO_2$ (mL/kg/min) | 14.3 ± 3.7 | 14.2 ± 3.4 | .96 |
| VT, $VO_2$ (mL/kg/min) | 12.1 ± 2.8† | 11.8 ± 3.3‡ | .75 |
| $VCO_2$ (L/min) | 1.4 ± .4 | 1.3 ± .3 | .21 |
| CPX exercise duration (min) | 6.7 ± 2.9 | 6.3 ± 2.6 | .53 |
| Workload (watts) | 82.9 ± 29.1 | 71.0 ± 23.3 | .05* |
| RQ (L/min) | 1.0 ± .1 | 1.1 ± .1 | .17 |
| HR (beats/min) | 117.0 ± 19.5 | 120.7 ± 23.2 | .44 |
| RPP (beats/min × mm Hg) | 17354.1 ± 4144.6 | 18017.7 ± 3895.0 | .47 |
| Submaximal VT, $VO_2$ (mL/kg/min) | 12.1 ± 2.8† | 11.8 ± 3.3‡ | .75 |

Values are given as mean ± SD. *HR,* Heart rate; *RPP,* rate-pressure product; *Ve,* ventilation; *VCO2,* carbon dioxide uptake; *CPX,* cardiopulmonary exercise test; *RQ,* respiratory quotient.
*Used as a covariate in analysis.
†n = 36.
‡n = 32.

.05. For the primary outcome of functional status, the Bonferroni correction was applied for multiple comparisons, and significance was set at $P \leq .008$. Analyses were conducted with SPSS for Windows, V.10 (SPSS Inc, Chicago, Ill).

## Results

### Patient characteristics

Baseline characteristics of the study population are shown in Table I. Using the ventilatory equivalent method, data from only 68 patients were available for VT analysis. Except for LVEF, there were no significant differences between groups in baseline demographic or clinical data (Table I). Among randomized patients, dropouts in each group (with corresponding reasons) are shown in Figure 1. Three of these dropouts completed posttest measures (training group = 2; control group = 1).

### Event rates

**Major adverse events.** No major adverse events occurred during or immediately following exercise testing or training sessions. Over the course of the study, major adverse events in the training group included: 2 sudden cardiac deaths, 2 hospitalizations for worsening HF, and 1 hospitalization for a noncardiac condition. Major adverse events in the control group included: 1 sudden cardiac death, 3 nonfatal cardiac events requiring hospitalization (2 for worsening HF and 1 for angioplasty), and 1 hospitalization for a noncardiac condition. Hospitalization due to progressive HF was related to dietary indiscretion, noncompliance to medical treatment, and/or comorbidities. These adverse events were not different between groups (11.9% vs 13.5%, respectively; $\chi^2 = 0.05$, $P = .83$).

**Minor clinical events.** Minor clinical events (ie, flu, effects of comorbidities, etc.) did not necessitate patient's withdrawal from the study, but interrupted the 12-week program. Nineteen patients (51.4%) in the training group compared to 5 patients (15.6%) in the control group experienced minor clinical events ($\chi^2 = 9.66$; $P = .002$).

### Compliance to training

The overall mean compliance with the exercise training prescription was 74.3 ± 37%. Ten patients had an overall mean compliance > 100%, which was not correlated with the incidence of minor clinical events. For completers (n = 63), walking distance of patients in the training group was significantly greater than those in the control group (1.87 ± .98 miles vs. 1.33 ± .85 miles, respectively; *t* test = −2.34, $df = 61$, $P = .02$). Average weekly compliance rates were highest during the first 4 weeks of the program (Figure 2). Compliance rates progressively declined from 81% in the 5th week to 65% to 71% in the last 6 weeks.

### Functional status

There were no cases of early ischemia, sustained arrhythmias, or hyper- or hypotension at baseline CPX testing, and only 1 case of ischemia in a control patient at posttest. Except for peak workload, baseline cardiorespiratory variables were not significantly different between groups (Table II). Using LVEF and

peak workload as statistical covariates, peak $Vo_2$ and VT did not differ between groups over time. There was a trend toward increased CPX exercise duration (Table III).

Although VT was similar between groups over time (Table III), VT improved in the training group following the program (12.1 ± 2.8 to 13.2 ± 2.8, $P = .001$), but was unchanged in the control group. Furthermore, change scores of VT and CPX exercise duration were highly correlated ($R = .26$, $P = .02$).

Using LVEF as a covariate, training increased the walking distance on the 6-MWT (Table III). Compared to baseline scores, the training group increased 6-MWT an average of 118 feet at 3 months follow-up. Figure 3 shows the change in 6-MWT for each individual patient in the training and control groups. Moreover, the 6-MWT was evaluated by examining change scores in relation to a standard reported to represent a clinically important difference in patients with HF (> 99 feet).[23] In each group, the proportions of patients whose 6-MWTs improved (> 99 feet), stayed the same (± 99 feet), or declined (> −99 feet) were compared by $\chi^2$. In the training group, improvement, stasis, and decline were seen in 19 (45.2%), 20 (47.6%), and 3 (7.1%) patients, respectively, compared to 9 (24.3%), 19 (51.4%), and 9 (24.3%) patients, respectively, in the control group ($\chi^2 = 6.31$, $P = .04$).

Using LVEF as a covariate, HFFSI scores did not differ between groups over time (Table III).

### Symptoms

The Dyspnea-Fatigue Index scores did not differ between groups over time. However, after the HWE program, the global rating of dyspnea and/or fatigue symptoms was reduced in the training group compared to the control group (3.2 ± .10 vs. 3.7 ± .8, $t = 2.17$, $df = 62$, $P = .03$). The posttest global rating of symptoms was inversely correlated with the posttest Dyspnea-Fatigue Index score ($R = -.35$, $P = .002$).

## Discussion

This study is the largest prospective randomized trial to date on the effects of home-based exercise for patients with chronic HF. It is the only study to evaluate walking at home as the single form of exercise training. Although peak $Vo_2$ and the Dyspnea-Fatigue Index scores were not different between groups, significant improvements were found in 6-MWT and global rating of symptoms.

### Safety

Major adverse events were not related to exercise testing or training. In this study, cardiac mortality (4%) and cardiac morbidity (6%) were similar to previous exercise studies with comparable sample sizes.[4,7] With exercise in HF, short-term and long-term rates for mortality (4% and 6%, respectively) and morbidity (3% and 7%, respectively) have been reported. Importantly, Ho et al recently reported that 1-, 2-, 5- and 10-year survival rates were 57%, 46%, 25%, and 11%, respectively, in men with HF.[24] Thus, the training group's cardiac mortality rate (5%) was within and less than the rates of data from exercise trials and recent epidemiologic studies, respectively. The rate of hospitalization due to HF in the training group (5%) was markedly lower than the early estimates of 35% annual rate.[25] Further long-term studies for HWE programs are needed to validate safety in this population.

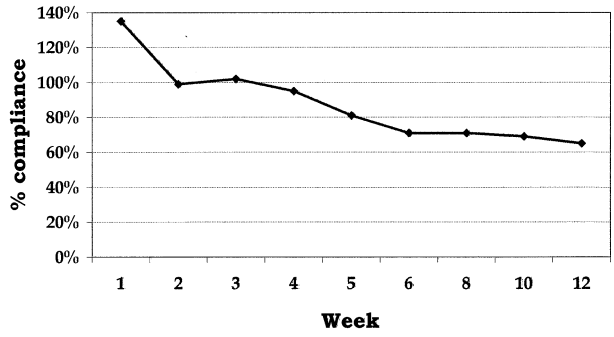
The incidence of minor clinical events has not been reported in previous exercise trials. These events are likely explained by exposure to environmental elements and/or by the effects of coexisting comorbidities rather than by overcompliance to training.

The reasons for dropout in this study were similar to previously reported trials.[2,6,7,26] The study's overall dropout rate of randomized patients (21%) is similar to that reported by Hambrecht (23%)[6] and Wielenga (16%)[7] and lower than that reported by Oka (40%).[2] Prior to randomization, patient dropout (n = 20) is an indication that exercise may not be an attractive or realistic option for some patients with HF. While the HWE program was well tolerated and well accepted by those patients who participated, they may not represent the greater population of patients with HF. Further study is needed to identify barriers to exercise in a larger, representative sample.

### Compliance

The overall compliance rate of all randomized patients (74%) compared favorably to compliance reports of those investigators who implemented a home-based exercise program (70%–110%).[1,2] In fact, the mean compliance of those patients who completed this

**Figure 2**



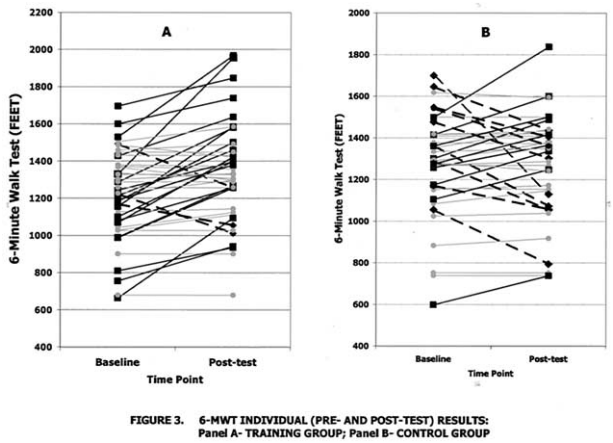

Compliance: 12-week home walking exercise (n = 79).

**Table III.** Baseline and 3-month functional status outcome (n = 79)

| | Training group (n = 42) | | Control group (n = 37) | | |
|---|---|---|---|---|---|
| **Variable** | **Baseline** | **3-Month** | **Baseline** | **3-Month** | ***P* (T×G)** |
| Peak $VO_2$ (mL/kg/min) | 14.3 ± 3.7 | 15.3 ± 3.8 | 14.2 ± 3.4 | 15.2 ± 4.1 | .70 |
| VT (mL/kg/min) | 12.1 ± 2.8 | 13.2 ± 2.8† | 11.8 ± 3.3 | 12.3 ± 3.7‡ | .13 |
| CPX exercise time (min) | 6.7 ± 2.9 | 7.5 ± 3.0 | 6.3 ± 2.6 | 6.4 ± 2.9 | .02 |
| Workload (watts) | 82.9 ± 29.1 | 85.0 ± 27.2 | 71.0 ± 23.3 | 72.2 ± 25.1 | .87 |
| 6-Minute walk test (feet) | 1219.0 ± 241.5 | 1337.1 ± 272.2 | 1273.2 ± 249.2 | 1263.9 ± 254.5 | .001* |
| HFFSI scores | 6.4 ± 1.4 | 6.1 ± 1.6 | 6.2 ± 1.4 | 6.3 ± 1.5 | .15 |

Values are given as mean ± SD. *T×G,* Time by group interaction; *$VO_2$,* oxygen uptake; *VT,* ventilatory threshold; *HFFSI,* Heart Failure Functional Status Inventory.
*P < .008.
†n = 36.
‡n = 32.

**Figure 3**




Six-minute walk test individual (pre- and post-test) results. Panel **A,** training group; panel **B**, control group. *Gray* signifies no change; *black*, improvement; *dashed line*, decline.

study was 88%. Aside from its simplicity, low intensity, and easy accessibility, the HWE program also featured the use of pedometers and frequent home visits, which may have enhanced compliance. Nevertheless, a 12-week home walking and resistance training without home visits also had a higher compliance rate.[2]

In the first 4 weeks of the program, an average weekly compliance rate > 100% indicates that a patient performed more exercise than prescribed. In the last 6 weeks, the decline in average weekly compliance rate was primarily explained by the 24% patient dropout and by clinical effects of comorbidities. Also, exercise durations ≤30 minutes in the first 4 weeks may have been more reasonable for the capacity of some HF patients than the longer durations in the last 8 weeks.

## Functional status

Our findings of significant improvement in the 6-MWT are in agreement with other investigators.[3,8–10,27] In elderly patients with HF, most investigators used the 6-MWT as a sole measure of exercise capacity.[9,28] Based on Guyatt's report of a minimum important difference >99 feet (30.5 m) in patients with HF, the 118-feet increase in 6-MWT is clinically meaningful.[23] This finding is unlikely to be explained by a higher baseline LVEF in the training group because we controlled for its effect statistically. Also, another investigator reported a lack of relationship between LVEF and functional status in HF patients.[29] The modest increase in mean 6-MWT distances may be explained by the intention-to-treat analysis that included patients who dropped out in the training group. Of the patients in the training group whose 6-MWT distances remained the same (n = 20) or declined (n = 3), 10 were dropouts. While slightly less than half of training group patients (45%) improved their 6-MWT distances >99 feet, only 25% of control group patients showed that level of improvement. In fact, patients in the training group who improved had remarkably increased 6-MWT distances (mean 279.6 ± 130.8 feet). These findings suggest that a simple walking program is beneficial for many patients with HF and can result in dramatic increases in walking distances in some patients. Further study is needed to identify those patients most likely to benefit from HWE protocols.

There was a concurrent trend towards increase in VT in the training group compared to the control group. Possibly, a low-intensity HWE program leads to increased oxygen utilization by the skeletal muscles. This suggestion is supported by previous studies.[5,6,30] For example, a significant correlation between increased VT and improved oxidative capacity of skeletal muscle has been reported.[6] However, the relationship of skeletal muscle changes to HWE was not evaluated.

This remains an important question for future research.

Increase in CPX exercise duration (with or without increases in peak $Vo_2$) has been a consistent finding in most physical training trials.[1,6,7,12,15,16] Increased VT together with increased self-confidence (provided by the training program) may have contributed to the trend toward longer exercise time during CPX testing.

The combination of significant increase in 6-MWT and a trend towards increased VT and CPX exercise duration suggests improved functional performance, which is usually correlated with ability to perform ADLs. Future study is needed to explore the relationship between exercise capacity or functional performance and performance of ADLs.

Many physical training studies have reported an improvement in peak $Vo_2$ of 12.5% to 29%,[31] but some have not documented any change.[2,7,8,16,32] The lack of difference in peak $Vo_2$ may be due to several factors. A low-intensity walking intervention (40%–65% maximal HR) may have produced a smaller training effect than previous high intensity studies.[1,3,6,12,32] Current study patients were older (mean age: 62.6 years) compared to those in previous studies (mean ages: 50–57 years)[4,6,10,12,13,15,30,31] in which increased peak $Vo_2$ was reported, and were similar in age to patients in a study in which there was no improvement in peak $Vo_2$.[9] This suggests that older patients experience a smaller training effect from a low-intensity exercise than do younger patients. Finally, decline in compliance rates may have influenced the training effects on peak $Vo_2$.

### Symptoms

Although the mean scores of the Dyspnea-Fatigue Index were not different between groups, the HWE program improved global rating of symptoms. The lack of change in the Dyspnea-Fatigue Index scores may be due to the presence of significant comorbidity (ie, diabetes, arthritis, mild chronic obstructive pulmonary disease, or gout). Willenheimer et al[14] used a similar instrument to evaluate quality of life and/or symptoms, and reported similar findings. Possibly, specific symptoms of HF are not improved in a low-intensity program, but the global rating reflects an improvement in more general well-being.

### Limitations

A number of limitations must be considered. First, 99% of the study population were men. Thus, the benefit of a HWE program to the population of women with HF is unknown. Although a strict protocol was implemented and test-retest reliability of the 6-MWT was evaluated, the fact that research assistants were not blinded to group assignment may have affected some patients' 6-MWT performance. However, this is an unlikely source of bias because there were patients in both groups that improved, remained the same, and declined in 6-MWT (as shown in Figure 3). In addition, patients whose improved distance was >99 feet had a remarkably longer distance in the training group (45%) compared to the control group (24%), with a mean average of 279.6 ± 130.8 versus 171.8 ± 67.1 feet, respectively. Finally, the potential impact of nurse visits may have affected outcomes. However, nurse visits were structured to avoid provision of additional information or unintended nursing support.

### Clinical implications

This study demonstrates that a low-intensity HWE program for patients with stable moderate HF is safe, well accepted, and effective in improving functional status (submaximal exercise capacity) and global perception of symptoms. Clinicians should consider the use of HWE programs for HF patients without access to hospital-based cardiac rehabilitation programs. Since home visits may be related to patients' high acceptance of the program, clinicians should consider home visits for any home-based exercise program recommendation, and home health programs for patients with HF should consider including HWE programs in their care delivery model. At a time when management of patients with HF is moving out of the hospital and into the home with increasing frequency, these findings provide support for the safety and efficacy of home-based exercise.

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