Predictors of a sustained response to exercise training in patients with chronic heart failure: A telemonitoring study

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Background  Exercise training (ExT) improves exercise capacity in chronic heart failure, but the results of home-based training have been variable. We sought the predictors of favorable outcome using a telemonitoring approach.

Methods  Exercise capacity and quality of life (QOL) were assessed in 30 patients (28 men, age 64 ± 8 years) with symptomatic chronic heart failure and left ventricular ejection fraction ≤35% (28% ± 9%) undergoing 8 months of home ExT. Patients were provided with heart rate monitors and exercise diaries after undergoing 4 months of hospital-based ExT. Weekly telephone contact was established and heart rate data were downloaded bimonthly. Changes in peak oxygen consumption per unit time ($\dot{V}O_2$) and QOL were compared between the 15 most and 15 least adherent patients defined by the number of hours per week at >60% maximum heart rate, observed during heart-rate monitoring.

Results  Peak $\dot{V}O_2$ increased by 26% ($P < .001$) after 4 months of hospital ExT, but this increase had fallen to 8% ($P = .07$) at 12 months; only adherent patients ($n = 15$) showed persistent improvement of peak $\dot{V}O_2$ at 12 months ($P = .02$). Improvement in peak $\dot{V}O_2$ at 12 months was associated with baseline peak $\dot{V}O_2$ ($r = -0.61$, $P < .001$) and hours logged on the heart rate monitor ($r = 0.47$, $P = .01$). Quality of life improvements were sustained at 12 months for the Minnesota Living with Heart Failure Questionnaire and Hare-Davis Depression Questionnaire. Nevertheless, QOL improvements achieved during the outpatient program were lost or attenuated at 12 months in nonadherent patients but were maintained in adherent patients.

Conclusions  Telemonitoring is feasible for following adherence to home ExT. Ongoing adherence is critical in obtaining sustained benefit from ExT in heart failure. (Am Heart J 2005;150:1240-7.)

Exercise training (ExT) for patients with chronic heart failure (CHF) has beneficial effects on functional capacity, with a recent meta-analysis reporting a 17% improvement in measured oxygen consumption per unit time ($\dot{V}O_2$). The most favorable effects have been obtained with supervised training, especially high exercise volume, and hospital-based or residential programs. However, although a hospital-based multidisciplinary approach is safe and effective, it is also relatively costly and of limited availability. Deconditioning occurs rapidly in the absence of ongoing training, so successful graduation to a home-based program is critical if the effects of training are to be maintained.

Unfortunately, unpredictable results have been reported from unsupervised training, with ongoing adherence to a training regimen posing a significant problem. The key to optimal home training may be the identification of strategies that adequately motivate patients as well as the identification of patients who are having difficulty with the transition from group- to individual-oriented exercise programs, perhaps enabling more intensive supervision. Telemonitoring of an exercise program may address these needs. Home monitoring has been shown to reduce hospitalization and readmission rates in patients with CHF, but not including ExT. In this study, we sought whether e-mail, telephone, exercise diaries, and heart rate monitoring were practical motivational tools and methods of accurately gathering exercise adherence data and whether improved adherence could ensure maintenance of the functional capacity and quality of life (QOL) benefits obtained from hospital-based training.
Methods

Patient selection

Patients with symptomatic heart failure and a left ventricular ejection fraction (LVEF) ≤35% were identified at the time of presentation for echocardiography and from advertisements in the local media. Other than the exclusion of patients with severe valvular heart disease or inability to exercise, inability to attend the initial hospital-based rehabilitation, lack of stabilization on appropriate medications at a constant dose for at least 1 month before study entry, and inability to provide informed consent, there was no other selection criterion for these patients. Patients with ischemia were admitted into the study provided that they were not limited by angina. The study was approved by the ethics committee of the Princess Alexandra Hospital and all patients gave written informed consent.

All patients were categorized as either New York Heart Association class II or New York Heart Association class III. Patients in class II had mild limitation of activity, comfortable with rest or with mild exertion. Class III patients exhibited marked limitation of activity, only at rest.

Exercise testing

All subjects underwent metabolic exercise testing on a cycle ergometer using a 10 W/min stepped protocol. The electrocardiogram was continuously monitored for ST-segment changes and arrhythmias; blood pressure and 12-lead electrocardiograms were recorded before exercise, every 2 minutes during the test, and during the recovery period after exercise. Tests were symptom limited, with the usual end points being dyspnea and leg fatigue, and a few studies were limited by arrhythmia and decreased or exaggerated blood pressure response. Measured peak VO₂ was obtained by breath-by-breath analyses of expired gas (V29C Sensormedics, Yorba Linda, Calif), averaged over 20-second intervals. Every 3 sequential measurements were averaged and peak VO₂ was defined as the greatest mean value during exercise. Anaerobic threshold (AT) was calculated using the V-slope method.

Exercise echocardiography

Before commencement of the exercise test, 2-dimensional echocardiography was recorded with commercially available equipment with the patient in the supine left lateral decubitus position. Images were obtained using a 3.5-MHz transducer at 16-cm depth in 5 standard views at rest and immediately after the exercise test. Resting and peak LVEF were calculated using Simpson’s biplane method.

Quality of life measures

Three previously validated questionnaires assessing QOL were completed by all patients at baseline, 8 weeks, and 16 weeks. The Minnesota Living with Heart Failure Questionnaire is specific to heart failure; its 21 questions give a total score and a physical and emotional dimensional score. The Hare-Davis Cardiac Depression Scale is a general tool administered to the cardiac patient population; as with the Minnesota Living with Heart Failure questionnaire, lower scores indicate that patients perceive their health to be improving. We focused on 4 of the 8 dimensions of the SF-36 General Health Questionnaire.

Emotional role is the extent to which emotional problems interfere with work or other daily activities, including decreased time spent on activities, accomplishing less, and not working as carefully as normal. Reduction of vitality reflects the experience of lack of energetic feelings. Social functioning corresponds to the extent to which physical health or emotional problems interfere with normal social activities. Bodily pain reflects the intensity of pain and effect of pain on normal work, both inside and outside the home.

Exercise training

All patients initially undertook 16 weeks of cycle ergometer ExT at 60 RPM, at a workload (in watts) corresponding to an initial intensity of 60% to 70% peak oxygen consumption, 3 sessions per week. In addition, during weeks 8 to 16, patients also performed a series of 5 strength exercises including wall
pushups, alternating leg lunges, tricep dips, bicep curls, and sits to stands from a chair. Exercise intensity was titrated upward by 2 to 5 W/wk, provided that patients were tolerating the cycle training. In patients who were paced or experienced frequent ectopy, rate of perceived exertion (RPE) was also used to guide exercise intensity, using a target RPE 3 to 5 (moderate to hard) on the modified Borg scale.18 In patients who were most limited by shortness of breath, a respiratory rate <30 minutes was used to monitor intensity.

Home exercise program and telemonitoring
After 16 weeks, hospital-based training patients were then encouraged to exercise independently. All patients were provided with a home program consisting of an aerobic and a strength component using the same exercises as above. The aerobic program (Appendix A) consisted of a 15-minute stair/step exercise once weekly, approximately 30 minutes of repeated 6-minute walks once weekly, and a 60-minute walk weekly, totaling approximately 105 minutes per week. Patients were told to take rest breaks during their 60-minute walks, when required, the goal being not to cover a set distance but walk for the prescribed duration. The aerobic exercise intensity was governed by the modified Borg (RPE) scale. Patients were also provided with an exercise diary and a Polar s610i Heart Rate Monitor (Polar, Kempele, Finland) for recording heart rate data in a format that was computer downloadable. During the last 2 weeks of their hospital-based exercise program, each patient was given training on how to

Table II. Changes in functional capacity, ejection fraction, and QOL up to 12 months in all 30 patients

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>16 wk % change</th>
<th>P</th>
<th>12 mo % change</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak ( \dot{V}O_2 )</td>
<td>12.2 ± 4.8</td>
<td>15.1 ± 5.2</td>
<td>23.7</td>
<td>&lt;.001</td>
<td>13.2 ± 3.8</td>
</tr>
<tr>
<td>AT</td>
<td>7.8 ± 1.6</td>
<td>10.4 ± 2.9</td>
<td>33.3</td>
<td>&lt;.001</td>
<td>9.6 ± 3.1</td>
</tr>
<tr>
<td>( V_{E}/VCO_2 ) slope</td>
<td>34.1 ± 6</td>
<td>31.3 ± 5.3</td>
<td>−8.3</td>
<td>.03</td>
<td>31.5 ± 6</td>
</tr>
<tr>
<td>Resting EF</td>
<td>29 ± 10</td>
<td>32 ± 10</td>
<td>10.0</td>
<td>.15</td>
<td>36.2 ± 10</td>
</tr>
<tr>
<td>Peak EF</td>
<td>32 ± 10</td>
<td>36.3 ± 10.6</td>
<td>13.4</td>
<td>.02</td>
<td>40.8 ± 10.6</td>
</tr>
<tr>
<td>QOL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minnesota Living with Heart Failure</td>
<td>43.5 ± 16.6</td>
<td>31.6 ± 18</td>
<td>27.4</td>
<td>&lt;.001</td>
<td>34.1 ± 18.7</td>
</tr>
<tr>
<td>Hare-Davis Cardiac Depression Scale</td>
<td>94.7 ± 17.9</td>
<td>77.6 ± 21.6</td>
<td>18.1</td>
<td>&lt;.001</td>
<td>86.3 ± 20.9</td>
</tr>
<tr>
<td>SF-36 RETS</td>
<td>56.7 ± 41</td>
<td>77.4 ± 34</td>
<td>36.0</td>
<td>.03</td>
<td>68.3 ± 29.8</td>
</tr>
<tr>
<td>SF-36 VTS</td>
<td>42.2 ± 19</td>
<td>53.8 ± 19.8</td>
<td>26.0</td>
<td>.03</td>
<td>47.2 ± 18.1</td>
</tr>
<tr>
<td>SF-36 SFTS</td>
<td>67.6 ± 24.4</td>
<td>70.1 ± 20</td>
<td>3.6</td>
<td>.15</td>
<td>74.2 ± 18.8</td>
</tr>
</tbody>
</table>

Unless % change is preceded by a negative sign, it denotes an improvement.

Hours recorded (per week) at >60% HRmax (light) and hours reported in patient diaries (dark) in all 30 patients completing the home exercise program.

Figure 2

[Graph showing data for hours recorded and hours reported in patient diaries over 30 patients completing the home exercise program.]

Table II. Changes in functional capacity, ejection fraction, and QOL up to 12 months in all 30 patients
operate the heart rate monitor and was then required to demonstrate its correct use. Patients were asked to record the type, frequency, intensity, and duration of activity undertaken, body weight, and pulse rate in the exercise diaries and to comment on their general health. Patients were contacted weekly by telephone or e-mail for a report on their progress; heart rate monitors and exercise diaries were returned every 4 to 6 weeks. After comparison of exercise diaries and heart rate files, feedback was given to each patient about adherence, exercise intensity, and duration.

Adherence

Adherence to the 35-week home exercise program was characterized by 2 methods. First, the number of hours logged at ≥60% maximum heart rate (HR\textsubscript{max}) on the heart rate monitor was calculated. The group was divided into the 15 most and 15 least adherent patients, with the cutoff defined as ≥1 h/wk at ≥60% HR\textsubscript{max}, observed during heart rate monitoring.

The primary source of data was the heart rate monitor, but exercise diary entries were used to verify exercise duration when extended or shortened heart rate monitor files had been created because of incorrect use of the heart rate monitor (eg, patient had forgotten to start or stop the timing mechanism on the heart rate watch or the heart rate belt sensor had failed to receive the heart rate signal). Second, adherence was gauged by the number of exercise sessions, defined from the diary and heart rate monitor. Program adherence was measured by expressing the number of completed sessions as a percentage of the 175 sessions (35 weeks × 5 per week) required to constitute a completed program.

Statistical analysis

Results are reported as mean ± SD. Correlations with change in peak VO\textsubscript{2} were performed with clinical variables, resting and peak LVEF, contractile reserve, and hemodynamic responses to stress. Patients were characterized as adherent and nonadherent as described above, and repeated-measures analysis of variance with Bonferroni correction was used to assess differences in primary end points between adherent patients and nonadherent patients at various phases of the program. Statistical analyses were performed with an SPSS version 10.1 (SPSS, Chicago, IL).

Results

Patient characteristics

Patients were approached from the hospital echocardiography laboratory and from advertisements in the local media. Of 73 patients who were approached, 37 were enrolled, including 2 women (5%); of the 36 who declined, 7 were women (19%, \( P = .07 \)). Of the 37
patients initially embarked upon the ExT phase of the program, 3 failed to complete 16 weeks of supervised ExT whereas 4 patients withdrew between the 16th week and the 12th month. All patient withdrawals were caused by noncardiac reasons—2 caused by time constraints, 1 because of moving from the locality, and another because orthopedic surgery prohibited continuation of ExT. There were no significant differences in the demographics, medications, and baseline metabolic, echocardiographic, and QOL measures in those who did and did not complete the program. Most patients were in functional class III.

Of the 30 patients (28 men, age 64 ± 11 years) who completed the program, heart failure was caused by coronary artery disease in 20, and the LVEF was 28% ± 9%. The baseline characteristics of patients completing the program are listed in Table I, only ischemic disease etiology was significantly different between adherent patients (47%) and nonadherent patients (100%) (P < .001).

Patient complications and withdrawals

There were no deaths during exercise testing and training procedures, although one patient had a nonfatal myocardial infarction, one had a stroke, and another was briefly hospitalized because of worsening heart failure. Nevertheless, these 3 patients all completed 12 months of ExT after temporary breaks through illness. Of the 37 patients, total adherence in terms of patient number was 30 (82%) for the hospital phase and 15 (41%) for the home exercise phase.

Adherence during the hospital exercise program

Hospital program adherence was classified as 3 × 30 minutes of exercise weekly, at a heart rate ≥70% of peak VO$_2$. Hospital exercise adherence in all 30 patients was 84%, with no significant difference between patients who were adherent and those who were nonadherent with subsequent home exercise (87% ± 19% vs 82% ± 17%, P = .78).

Adherence during the home exercise phase

Home program adherence was characterized by 2 methods. Overall, 36% of the total hours recorded was logged at >60% HR$_\text{max}$ on the heart rate monitor. The mean number of hours per week recorded at >60% HR$_\text{max}$ was 1.2 ± 1.3, and the number of hours of exercise at >60% HR$_\text{max}$ in the 15 adherent and 15 nonadherent patients was 83.1 ± 36.4 versus 4.9 ± 9.7 hours, respectively (P < .001) (Figure 1). The adherent patients also showed a greater completed proportion of the maximum of 175 exercise sessions (65.7% ± 34.1% vs 5.7% ± 13.6%, P < .001). Overall, the target number of exercise sessions for all 30 patients was 43% from a total of 175 exercise sessions, with 4 patients achieving 100% exercise session adherence. Figure 2 shows hours recorded at >60% HR$_\text{max}$ and hours reported in patient diaries in all 30 patients completing the home exercise program. Importantly, patients who were nonadherent to training were not more sick than the adherent patients, with similar baseline peak VO$_2$ and ejection fraction values.

Effects of ExT change on functional capacity

All patients. The response of exercise capacity in the overall group is summarized in Table II. Overall, baseline peak VO$_2$ increased from baseline by 21% at 16 weeks (P < .001) and by 8% at 12 months (P = .08). Body mass was essentially unchanged (P = NS) at 16 weeks in this patient group and cannot therefore explain improved peak VO$_2$ values. Both AT (P = .001) and the expired volume per unit time/carbon dioxide production per unit time slope (P = .04) were improved significantly at 12 months. This improvement was matched by an increment in workload at 16 weeks (P < .001) and a reduction in peak heart rate during exercise at 16 weeks.

Table III. Comparison of the primary end points between adherent and nonadherent patients during 3 phases of the exercise program

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group</th>
<th>Baseline</th>
<th>16 wk</th>
<th>P (baseline vs 16 wk)</th>
<th>12 mo</th>
<th>P (baseline vs 12 mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota Living with Heart Failure (QOL)</td>
<td>Adherent</td>
<td>45.3 ± 17.5</td>
<td>32.5 ± 19.2</td>
<td>.04</td>
<td>30.9 ± 17.6</td>
<td>.007</td>
</tr>
<tr>
<td></td>
<td>Nonadherent</td>
<td>41.7 ± 16.1</td>
<td>30.7 ± 17.3</td>
<td>.002</td>
<td>37.0 ± 20.1</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>P (adherent vs nonadherent)</td>
<td>.49</td>
<td>.73</td>
<td>.06</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Hare-Davis Cardiac Depression Scale (QOL)</td>
<td>Adherent</td>
<td>91.9 ± 18.1</td>
<td>74.9 ± 21.3</td>
<td>.001</td>
<td>79.2 ± 20.2</td>
<td>.005</td>
</tr>
<tr>
<td></td>
<td>Nonadherent</td>
<td>97.5 ± 17.8</td>
<td>80.3 ± 22.3</td>
<td>.003</td>
<td>93.8 ± 19.2</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>P (adherent vs nonadherent)</td>
<td>.40</td>
<td>.38</td>
<td>.05</td>
<td>.46</td>
<td></td>
</tr>
<tr>
<td>SF-36 social function (QOL)</td>
<td>Adherent</td>
<td>68.3 ± 21.6</td>
<td>74.2 ± 19.3</td>
<td>.10</td>
<td>72.5 ± 18.4</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td>Nonadherent</td>
<td>61.7 ± 26.9</td>
<td>73.8 ± 21</td>
<td>.07</td>
<td>75.8 ± 19.7</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td>P (adherent vs nonadherent)</td>
<td>.06</td>
<td>.17</td>
<td>.49</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>Peak ejection fraction</td>
<td>Adherent</td>
<td>33.6 ± 7.5</td>
<td>39.2 ± 9.8</td>
<td>.21</td>
<td>44.3 ± 9.9</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>Nonadherent</td>
<td>30.2 ± 11.3</td>
<td>35.7 ± 10.6</td>
<td>.49</td>
<td>37.4 ± 10.5</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>P (adherent vs nonadherent)</td>
<td>.34</td>
<td>.32</td>
<td>.46</td>
<td>.10</td>
<td></td>
</tr>
</tbody>
</table>
(P = .007) but not at 12 months (P = .42). Improvement in peak VO2 at 12 months was associated with lower baseline peak VO2 (r = 0.41, P = .01) (Figure 3) and hours logged on the heart rate monitor (r = 0.47, P = .01).

Training adherence and functional capacity. Peak VO2 was significantly changed in both groups (both P = .01) at 16 weeks, but it only remained significant at 12 months in adherent patients (P = .02 vs P = 1.00) (Figure 4). Anaerobic threshold changed significantly at 16 weeks (adherent patients P = .005, nonadherent patients P < .001) and 12 months only in the adherent group (P = .04 vs P = .07) (Figure 5). Baseline respiratory exchange ratio (RER) was not correlated with change in peak VO2. β-Blocker dose was not correlated with change in peak VO2 at 16 weeks or at 12 months or with adherence or hours logged on the heart rate monitor.

Effects of ExT on QOL

All patients. Significant increments in the 3 QOL measures are summarized in Table II. The Minnesota Living with Heart Failure total score and Hare-Davis Cardiac Depression Scale score both improved at 8 and 16 weeks (all P < .001) and at 12 months. Similarly, the SF-36 questionnaire dimensions emotional role (RETS) and vitality (VTS) improved at 16 weeks and the SF-36 dimension social functioning (SFTS) was significantly improved at 12 months (P = .006).

Training adherence and QOL. Quality of life improvements achieved during the outpatient program were lost at 12 months in the nonadherent patients but were maintained in the adherent patients (Table III). The Minnesota Living with Heart Failure and Hare-Davis Cardiac Depression Scale scores both showed significant changes in both groups at 16 weeks, but changes were only maintained in the adherent group at 12 months (Minnesota Living with Heart Failure P = .007), and this was also true of the Hare-Davis Cardiac Depression Scale score (P = .005).

Effects of ExT on global left ventricular function

All patients. Resting ejection fraction improved at 8 weeks (P = .01), 16 weeks (P = .15), and 12 months (P = .01) (Figure 6). Exercise ejection fraction improved slightly at 8 weeks (P = .40) and significantly at 16 weeks (P = .02) and 12 months (P < .001) (Table II).

Training adherence and left ventricular function. When the groups were analyzed separately, neither resting nor peak LVEF was significantly altered at 16 weeks, although improvements were identified in adherent patients at 12 months (Table III). Direct comparison at 12 months showed a trend toward greater improvement in peak LVEF in adherent patients (P = .04).

Predictors of change in functional capacity

A univariate, general linear regression model was used to predict change in functional capacity between baseline and 12 months and between 16 weeks and 12 months. Increment in peak VO2 between baseline and 12 months was predicted by baseline resting ejection fraction (r = 0.26, P = .004). A univariate model (r = 0.44, P = .001) of increment in peak VO2 between 16 weeks and 12 months was predicted by total hours (P = .02), hours >60% HBmax (P = .01), and the bodily pain dimension of the SF-36 (P = .01).

Discussion

Changes in QOL and peak VO2 after 16 weeks of supervised ExT may be sustained during home-based ExT, especially in patients adherent to a telerehabilitation-supervised home exercise program. Monitoring and careful follow-up of adherence could be used to identify patients requiring more than an unsupervised home-based exercise program.

Factors influencing sustained improvement in peak VO2

Improvement in peak VO2 at 12 months was associated with baseline peak VO2 (r = 0.41, P = .01) and hours logged on the heart rate monitor (r = 0.47, P = .01), although baseline peak VO2 was not a univariate predictor of 12-month peak VO2 change. Although an ischemic etiology for heart failure did not emerge as a reason for a lower level of response to ExT, contrary to previous studies,19 the amount of bodily pain experienced at baseline could be used to predict nonadherent patients. Importantly, however, there was no evidence that lack of adherence was associated with a more impaired group at baseline, with greatest changes in peak VO2 at 12 months associated with lower baseline peak VO2, although this trend appeared to occur in most (21/30) patients (Figure 3). Body mass was unchanged after ExT; nevertheless, increased lean body mass may have occurred (unfortunately, body composition was not measured) and could have contributed to increased peak VO2 values.
**Effects of drug therapy**

Although this study did not provide a control group, it is likely that because improved LVEF was also seen in nonexercising patients, the changes are probably caused by prolonged medical therapy rather than ExT. It is possible that this improvement simply reflects the longer-term effects of β-blockade. Nevertheless, β-blocker dose did not appear to affect adherence to the home exercise program or change in peak VO₂ at 16 weeks and 12 months.

**Strategies for improving exercise adherence**

Exercise training in the heart failure population is resource intensive in terms of both personnel and equipment. Nonetheless, the improvement in exercise capacity from this intervention may facilitate ongoing independence and may translate into avoidance of hospitalization and even reduce mortality. The graduation from a supervised to an unsupervised environment remains a pivotal event that may be associated with loss of effectiveness if adherence is poor.

Previous work has highlighted the importance of patient reporting in optimizing adherence to home ExT programs in other patient populations. In this study, we provided regular patient contact with an exercise physiologist, by e-mail or telephone, and the heart rate monitor provided a method of verification for information provided by the exercise diaries. Interestingly, although ongoing adherence was associated with preservation of the improvement in function derived from supervised training, only half of the group were unable to make the transition from group to individual ExT. Reasons for this may be lack of self-motivation, concerns about safety, or preference of cycling versus walking exercise.

Table IV demonstrates the total number of exercise tests eliciting RER values <1.05 at baseline, 16 weeks, and 12 months. There is no significant difference between the number of adherers and nonadherers eliciting RER values <1.05. The RER was not correlated with change in peak VO₂ at any test period during the study. Anaerobic threshold (VO₂ at AT) (Figure 5) is less influenced by submaximal exercise tests and confirms the sustained improvement in exercise capacity among patients who adhered to training.

A comparison of other home exercise studies demonstrated that our patients were generally comparable with those enrolled in those studies (predominantly men, aged 60 to 70 years, with LVEF from 25% to 35%). However, the low recruitment of women was less in this study than the 20% prevalence of women reported in a meta-analysis of 81 studies of heart failure ExT. This represents both lower response to the recruitment process (mainly advertisement) as well as a lower proportion of women who elected to proceed into the study.

**Figure 2** demonstrates a difference in hours recorded at >60% HRmax and hours reported in patient diaries in all 30 patients completing the home exercise program. The difference in hours recorded at >60% HRmax and hours reported in patient diaries may reflect overestimation of exercise time, the performance of low-level exercise by some patients, inclusion of rest time, and the possibility of errors in operation of the heart rate monitors.

**Conclusion**

The response to a home ExT program for heart failure is related to compliance. Telephone and e-mail contacts, combined with exercise diaries and heart rate monitoring, were well accepted by the patients and may prove to be practical motivational tools for maintaining adherence with ExT for heart failure on an outpatient basis.

We gratefully acknowledge the assistance of Colin Case, MS; Jonathon Chan, MD; Chiew Wong, MD; Dhrubo Rakshit, MD; Philip M. Mottram, MD; Lizzelle Hanekom, MD; Robert Fatbi, MD, PhD; W. Stuart Moir, MD; Carly Jenkins; and Rodel Leano during exercise testing.

**References**


### Appendix A
Components of the aerobic home exercise program

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
<th>Duration</th>
<th>Rest</th>
<th>RPE</th>
<th>Sets</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stair climb</td>
<td>Once a week</td>
<td>15 × 30 s</td>
<td>1 min between sets</td>
<td>Somewhat hard, RPE 5</td>
<td>10-20</td>
<td>Start 10 sets, add 1 set per week, decrease rest breaks</td>
</tr>
<tr>
<td>6-Min walks</td>
<td>Once a week</td>
<td>3-5 × 6 min</td>
<td>3-5 min between walks</td>
<td>Moderate, RPE 4 (walk as far as possible in 6 min)</td>
<td>3-5</td>
<td>Start with 3 repeats, add 1 every 2 months up to 5</td>
</tr>
<tr>
<td>Long walk</td>
<td>Once a week</td>
<td>60 min</td>
<td>As required</td>
<td>Easy, RPE 5</td>
<td>1</td>
<td>Walk faster, up hills, less rests</td>
</tr>
</tbody>
</table>