Introduction

Chronic heart failure is characterised by dyspnoea, fatigue, and exercise intolerance. It is an increasingly common public health problem that leads to a poor prognosis and is associated with increased morbidity and decreased quality of life (Bennett et al 2003, Gwadry-Sridhar et al 2004). Some previous studies have demonstrated that co-existing psychological conditions such as anxiety or depression are common among people with chronic heart failure in the community. These concomitant psychological conditions may lead to deterioration in the health of people with chronic heart failure and increase the risk of adverse outcomes (Friedmann et al 2006, Haworth et al 2005, Holzapfel et al 2009, Rumsfeld et al 2003, Tsuichish-Makaya et al 2009). Anxiety is also more likely as chronic heart disease becomes more severe on the New York Heart Association classification system (Haworth et al 2005). Quality of life might also be affected by these psychological conditions in people with chronic heart failure. However, the relationship that anxiety and depression have with quality of life and physical function remains to be determined.

Exercise improves depression and anxiety scores in the general population and in some clinical populations (Herring et al 2010, Mead et al 2009). Several studies have investigated the psychological changes after exercise training in chronic heart failure patients (Koukouvou et al 2004, Kulcu et al 2007, Radzewitz et al 2002). However, the results are inconsistent. Exercise training improved symptoms and quality of life in people with chronic heart failure in some studies investigating centre-based programs (Belardinelli et al 1999, McKelvie et al 2002, Rees et al 2004, van Tol et al 2006). However, little is known about the short-term effects of home-based exercise on psychological status and quality of life in these patients. The specific research questions of this study therefore were:

1. Do the levels of anxiety and depression correlate with physical function, disability, and quality of life in people with chronic heart failure? Does 8 weeks of home-based exercise improve anxiety, depression, physical function, disability, and quality of life in these patients? Do the changes in these outcomes correlate?

Design: Randomised trial. Participants: 51 people with clinically stable chronic heart failure were randomised into an experimental group (n = 24) or a control group (n = 27). Intervention: The experimental group undertook an individualised home-based exercise program, 30 minutes per session, 3 sessions per week for 8 weeks, with regular telephone follow-up and consultations. The control group maintained their usual activity during this period. Outcome measures: The Hospital Anxiety and Depression Scale, six-minute walk test, Groningen Activity Restriction Scale, and Minnesota Living with Heart Failure Questionnaire were administered at baseline and 8 weeks. Results: At baseline, anxiety and depression were inversely moderately correlated with walking distance, activity, and quality of life. Compared with controls, the experimental group improved significantly more in their walking distance (by 21 m, 95% CI 7 to 36) and their quality of life (by 7 points on the 105-point Minnesota score, 95% CI 1 to 12). In the experimental group, the changes in quality of life correlated moderately strongly with changes in anxiety (r = 0.539, p = 0.01). Conclusions: Anxiety and depression were associated with physical function, disability, and quality of life in people with chronic heart failure. Home-based exercise improved quality of life and physical function significantly but not psychological status in these patients. Trial registration: ClinicalTrials.gov: NCT01197313. [Chien C-L, Lee C-M, Wu Y-W, Wu Y-T (2011) Home-based exercise improves the quality of life and physical function but not the psychological status of people with chronic heart failure: a randomised trial. Journal of Physiotherapy 57: 157–163]
Method

Design
A randomised trial with intention-to-treat analysis was conducted. People with chronic heart failure were recruited from one centre: Heart Failure Clinics, National Taiwan University Hospital. After eligibility was confirmed, each participant was randomly allocated into an experimental group or a control group. Patients attending a clinic on the same day were co-randomised to avoid possible cross-talking between the groups. Each participant allocated to the experimental group attended a 30-minute face-to-face interview with a physical therapist in the clinic to provide an individualised exercise program and instructions to perform exercise safely at home, with a 1-page summary brochure provided. The control group was asked to keep their daily activities unchanged during the 8-week study period. All participants were asked to maintain their medications and habitual diet.

Participants
Participants were required to have had a diagnosis of chronic heart failure (New York Heart Association Class I–III) for at least six months and to have been medically stable for at least three months. Subjects were excluded if they had malignancy, psychiatric disease, or psychotropic use, or primary neurological, musculoskeletal or respiratory diseases that affected the assessment of functional capacity or exercise capacity.

Intervention
Participants allocated to the exercise group were instructed at the interview to perform walking exercise combined with strengthening exercises of major limb muscles for at least 30 minutes per session, 3 sessions per week for 8 weeks at home. How to exercise in a safe and proper way, including self-monitoring of symptoms, level of exertion and exercise-related problems, was explained and summarised in a 1-page brochure. Subjects were asked to keep a daily activity log and were followed up by telephone every 1–2 weeks to monitor progress, provide feedback, and discuss the exercise program, adherence, and barriers to adherence.

Outcome measures
Anxiety, depression, functional exercise capacity, disability, and health-related quality of life were measured at baseline and at the end of the 8-week intervention period.

Anxiety and depression were measured by the Hospital Anxiety and Depression Scale, a 14-item self-report questionnaire incorporating anxiety and depression subscales. Each item is scored from 0 to 3, and a subscale score of 8 or greater indicates psychological distress from anxiety or depression (Bjelland et al 2002). The scale is a valid screening tool to detect anxiety and depression in patients with hypertrophic cardiomyopathy and has high sensitivity when a cutoff score of 8 is used (Poole and Morgan 2006).

Functional performance was measured using the standard, indoor, six-minute walk test protocol recommended by the American Thoracic Society (2002). Subjects were instructed to walk along a 30-metre corridor at their own pace for a six-minute period. This test serves as an indicator of exercise tolerance and symptoms (Olsson et al 2005) and as a prognostic indicator for subsequent cardiac death (Rostagno et al 2003). We also converted the result to a percentage of the predicted distance on the test for each participant, according to the reference equation of Enright and Sherrill (1998).

Disability was measured using the Groningen Activity Restriction Scale, which was administered by face-to-face interview to measure disability in the domains of personal care and domestic activities. It includes 18 items with scores from 1 to 4, assessing disability in the area of activities of daily living, including mobility and instrumental activities of daily living. The total score can range from 18 (absence of disability) to 72 (highly disabled) (Kempen et al 1996).

Health-related quality of life was measured with the Minnesota Living with Heart Failure Questionnaire. It is a validated 21-item disease-specific questionnaire that measures physical, socioeconomic, and psychological impairment related to heart failure. The score is based on how each person ranks each item on a common scale and it is used to quantify how much heart failure has influenced aspects of a subject’s daily life during the previous month and how it is affected by therapeutic intervention. Scores range from 0 to 105 points, with lower scores indicating less effect from heart failure symptoms and thus a better quality of life (Middel et al 2001, Rector and Cohn 1992).

Statistical analyses
Group characteristics were analysed with descriptive statistics and are presented as means with standard deviations. Pearson correlation was used to evaluate the bivariate relationship among the variables at baseline of all the subjects, and also to analyse the relationships between changes in outcome measures for subjects in the experimental group. Group comparisons were tested by two-way repeated measures analysis of variance. For a given outcome without significant group × time interaction, analysis of main effect was performed. A p value less than 0.05 was considered as statistically significant. We sought to detect a between-group difference in the change in the Minnesota Living with Heart Failure Questionnaire score of 5 points as this is considered a clinically important improvement in quality of life (Riegel et al 2002). Assuming that the standard deviation in this score would be similar to that observed in a similar study of exercise in people with chronic heart failure (Koukouvou et al 2004), a total sample size of 32 would provide 80% power to detect a difference of 5 points as statistically significant. We recruited additional participants to allow for withdrawals.

Results

Flow of participants and therapists through the study
A total of 51 participants were recruited, 24 of whom were allocated to the experimental group and 27 to the control group. The flow of participants through the study is presented in Figure 1. The baseline characteristics of the participants are presented in Table 1 and in the first two columns of Table 2. The predominant causes of heart failure were ischaemic heart disease and idiopathic cardiomyopathy, with wide diversity of aetiology among the other participants. No adverse events were reported during the study period. Clinically elevated anxiety (≥ 8 points) was found in four
Eligible participants (n = 51)

Measured anxiety, depression, functional exercise capacity, disability and quality of life

Randomised (n = 51)

(n = 24) (n = 27)

Experiment group
- usual daily activity
- home strengthening exercises and walking
- 30 min x 3/wk x 8 wk
- regular phone consultation and follow up

Control group
- usual daily activity

Week 0

2 refused

Week 8

Measured anxiety, depression, functional exercise capacity, disability and quality of life

(n = 22) (n = 22)

5 refused

Table 1. Baseline characteristics of the participants.

<table>
<thead>
<tr>
<th></th>
<th>All (n = 51)</th>
<th>Exp (n = 24)</th>
<th>Con (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr), mean (SD)</td>
<td>58 (16)</td>
<td>57 (16)</td>
<td>59 (16)</td>
</tr>
<tr>
<td>Gender, n male (%)</td>
<td>38 (75)</td>
<td>20 (83)</td>
<td>18 (67)</td>
</tr>
<tr>
<td>Height (cm), mean (SD)</td>
<td>165 (9)</td>
<td>166 (8)</td>
<td>164 (9)</td>
</tr>
<tr>
<td>Weight (kg), mean (SD)</td>
<td>67 (14)</td>
<td>70 (15)</td>
<td>65 (13)</td>
</tr>
<tr>
<td>Body mass index (kg/m²), mean (SD)</td>
<td>25 (4)</td>
<td>25 (4)</td>
<td>24 (3)</td>
</tr>
<tr>
<td>Left ventricular ejection fraction (%), mean (SD)</td>
<td>40 (13)</td>
<td>40 (14)</td>
<td>40 (12)</td>
</tr>
<tr>
<td>Aetiology, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>26 (51)</td>
<td>11 (46)</td>
<td>15 (56)</td>
</tr>
<tr>
<td>Idiopathic cardiomyopathy</td>
<td>14 (27)</td>
<td>6 (25)</td>
<td>8 (30)</td>
</tr>
<tr>
<td>Valvular heart disease</td>
<td>8 (16)</td>
<td>5 (21)</td>
<td>3 (11)</td>
</tr>
<tr>
<td>Others</td>
<td>3 (6)</td>
<td>2 (8)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>NYHA classification, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>3 (6)</td>
<td>3 (13)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>II</td>
<td>42 (82)</td>
<td>20 (83)</td>
<td>22 (82)</td>
</tr>
<tr>
<td>III</td>
<td>6 (12)</td>
<td>1 (4)</td>
<td>5 (18)</td>
</tr>
<tr>
<td>Medication, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACE inhibitor/ ARB</td>
<td>39 (76)</td>
<td>17 (71)</td>
<td>22 (82)</td>
</tr>
<tr>
<td>β-blocker</td>
<td>35 (69)</td>
<td>16 (67)</td>
<td>19 (70)</td>
</tr>
<tr>
<td>Diuretics</td>
<td>43 (84)</td>
<td>19 (79)</td>
<td>24 (89)</td>
</tr>
<tr>
<td>Digoxin</td>
<td>15 (29)</td>
<td>7 (29)</td>
<td>8 (30)</td>
</tr>
</tbody>
</table>

Exp = experimental group, Con = control group, ACEI = angiotensin-converting enzyme inhibitors, ARB = angiotensin II receptor blockers
Table 2. Mean (SD) outcomes for each group, mean (SD) difference within groups, and mean (95% CI) difference between groups.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Groups</th>
<th>Difference within groups</th>
<th>Difference between groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Week 0</td>
<td>Week 8 minus Week 0</td>
<td>Week 8 minus Week 0</td>
</tr>
<tr>
<td></td>
<td>Exp (n = 24)</td>
<td>Con (n = 27)</td>
<td>Exp (n = 22)</td>
</tr>
<tr>
<td>HADS anxiety (points)</td>
<td>2.9 (3.0)</td>
<td>3.2 (3.8)</td>
<td>−0.8 (2.8)</td>
</tr>
<tr>
<td>HADS depression (points)</td>
<td>3.7 (3.1)</td>
<td>3.9 (3.1)</td>
<td>−1.1 (3.3)</td>
</tr>
<tr>
<td>6MWT (m)</td>
<td>424 (145)</td>
<td>432 (81)</td>
<td>15 (25)</td>
</tr>
<tr>
<td>6MWT (% predicted)</td>
<td>78 (21)</td>
<td>82 (20)</td>
<td>3 (5)</td>
</tr>
<tr>
<td>GARS (points)</td>
<td>20 (3)</td>
<td>20 (6)</td>
<td>0 (5)</td>
</tr>
<tr>
<td>MHFQ (points)</td>
<td>11 (11)</td>
<td>16 (16)</td>
<td>−5 (6)</td>
</tr>
</tbody>
</table>

Exp = experimental group, Con = control group, HADS = Hospital Anxiety and Depression Scale, 6MWT = six-minute walk test, GARS = Groningen Activity Restriction Scale, MHFQ = Minnesota Living with Heart Failure Questionnaire

subjects (one in the exercise group and three in the control group), whereas an elevated level of depression (≥ 8 points) was noted in seven subjects (three in the exercise group and four in the control group). Most subjects had a low level of disability as assessed by the Groningen Activity Restriction Scale. The mean score was 20 (SD 4, range 18–40), which is consistent with independence in self-care and domestic activities.

Exercise program instruction was conducted by a physical therapist with five years of clinical experience. Three cardiopulmonary physical therapists underwent half a day of training in applying the outcome measures.

Correlation between baseline measures

Anxiety scores as assessed by Hospital Anxiety and Depression Scale were negatively correlated with the six-minute walk distance as a percentage of predicted (r = −0.309) and were positively correlated with the Groningen scale score (r = 0.341) and the Minnesota questionnaire score (r = 0.753) (all p < 0.05). A similar pattern was noted between the depression scores and the following outcome measurements: the six-minute walk distance as a percentage of predicted distance (r = −0.397), the Groningen scale score (r = 0.431), and the Minnesota questionnaire score (r = 0.357) (all p < 0.05). That is, higher levels of anxiety or depression were moderately related to a higher level of disability and lower functional exercise capacity and quality of life.

Effect of intervention

The exercise group completed home-based training without any reported adverse events, such as cardiac events or musculoskeletal injuries. Significant interaction of group and time was noted in the six-minute walk distance and the Minnesota questionnaire score, while no interaction effect was noted in the other outcome measurements. Compared with baseline, participants in the experimental group significantly improved their physical capacity (walking 15 m further in six minutes) and their quality of life (scoring 5 points better on the 105-point Minnesota questionnaire), while control participants showed mild deteriorations on these outcomes over the same period. Therefore, the intervention produced significant benefits in walking distance (by 21 m, 95% CI 7 to 36) and quality of life (by 7 points on the 105-point Minnesota score, 95% CI 1 to 12). Group data for all outcomes at baseline and Week 8 for experimental and control groups are presented in Table 2 while individual data are presented in Table 3 (see eAddenda for Table 3).

Correlation between changes in outcome measures

In the experimental group, the decrease in the Minnesota questionnaire score was positively correlated with a decrease in the anxiety subscale of the Hospital Anxiety and Depression Scale (r = 0.539, p = 0.01), indicating that the improvement in quality of life was moderately strongly related to the improvement in the level of anxiety.

Discussion

In this study, we found that baseline anxiety and depression were moderately correlated with disability and moderately inversely correlated with functional exercise capacity and quality of life in outpatients with mild to moderate chronic heart failure. The 8-week individualised home-based exercise intervention significantly improved functional exercise capacity and health-related quality of life. The improvement in quality of life was moderately strongly correlated with the improvement in the level of anxiety.
associated with the improvement in anxiety after the home-based exercise in these patients.

Clinically important levels of anxiety and depression were identified in a small but substantial number of the participants at baseline. Depression has been found to be more prevalent among people with chronic heart failure than in people with other cardiac conditions (11% versus 5%) (Turvey et al 2002). Several sources of stress associated with chronic heart failure appear to contribute to depression. Unemployment due to illness, negative attitude about impairment, and more severe illness (as indicated by the New York Heart Association classification) each correlate significantly with depression in heart failure patients (Adewuya et al 2006, Gottlieb et al 2009, Turvey et al 2003). Reduced activity level and self-care ability as well as poor psychosocial support also predispose people with chronic heart failure to depression (Holzapfel et al 2009, Tousoulis et al 2010). A recent study has also demonstrated a correlation between reduced heart rate recovery indicative of impaired vagal tone and psychological distress (von Kanel et al 2009). Furthermore, increased activity of the renin-angiotensin-aldosterone axis and hypothalamus-hypophysis axis, increased serotonin and catecholamine level, alteration of the autonomic nervous system, and activation of systemic inflammation were associated with depression in chronic heart failure (Tousoulis et al 2010). In our results, anxiety and depression scores correlated with disability and inversely correlated with functional exercise capacity and quality of life. Correlations among some of these outcomes are supported by previous research (Ola et al 2006). Thus it appears important to address psychological issues in the management of people with chronic heart failure.

Our study showed that after 8 weeks individualised home-based exercise training improves functional exercise capacity in patients with chronic heart failure. Home-based training therefore provides an effective alternative for those who have no access to hospital-based exercise programs. More important, the management of chronic heart failure has shifted from hospital-based care to an outpatient model, and we have demonstrated an effective exercise intervention that can be incorporated in this model. Significant benefits in functional exercise capacity have also been identified after six weeks to six months of home-based training in people with chronic heart failure (Corvera-Tindel et al 2004, Evangelista et al 2006, Harris et al 2003) and in a meta-analysis of these studies (Chien et al 2008). The improvement in six-minute walk distance in our study was somewhat smaller than that reported in studies related to supervised or centre-based training (Rees et al 2004, van Tol et al 2006). This may be related to the clinical characteristics of our subjects (who tended to have less severe disease), the low to moderate intensity of the exercise, and the relatively short period of exercise training. Some other strategies of reinforcement, such as a personalised workbook, an interactive video, or an intervention of longer duration may be considered in future studies to gain better adherence and thereby to maximise improvement. Nevertheless, home-based exercise can be recommended when all the physical and psychological benefits are considered.

Health-related quality of life showed an overall between-group difference of 7 points on the 105-point Minnesota questionnaire. This exceeds the minimum clinically important difference of 5 points proposed by Riegel et al (2002). However, the lower limit of the confidence interval around this result may not be clinically worthwhile. Exercise training might improve quality of life by ameliorating the fatigue, shortness of breath, oedema, and other common symptoms in chronic heart failure. The improved quality of life could also be related to the improvement in functional exercise capacity and, hence, in disability. Our finding that home-based exercise improves quality of life in people with chronic heart failure is consistent with past research in this area (Harris et al 2003, McKelvie et al 2002, Oka et al 2000).

Anxiety and depression are of multi-factorial origin and may be bi-directionally related to the cardiac dysfunction, functional disability, and prognosis in subjects with chronic heart failure (Haworth et al 2005, Rutledge et al 2006, Tousoulis et al 2010). Antidepressant effects of exercise have previously been attributed to social contact and changes in stress hormones and brain-derived neurotrophic factors (Herring et al 2010, Tousoulis et al 2010). Previous studies have demonstrated some beneficial effects of exercise training on reducing anxiety and depression in people with chronic heart failure, although the effect sizes were relatively small (Koukouvou et al 2004, Kulcu et al 2007). Subjects in our study were relatively stable, with predominantly low levels of anxiety and depression and less dependence with the activities of daily living. Floor effects might therefore partially account for the non-significant results. In addition, studies with positive effects used long-term training periods (up to six months) and mainly hospital-based training, which would provide more social contacts, especially for those exercised in small groups. Although the improvement in quality of life in the exercise group was related to the reduction in anxiety, the causality is unknown. In contrast, Koukouvou and colleagues (2004) found no correlations between the improvements in psychological status and exercise capacity after exercise training. Their sample size was approximately half of ours, which may contribute to their lack of significant correlations. Whether home-based exercise can improve psychological health in chronic heart failure patients needs to be investigated further. A comprehensive strategy combining exercise therapy, education, social support, stress management, and relaxation may be indicated, especially for those with psychological distress.

There were limitations to our study. First, our participants were all clinically stable outpatients with chronic heart failure of mild to moderate severity, which limits the generalisability of the results. The heterogeneity of the aetiology of heart failure in the study participants may concern some readers, although many researchers recognise that all people with chronic heart failure have common clinical features regardless of their aetiology. Further studies may be needed to explore the relationship among psychological status, physical function, and quality of life where chronic heart failure is more severe or co-exists with depression. Investigation of other intervention components, such as behaviour therapy, is also needed. Another limitation of the study was that the therapists and participants were not blinded. Finally, the few participants who refused to attend for outcome assessment tended to have high levels of anxiety and depression. (See Table 3, and note that these dropouts account for the apparent discrepancies in Table
2.) This suggests that participants with clinically elevated levels of anxiety and depression may require additional strategies to improve adherence with clinical research.

Psychological measurements were correlated with physical function, level of disability and quality of life in outpatients with mild to moderate chronic heart failure. An eight-week, individualised home-based training program significantly improved physical function and quality of life but not the psychological status in these patients.

References


