Effects of the implementation of a multidisciplinary cardiac rehabilitation programme in clinical practice

Elisa Stoira[a,b], Mauro Capoferri[a], Antonello Molteni[a], Lucas M. Bachmann[b], Tiziano Moccetti[a]

[a] Cardiocentro Ticino, Lugano, Switzerland

[b] Horten Center, University of Zurich, USZ, Zurich, Switzerland

Summary

Background: Various studies show that multidisciplinary rehabilitation programmes including physical training, nutritional counselling and risk factor management for patients with cardiac disease result in behavioural change and improve both quality of life and physical performance. To what extent these results can be translated into clinical practice is less well understood.

Purpose: To measure changes in nutrition habits, smoking habits, wellbeing, self-perceived physical fitness and physical performance of patients with various cardiac diseases attending a multidisciplinary cardiac rehabilitation programme in a regional outpatient cardiological rehabilitation centre in Switzerland. To study variability of effects in female and elderly patients.

Methods: 139 consenting patients (mean age: 61.9 years [±10.1], 119 [85.6%] male) attending a cardiac rehabilitation programme were asked to complete a questionnaire before and after a 3-month outpatient cardiac rehabilitation programme of 36 sessions. We also assessed physical performance before and after rehabilitation. We tested changes from baseline statistically and investigated whether the patients' age and gender had an influence on the rehabilitation effects.

Results: Patients reduced the intake of fatty food by 1.70 score points (95%CI: –2.06 to –1.28; p <0.001) and increased their intake of healthy food by 2.23 score points (1.88 to 2.58, p <0.001). We observed a significant reduction in the number of smokers (p <0.001).

Wellbeing increased by 1.39 score points (1.11 to 1.67, p <0.001) and self-perceived physical fitness increased by 2.97 score points (2.45 to 3.49, p <0.001).

The 6-minute walking test increased by 118.82 metres (105.46 to 132.20, p <0.001) and exercise capacity increased by 0.28 watt/bodyweight (kg) (0.22 to 0.34, p <0.001).

Elderly patients tended to be less willing to change nutritional behaviour. Gender had no influence on changes in the five domains investigated.

Conclusions: Our multidisciplinary rehabilitation programme can be successfully implemented in clinical practice and has similar beneficial effects to those reported in clinical trials. Our results encourage broad implementation of such programmes in clinical practice.

The authors certify that there is no actual or potential conflict of interest in relation to this article.

Introduction

Cardiovascular diseases are the most important causes of death and loss of disability-adjusted life years worldwide [1]. In Switzerland cardiovascular diseases are the major causes of death in the male and female population (37% in 2006) [2]. Lifestyle modification such as a healthy diet with regular intake of fruit, vegetables and fish and a limited intake of fat, as well as avoidance of smoking, regular moderate physical activity and reduction of stress, has a substantial impact in primary and secondary prevention of coronary heart diseases in both men and women of all ages [1]. Both the European and the American guidelines recommend a multidisciplinary rehabilitation programme for patients with cardiovascular diseases as useful and effective (Class I) [3, 4]. Cardiac rehabilitation programmes are recognised as a core component of the management of patients who sustained ST-segment elevation myocardial infarction, unstable angina/non-ST-segment elevation myocardial infarction or chronic stable angina, patients who underwent coronary artery bypass surgery or percutaneous coronary intervention, and patients with heart failure or heart valve diseases [5]. Unlike earlier recommendations, modern cardiac rehabilitation not only aims at improving physical

Correspondence:
Elisa Stoira
Horten Center
Bolleystrasse 40
Postfach Nord, USZ
CH-8091 Zürich
elisa_stoira@hotmail.com

function but also includes interdisciplinary counselling where patients learn about their illness, find ways to lower their cardiovascular risks, receive nutritional advice and receive motivational support in changing their lifestyle [3, 6].

Various studies show that multidisciplinary rehabilitation programmes for patients with cardiac diseases have beneficial effects on behavioural change and physical fitness, resulting in enhanced quality of life and functional status, and lower rates of hospitalisation, recurrent myocardial infarction and long-term mortality [5, 7–10].

However, many clinicians argue that these programmes are not susceptible to straightforward implementation in daily clinical practice. They require a trained multidisciplinary team of physicians, physiotherapists, nutritionists and psychologists who are not regularly available in smaller hospitals. Others have questioned whether effects observed in clinical trials can be reproduced in everyday practice [11].

We set out to assess the clinical value of a recently implemented multidisciplinary rehabilitation programme which meets the requirements of modern guidelines. We were interested in investigating the effects of the cardiac rehabilitation programme by measuring changes from baseline in nutrition and smoking habits, wellbeing and self-perceived physical activity and objective physical performance. Besides investigating the overall effect of such an intervention, we were also interested in finding out whether these effects were different in elderly patients and females.

Methods

Patient recruitment and enrolment

This study was approved by the cantonal ethics committee of Canton Ticino.

Between January 2007 and July 2008 we asked all patients with coronary artery diseases, heart valve diseases or heart failure who attended and completed the cardiac rehabilitation programme at Cardiocentro Ticino in Lugano, Switzerland, to participate to our study.

Rehabilitation programme

Our programme complies with the SAKR (Swiss Workgroup for Cardiac Rehabilitation) guidelines. The multidisciplinary rehabilitation programme provides training in six different domains:

1. Nutritional counselling (8 hours)
2. Physical training (48 hours)
3. Risk factor management (4 hours)
4. Psychosocial support (7 hours)
5. Optimisation of medical therapy (1 hour)
6. Educational programme on cardiovascular diseases (4 hours)

The programme consists of 36 sessions of two hours over three months. Patients are asked to follow a bicycle or treadmill exercise programme three times a week for a total of 36 sessions. Exercise capacity has been chosen on the basis of the stress test the patient underwent at the beginning of the rehabilitation programme, of the patient's current physical situation and the therapists' opinion. The exercises are performed in steady state and in aerobic metabolic conditions. Each exercise session lasts one hour and consists of warming-up, exercise training and a cool-down period which includes stretching, gymnastics, breathing exercises and relaxation. The patients also receive nutritional counselling from a nutritionist and psychological support from a psychologist, follow a smoking cessation programme, learn strategies for stress management and receive training advice.

Data collection

At baseline we obtained physical performance data: all patients performed at baseline a 6-minute walking test and underwent ergometry or treadmill testing from which we obtained exercise capacity (measured in watts/bodyweight).

All patients completed an ad hoc questionnaire assessing their current food habits, smoking habits, wellbeing and self-perceived physical fitness. In the part of the questionnaire referring to cardiac diagnoses and interventions, patients were assisted by a member of the rehabilitation team.

In the part of the questionnaire dealing with food habits, the questions had four possible answers, each with its own score. Higher consumption of healthy foods (fruit, raw and cooked vegetables and fish) produces a higher score. The same applies to unhealthy foods (butter, cheese, red meat, eggs and sausages). This means, for healthy foods, the higher the score the better the dietary habits, and for the unhealthy foods, the higher the score the less good the dietary habits.

Following established recommendations [12] smokers were all those patients who were active smokers and those who had stopped smoking less than 6 months before. We assessed current wellbeing status using a visual analogue scale from 1 to 10, and assessed self-perceived physical fitness using a set of questions from the SF_{36} questionnaire. A higher score indicates better wellbeing and self-perceived physical fitness.

At baseline we also obtained information, based on each patient's medical records, on the concomitance of other illnesses such as hypercholesterolaemia, diabetes, hypertension and stroke. The detailed questionnaire is given in the appendix.

For each patient we also registered the cardiac diagnoses and treatments received.

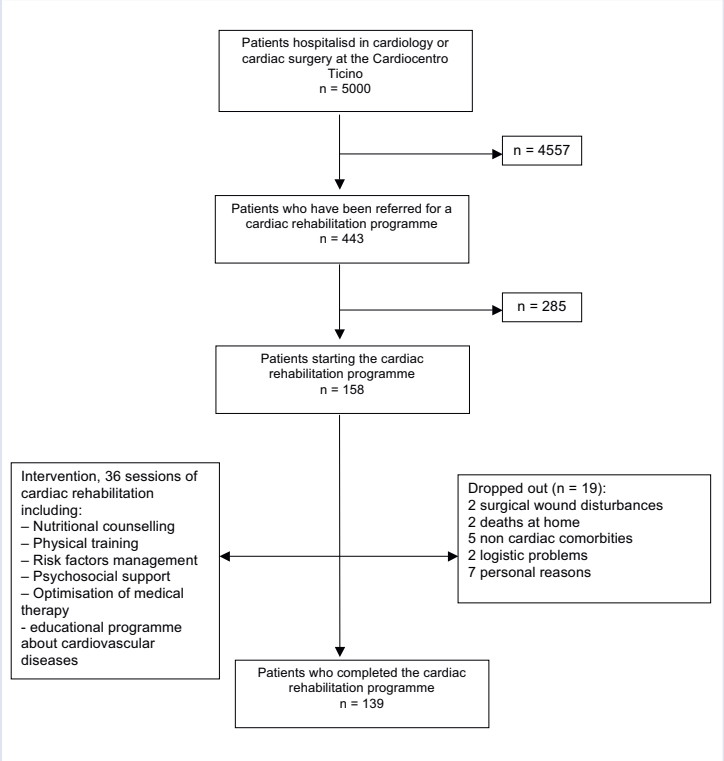
At three months, after completing the rehabilitation programme, all patients completed the questionnaire again, underwent ergometry or treadmill tests, and all patients performed a 6-minute walking test. The corresponding flowchart is presented in figure 1.

Outcome assessments

We were particularly interested in investigating changes in food habits, smoking habits, wellbeing, self-perceived physical fitness and objective physical performance parameters. We specified *a priori* that a reduction in consumption of butter, cheese, red meat, eggs and sausages would be beneficial [13, 14].

On the other hand, we specified that increased consumption of cooked and raw vegetables, fruit and fish would be beneficial [1, 15, 16]. We were also interested in exploring variability in these performance categories in relation to the patients' age and gender.

Figure 1
Flowchart.



Statistical analysis

Data were summarised using standard descriptive statistics. For each of the outcome variables we calculated changes from baseline. We tested these differences using a one-sample t-test. A p-value smaller than 0.05 was considered statistically significant. To assess the effect of patients' age and gender on the various outcomes we performed multivariable analyses entering age (continuous scale) and gender (male/female) as the independent and the change values in outcomes each as the dependent variable. Statistical analyses were performed using the Stata 10 statistical software package (StataCorp LP, 4905 Lakeway Drive, College Station, TX 77845, USA).

Results

Patients' characteristics

443 patients fulfilled the inclusion criteria for the cardiac rehabilitation programme and were referred by the treating physician. Of these, 285 attended a rehabilitation programme elsewhere or were not enrolled in any programme, and 158 attended the cardiac rehabilitation programme in the Cardiocentro Ticino and agreed to participate to our study. During the programme 19 patients dropped out due to non-cardiac comorbities or for personal reasons. Thus 139 patients completed the programme and constituted our study population.

Detailed descriptions of patients' characteristics are given in table 1.

Overall effects

Regarding nutritional habits compared to baseline, patients reduced the intake of fatty food by 1.70 score points (95% confidence interval [95%CI]: –2.06 to –1.28; p <0.001) and increased their intake of healthy food by 2.23 score points (95%CI: 1.88 to 2.58; p <0.001).

At baseline the number of smokers was 37, at the end of rehabilitation the number of smokers was reduced to 22 (p <0.001).

Overall wellbeing increased by 1.39 score points (95%CI: 1.11 to 1.67; p <0.001).

Overall self-perceived physical fitness increased by 2.97 score points (95%CI: 2.45 to 3.49; p <0.001).

Regarding objective physical performance, the 6-minute walking test increased by 118.82 metres (95%CI: 105.46 to 132.20; p <0.001) and exercise capacity measured in watts/bodyweight (kg) increased by 0.28 (95%CI: 0.22 to 0.34; p <0.001).

The main results are summarised in tables 2 and 3.

Subgroup analyses

Elderly patients were less willing to reduce fatty food (–0.04 [95%CI: –0.01 to –0.08]; p = 0.025). Age did not affect increased intake of healthy food.

There was a positive trend towards higher levels of wellbeing with increasing age (0.024 [95%CI: –0.004 to 0.051]; p = 0.10) without reaching statistical significance, but not for self-perceived physical fitness. In-

Table 1
Patients' characteristics.

Age		61.9 years (SD 10.1)
Gender	Male	119 (85.6%)
	Female	20 (14.4%)
Diagnosis	Stable coronary artery disease	33 (23.7%)
	Unstable angina, NSTEMI	60 (43.2%)
	STEMI	37 (26.6%)
	Other	9 (6.5%)
Intervention	PTCA + stent	64 (46.0%)
	Bypass	58 (41.7%)
	Other	17 (12.2%)
Diabetes	Yes	22 (15.8%)
	No	117 (84.2%)
Hypertension	Yes	55 (39.6%)
	No	84 (60.4%)
Smoking-status	Smokers	37 (26.6%)
	Non-smokers	102 (73.4%)
Cholesterol	Yes	43 (30.9%)
	No	43 (30.9%)
	Unknown	53 (38.1%)

NSTEMI = Non-ST-segment elevation myocardial infarction; STEMI = ST-segment elevation myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty; SD = Standard deviation.

Table 2
Results I.

Outcomes		Baseline values (SD)	Mean difference from baseline	95%CI	p-value
Food habits	Fatty food*	5.96 (2.59)	–1.70	–2.06 to –1.28	<0.001
	Healthy food**	5.08 (2.24)	+2.23	1.88 to 2.58	<0.001
Wellbeing	Wellbeing	6.46 (2.21)	+1.39	1.11 to 1.67	<0.001
Physical activity	Self-perceived	6.22 (3.72)	+2.97	2.45 to 3.49	<0.001
	6-minute walking test	551.58 (95.71)	+118.82	105.46 to 132.20	<0.001
	Exercise capacity (W/kg)	1.57 (0.48)	+0.28	0.22 to 0.34	<0.001

* Butter, cheese, red meat, eggs and sausages; ** Cooked and raw vegetables, fruits and fish.

Table 3
Results II.

Outcomes		Baseline	End	p-value
Smoking habits	Smokers	37	22	<0.001
	Non-smokers	102	117	

crease in objective measures of physical performance tended to be lower with increasing age, without reaching statistical significance. Female gender did not affect outcome performance.

Discussion

Main findings

This study has three main findings. First, we show that multidisciplinary cardiac rehabilitation can be successfully implemented in clinical practice. Patients who attended the cardiac rehabilitation programme showed an improvement in dietary habits, smoking habits, wellbeing, self-perceived physical fitness and objective physical performance.

Second, we show that the multidisciplinary approach was highly beneficial for all the subgroups investigated. Finally, we found a slight decrease in benefit, in particular with respect to nutritional change among the elderly.

Results in context with other studies

Our effects on nutritional habits, wellbeing, self-perceived physical activity and objective physical performance were similar to those measured in clinical studies [9, 17–19].

Our findings chiefly conform also to subgroup analyses investigating effects in female or elderly patients [17, 20, 21]. However, concerning the reduction in fatty aliment we found a trend towards lower adherence among the elderly. This finding contradicts a small study among 52 patients by Komorovsky and colleagues [22], who observed greater adherence in elderly patients.

In our study objective measurements of physical performance tended to show less improvement with increasing age, without reaching statistical significance. This finding confirms earlier reports that the effects of cardiac rehabilitation on objective physical performance may be less pronounced in patients over 75 [23].

Strengths and limitations

What are the limitations of this study? Among some 5000 patients who attend the cardiology centre annually, only a minority were referred to the cardiac rehabilitation programme.

A considerable number of patients were not referred by the treating physicians because it was judged unnecessary, not feasible or inappropriate. Some patients were not informed at all of the opportunity to follow a cardiac rehabilitation programme or stated that they were not motivated enough to attend it. Moreover, patients of the Canton Ticino often do not attend cardiac rehabilitation programmes because of geographical obstacles, such as the difficulty in reaching the hospital offering the programme, despite the fact that more than one rehabilitation centre is available in Ticino. Hence we cannot rule out selection bias resulting from this enrolment process. Arguably our sample was more likely to benefit from the programme than the average cardiology patient.

Further, this study had no control group to assess the programme's overall effect. However, since data of various previous studies showed that usual care does not improve performance in the outcomes, we are confident that the effects are specific to rehabilitation. We chose a typical observation period of 3 months but were unable to assess the long-term effects of our programme. Finally, the number of female patients was rather low. Hence caution is necessary in extrapolating our findings to females.

A strength of this study lies in the fact that it reflects the reality of a peripheral hospital's cardiac rehabilitation programme and shows the effects of the cardiac rehabilitation programme in everyday life.

We believe that the findings are of value for clinicians and hospitals planning to implement a cardiovascular rehabilitation programme.

Implications for research

There is a substantial body of evidence which confirms the value of a multidisciplinary cardiac rehabilitation programme for patients with cardiac diseases. The beneficial effects can be observed within a broad spectrum of age and co-morbidity in both genders. Astonishingly, despite this, only a small proportion of all patients receive adequate cardiac rehabilitation. There are various reasons for this: older patients, females and patients with co-morbidities are less likely to attend cardiac rehabilitation [24, 25]. On the other hand, patients living a shorter distance from the rehabilitation centre, with a higher educational level and a higher income, as well as patients with coronary bypass grafts, are more likely to receive adequate rehabilitation [24]. In his 2004 paper Julian stated that important additional reasons why effective treatments do not translate into clinical practice are doctors' and patients' ignorance, uncertainty about the applicability of research findings to individual patients and financial considerations [11].

In terms of implications for research two major topics emerge. First, we require concerted strategies to optimise transfer of medical knowledge to practice. This requires a careful examination of potential barriers to implementation on the one hand, and strategies to overcome them on the other. Second, we need to know more about the sustained value of rehabilitation programmes. It is our impression that the benefits of cardiac rehabilitation can be shown as long as one attends the programme. Most likely the beneficial effects and patient compliance regarding changes of lifestyle decrease when the cardiac rehabilitation programme is over. At the moment there is a paucity of long-term follow-up studies assessing the effects of cardiac rehabilitation.

Implications for practice

We believe that clinicians should be more aware of the benefits of cardiac rehabilitation programmes. Lieberman and colleagues noted that the most important factor in enrolling patients in a rehabilitation programme is the actual physician's recommendation [26]. Physicians should be encouraged to screen their cardiological patients, and the appropriateness of enrolling the individual patient should be discussed with those who run rehabilitation programmes.

Conclusions

This study shows that our multidisciplinary rehabilitation programme can be successfully implemented in clinical practice and has similar beneficial effects to those reported in clinical trials. The effects can also be observed in elderly people and in both genders. Our results encourage broad implementation of such programmes in clinical practice.

References

1 Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):937–52.
2 Statistik Bf. Todesursachestatistik, Ursachen der Sterblichkeit 2005–2006, Bundesamt für Statistik (BFS). http://wwwbfsadminch/bfs/portal/de/index/news/publikationenDocument111467pdf. 2008.
3 Balady GJ, Williams MA, Ades PA, Bittner V, Comoss P, Foody JM, et al. Core components of cardiac rehabilitation/secondary prevention programs: 2007 update: a scientific statement from the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee, the Council on Clinical Cardiology; the Councils on Cardiovascular Nursing, Epidemiology and Prevention, and Nutrition, Physical Activity, and Metabolism; and the American Association of Cardiovascular and Pulmonary Rehabilitation. Circulation. 2007;115(20):2675–82.
4 Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, et al. European guidelines on cardiovascular disease prevention in clinical practice: full text. Fourth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of nine societies and by invited experts). Eur J Cardiovasc Prev Rehabil. 2007;14(Suppl 2):S1–113.
5 Wenger NK. Current status of cardiac rehabilitation. J Am Coll Cardiol. 2008;51(17):1619–31.
6 Haskell WL, Alderman EL, Fair JM, Maron DJ, Mackey SF, Superko HR, et al. Effects of intensive multiple risk factor reduction on coronary atherosclerosis and clinical cardiac events in men and women with coronary artery disease. The Stanford Coronary Risk Intervention Project (SCRIP). Circulation. 1994;89(3):975–90.
7 Ades PA. Cardiac rehabilitation and secondary prevention of coronary heart disease. N Engl J Med. 2001;345(12):892–902.
8 Williams MA, Ades PA, Hamm LF, Keteyian SJ, LaFontaine TP, Roitman JL, et al. Clinical evidence for a health benefit from cardiac rehabilitation: an update. Am Heart J. 2006;152(5):835–41.
9 Oldridge N, Guyatt G, Jones N, Crowe J, Singer J, Feeny D, et al. Effects on quality of life with comprehensive rehabilitation after acute myocardial infarction. Am J Cardiol. 1991;67(13):1084–9.
10 Giannuzzi P, Saner H, Bjornstad H, Fioretti P, Mendes M, Cohen-Solal A, et al. Secondary prevention through cardiac rehabilitation: position paper of the Working Group on Cardiac Rehabilitation and Exercise Physiology of the European Society of Cardiology. Eur Heart J. 2003;24(13):1273–8.
11 Julian DG. Translation of clinical trials into clinical practice. J Intern Med. 2004;255(3):309–16.
12 Prochaska JO, DiClemente CC, Velicer WF, Ginpil S, Norcross JC. Predicting change in smoking status for self-changers. Addict Behav. 1985;10(4):395–406.
13 Iestra JA, Kromhout D, van der Schouw YT, Grobbee DE, Boshuizen HC, van Staveren WA. Effect size estimates of lifestyle and dietary changes on all-cause mortality in coronary artery disease patients: a systematic review. Circulation. 2005;112(6):924–34.
14 Krauss RM, Eckel RH, Howard B, Appel LJ, Daniels SR, Deckelbaum RJ, et al. AHA Dietary Guidelines: revision 2000: A statement for healthcare professionals from the Nutrition Committee of the American Heart Association. Circulation. 2000;102(18):2284–99.
15 Bazzano LA, He J, Ogden LG, Loria CM, Vupputuri S, Myers L, et al. Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. Am J Clin Nutr. 2002;76(1):93–9.
16 de Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. Circulation. 1999;99(6):779–85.
17 Lavie CJ, Milani RV. Effects of cardiac rehabilitation and exercise training on exercise capacity, coronary risk factors, behavioral characteristics, and quality of life in women. The Am J Cardiol. 1995;75(5):340–3.
18 Maines TY, Lavie CJ, Milani RV, Cassidy MM, Gilliland YE, Murgo JP. Effects of cardiac rehabilitation and exercise programs on exercise capacity, coronary risk factors, behavior, and quality of life in patients with coronary artery disease. South Med J. 1997;90(1):43–9.
19 Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. Ann Intern Med. 2005;143(9):659–72.
20 Lavie CJ, Milani RV. Benefits of cardiac rehabilitation and exercise training programs in elderly coronary patients. Am J Geriatr Cardiol. 2001;10(6):323–7.
21 Lavie CJ, Milani RV. Benefits of cardiac rehabilitation and exercise training in elderly women. Am J Cardiol. 1997;79(5):664–6.
22 Komorovsky R, Desideri A, Rozbowsky P, Sabbadin D, Celegon L, Gregori D. Quality of life and behavioral compliance in cardiac rehabilitation patients: a longitudinal survey. Int J Nurs Stud. 2008;45(7):979–85.
23 Marchionni N, Fattirolli F, Fumagalli S, Oldridge N, Del Lungo F, Morosi L, et al. Improved exercise tolerance and quality of life with cardiac rehabilitation of older patients after myocardial infarction: results of a randomized, controlled trial. Circulation. 2003;107(17):2201–6.
24 Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. Circulation. 2007;116(15):1653–62.
25 Worcester MU, Murphy BM, Mee VK, Roberts SB, Goble AJ. Cardiac rehabilitation programmes: predictors of non-attendance and drop-out. Eur J Cardiovasc Prev Rehabil. 2004;11(4):328–35.
26 Lieberman L, Meana M, Stewart D. Cardiac rehabilitation: gender differences in factors influencing participation. Journal of women's health / the official publication of the Society for the Advancement of Women's Health Research. 1998;7(6):717–23.