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Cardiac rehabilitation: The psychological changes that predict health outcome and healthy behaviour

SUSAN MICHIE[1], DARYL O'CONNOR[2], JULIAN BATH[3], MARK GILES[3], & LOUISE EARLL[3]

[1]*Centre for Outcomes Research and Effectiveness, Department of Psychology, University College London,* [2]*School of Psychology, University of Leeds, and* [3]*Health Psychology Department, Gloucestershire Royal Hospital, Gloucester, UK*

Abstract
Although there is good evidence that cardiac rehabilitation is effective in improving health outcomes, little is known about the psychological changes that may contribute to these outcomes. This study describes changes in cognition, emotion, behaviour, and health following cardiac rehabilitation and investigates predictors of health outcome and healthy behaviour. Sixty-two people were followed up 2 months after the end of a cardiac rehabilitation programme and 29 people were followed up for 8 months. Compared with before the programme, patients showed increased perceived control over their illness, more confidence in their ability to change their eating habits, and decreased anxiety and depression at both 2 and 8 months after the end of the programme. The increase in perceived control, predicted anxiety and depression 2 months after the course and increased confidence in change predicted better mental health 8 months after. The decrease in depression predicted lower anxiety at 8 weeks and lower anxiety, depression and better mental health at 8 months. The decrease in anxiety predicted lower depression at 8 weeks and lower anxiety, depression, and a trend towards better physical health at 8 months. These results suggest that changing health cognitions after myocardial infarction may reduce distress and this may have long-term benefits for physical health.

Keywords: *Cardiac rehabilitation, perceived control, illness representations*

Introduction

Cardiac rehabilitation that combines exercise, psychological and educational interventions improves recovery of physical functioning and long-term health following acute myocardial infarction (MI) or a coronary artery bypass graft (CABG) (University of York, 1998). A review of 37 studies showed a 34% reduction in cardiac mortality, 29% reduction in recurrence of MI and positive effects on blood pressure, cholesterol, body weight, smoking behaviour, physical exercise, and eating habits (Dusseldorp, Elderen, Maes, Meulman, & Kraaij, 1999). Cardiac rehabilitation is recognized by the UK government as a cost-effective approach to reduce future health problems (National Service Framework on Coronary Heart Disease, 2000; National Institute for Clinical Excellence, 2001).

Correspondence: Susan Michie, Centre for Outcomes Research and Effectiveness, Department of Psychology, University College London, 1 – 19 Torrington Place, London WC1E 7HB, UK. Tel: 0207 679 5930. Fax 0207 916 8511. E-mail: s.michie@ucl.ac.uk

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Although meta-analyses can give good estimates of the effects of interventions, they may cancel out contradictory findings from different studies and do not investigate the processes of change. For example, adding health education and/or a psycho-educational prevention programme to standard medical care and physical training had a favourable short-term effect on eating habits, yet led to less change in sedentary lifestyle and smoking (Van Elderen & Dusseldorp, 2001). One explanation for this finding is that these educational interventions may increase patients' tendency to believe that stress is the most important risk factor for the onset and progression of their condition (French, Marteau, Senior, & Weinman, 2002; Furze and Lewin, 2000) and believe that physical activity or the stress of smoking cessation may contribute to another MI.

This notion is consistent with Leventhal's self-regulatory model of illness (Leventhal, Meyer, & Nerenz, 1987), which posits that when individuals are faced with an illness threat, they form cognitive representations of illness that direct their emotional and behavioural responses. These representations have been shown to consist of five components: (a) identity, which refers to the label given to the disease (e.g., heart attack) and the associated symptoms (e.g., chest pain); (b) the patients' beliefs about the consequences (e.g., physical, economic and social implications); (c) the cause (e.g., stress); (d) duration (timeline); and (e) the controllability and/or curability of their condition.

Patients' cognitive representations of illness shortly after an MI have implications for aspects of recovery. Those believing that their MI had very serious consequences had greater levels of illness-related disability and took longer to return to work (Petrie, Weinman, Sharp, & Buckley, 1996). An intervention that altered patients' negative beliefs about their MI resulted in substantially improved functional outcomes, such as earlier return to work and lower rates of angina symptoms (Petrie, Cameron, Ellis, Buick, & Weinman, 2002). These findings highlight the importance of psychological factors in cardiac rehabilitation programmes. Despite this, there is a paucity of research examining the influence of cardiac rehabilitation on changes in patients' cognitive representations or the influence of other psychological factors (e.g., depression, anxiety) on psychological and physical health outcomes.

The current study investigates psychological change, levels of distress and quality of life following a UK multidisciplinary hospital based cardiac rehabilitation programme. It aims to:

(a) Describe changes in cognition, emotion, behaviour and health following cardiac rehabilitation, and
(b) Determine whether changes in cognition or emotion predict health outcome and healthy behaviour.

Method

Design

Patients completed questionnaires three times: 2 weeks before attending the cardiac rehabilitation programme, and approximately 8 weeks and 8 months after the end of the programme.

Sample

One hundred and fifty-eight people, with an average age of 59 years, attended cardiac rehabilitation during April 1998 to April 1999. Sixty-two people fully completed questionnaires at baseline and 8 weeks after the end of the programme, and 29 people

completed questionnaires 8 months after the end of the programme. The demographic profile of the two groups that completed questionnaires closely mirrored that of the attendees.

Cardiac rehabilitation programme

The programme aims to reduce the risk of cardiac problems in those admitted to hospital with a MI or having undergone a CABG within the previous 4 weeks and to promote their return to a full and active life. Methods include improving knowledge about coronary heart disease and reducing misconceptions, helping patients initiate and maintain lifestyle changes (e.g., smoking, eating and exercise) by goal setting and action planning, managing stress and reducing psychological distress, enhancing adherence to medical advice and cardiac medication, and improving the quality of life by restoring confidence.

Seven weekly 2-h sessions, led by a nurse, physiotherapist and a health psychologist, are followed by 1-h sessions approximately 8 weeks and then 6–8 months after completing the programme to reinforce key points of the programme.

Compared to national figures, this programme has a high take-up and attendance rate, and low dropout.

Psychological measures

Illness perceptions. The Illness Perceptions Questionnaire, a reliable and valid measure (Weinman, Petrie, Moss-Morris & Horne, 1996), assessed patients' cognitive representations of their heart condition/heart attack on scales of identity, causes, timeline, consequences and cure/control.

Self-efficacy measures. Single-item study specific measures assessed self-efficacy relating to eating, exercise and stress (i.e., ''How confident are you in your ability to change your eating habits?'', ''How confident are you in your ability to increase your level of fitness?'', ''How confident are you in your ability to reduce your level of stress?''). These items were based on Bandura (1982) and rated on a 10-point Likert-type scale ranging from 1: ''Not at all'' to 10:''A great deal''.

Emotional state. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scales (HADS), which has good reliability and validity (Zigmond & Snaith, 1983). Seven items measure anxiety and seven items measure depression, with four response categories (0–3) ordered in terms of frequency or severity.

Quality of life. Mental and physical health outcomes were assessed using the 12-item Short Form (SF-12) health survey, which has good reliability and validity (Crispin & Layte, 1997). Seven items measured physical functioning and five measured mental health.

Healthy eating. A study specific single-item measured healthy eating: ''How many servings of fruit and vegetables do you eat each day?'' Response categories were ''none'', ''1–2 servings'', ''3–4 servings'' and ''5 or more servings''.

Procedure. The invitation to attend the cardiac rehabilitation programme was accompanied by a study information sheet, consent form, and assessment questionnaire. Patients were asked to bring the completed questionnaire to the first session of the programme. After the end of the programme, patients were sent a questionnaire to bring to each of their follow-up appointments.

Statistical analysis

Depression was skewed to the right and was normalized by the square-root function transformation. The eating self-efficacy measure had non-normal kurtosis and skewness at first follow-up. Since it was normally distributed at the other two time-points, it was not transformed. Three participants scored below the third standard deviation on one variable (two on mental health and one on the control/cure scale). They were retained in the study and assigned the score of the next highest score in the data set. One participant scored below the third standard deviation on three variables (mental health, physical health, and the control/cure scale) and was removed from the study.

Changes over time were analysed non-parametrically, using the Wilcoxon Signed Ranks Test and the Friedman Test. The impact of change in predictor variables between baseline and 8-week follow-up on outcome variables at 8-week and 8-month follow-up was tested by linear regression, controlling for baseline scores of predictor variables. Probability levels were adjusted for multiple comparisons and for directional hypotheses, giving a cut-off of for significance of $p < .006$ and for a trend as $p < .012$.

Results

Eight-week follow-up

Change over time. Eight weeks after the cardiac rehabilitation course, heart condition/heart attack was seen as more controllable ($Z = 2.21$, $p = .027$) and less likely to be caused by diet ($Z = 2.68$, $p = .007$) than before the programme (Table I). Participants felt more confident in their ability to change their eating habits and to reduce their level of stress ($Z = 2.85$, $p = .004$ and $Z = 2.11$, $p = .035$, respectively). Anxiety and depression decreased ($Z = 2.50$, $p = .012$ and $Z = 4.11$, $p < .001$, respectively). Physical and mental health improved ($Z = 3.70$, $p < .001$ and $Z = 2.56$, $p = .010$, respectively). Participants reported eating more servings of fruit and vegetables ($Z = 3.13$, $p = .002$ at 8 weeks).

Prediction of 8-week outcome from baseline scores. Mental health 8 weeks after the course was predicted by baseline anxiety and depression ($r = .34$, $p = .004$ and $r = .44$, $p < .001$, respectively). Anxiety was predicted by having, at baseline, low self-confidence in being able to change diet and stress level ($r = .38$, $p = .002$ and $r = .36$, $p = .005$, respectively). Anxiety and depression were both predicted by baseline anxiety and depression (Table II).

Prediction of 8-week outcome from change in scores. Increased perception of control over the illness predicted lower depression and a trend towards lower anxiety 8 weeks after the course (Beta weights = .468, $p < .001$ and .331, $p = .012$, respectively). Reductions in depression predicted lower anxiety and reductions in anxiety predicted lower depression (Beta weights = .652, $p < .001$ and .429, $p < .002$, respectively; Table III).

Eight-month follow-up

Change over time. Heart condition/heart attack was seen as more controllable ($\chi^2 = 8.83$, $p = .012$) and participants felt more confident in their ability to change their eating habits ($\chi^2 = 8.96$, $p = .011$) and to increase their level of fitness ($\chi^2 = 6.69$, $p = .035$). Anxiety and depression decreased ($\chi^2 = 12.40$, $p = .002$ and $\chi^2 = 17.07$, $p < .001$, respectively; Table IV.

Table I. Changes over time at 8-week follow-up ($n = 62$).

Measures	2 weeks before programme	8-week follow-up	Wilcoxon Signed Ranks Test, Z
Illness perceptions (IPQ)			
Identity	5.74 (2.25)	5.45 (2.79)	ns
Timeline	3.20 (0.84)	3.40 (0.84)	ns
Consequences	3.13 (0.54)	3.07 (0.50)	ns
Control/cure	4.04 (0.44)	4.18 (0.42)	− 2.21, $p = 0.027$
Cause: diet	2.63 (1.13)	3.02 (1.05)	− 2.68, $p = 0.007$
Cause: stress	3.03 (1.21)	3.10 (1.20)	ns
Self-efficacy (single item)			
Eating	7.65 (2.09)	8.29 (1.88)	− 2.85, $p = 0.004$
Exercise	7.17 (2.12)	7.51 (1.96)	ns
Stress	5.95 (2.47)	6.64 (2.23)	− 2.11, $p = 0.035$
Emotional state (HADS)			
Anxiety	5.81 (3.92)	4.73 (3.38)	− 2.50, $p = 0.012$
Depression	3.79 (2.76)	2.42 (2.27)	− 4.11, $p < 0.001$
Quality of life (SF-12)			
Physical health	46.09 (8.00)	50.58 (5.89)	− 3.70, $p < 0.001$
Mental health	50.16 (10.07)	54.17 (6.51)	− 2.56, $p = 0.010$
Healthy behaviour			
No. servings of fruit and veg.	1.97 (0.75)	2.19 (0.72)	− 3.13, $p = 0.002$

IPQ, Illness Perceptions Questionnaire; HADS, Hospital Anxiety and Depression Scales; SF-12, 12-item Short Form; ns, not significant

Table II. Correlations between predictor variables at baseline and outcome at 8-week follow-up ($n = 62$).

	8-week follow-up				
Baseline	Physical health	Mental health	Healthy eating	Anxiety	Depression
Identity	− .11	− .24	− .13	.10	.18
Timeline	.03	− .19	.18	.10	.07
Consequences	.04	− .06	− .03	.28	.18
Control	.16	.006	.07	− .001	− .04
Cause: diet	.06	.007	− .03	.054	.11
Cause: stress	.16	− .11	.05	.19	− .09
Self-efficacy: eating	.09	− .01	.11	− .38**	− .14
Self-efficacy: exercise	.13	.16	.18	− .29	− .16
Self-efficacy: stress	− .05	.08	.07	− .36*	− .16
Anxiety	.05	− .34*	− .004	.66***	.33**
Depression	− .05	− .44***	− .11	.47***	.54***

*$p < .006$, **$p < .003$, ***$p < .001$.

Physical health improved ($\chi^2 = 9.93$, $p = .007$) and participants reported eating more servings of fruit and vegetables ($\chi^2 = 8.00$, $p = .018$).

Prediction of 8 months outcome from baseline scores. Mental health 8 months after the course was predicted by baseline anxiety and low self-confidence in being able to change diet ($r = .71$, $p < .001$ and $r = .52$, $p = .003$, respectively). Anxiety and depression were both predicted by baseline anxiety ($r = .72$, $p < .001$ and $r = .56$, $p < .002$, respectively) and depression was predicted by baseline depression ($r = .58$, $p < .001$; Table V).

Table III. The impact of changes in perceived control and emotional state on anxiety and depression at 8-week follow-up.

	Independent variables														
	Change in perceived control					Change in anxiety					Change in depression				
Dependent variables	β	Adj. R^2	ΔR^2	ΔF	$p <$	β	Adj. R^2	ΔR^2	ΔF	$p <$	β	Adj. R^2	ΔR^2	ΔF	$p <$
Anxiety	− .331	.07	.10	6.67	.012						.429	.29	.13	10.9	.002
Depression	− .468	.20	.20	15.40	.001	.652	.28	.24	20.3	.001					

Table IV. Changes over time at 8 months follow-up ($n = 29$).

Measures	2 weeks before programme	8-week follow-up	6 – 8-month follow-up	Friedman Test, χ^2
Illness perceptions (IPQ)				
Identity	6.07 (2.25)	5.31 (2.81)	5.76 (2.81)	ns
Timeline	3.33 (0.80)	3.41 (0.93)	3.41 (0.86)	ns
Consequences	3.06 (0.41)	3.08 (0.54)	2.95 (0.50)	ns
Control/Cure	3.98 (0.41)	4.19 (0.42)	3.86 (0.50)	8.83, $p = .012$
Cause: diet	2.38 (1.18)	2.83 (1.04)	2.66 (1.04)	ns
Cause: stress	3.03 (1.18)	3.14 (1.30)	3.21 (1.26)	ns
Self-efficacy (single item)				
Eating	7.69 (2.21)	8.38 (2.23)	8.86 (1.38)	8.96, $p = .011$
Exercise	6.79 (2.18)	7.61 (2.18)	7.48 (1.68)	6.69, $p = .035$
Stress	5.67 (2.83)	6.29 (2.59)	6.86 (2.06)	ns
Emotional state (HADS)				
Anxiety	6.28 (4.03)	4.86 (3.28)	4.72 (3.90)	12.40, $p = .002$
Depression	3.97 (2.82)	2.24 (2.13)	2.55 (2.47)	17.07, $p < .001$
Health outcome (SF-12)				
Physical	45.94 (7.84)	50.45 (6.30)	51.68 (5.98)	9.93, $p = .007$
Mental	49.88 (9.70)	54.43 (5.27)	54.84 (5.41)	ns
Healthy behaviour				
No. servings of fruit and veg.	2.14 (0.69)	2.41 (0.57)	2.41 (0.68)	8.00, $p = .018$

IPQ, Illness Perceptions Questionnaire; HADS, Hospital Anxiety and Depression Scales; SF-12, 12-item Short Form; ns, not significant

Prediction of 8 months outcome from change in scores. Reductions in depression 8 weeks after the course predicted lower depression, anxiety and improved mental health 8 months after the course (Beta weights = .713, $p < .001$; .793, $p < .001$; and − .571, $p < .001$, respectively). Reductions in anxiety 8 weeks after the course predicted lower anxiety, depression and a trend towards improved physical health 8 months after the course (Beta weights = .690, $p < .001$; .658, $p < .006$; and − .718, $p < .011$, respectively; Table VI).

Associations between 8-week and 8-month follow-up

In addition to correlations between anxiety and depression at 8 weeks and mental health at 8-month follow-up, there was a correlation between depression at 8 weeks and physical health at 8-month follow-up ($r = .52$, $p = .002$). There was no association between physical health at 8 weeks and depression at 8-month follow-up.

Table V. Correlations between predictor variables at baseline and outcome variables at 8 months follow-up ($n = 29$).

	8 months follow-up				
Baseline	Physical health	Mental health	Healthy eating	Anxiety	Depression
Identity	− .38	.05	.05	− .21	− .21
Timeline	.04	− .23	− .18	.38	.38
Consequences	.41	− .07	.11	.32	− .06
Control	.28	− .25	.16	.22	− .03
Cause: diet	.07	.28	.11	− .03	− .25
Cause: stress	.31	− .27	.12	.13	.08
Self-efficacy: eating	.02	.52**	− .36	− .42	.48
Self-efficacy: exercise	.12	.32	− .11	− .19	− .47
Self-efficacy: stress	− .03	.34	− .25	− .29	− .11
Anxiety	.12	− .71***	− .08	.72***	.56**
Depression	− .16	− .28	− .02	.18	.58***

*$p < .006$, **$p < .003$, ***$p < .001$.

Table VI. The impact of changes in emotional state on health and emotional state at 8 months follow-up.

	Independent variables									
	Change in anxiety					Change in depression				
Dependent variables	β	Adj. R^2	ΔR^2	ΔF	$p <$	β	Adj. R^2	ΔR^2	ΔF	$p <$
Anxiety	.690	.70	.20	19.19	.001	.793	.75	.61	69.08	.001
Depression	.658	.45	.20	8.98	.006	.713	.45	.32	14.36	.001
Physical health	− .718	.18	.22	7.56	.011					
Mental health						− .571	.42	.30	14.59	.001

Discussion

Cardiac patients attending a cardiac rehabilitation programme showed increased perceived control over their illness, more confidence in their ability to change their eating habits and decreased anxiety and depression at both 2 and 8 months after the end of the programme, compared to before. The increase in perceived control predicted anxiety and depression 2 months after the course and increased confidence in change predicted better mental health 8 months after. The decrease in depression predicted lower anxiety at 8 weeks and lower anxiety, depression and better mental health at 8 months. The decrease in anxiety predicted lower depression at 8 weeks and lower anxiety, depression and a trend towards better physical health at 8 months.

We also found depression at 8-weeks follow-up predicted physical health at 8-months follow-up, but physical health did not predict subsequent depression. These results suggest that reductions in depression and anxiety are drivers of physical recovery, and that increasing perceived control over one's illness plays a part in reducing depression and anxiety. Although causal attributions and self-efficacy changed over time, they did not predict outcome. Perceptions of the nature of the illness, its time-line and its consequences did not appear to change nor to predict outcome.

The absence of a control group in this study means that it is not possible to attribute the observed changes to the rehabilitation course. However, the results suggest that any impact is through perception of control over the illness and emotional changes rather than through changing self-efficacy over health behaviours or changing perceptions of the nature, cause and consequences of the illness. Replication studies should be conducted to inform the development of future interventions.

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