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Original Article

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Abstract

Background: Despite well-established evidence of benefit from cardiac rehabilitation, typically fewer than 35% of eligible patients attend.

Objective: The purpose of this study was to evaluate whether theory-based invitations increase attendance at cardiac rehabilitation.

Method: The study was a randomized controlled trial (RCT) with two by two factorial design. A total of 375 participants with acute myocardial infarction or coronary revascularization was recruited from medical and surgical cardiac wards at Aberdeen Royal Infirmary (ARI). They were randomly assigned to receive either the standard invitation letter or a letter with wording based on the 'theory of planned behavior (TPB)' and the 'common sense model of illness perception', and either a supportive leaflet with motivational messages or not. The primary outcome was one or more attendances at cardiac rehabilitation.

Results: The theory-based letter increased attendance at cardiac rehabilitation compared to the standard letter (84% versus 74%, odds ratio (OR) 2.93, 95% confidence interval (CI) 1.54–5.56), independent of age, gender, working status, hypertension, identity and TPB constructs. The number needed to treat (NNT) was 9 (95% CI 7–12). The motivational leaflet had no significant effect on attendance at rehabilitation (OR 1.02, 95% CI 0.57–1.83).

Conclusions: The use of theory-based wording in invitation letters is a simple method to improve attendance at cardiac rehabilitation. Our letter, reproduced in this paper, could provide a template for practitioners and researchers.

Keywords

Cardiac rehabilitation, common sense model, theory of planned behavior

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Introduction

Cardiac rehabilitation (CR) programs improve physical and psychological recovery and reduce mortality and morbidity after acute cardiac events.[1–3] In a systematic review of randomized controlled trials (RCTs), rehabilitation (exercise based CR) reduced mortality rates by 10–25%.[4] In worldwide reports, typically fewer than 35% of eligible patients take part in cardiac rehabilitation.[5–7] CR is a long-term process starting from diagnosis: most evidence of benefit relates to exercise-based or 'comprehensive' CR conducted in an outpatient setting (called 'phase 3' in the UK). Typically this commences six weeks after the initial recovery phase and comprises at least twice weekly sessions of exercise, relaxation and education, for eight weeks.[8]

There have been many suggested measures to improve participation in cardiac rehabilitation, but few have been evaluated. A systematic review in 2004 found only six studies reporting interventions designed to improve the

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uptake of cardiac rehabilitation, of which three were evaluated in RCTs.[9] All three improved attendance significantly but two were resource intensive: one intervention involving extra staff for liaison and group discussions increased CR attendance by 18%; another involving telephone calls and home visits increased CR attendance by 30%.[10,11] The third small trial involved only rewording invitation letters.[12] Attendance was 86% among those receiving the reworded letters compared with 59% in the control group ($p<0.002$). The idea that something as simple as a change in wording could have such a dramatic effect on attendance may appear unlikely. It does, however, have some support from another, albeit non-randomized, study, where a motivational message via a pamphlet containing information about heart disease and cardiac rehabilitation also increased participation in cardiac rehabilitation.[13]

We believed that an effective intervention would have to provide incentives and tackle key barriers to attendance. We followed the Medical Research Council (MRC) Framework for the development of complex interventions which provides guidance on key steps and strategies, including identification of evidence, development of theoretical understanding, and modeling of processes and outcomes.[14,15] We developed two postal interventions which sought to increase attendance at cardiac rehabilitation.[16] The first was a new invitation letter and the second was a supportive leaflet, both of which had been informed by theories of health-related behavior. We hypothesized that these interventions would increase attendance at outpatient (phase 3) cardiac rehabilitation.

Methods

Trial design

A two by two factorial design was used to compare the new invitation letter with the standard letter previously used by the cardiac rehabilitation program, and to compare a supplementary leaflet with no leaflet, with equal allocation between four groups (Figure 1). The factorial design is an efficient way to evaluate two interventions in one RCT.

	No leaflet	Leaflet
Standard letter	A	C
New letter	B	D

Figure 1. Allocation of the interventions in the two by two factorial design.

Participants

Patients were eligible to take part if admitted with acute myocardial infarction or for coronary artery bypass surgery or coronary angioplasty at the Aberdeen Royal Infirmary (ARI) and referred to either the hospital-based CR program in Aberdeen city or one of the three community programs in Aberdeenshire. Exclusion criteria were terminal illness, arrhythmia, alcohol or drug abuse, or mental or physical disability.

The interventions

Details of the interventions and their development are described elsewhere[16] and they are replicated in Boxes 1

Box 1. The relationship between the text of the intervention letter and theoretical constructs.

Theoretical constructs (from source theory)	Operational intervention letter (words in italics)
Subjective norm (TPB)	***Your consultant and health team have recommended*** that you undergo an eight-week CR program, which aims to help you to recover and improve your health and life.
Perceived behavioral control (TPB)	The program is multi-disciplinary, which means that the doctor, CR nurse, dietician, physiotherapist and occupation therapist ***work together to tailor the program to meet your individual needs***
Perceived controllability of the condition (CSM), perceived behavioral control (TPB)	During the program you will participate in ***supervised aerobic exercise in a safe environment***, followed by relaxation sessions.
Perceived consequences of the condition (CSM)	After leaving hospital, ***many patients still have episodes of chest pain and emotional distress***, which can stop them returning to normal daily activities quickly.
Attitude towards the behavior (TBP), controllability (CSM)	Research shows, however, ***that people who attend CR are more physically fit, return to work and other activities more quickly, and have lower chances of having chest pain, anxiety or depression than those who don't attend***.

Box 2. Theoretical constructed letter.

Dear,
Your consultant and health team have recommended that you undergo an eight-week cardiac rehabilitation program, which aims to help you to recover and improve your health and life. The program is multidisciplinary, which means that the doctor, cardiac rehabilitation nurse, dietician, physiotherapist and the occupational therapist work together to tailor the program to meet your individual needs. During the program you will participate in supervised aerobic exercise in a safe environment, followed by relaxation sessions. In addition, there are education sessions once per week, providing information on anatomy and physiology, healthy eating, long-term exercise, medicines, and stress management.
After leaving hospital, many patients still have episodes of chest pain and distress, which can stop them returning to normal daily activities quickly. Research shows, however, that people who attend cardiac rehabilitation are more physically fit, return to work and other activities more quickly, and have lower chances of having chest pain, anxiety, or depression, than those who don't attend.
Your appointment is on ……You should come to the Westburn Centre on the Foresterhill site, off Westburn Road (see enclosed map).
If for any reasons you are unable, or do not wish to attend please contact us on 01224553946. If we are not in the office please leave a message and we will call you back. You should allow approximately one hour and 15 minutes for this visit. During this time you will be given information about the program.
You will be asked to do a walking test in a safe supervised environment, so please do not plan a busy day. You should wear comfortable clothing and flat, rubber soled shoes.
Please bring a list of your medication with you and reading glasses if needed.
We look forward to meeting you.

Yours sincerely

Box 3. The content of the supportive leaflet.

Please read this paper on the day before the first session of the cardiac rehabilitation program is scheduled.
Tomorrow is your chance to attend cardiac rehabilitation. We are aware that some people have doubts about attending. Some common concerns are:

- Feeling your health is not up to it.
- Or feeling so well that you think you don't need cardiac rehabilitation.
- Having a condition that affects your movement-such as arthritis or osteoporosis.
- Fear of having another heart event or feeling anxious about exercising after a cardiac event.
- Having commitments with other people or not having enough time.
- Living far away from the rehabilitation centre or having transport problems.
- Feeling unconfident or uncomfortable about doing exercise in front of other people.

We know that many people have concerns like these, which is why your first appointment is for an assessment. We will use this to take account of your current health, and the difficulties you may have attending. Remember that our aim is to work through the cardiac rehabilitation program to help you to recover, benefit your future health and prevent further cardiac events. We want to increase your confidence, speed your recovery and improve your quality of life.

When you are at cardiac rehabilitation, you will have the chance to:

- Learn how the heart works and why and how people develop heart disease.
- Discover how to identify your own risk factors for heart disease.
- Learn about diet and healthy eating – and discuss your own diet with a health professional.
- Find out how to recognize your own stress and how to manage it.
- If you are a smoker, you will be offered advice on how to stop and support with doing it.
- Find out about your medication, and discuss it with the doctor, nurse or pharmacist.
- Learn what to do in an emergency.
- Find out about practical things like driving and holidays.
- Have the cardiac rehabilitation team help you decide about going back to work.
- Ask questions and be able to talk privately about any worries you may have.

All of these things have real benefits. Many people find that by following cardiac rehabilitation they become fitter than before, are able to control their stress, can return to work and/or everyday activities in a short time, and are more confident in maintaining a healthy diet and regular exercise. Importantly, research shows that people who attend cardiac rehabilitation have a reduced risk of a further cardiac event.

We hope you now think it is time to attend cardiac rehabilitation. Do not miss the chance to improve your health. We have reserved a place for you tomorrow. If there is anything about cardiac rehabilitation that you wish to discuss, please feel free to contact the cardiac rehabilitation team

and 2. The wording of both was based on the theory of planned behavior (TPB)[17,18] and the common sense model (CSM) of illness perception.[19] The CR program secretary posted either the standard or the new letter, with or without the supplementary leaflet (according to group allocation), to the participant's home address two weeks before they were due to attend their outpatient CR. The leaflet included instructions for it to be read the day before the participant's first appointment. As per usual practice, participants in all groups received a follow up telephone call after their postal invitation to encourage attendance.

Participant recruitment and randomization

Patients were approached by the ward nurses or physiotherapist who conducted inpatient CR. Those eligible were offered outpatient CR. The names of those who indicated they were willing to be approached about the study, were given to the researcher (SM). The researcher provided oral and written information about the study, obtained informed consent, and then collected baseline information from medical records including age, gender, reason for admission and previous medical history.

The researcher assigned sequential ID numbers to newly recruited participants and, on a weekly basis, sent this list to the CR secretary. An independent statistician randomly allocated a list of ID numbers into four groups and provided this to the CR secretary, who posted the appropriate invitation letter plus or minus the leaflet according to the allocation.

Outcome

The primary outcome was attendance at one or more of the bi-weekly sessions of the eight-week outpatient CR programme, as recorded by the CR nurses. There are no other phase 3 CR programs in the region, so participants who did not attend any of the four monitored locations (the hospital and three community programs) were deemed non-attenders.

Data collection

Baseline data (before discharge from hospital) were collected by a self-report questionnaire on factors previously found to be associated with CR attendance. These included age, sex, co-habitation, and smoking status. Employment status was categorized as employed (full or part time), retired, unable to work due to illness, or unemployed. Carstairs deciles were used as an indicator of socioeconomic deprivation. These small area-based scores, calculated from 2001 Census data, were allocated according to the participant's postcode of residence and collapsed into three categories, the first representing the least deprived 30% of the Scottish population and the third representing the most deprived 30%. Data were also collected on key medical co-morbidities: diabetes, stroke, cancer, myocardial infarction, cardiac surgery, percutaneous transluminal coronary angioplasty, high blood pressure, respiratory diseases (such as asthma, emphysema, chronic bronchitis) and joint diseases (such as rheumatism, arthritis, chronic back pain).

The Hospital Anxiety and Depression Scale (HADS) is a well-validated instrument to screen for anxiety and depression.[20] It has a sensitivity and specificity greater than 80% in cardiac patients[21] and good internal consistency with mean Cronbach's α 0.83 for anxiety and 0.82 for depression in a review of 15 studies.[22] Anxiety and depression subscales each comprise seven separate items and scores range from 0–21. HADS scores are not normally distributed so data were recoded into three groups: 'not depressed or anxious' (≤7 points), 'possibly depressed or anxious' (8–10 points) and 'depressed or anxious' (≥11 points).

The TPB scale has been found to be a valid and reliable tool to predict a patient's intentions to attend a CR program.[17] The internal reliability for the four TPB subscales predicting behavior ranges from $\alpha = 0.87$ to 0.93.[17,18] These subscales are: **Attitude,** a six item seven-point semantic differential adjunctive scale that rates both instrumental (useless–useful, harmful–beneficial, bad–good) and affective (unpleasant–pleasant, not enjoyable–enjoyable, boring–fun) responses. The total score of the subscale ranged from 1–7 with a higher score indicating that the patient valued attending the CR program more, while a lower score indicated a more negative view; **Subjective norms**, a two item seven-point scale that ranged from 1 (strongly disagree) to 7 (strongly agree). Higher scores indicate stronger perceived recommendations from members of the health team and, if possible, friends and relatives to attend the CR program, while a lower score indicates low perceived support from family friends or health team to attend the CR program: **Perceived behavioral control**, a four item seven-point scale from 1 (extremely difficult) to 7 (extremely easy) evaluated a person's perception of how easy or difficult it was to attend the CR program and the degree to which the person believed he, or she, had control over attending the program after considering the resources and barriers associated with that attendance and **Intention**, a two item seven-point scale from 1 (strongly disagree) to 7 (strongly agree) with a higher total score indicating a high level of intention to attend the CR program. TPB subscales were normally distributed and analyzed as continuous variables.

The Illness Perception Questionnaire (IPQ) provides a comprehensive psychometric tool to assess cognitive representation of patients' illness.[19] It has been used extensively with different populations, including those with cardiac disease.[23–25] IPQ has five cognitive components of illness representation. The identity subscale indicates the numbers of symptoms the respondent associates with the illness, with scores ranging from 0–14. The timeline subscale contains four items with scores ranging from 4–20. Higher scores indicate a belief that the illness is going to last for a longer

time. The consequences subscale contains nine items, and scores range from 9–45, with higher scores representing a stronger belief that the illness will have serious consequences. The cure and control subscale contains seven items, and scores range from 7–35, with higher scores indicating a higher level of belief in control or potential for cure of the illness. Patients also rate their distress about their symptoms on a two-item scale ('The symptoms of my heart condition are distressing to me' and 'The symptoms of my heart condition are puzzling to me'). Scores on this scale range from 2–10, with higher scores indicating greater distress. The internal reliability for each subscale is satisfactory, with mean Cronbach's α ranging from 0.73–0.82 in respondents with myocardial infarction.[19,24,25] The IPQ subscales were normally distributed and analyzed as continuous variables.

Sample size

The sample size calculation was based on detecting a difference in the proportion of participants attending CR between those allocated to receive the standard letter versus the new letter and between those allocated to receive the leaflet versus no leaflet. A total of 103 participants would be required in each group to detect a difference of 20% (from 15–35%) in attendance with 80% power and a two-sided 5% significance level. Therefore, 412 participants were required to enable comparison between each of the four groups.

Blinding

The researchers were kept blind to group allocation. Details of which participants were allocated to which groups were released to the researcher and the researcher's advisors after all participants had completed the eight-week outpatient CR program and data collection was complete. In addition, the CR secretary kept the allocation schedule secure from the other CR staff in a computerized locked file.

Statistical methods

Analysis was by intention to treat with participants analyzed according to the trial arm to which they were randomized. Data were analyzed using SPSS version16, with a two-sided p value$\leq$0.05 considered statistically significant. Univariate analysis used the Chi-square test to compare CR attendance in the different groups. The Chi-square test for proportions and independent samples t-test for means was used to examine associations between baseline variables and CR attendance. Correlations between potential confounders were examined prior to multivariate analyses; 'marital status' and 'co-habitation' were highly correlated (r=0.818) so only 'marital status' was considered for inclusion in the multivariate analyses. Multiple logistic regression was then used to compare attendance between randomised groups, following adjustment for those potential confounders whose univariate associations with CR attendance were statistically significant at the 5% level. This multivariate analysis was based on all complete data, with missing values treated as missing at random.

Ethical approval was granted by the Grampian Research Ethics Committee. The International Standard Randomized Control Trial Number Registered is ISRCTN12160517.

Results

Recruitment took place from January 2007 to December 2007. Of the 551 patients eligible to take part in the study, 115 (21%) declined. Another 49 (9%) patients became ineligible for CR: 29 became unwell, 16 were not referred to CR as the referral sheets were lost, and four died. An additional 12 (2%) patients became ineligible for the study because they were sent standard invitations before random assignment commenced. The remaining 375 patients (68%) agreed to take part, completed the baseline questionnaire, and were then randomized to one of the four groups (Figure 2). Follow-up took place until June 2008 by which time all participants' phase 3 CR was, or would have been, complete.

The mean age of participants was 62.5 years (standard deviation (SD) 11.2) and 69% were male (Table 1). Most (72%) participants had suffered a myocardial infarction with only 31% having received angioplasty. Few (10%) participants lived in the most deprived areas. There were no clinically important differences in baseline characteristics between the groups (Table 1).

The new, theory-based letter significantly increased attendance at CR from 74% to 84% (p=0.018) (Table 2). The number needed to treat (NNT) was nine (95% CI 7–12). The leaflet showed no significant effect on CR attendance (p=0.680). Univariate analyses showed that attenders tended to be male (p=0.028), younger (p=0.001), employed (p=0.014) and less likely to have hypertension (p=0.030). Attenders had higher scores in intention (p=0.001), attitude (p=0.001), subjective norm (p=0.001) and perceived behavioral control (p=0.001) towards attending the CR program than non-attenders. In terms of illness perception, the identity subscale was the only subscale which showed a significant association with attendance at rehabilitation: attenders attributed significantly more symptoms to their illness than did non-attenders (p=0.046). There were no significant differences in attendance rates between categories of anxiety (p=0.77) or depression (p=0.70).

Following simultaneous adjustment for the potential confounders identified as significant on univariate analyses, those receiving the new letter had almost three times the odds of attending one or more rehabilitation sessions compared to those receiving the standard letter (adjusted

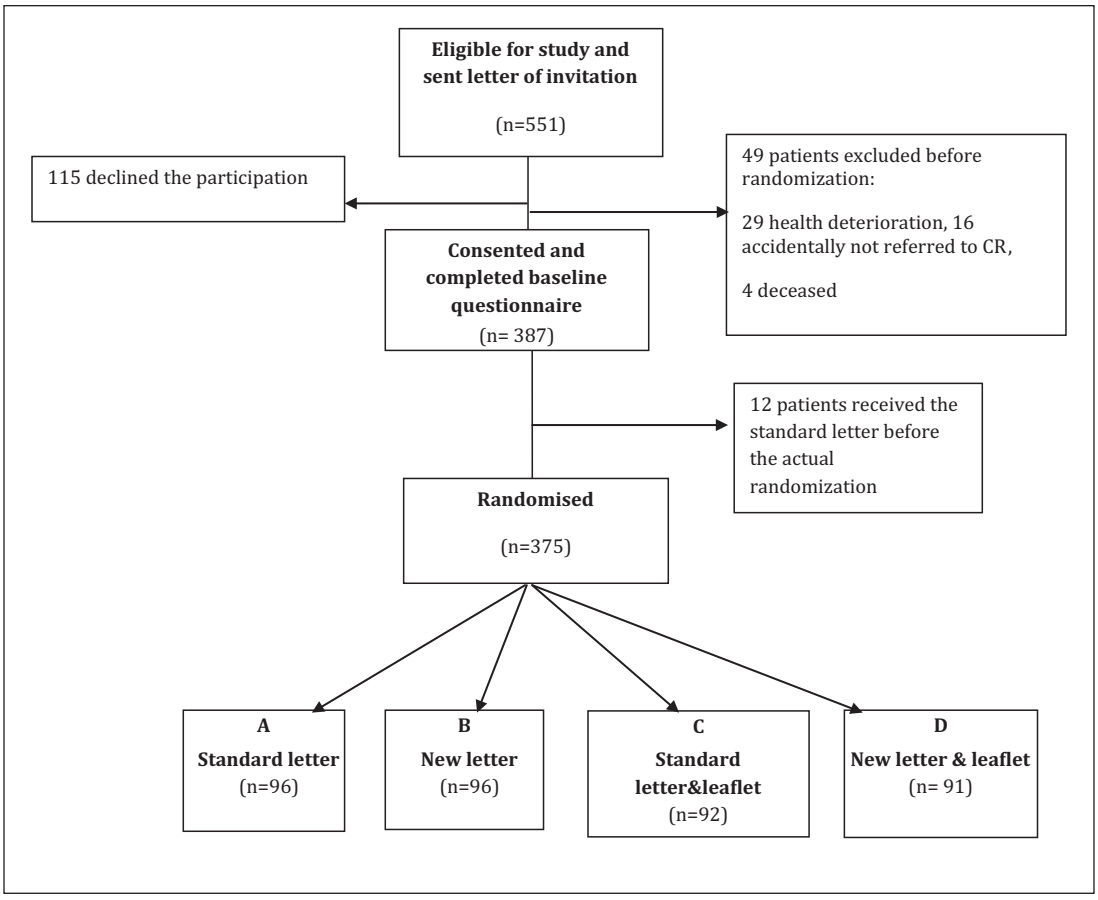

Figure 2. Study recruitment.

odds ratio (OR) 2.93, 95% CI 1.54–5.56) (Table 3). In contrast, there was no significant effect of receiving the leaflet on CR attendance (adjusted OR 1.02, 95% CI 0.57–1.83) (Table 3).

In univariate analysis of the four randomization groups, differences in rehabilitation attendance were not statistically significant (p=0.072, Table 2). However, after adjusting for the potential confounders previously mentioned, attendance at CR was statistically significantly higher in the groups that received the new theory-based letter only (adjusted OR 2.89, 95% CI 1.21–6.88) or the new theory-based letter plus supportive leaflet (adjusted OR 2.85, 95% CI 1.20–6.76) compared to those receiving the standard letter (Table 4).

Discussion

The results of this RCT confirmed our study hypothesis that, compared with a standard invitation letter, an invitation letter with theory-based wording significantly increased the attendance at outpatient CR. A supplementary leaflet, which sought to tackle concerns and provide motivation the day before attendance, had no significant effect on attendance. These findings are important: they show that a simple, inexpensive approach (i.e. rewording an invitation letter) can increase attendance at CR.

Strengths and limitations

Our RCT used a factorial design which provided an efficient way to test two interventions in one study. We did not quite achieve the target sample size in order to have 80% power for the four-group comparison during the time available for recruitment. Accrual was lower than anticipated for several further reasons: some eligible patients were missed during the initial stages of recruitment; some patients were discharged from hospital without being assessed for CR (or invited to take part in the trial) during a period of when key CR staff were absent. In our univariate analysis, the difference we detected between groups (up to 13%) would be clinically important, but did not reach statistical significance. On the other hand, we exceeded target recruitment for the two-group comparisons. Participants were allocated using simple randomization, so were not divided into strata before random assignment. Some researchers prefer stratified randomisation, to ensure that particular groups (e.g. by age and sex) were well-balanced. Others, however, argue that this

Table 1. Characteristics of the study sample. Values are numbers (percentages) unless otherwise stated. There are no statistically significant differences between the four groups.

	All	Standard letter	Theory-based letter	Standard letter+leaflet	Theory-based letter+leaflet
	(*n*=375)	A (*n*=96)	B (*n*=96)	C (*n*=92)	D (*n*=91)
Age mean (SD)	62.5 (11.2)	63.0 (10.3)	60.7 (12.5)	63.4(10.3)	63.2 (11.3)
Male	259 (69)	64 (67)	72 (75)	61 (66)	62 (68)
Married or living as married	277 (74)	72 (75)	71 (74)	69 (75)	65 (71)
Live alone	72 (19)	20 (21)	18 (19)	13 (14)	21 (23)
Working status:					
Employed	152 (41)	41 (43)	42(44)	38 (41)	31 (34)
Sick	18 (5)	4 (4)	8 (8)	5 (5)	6 (7)
Unemployed	23 (6)	6 (6)	5 (5)	6 (7)	1 (1)
Retired	182 (48)	45 (47)	41 (43)	43 (47)	53 (58)
Myocardial infarction	269 (72)	71 (74)	68 (71)	70 (76)	60(66)
Cardiac surgery	146 (40)	31 (32)	37 (38)	34 (37)	44 (48)
PTCA	116 (31)	34 (35)	28 (29)	27 (29)	27 (30)
High blood pressure	158 (42)	41 (43)	36 (37)	43 (47)	38 (42)
Diabetes	57 (15)	16 (17)	11 (11)	14 (15)	16 (18)
Cancer	9 (2)	2 (2)	4 (4)	1 (1)	2 (2)
Stroke	10 (3)	1 (1)	6 (6)	3 (3)	0 (0)
Joint problems	63 (17)	14 (15)	21 (22)	13 (14)	15 (17)
Respiratory problems	47 (12)	10 (10)	9 (9)	14 (15)	14 (15)
Smoking status:		(*n*=95)	(*n*=96)	(*n*=92)	(*n*=91)
Current smoker	58 (15)	14 (15)	14 (15)	16 (17)	14 (15)
Ex-smoker	205 (55)	52 (54)	57 (60)	46 (50)	50 (55)
Never smoked	111 (30)	30 (31)	24 (25)	30 (33)	27 (30)
Deprivation level:		(*n*=93)	(*n*=94)	(*n*=91)	(*n*=90)
Level 1 - affluent	243 (66)	58 (62)	62 (66)	63 (69)	60 (66)
Level 2	87 (24)	26 (28)	22 (23)	17(18)	22 (24)
Level 3 - deprived	38 (10)	9 (9)	10 (10)	11 (12)	8 (9)

SD: standard deviation; PTCA: percutaneous transluminal coronary angioplasty.

Table 2. Effect of different invitation letters and leaflets on attendance at cardiac rehabilitation.

	n	Attenders		*p*-value[a]
		n	(%)	
Pairwise comparisons:				
Standard letter	188	138	(74)	
New letter	187	157	(84)	0.018
No leaflet	192	153	(80)	
Leaflet	183	142	(78)	0.680
Four group comparison:				
Standard letter	96	70	(73)	0.072
New letter	96	83	(87)	
Standard letter and leaflet	92	68	(74)	
New letter and leaflet	91	74	(81)	

[a]Chi square test.

creates an illusion because there are many other potential confounders which are not accounted for and may not even be measured. Simple randomisation ensures that any imbalance in these factors was randomly distributed between the groups and comparison of baseline characteristics showed that the four groups were well matched. It also avoids the opportunity for several biases that have been described with more complex randomisation procedures.[26] The interventions are reproduced in full, and the process of their development has been described previously in a way that should enable them to be replicated in different contexts.[16] Our recruitment rate was good, suggesting that our sample is representative of the population eligible for CR at this centre. Relatively few participants had been treated by angioplasty which may reflect the long travelling times for emergency treatment in this rural area: Scottish guidelines recommend pre-hospital thrombolysis instead if time to primary angioplasty will exceed 90 minutes.[27]

Comparison with previous research

RCTs of previous interventions used to increase attendance at CR have mostly been small (sample size <100). The only

Table 3. Logistic regression analysis showing the effect of the new theory-based letter and the supplementary leaflet on attendance at cardiac rehabilitation, following simultaneous adjustment of the potential confounders listed.

	Model 1: 275 attenders, 65 non-attenders, pseudo R2=0.208, Wald Chi-square=47.30		Model 2: 275 attenders, 65 non-attenders, pseudo R2=0.162, Wald Chi-square=36.20	
	OR	(95% CI)	OR	(95% CI)
Intervention				
Theory-based letter vs standard letter	2.93	(1.54–5.56)		
Leaflet vs no-leaflet			1.02	(0.57–1.83)
Age	0.99	(0.95–1.03)	0.95	(0.95–1.02)
Gender, male (reference: female)	1.49	(0.77–2.86)	1.49	(0.78–2.82)
Working status (reference: employed)				
Sick	0.24	(0.07–0.87)	0.32	(0.09–1.14)
Unemployed	0.71	(0.71–3.22)	0.57	(0.13–2.44)
Retired	0.53	(0.23–1.23)	0.60	(0.26–1.38)
Hypertension	0.56	(0.30–1.05	0.55	(0.30–1.03)
Intention	1.16	(1.00–1.16)	1.14	(0.98–1.32)
Attitude	1.02	(0.97–1.06)	1.01	(0.97–1.06)
Subjective norm	0.97	(0.83–1.13)	0.98	(0.84–1.14)
Perceived behavioural control	1.05	(0.89–1.23)	1.04	(0.89–1.23)
Identity	1.04	(0.94–1.16)	1.05	(0.95–1.17)

CI: confidence interval; OR: odds ratio; PBC: perceived behavior control.

Table 4. Logistic regression analysis with a four-way comparison of combinations of interventions showing their effects on attendance at cardiac rehabilitation following simultaneous adjustment for the potential confounders listed.

	275 attenders, 65 non-attenders, pseudo R2=0.208, Wald Chi-square=47.30	
	OR	(95% CI)
Intervention (Reference: standard letter)		
Theoretical letter	2.89	(1.21–6.88)
Standard letter and leaflet	1.02	(0.48–2.18)
New letter and leaflet	2.85	(1.20–6.76)
Age	0.99	(0.95–1.03)
Gender, male (reference: female)	1.49	(0.77–2.86)
Working status (reference: employed)		
Sick	0.25	(0.07–0.88)
Unemployed	0.71	(0.15–3.22)
Retired	0.53	(0.23–1.23)
Hypertension	0.56	(0.30–1.00)
Intention	1.16	(1.00–1.35)
Attitude	1.02	(0.97–1.06)
Subjective norm	0.97	(0.83–1.13)
Perceived behavioral control	1.05	(0.89–1.23)
Identity	1.04	(0.94–1.16)

CI: confidence interval; OR: odds ratio.

larger previous trial also found a positive effect[10] but the intervention was resource intensive, involving extra cardiac liaison staff: this may not be possible for rehabilitation program with limited budgets.[28] Two other interventions evaluated in small randomized trials have required extra resources for group discussions, education sessions, telephone calls and home visits:[11,28] one was effective but the other was not, although both studies had statistical power to detect large differences only. One previous trial involved reworded letters and also showed an increase in CR attendance.[12] This trial was small (n=87) and the intervention included two letters, one to influence acceptance and one to influence uptake, which were evaluated as a single package. Participants were restricted to those with acute myocardial infarction who had already indicated their intention to attend CR. Our study confirms the benefits of invitation letters using theory-based wording in a larger and broader sample, including people who initially did not intend to attend. By evaluating two interventions separately and together in a single trial, we have shown benefit only from the initial letter. Compared with other studies, CR attendance in the standard letter group was high (74%). This may have been due to pre-existing efforts to increase attendance, including appointments to the program made in advance and telephone call reminders. It may also have reflected our less-deprived population.

Meaning and implications

Rewording of invitation letters is simple and low cost, so our reported positive effects on CR uptake rates are important. Increased attendance at programs which reduce both

morbidity and survival are worthwhile. However, an increase in people attending CR will have implications for the programs themselves. CR programs in the UK are resource limited,[29] so careful planning is needed if interventions increase attendance beyond current capacity. Furthermore, in our study some people still did not attend, so a need for additional approaches remains. For example, some of the exclusions we reported before randomization (Figure 2) were due to missed referrals, so interventions targeting referral and enrolment may also be needed.

Our invitation letter was specific to CR programs, so our findings are relevant primarily to them. The mechanism by which the letters were designed to work was by targeting theoretical constructs from the TPB and CSM (Box 1) and this proved successful.[16] If similar methods were used to formulate invitation letters to other activities and programs, they may also be effective. Possible applications include invitations for screening and health promotion. Attempts to use theory to modify invitations to those activities have usually involved tailoring of wording to individuals;[29] this requires relevant baseline data which may be expensive to collect. A common invitation for all, with no requirement for individualization may be attractive and, as we have shown, would not be difficult to evaluate.

Conclusions

Rewriting invitation letters with theory-based wording is a simple way to increase attendance at CR. The wording which proved effective in this study is available in Box 1.

Implications for practice

- Invitations to CR can use theory-based wording. This increases attendance significantly.
- An extra attendance for every nine invitations to CR.

Conflict of interest

The authors declare that there are no conflicts of interest.

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