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Effect of Home-Based Cardiac Rehabilitation in a Lower-Middle Income Country: RESULTS FROM A CONTROLLED TRIAL. — Source link

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The effect of Home-based Cardiac Rehabilitation in a Lower Middle Income Country: Results from a Controlled trial

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ABSTRACT

Purpose: Cardiovascular disease is the leading cause of mortality and morbidity in lower middle income countries (LMIC), including Bangladesh. Cardiac Rehabilitation (CR) as part of secondary prevention of cardiovascular disease has been shown to improve mortality, morbidity, quality of life and exercise capacity. However, to date very few controlled trials of CR have been conducted in LMIC.

Methods: A quasi-randomised controlled trial comparing home-based CR plus usual care to usual care alone was undertaken with patients following coronary artery bypass graft (CABG) surgery. The CR group received an in-hospital CR class and were introduced to a locally developed educational booklet with details of a home-based exercise programme, then received monthly telephone calls for 12 months. Primary outcomes were coronary heart disease (CHD) risk factors, health-related quality of life (HRQL) and mental well-being. Maximal oxygen uptake as a measure of exercise capacity was a secondary outcome.

Results: 142 participants out of 148 eligible, participated in the trial (96%); 71 in each group. At 12 months follow-up, 61 (86%) patients in the CR group and 40 (56%) in the usual care group provided complete outcome data. Greater improvements in CHD risk factors, HRQL, mental well-being and exercise capacity were seen for the CR group compared to usual care.

Conclusions: In the context of a single centre LMIC setting, this study demonstrates the feasibility of home-based CR programmes and offers a model of service delivery that could be replicated on a larger scale.

CONDENSED ABSTRACT

A quasi-randomised controlled trial comparing home-based cardiac rehabilitation to usual care was undertaken with patients following coronary artery bypass graft surgery, in Bangladesh, a lower to middle income country. The trial found cardiac rehabilitation was feasible and provided similar patient benefits to trials of cardiac rehabilitation based in high-income countries.

INTRODUCTION

Cardiovascular disease is the leading cause of non–communicable disease death globally[1]. Over 80% of these deaths occur in low, and lower middle income countries (LMIC), including Bangladesh[2-4]. Like many LMIC, Bangladesh is passing through an epidemiological transition from communicable to non-communicable diseases[5]. The rates of communicable disease have fallen while mortality due to cardiovascular disease including coronary artery disease has risen thirty-fold[5].

LMICs including Bangladesh have made impressive gains in public and private health care services, offering sophisticated technology-based diagnostic and therapeutic procedures for coronary artery disease including percutaneous coronary interventions and coronary artery bypass grafting (CABG)[6]. However, the provision of evidence-based preventive strategies including cardiac rehabilitation (CR) is running alarming behind[7].

CR is a comprehensive approach to rehabilitation and secondary prevention involving activities that improve the physical, mental and social well-being of patients as well as targeted secondary preventive strategies to reduce the risk of future cardiovascular events[8]. Exercise-based CR and secondary prevention have been shown in multiple studies to improve cardiovascular mortality, morbidity, health-related quality of life (HRQL) and exercise capacity and reduce cardiovascular disease risk in high-

income countries[9,10]. Despite the clear benefits of CR, there is low availability in LMIC, with only 23% of LMIC having CR programmes compared with 68% in high-income countries[11].

There also remains limited evidence for the effectiveness of CR in the LMIC settings. Following a literature search in 2013, Turk-Adawi and Grace found only two randomised controlled trials of CR conducted in LMICs[1]. The majority of the studies described in the review were in upper-middle income countries with only two studies placed in the same, lower-middle income bracket as Bangladesh, as defined by the World Bank as economies with a gross national income per capita between $1,026 and $4,035[12]. One study in India, used in-patient CR followed by home based CR compared to usual care[13]. They found significant improvements in 6-minute walk distance and HRQL following the intervention compared to control group[13]. Another, in China, found improvements in walking ability and coronary heart disease (CHD) risk factors following a six-month nurse led CR programme[14]. CR studies in upper-middle income countries have shown significant reductions in triglycerides, total cholesterol, low density lipoproteins, body mass index, systolic and diastolic blood pressure as well as significant improvements in high density lipoproteins, exercise capacity and HRQL[15-17].

However, it cannot be assumed that results in high or middle income countries will be directly transferable to a Bangladeshi population due to the potential differences in culture, health, transport, environment and communication infrastructure. Patients in Bangladesh may be required to travel for several days by scarce public transport and may need to stay overnight to attend hospital appointments. They may also have caring responsibilities at home or require time off from work to attend CR. The indirect costs (loss of earnings and transport) of healthcare have been shown to be much higher than the direct costs for people in Bangladesh and those costs are even higher for those from rural areas[18]. Facilities to undertake CR within the hospital or local community are also limited. A report in 2012

identified only one CR programme in Bangladesh, based in a private hospital[7]. A small number of studies investigating home-based CR suggest it may be equally effective as centre-based CR, in terms of clinical outcomes and HRQL [19]. Home-based CR has also been suggested as overcoming some of the barriers to participation caused by limitations in transport, time or cost of attendance[19-21].This quasi-randomised controlled trial design was undertaken to and impact of home-based CR on patients following CABG surgery in Bangladesh.The study had two objectives: Firstly, to evaluate the feasibility of a home-based CR program in addition to usual care (UC) in post-CABG surgery patients in Bangladesh. Secondly, to test the hypothesis that the addition of a CR intervention would lead to greater improvements in CHD risk factors, HRQL, mental well-being (primary outcomes) and exercise capacity (secondary outcome), compared to UC alone.

METHODS

The trial was not preregistered in a formal trial registry nor published, in part due to the level of research expertise of the research team and also the lack of infrastructure in registering clinical trials in 2012, in Bangladesh. However, a protocol was prepared, based on existing literature, and submitted to the Institutional Review Board of Ibrahim Cardiac Hospital & Research Institute (ICH&RI) (hospital ethics committee), from whom ethical approval for the study was obtained (REF: IEC 032/ICHRI/2012). All trial participants received written information describing the study and implications in detail and a signed consent form was obtained. The trial is reported here according to the Consolidated Standards of Reporting Trials (CONSORT)– extension for randomised trials of non-pharmacologic treatment[22].

A quasi-random method was used to allocate patients to either a home-based CR programme in addition to UC or UC alone. Allocation was done according to patients' given week of surgery, with every other week allocating patients to either CR group or UC group. Allocation was done by the research team and was not influenced by the preferences of the research team, patients or relatives.

The study was based at ICH&RI in Dhaka, where all patients pay for their treatment, including the study participants. There are 22 cardiac institutions in Bangladesh with 18 of these based in Dhaka. Very few institutions outside Dhaka offer CABG surgery hence patients may travel long distances by public transport and require overnight accommodation, to attend hospital appointments. Dhaka is one of the most densely populated cities in the world. Hence, travel to the hospital, even within Dhaka, may take several hours. Thus, a home-based CR programme was considered more feasible than a centre-based programme.

All patients who were admitted from July 2012 to July 2013 were screened for inclusion in the study (Figure 1.). Patients were included if they were admitted for elective CABG surgery, aged between 25-65 years and understood Bangla. Patients were excluded if they were admitted for emergency CABG or revision CABG surgery or if they had any neurological problems, severe co-morbidities or were not planning on staying in Bangladesh for one year after CABG surgery. Eligible participants were approached by a member of the research group following their surgery.

Patients allocated to the CR group participated in a 45 minute in-hospital CR class and were provided with an educational booklet in Bangla. The materials were based on the Monash Heart Cardiac Education Booklet[23] and developed by the research team (cardiologists, cardiac surgeons,

physiotherapists and specialist nurse) to fit the specific needs of patients in Bangladesh. The booklet described the home exercise training programme including upper and lower limb exercises, breathing exercises, chest movements and aerobic exercise (walking program). The educational booklet provided information about safe levels of activity, details of personal risk factors, useful telephone numbers, advice on when to seek medical advice and how to manage recurrent breathlessness or chest pain. The CR programme was delivered in the physiotherapy department in groups of 6-10 patients, 7-8 days after surgery. The medical team confirmed that patients were medically fit for CR before attending.

Patients allocated to the CR group received a monthly telephone call for twelve months. Calls were made by qualified physiotherapists trained by the research team on the CR advice booklet and exercise programme. The physiotherapists answered any questions subjects may have, reminded them to follow the CR advice booklet and exercise programme, and to attend their next hospital appointment. The phone calls did not follow a script nor did the physiotherapists individually tailor the progression of the CR plan. In addition to the intervention, the CR group received UC. UC consisted of conventional hospital discharge care including drug treatment and routine follow-up hospital visits. The physician who discharged and saw the patient for follow-up visits was responsible for initiating or adjusting medication. Follow-up hospital visits occurred at 7 days, 6 weeks, 3 months, 6 months and 12 months post-op. Appendix 1 provides further details of the in-hospital CR class, UC and home-based CR programme.

Prior to discharge and before allocation to either the CR or UC group, baseline data were collected on each patient. (Table 1.) Due to the short time available when patients returned for follow-up hospital appointments, it was decided to collect selected outcomes at each follow-up appointment (Table 2.).

CHD risk factors were collected routinely at the 6 month follow-up appointment; this required patients to fast 12-24 hours before they had the blood test, and then eat breakfast. They then undertook the maximal oxygen uptake test but no further outcomes were possible at this appointment due to time constraints.

The World Health Organisation Quality of Life– abbreviated, required up to an hour to complete hence it was decided to collect this outcome at the last follow-up appointment, at 12 months.
The questionnaire consists of 26 items: the first two questions ask patients about their overall perception of HRQL and the remaining 24 questions address four domains: physical health, psychological health, social relationships, and environmental health. Higher scores represent a higher level of patient HRQL. The Bangla version of this measure has been found to a valid and reliable measure of HRQL in an adult population in Bangladesh[24].

Patients' mental well-being was assessed by using the Patient Health Questionnaire[25], with higher scores indicating greater levels of depression and was completed at the 3 months follow-up appointment.

Exercise capacity was assessed using a single stage treadmill walking test protocol[26]**.** Maximum oxygen uptake was estimated using the following equation: VO_{2max}= 15.1 + (21.8 x treadmill speed) – (0.327 x heart rate) – (0.263 x treadmill speed x age) + (0.00504 x heart rate x age) + (5.98 x gender). At the time the study was undertaken it was not possible for patients to undergo exercise testing as in-patients, hence no baseline exercise capacity was collected.

Statistical analysis

Data analyses were performed on an intention-to-treat basis, i.e., comparison of outcomes between UC and CR groups defined according to the initial quasi-random allocation in those patients with complete follow-up data. No imputation of missing follow-up outcome data was performed. Outcomes were compared using an independent two-sample t-test. Where baseline data were collected, we compared groups using the outcome difference between baseline and follow-up. For exercise capacity, groups were compared using outcome values at follow-up. Outcomes were summarised as raw numbers, percentages, or means/standard deviations, and the difference of within group reported as means, 95 percent confidence intervals [95% CI] and p-values. We also compared between group differences reported as mean difference [95% CI] and p-value. All tests were two-sided and the level of statistical significance set at a p-value of ≤ 0.05.

RESULTS

A total of 210 patients were screened for participation in the trial. Of these, 62 were excluded, leaving 148 patients eligible. Six patients declined consent, providing a total of 142 participants (96% of eligible patients) of which 71 were allocated to the CR group and 71 were allocated to the UC group. The two groups were well balanced in terms of their demographic characteristics and baseline CHD risk factors. The mean age of participants was 54 years and 93% were male. This CABG population mainly had a normal left ventricular ejection fraction (mean 52%) and 42% had a history of diabetes mellitus. Mean blood pressure was 124/78 mmHg and 54% were smokers at trial enrolment.

At 12 months follow-up, 61 (86%) and 40 participants (56%) in the CR and UC group respectively had complete outcome data. The demographic characteristics (i.e., age, gender, level of education) and risk

factor levels (family history of CHD, smoking history, diabetes history, serum cholesterol levels, and left ventricular ejection fraction) of patients lost to follow-up were similar to patients with complete data at 12 months.

CHD risk factors

In the CR group, mean CHD risk factors at 6 months were all significantly improved compared to baseline (Table 3). In the UC group, only blood pressure and HbA1c significantly improved in the UC group compared to baseline, while mean body mass index and lipid profile remained unchanged. Between group differences showed significant improvements of mean difference in body mass index (-0.61kg/m^2[95%CI -1.07 to -0.16] *P*= 0.008) and lipid profile (total cholesterol (-52.98mg/dl[95%CI 80.41 to 25.55] *P*=0.001; low density lipoproteins: -40.21mg/dl [95% CI -60.26 to 20.15] *P*= 0.001; triglycerides: -53.02mg/dl, [95% CI -86.24 to -19.80]*P*= 0.002; high density lipoproteins: 3.54mg/dl, [95% CI 0.81 to 6.26]*P*= 0.01) in favor of the CR group.

Changes in blood pressure and HbA1c were not shown to be significantly different in the CR compared to the UC group (Systolic blood pressure: 1.35 mmHg[95%CI -4.21 to 6.90]*P*=0.63; diastolic blood pressure: -0.31 mmHg[95% CI -0.39 to 3.33]*P*= 0.86; HbA1c: -0.49 mg/ml [-1.14 to 0.16]*P*= 0.14) (Table 3).

HRQL

There were significant improvements in the overall perception of quality of life and overall perception of health in both CR and UC groups at 12 months (Table 4). Domain specific scores in the CR group

also significantly improved. Domain specific scores in the UC group all showed no significant change except for social relationship which was significantly worse at 12 months.

Between group differences showed improvements in the overall perception of quality of life, overall perception of health, and all domain scores were significantly greater for the CR compared to the UC group (Table 4).

Mental well-being

Patient health questionnaire scores from baseline to 3 month follow-up improved significantly for both groups but with significantly greater improvement found in the CR group compared to the UC group (mean difference - 3.53 [95% CI -4.40 to -2.73]p=<0.001) (Table 4).

Exercise capacity

Exercise capacity was only measured at 6 months follow-up. Maximal oxygen uptake was significantly higher in the CR group (36 ml/kg/min) compared to the UC group (29 ml/kg/min) (mean difference 6.57 [95% CI 1.99 to 11.14] p = 0.005) (Table 4).

DISCUSSION

The aim of this controlled trial was to evaluate the feasibility and impact on patients following CABG surgery of a home-based CR programme in the LMIC setting of Bangladesh. The study indicates that CR is feasible within the constraints of a LMIC, i.e. it was possible to provide education to patients following CABG surgery and follow them up at home over the telephone. The study also demonstrated potentially significant benefits to patients of CR compared to UC alone, in terms of CHD risk factors, HRQL, mental well-being, and exercise capacity.

There are several key limitations that need to be considered. Due to practical restrictions, it was not possible to randomise the allocation of patients to the CR and UC groups, but instead patients were allocated using a quasi-random approach according to the week of their CABG surgery. However, the allocation process was not influenced by the preference of patients, researchers, or clinicians, and we therefore believe the risk of selection bias and confounding to be low. This is supported by the balance in the baseline characteristics of the two groups. Due to the nature of the CR, we were not able to blind patients or clinicians to group allocation which may have introduced bias in terms of patients' responses to outcome questionnaires at follow-up. It is not possible to report potential differences in the improvement of exercise capacity between CR and UC because we did not assess exercise capacity at baseline. The single centre nature of this study means that we must be cautious in generalising our findings to other Bangladeshi or LMIC settings beyond the population at ICH&RI as this was a single site study. Further, data on prescribed medications, participation in exercise during the study period and smoking cessation rates after surgery, were not collected but may have influenced the results. Baseline testing of exercise capacity was not possible hence the difference between groups over time cannot be stated. A high participation rate (96%) was achieved. However, the number of patients lost to follow up during the study was greater in the control group (43% versus 14%) (Table 2). This may be because the CR group received monthly phone calls that included reminding them about their follow-up appointments. Risk of drop-out did not appear to be related to patient demographics, health behaviour, clinical or mental health status.

This study is one of just a very few controlled trials of CR that has been undertaken to date in LMIC[13,14]. The results are in concordance with two previous studies showing improvements in exercise

capacity and HRQL with home-based CR and cardiac patients[13,27]. The findings of the study are in agreement with the large evidence base for CR in high-income countries[9,10], however, the study did not provide a comprehensive CR programme, (defined as including elements of exercise, psychological and education-based interventions[28]) as tested in many of the high-income studies, hence a direct comparison of results cannot be made. Recent recommendations on how to delivery CR in low-resource settings promotes the need to expand CR to LMIC and that home or community-based projects led by allied-health professionals may be most feasible[29]. Our study supports these recommendations but larger, randomised controlled trials on the effectiveness of CR in LMIC are needed before wide-spread implementation can take place. These trials should include economic evaluations, investigate the practical implementation of CR in low-resource settings and test comprehensive CR programmes.

CONCLUSION

In the context of a single centre LMIC setting, this study demonstrates the feasibility of home-based CR programmes and offers a model of service delivery that could be replicated on a larger scale. Multi centre randomised controlled studies are needed to assess if these results can be replicated on a larger scale and provide a cost-effective use of resources in these low-resource settings.

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AUTHOR CONTRIBUTIONS

Jamal U, MM, RK, Jalal U, SM and MR contributed to the conception and design of the study and acquisition of data. Jamal U, MM, RK, VLJ, HKR, RST and ADZ contributed to the analysis of the data and drafting of the manuscript. Jamal U, VLJ, HKR, RST and ADZ provided critical revision of the manuscript.

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Figure 1. CONSORT flow diagram

Table 1. Baseline patient characteristics and risk factor levels

	CR group (n = 71)	UC group (n = 71)
Demographics		
Age in years, Mean (SD)	54 (6)	55 (6)
Gender, Males, N (%)	66 (93)	63 (89)
Level of education, N (5) ≤ Secondary School Certificate ≥ Higher Secondary School Certificate (16 years)	 35 (49) 36 (51)	 41 (58) 30 (42)
Modifiable and non-modifiable risk factors		
Family history of CAD, N (%)	27 (38)	36 (37)
Smoking history, N (%)	42 (59)	35 (49)
History of diabetes mellitus, N (%)	42 (59)	45 (63)
Hypertension N (%)	44 (62)	46 (65)
Dyslipidemia*, N (%)	43 (61)	49 (69)
BMI(kg/m2), Mean (SD)	26 (3)	25 (3)
Clinical risk factors		
HbA1c (mmol/l), Mean (SD)	7(2)	7 (1.5)
Blood pressure (mmHg), Mean (SD) Systolic Diastolic	 124 (13) 78 (8)	 127 (16) 80 (8)
Cholesterol (mg/dl), Mean (SD) Total HDL LDL Triglycerides	 178 (53) 31 (7) 128 (7) 173 (114)	 179 (56) 29 (7) 125 (56) 183 (76)

LVEF %, Mean (SD)	52 (9.4)	52 (10.50)

Table 2. Summary of outcome data collection schedule

	Baseline	**3 months follow-up**	**6 months follow-up**	**12 months follow-up**
CHD Risk factors	√	-	√	-
WHOQOL-BREF	√	-	-	√
PHQ-9	√	√	-	-
VO_2max	-	-	√	-

√ = outcome collected - = no outcome collected

Table 3. Between group difference in baseline and 6 months follow-up CHD risk factors

Risk factors	CR group, (n=61)				UC group, (n=40)					
	Baseline Mean (SD)	6 months follow-up Mean (SD)	Within group Mean change (95% CI)*	*p*-value	Baseline Mean (SD)	6 months follow-up Mean (SD)	With group mean change (95% CI)*	*p*-value	Between group; mean difference (95% CI)*	P-Value
BMI (kg/m^2)	25.54 (2.53)	24.63 (2.26)	-0.91 (-1.75 to -0.07)	0.03	24.77 (2.86)	24.47(2.6 to 8.00)	-0.29 (-1.53 to 0.94)	0.63	-0.6 (-1.07 to -0.16)	0.008
SBP (mm Hg)	122.95 (13.02)	114.42 (6.71)	-8.52 (-12.11 to -4.93)	<0.001	126.75 (15.56)	116.87 (10.23)	-9.87 (-15.66 to -4.08)	0.001	1.35 (-4.21 to 6.90)	0.63
DBP(mm Hg)	77.45 (8.38)	74.01 (5.68)	-3.44 (-6.02 to -0.86)	0.009	79.75 (7.64)	76.62 (6.34)	-3.12 (-6.25 to 0.009)	0.05	-0.31 (-0.39 to 3.33)	0.86
Total cholesterol (mg/dl)	179.98 (53.17)	112.29 (36.40)	-67.68 (-84.42 to -50.95)	<0.001	175.27 (55.96)	160.57 (53.35)	-14.70 (-39.03 to 9.63)	0.23	-52.98 (-80.41 to 25.55)	<0.001

LDL-cholesterol (mg/dl)	131.44 (54.46)	87.14 (23.17)	-44.30 (-59.76 to -28.83)	<0.001	123.14 (56.38)	119.05 (40.31)	-4.09 (-25.61 to 17.43)	0.70	-40.21 (-60.26 to 20.15)	<0.001
Triglycerides (mg/dl)	180.42 (114.36)	108.85 (48.83)	-71.57 (-104.12 to -39.02)	<0.001	179.92 (75.94)	161.37 (64.72)	-18.55 (-49.63 to 12.53)	0.23	-53.02 (-86.24 to 19.80)	0.002
HDL-cholesterol (mg/dl)	30.80 (6.50)	35.34 (4.79)	4.54 (2.51 to 6.56)	<0.001	29.40 (6.53)	30.80 (4.94)	1.00 (-1.77 to 3.77)	0.47	3.54 (0.81 to 6.26)	0.01
HbA1c(mg/ml)	7.46 (2.07)	6.28 (0.92)	-1.18 (1.77 to -0.58)	<0.001	7.11 (1.5)	6.42 (1.03)	-0.68 (0.11 to 1.26)	0.019	-0.49 (-1.14 to 0.16)	0.14

Abbreviations: BMI, Body Mass Index; CR, Cardiac Rehabilitation; DBP, CHD, Coronary Heart Disease; Diastolic Blood Pressure; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; SBP, Systolic Blood Pressure; UC, Usual Care.* A reduction is stated as a negative number while an increase is stated as a positive number.

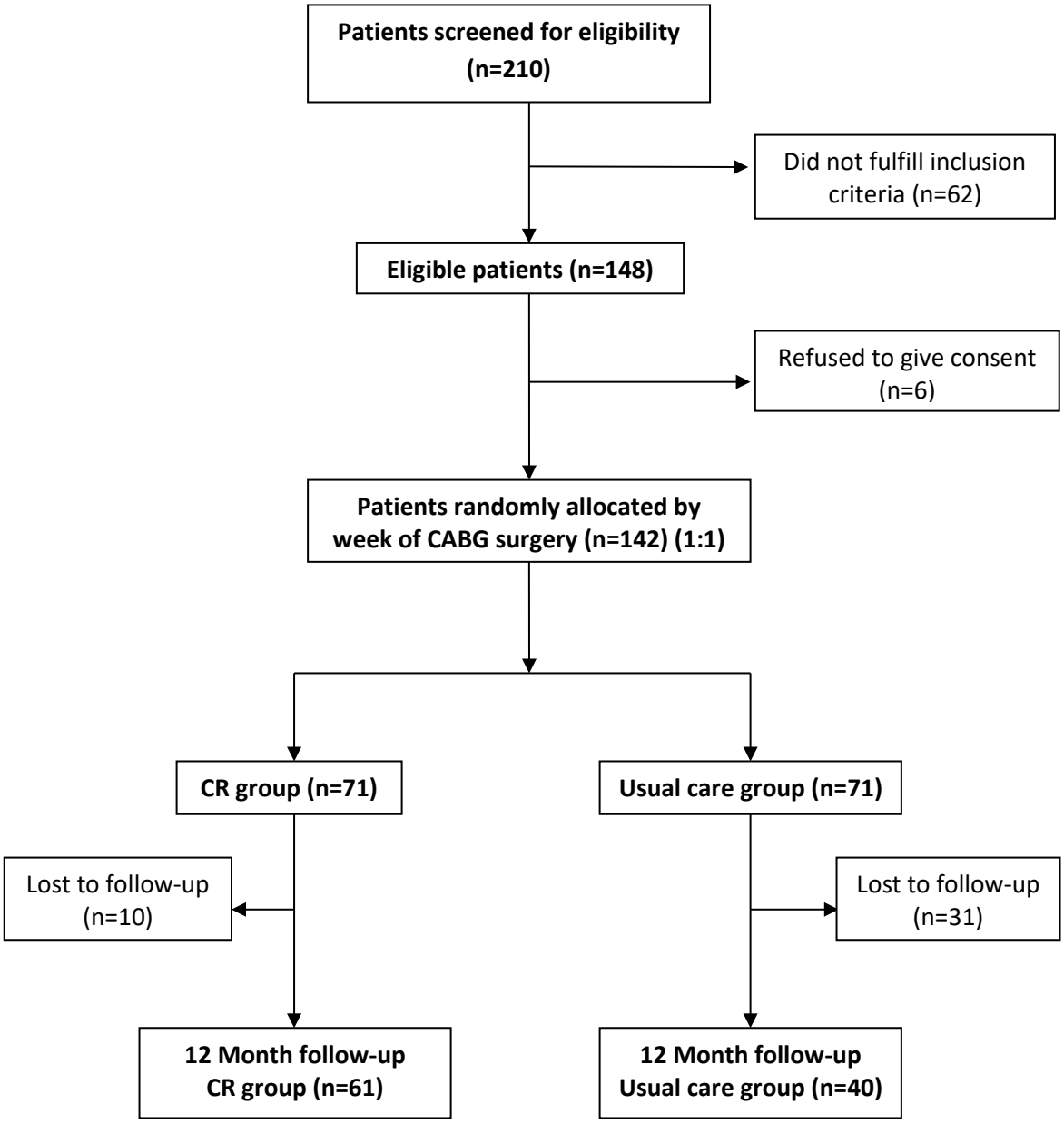
Table 4. Between group difference for PHQ-9 at baseline and 3 month follow-up, WHOQOL-BREF at baseline and 12 month follow-up and for exercise capacity at 6 months follow-up only

	CR Group (n=61)				**UC Group**(n=40)					
	Baseline Mean (SD)	**Follow-up** Mean (SD)	Within group Mean change [95% CI]*	*P*-value	**Baseline** Mean (SD)	**Follow-up** Mean (SD)	Within group Mean change [95% CI]*	*P*-value	**Between Group** Mean difference [95% CI]*	*P*-value
PHQ-9 3 months follow-up										
Total score	12.9 (1.83)	4.60 (1.93)	-8.29 (-9.06 to -7.52)	<0.01	14.40 (2.46)	9.67(1.83)	-4.72 (-5.68 to -3.76)	<0.01	-3.53 (-4.40 to 2.73)	<0.01
WHOQOL-BREF 12 months follow-up										
Overall Perception of QoL	2.96 (0.49)	4.03 (0.49)	1.06 (-0.88 to 1.24)	<0.01	2.85 (0.43)	3.20 (0.82)	0.35 (0.05 to 0.64)	0.02	0.71 (0.37 to 1.05)	<0.01
Overall Perception of Health	2.59 (0.67)	4.06 (0.40)	1.47 (-1.28 to 1.66)	<0.01	2.47 (0.55)	3.17 (0.38)	0.7 (0.48 to 0.91)	<0.01	0.77 (0.49 to 1.05)	<0.01
Physical Domain	20.81 (2.47)	26.90 (2.88)	6.08	<0.01	21.67 (1.76)	21.17 (3.35)	-0.50	0.40	6.58	<0.01

			(5.14 to 7.02)				(-1.69 to 0.69)		(4.99 to 8.16)	
Psychological Domain	17.67 (2.00)	23.42 (2.84)	5.77 (4.90 to 6.63)	<0.01	18.10 (1.70)	17.87 (3.19)	-0.22 (-1.35 to 0.90)	0.69	5.99 (4.52 to 7.46)	<0.01
Social Relationship Domain	10.13 (1.55)	11.83 (1.25)	1.70 (1.20 to 2.20)	<0.01	12.05 (1.35)	10.75 (0.89)	-1.3 (-1.83 to -0.76)	<0.01	3.15 (2.34 to 3.96)	<0.01
Environmental Domain	23.57 (2.91)	28.80 (4.24)	5.22 (3.92 to 6.53)	<0.01	20.25 (5.48)	21.77 (5.31)	1.52 (-0.87 to 3.92)	0.21	3.70 (1.25 to 6.15)	0.03
Exercise Capacity 6 months follow-up										
VO_2max(ml/kg/min)	-	35.70 (10.12)	-	-	-	29.13 (12.95)	-	-	6.57 (1.99 to 11.14)	<0.01

Abbreviations: CR, cardiac rehabilitation; PHQ-9, Patient Health Questionnaire-9; UC, usual care; WHOQOL-BREF, The World Health Organization Quality of Life (BREF: a shorter version of the original instrument).* A reduction is stated as a negative number while an increase is stated as a positive number.

Figure 1. CONSORT flow diagram



Appendix 1

Description of usual care and cardiac rehabilitation intervention

Usual care advice (received by both UC and intervention groups on discharge from hospital.)	- Received information on post-heart surgery precautions to be followed for six weeks: Do not lift heavy objects or weight>5Kg. Do not pull or push any heavy object. When lying in bed, use a supine position. - Dietary advice from a dietician.
In-patient cardiac rehabilitation (received in addition to usual care advice)	The in-hospital cardiac rehabilitation class consisted of: i. encouraging patients to comply with, and have knowledge of medical advice; ii. Advice about appropriate exercise, the home exercise program and iii. Stress management; iv. Advice on smoking cessation, alcohol intake and diet; and v. Encouragement to resume everyday activities and social interaction, all of which were supported by written information in the form of an education booklet.
Home-based cardiac rehabilitation	The exercise program was based on a phase two CR program: - The main exercise time was 30 minutes per day, with a 5-minute warm up and a five-minute cool down, to be completed four days per week. Exercise was undertaken at an intensity of 11 to 13 on the Borg Scale or rate of perceived exertion. Patients could choose activities involving use of large-muscle groups. - Walking for 30 minutes a day, five days a week was also recommended