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A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk parameters: evidence from Chengdu, China

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A nurse-led cardiac rehabilitation programme improves health behaviours and cardiac physiological risk parameters: evidence from Chengdu, China

Aim. The aim of this study was to examine the effect of a cardiac rehabilitation programme on health behaviours and physiological risk parameters in patients with coronary heart disease in Chengdu, China.

Background. Epidemiological studies indicate a dose-, level- and duration-dependent relationship exists between cardiac behavioural and physiological risks and coronary heart disease incidence as well as subsequent cardiac morbidity and mortality. Cardiac risk factor modification has become the very primary goal of modern cardiac rehabilitation programmes.

Design methods. A randomized controlled trial was conducted. Coronary heart disease patients ($n = 167$) who met the sampling criteria in two tertiary medical centres in Chengdu, south-west China, were randomly assigned to either an intervention group (the cardiac rehabilitation programme) or control group (the routine care). The change of health behaviours (walking performance, step II diet adherence, medication adherence, smoking cessation) and physiological risk parameters (serum lipids, blood pressure, body weight) were assessed to evaluate the programme effect.

Results. Patients in the intervention group demonstrated a significantly better performance in walking, step II diet adherence, medication adherence; a significantly greater reduction in serum lipids including triglyceride, total cholesterol, low-density lipoprotein; and significantly better control of systolic and diastolic blood pressure at three months. The majority of these positive impacts were maintained at six months. The effect of the programme on smoking cessation, body weight, serum high-density lipoprotein, was not confirmed.

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Conclusions. A cardiac rehabilitation programme led by a nurse can significantly improve the health behaviours and cardiac physiological risk parameters in coronary heart disease patients. Nurses can fill significant treatment gaps in the risk factor management of patients with coronary heart disease.
Relevance to clinical practice. This study raises attention regarding the important roles nurses can play in cardiac rehabilitation and the unique way for nurses to meet the rehabilitative care needs of coronary heart disease patients. Furthermore, the hospital–home bridging nature of the programme also created a model for interfacing the acute care and community rehabilitative care.

Key words: cardiac physiological risks, cardiac rehabilitation, coronary heart disease, health behaviour, nurse-led, nursing

Introduction

Compelling evidence has demonstrated the role of cardiac behavioural and physiological risks in the development and progression of coronary heart disease (CHD). Cigarette smoking, high-fat high-cholesterol diet and physical inactivity constitute the major cardiac behavioural risks; and serum dyslipidaemia, high blood pressure (BP) and being overweight are the major cardiac physiological risks being modifiable (Humes *et al.* 2000). Epidemiological studies indicate a dose-, level- and duration-dependent relationship exists between smoking, physical exercise, hypertension, serum dyslipidaemia and CHD incidence as well as subsequent cardiac morbidity and mortality (Multiple Risk Factor Intervention Trial Research Group 1982, MacMahon *et al.* 1990, Paffenbarger *et al.* 1993, Haapanen *et al.* 1997, Kujala *et al.* 1998, Vasan *et al.* 2001, Durrington 2003, Ying *et al.* 2003). Cardiac risk factor modification has become the very primary goal of modern cardiac rehabilitation programmes.

Investigations in six cities of China have revealed that, among patients with established CHD, the percentages of patients who smoke, have dyslipidaemia, hypertension and are overweight are as high as 65%, 72%, 71% and 48% respectively; and many patients have more than two coexisting risks (Yao *et al.* 1997, Yang *et al.* 2000, Han 2001, Zhang *et al.* 2002, Jing & Zhu 2003, Liu *et al.* 2003). However, only 2% of CHD patients could name all three major risk factors (smoking, dyslipidaemia and hypertension) and most of them did not know whether they carried a risk or not (Wang & Li 2002). Hence, it is crucial for Chinese healthcare professionals to address the issue.

The aim of this study was to examine the effect of a hospital-initiated home-based multifaceted cardiac rehabilitation intervention on health behaviours and cardiac physiological risk parameters of patients with CHD in Chengdu, China.

Methods

Design

The research design used in this study is a two-group randomized intervention design, involving randomized assignment of subjects into an intervention group and a control group according to a computer-generalized random table.

Participants

From September 2002 to December 2003, 167 patients who met the following sampling criteria were recruited from two tertiary medical centres in Chengdu, south-west China. Inclusion criteria were: (1) first hospitalization with either angina pectoris or myocardial infarction; (2) willing to participate in this study; (3) able to speak, read and write Chinese; (4) living at home with family after hospital discharge; (5) living in Chengdu and available for telephone follow-up; and (6) with fasting blood sample taken for lipid test within 24 hours of hospitalization. Exclusion criteria were: (1) planning for surgical treatment; (2) with pre-existing mobility problems; (3) with hypothyroidism or nephrotic syndrome; (4) with diagnosed psychosis or currently undergoing antipsychosis treatment; and (5) with terminal illness. The sample size calculation was based on the conventional method of power analysis by using a medium effect size of 0·5, power of 0·80 and significant level at 0·05 (Polit & Hungler 1995). Based on this estimation, it was planned to recruit 126 participants, 63 in each group. Taking into consideration a dropout rate not exceeding 20%, the sample size for each group was finalized at 75, giving a total expected sample size of 150 eligible subjects. Ultimately, 167 patients were recruited.

Ethical considerations

Prior to the pilot of this study, ethical approval was obtained from the Human Subjects Ethics Sub-committee of The Hong Kong Polytechnic University. In addition, written informed consent was obtained from each participant. They were assured that anonymity and confidentiality would be guaranteed and the right to withdraw from the study at any time.

Pilot study

From April 2002–August 2002, a pilot study was conducted on 26 participants to examine the feasibility of the proposed cardiac rehabilitation programme and data collection procedures. Based on the pilot, two major modifications were made for the programme: (1) individual instruction was suggested for the main study as there were not enough patients for group teaching; (2) to enhance the cost-effectiveness of the programme, instead of home visits for all the follow-up care, it was suggested to alternate with telephone follow-up in the main study.

Data collection

Before proceeding to data collection in the pilot study, two research assistants underwent the following training: lecturing on how to collect data, role play (demonstration and return demonstration) for problem identification and correction and supervised practice to further ensure the data collection standard. They were blinded to patient group assignment. One was responsible for the face-to-face interview according to the questionnaire. The other was responsible for conducting the health assessment for body weight and BP and for taking blood samples for lipid testing. The data collection points are baseline, three months and six months.

Cardiac rehabilitation programme

The cardiac rehabilitation programme of this study was a 12-week hospital-initiated home-based multifaceted cardiac rehabilitation intervention designed for enhancing cardiac self-management for recovery and secondary prevention during the transition from hospital to home. The design and delivery of the programme were based on the cardiac rehabilitation and secondary prevention guidelines established by the American Heart Association (Balady *et al.* 2000), as well as a synthesis of the major findings from international research in the area. The programme was started in hospital and maintained to 12 weeks after discharge, consisting of two phases.

Phase I: Hospital-based patient/family education

Phase I intervention was primarily designed to help the patients establish an attitudinal and knowledge foundation for self-managed cardiac rehabilitative care after discharge. The intervention was also designed to help family members develop a basic understanding of the importance of family support in facilitating patients' recovery, as well as explore ways to support the rehabilitative self-care of the patient at home. Seven education topics were selected: (1) CHD and self-management principles, (2) medication management, (3) angina prevention and management, (4) physical exercise, (5) dietary management, (6) smoking cessation and (7) family support. The education was conducted by individual teaching, each topic in a separate session. Family members were invited to attend. Each session included the following strategies which are aligned to the principles of adult learning: questioning and answering, instruction and sharing and discussion. The instruction was kept as short as possible to provide only essential information, to allow more time for discussion and questions and to cater for individual needs. During sharing and discussion, the patient and family member were asked to recall their own experience on the topic, to think over what they did before, any behaviour or attitude that should be changed and how to change. A healthy heart manual that covered the above education topics was provided as a self-help practical workbook for the patient.

Phase II: Home-based rehabilitative care

The aim of phase II intervention was to provide professional support for the patient and their family members during the transitional period from hospital to home, as well as to facilitate adaptation and active participation of the patient in conducting self-managed rehabilitative care on a daily basis at home. Patients were supervised, coached and supported by an experienced cardiac nurse (the researcher XJ) throughout a period of 12-week phase II home-based rehabilitation intervention. Major elements included were: (1) setting of daily behavioural goals for walking performance, smoking cessation, step II diet adherence and medication adherence; (2) setting of the goals for cardiac physiological risk control: plasma lipids of triglyceride (TG) $< 1{\cdot}70$ mmol/l, total cholesterol (TC) $< 4{\cdot}68$ mmol/l, low-density lipoprotein (LDL) $< 2{\cdot}60$ mmol/l (Chinese Dyslipidaemia Prevention and Treatment Study Group 1997), BP $< 140/90$ mmHg, normal body weight; (3) patients conducted a goal-directed self-managed rehabilitative care in medication management, angina management, physical exercise, dietary management and smoking cessation according to the recommended guidelines on a daily basis; (4) keeping a log record for

tracking progress as well as for self-evaluation and self-reinforcement; (5) family members were encouraged and instructed to participate in lifestyle change and provide support for the rehabilitative practice of the patient; (6) professional follow-up care through home visits and telephone calls for monitoring, facilitating and reinforcing the self-management practice of the patients and the supportive behaviours of the family member.

Outcome measures

Based on the literature review, four health behaviours and the relevant cardiac physiological risk parameters were assessed in the study.

Smoking cessation

Baseline smoking was defined as the use of cigarettes, cigars, cigarillos, pipe tobacco, or any other forms of tobacco within six months before hospital admission (DeBusk *et al.* 1994, Allen 1996). Smoking cessation measure (Dornelas *et al.* 2000) was used to assess the post-test smoking status. It is aimed at evaluating the point prevalence abstinence through two open-ended questions: (1) Are you currently smoking? (2) Have you smoked one cigarette, even a puff, during the past week? To examine the reliability of the patient's self-report, in this study, the same question was also put to one other member of the patient's household. A positive response to questions 1 or 2 by either the patient or the family member was coded as 'smoking'. Negative responses to questions 1 and 2 by both the patient and family member were coded as 'not smoking'. Inconsistent responses between the patient and family member were coded as 'smoking'.

Walking performance

The Jenkins Activity Checklist for Walking (Jenkins 1989) was used. There are 16 activities on the scale, ranging from walking from bed to bathroom to walking 6·5 km. The answer format is dichotomous. Subjects were required to indicate whether they had performed each activity in the previous 24-hour period. For scoring, the number of 'yes' responses was summed to provide an activity total score, ranging from 0 to 16. The reported content validity index of the scale is 0·92, the reliability coefficient alpha values were 0·93–0·96 among myocardial infarction patients (Jenkins 1989).

Step II diet adherence

Adherence to the step II diet was measured using a 3-day dietary record. Patients were instructed to keep a record of the amount of each kind of food they had eaten during the previous three 24-hour periods. A trained data collector calculated the percentage of total calories from saturated fat and the milligrams of cholesterol patients consumed each day through a Computer Dietary Analysis and Dietary Guide Service System (Huang *et al.* 1999). The results were dichotomized as 'yes' or 'no' according to whether the patients' diet each day met the step II diet criteria of saturated fat $< 8\%$ of total calories and cholesterol < 250 mg (Chinese Dyslipidaemia Prevention and Treatment Investigation Group 1997). The mean percentage of meeting the step II dietary criteria for all three days in each group was finally calculated.

Medication adherence

The self-reported drug compliance scale (Tsang 2001) was selected to assess the patients' level of medication adherence. The measure is a five-point Likert scale ranging from 1 (totally drug refusal) – 5 (about 100% drug compliance). The assessment span was one week.

Cardiac physiological risk parameters

Three categories of cardiac physiological risk parameters were assessed in this study: serum lipids, body weight and BP. Body weight was examined using a balance scale, with patients in light clothing, shoes removed and after urination. Arterial BP on the right arm in a sitting position was measured by the auscultatory method. Lipid testing was carried out in the Blood Biochemistry Laboratory of the two hospitals. All plasma samples were taken before 9 am Subjects were instructed to take nothing orally except water and medication for 12 hours before the test.

Data analysis

During the course of this study, four subjects in the intervention group and 12 subjects in the control group dropped out at three months; 10 (five in the intervention group and five in the control group) dropped out at six months. A total of 151 and 141 patients completed the study at three and six months, respectively. The examination of the programme effect was conducted on an intention-to-treat basis. In particular, Mann–Whitney *U*-test, *t*-test or chi-square test according to the types of variables and the normality test of the data were used to test the differences between control and intervention groups. All analyses were completed using SPSS, version 11·0 (SPSS Inc., Chicago, IL, USA).

Results

Demographic and clinical characteristics

The demographic and clinical characteristics of the subjects were listed in Tables 1 and 2. No significant difference was found between the intervention and control group.

Health behaviours

Walking performance, step II diet adherence, medication adherence

Both at three months and at six months, the Mann–Whitney *U*-test revealed a significant difference between the two study groups in the mean net change scores for walking performance and step II diet adherence (Tables 3 and 4). Compared with the baseline, the intervention group demonstrated a significantly greater increase in the mean scores of walking performance; for step II diet adherence, there was an increase in the mean score of the intervention group but a decrease in the mean score of the control group. The significant group difference in the net change scores of medication adherence was only found at three months. The mean scores for medication adherence of both groups were decreased, but to a significantly lesser extent in the intervention group (Table 3).

Smoking cessation

Both at three months and six months, no significant difference between the percentages of quitters in the intervention and control groups was found (Tables 5 and 6).

Cardiac physiological risk parameters

At three months, a significant greater reduction in TG, TC, LDL levels and a significant less increase in systolic and diastolic BP was found in the intervention group (Table 7). At six months, significant greater reduction was only found in TG, TC and LDL levels (Table 8).

Table 1 Demographic characteristics

	Intervention ($n = 83$) f (%)	Control ($n = 84$) f (%)	χ^2	p
Gender				
Male	57 (68·67)	62 (73·81)	0·54	0·497
Female	26 (31·33)	22 (26·19)		
Age	62·11 (7·44)*	61·37 (7·61)*	0·63†	0·527†
Marital status				
Married	75 (90·36)	78 (92·86)	1·74	0·418
Widowed	8 (9·64)	5 (5·95)		
Divorced	0 (0·00)	1 (1·19)		
Educational level				
Primary school	9 (10·84)	16 (19·05)	9·15	0·103
Junior high school	12 (14·46)	19 (22·62)		
Senior high school	25 (30·12)	14 (16·67)		
Associate degree	23 (27·71)	27 (32·14)		
Baccalaureate and above	14 (16·87)	8 (9·52)		
Employment status				
Not working	61 (73·49)	52 (61·90)	3·56	0·168
Working on a part-time basis	3 (3·61)	8 (9·52)		
Working on a full-time basis	19 (22·89)	24 (28·57)		
Occupation before retirement				
Manual labour	4 (4·82)	12 (14·28)	7·73	0·171
Technical	19 (22·89)	14 (16·67)		
Clerical	9 (10·84)	7 (8·33)		
Managerial	22 (26·51)	18 (21·43)		
Professional	24 (28·92)	22 (26·19)		
Business/commercial	5 (6·02)	11 (13·09)		
Medical payment				
Totally reimbursed	6 (7·23)	2 (2·38)	3·50	0·174
Partially reimbursed	68 (81·93)	67 (79·76)		
Totally self-paid	9 (10·84)	15 (17·86)		

*Mean (SD), †t-test.

Table 2 Clinical characteristics

	Intervention ($n = 83$) f (%)	Control ($n = 84$) f (%)	χ^2	p
Diagnoses				
Angina pectoris	56 (67·47)	58 (69·05)	0·05	0·869
Myocardial infarction	27 (32·53)	26 (30·95)		
Family history of coronary heart disease				
Yes	3 (3·61)	10 (11·90)	3·99	0·080
No	80 (96·39)	74 (88·09)		
Smoker				
Yes	33 (39·76)	38 (45·24)	0·51	0·532
No	50 (60·24)	46 (54·76)		
Hypertension				
Yes	61 (73·49)	51 (60·71)	3·08	0·100
No	22 (26·51)	33 (39·29)		
Diabetes				
Yes	10 (12·05)	19 (22·62)	3·25	0·101
No	73 (87·95)	65 (77·38)		
PTCA/stent				
Yes	28 (33·73)	20 (23·81)	2·01	0·174
No	55 (66·27)	64 (76·19)		
Medication				
Anti-platelets	81 (97·59)	80 (95·24)	0·66	0·682
Nitrates	69 (81·13)	75 (89·28)	1·33	0·270
Beta-blockers	74 (89·16)	73 (86·90)	0·20	0·812
Angiotensin-converting enzyme inhibitors	23 (27·71)	20 (23·81)	0·33	0·599
Calcium antagonists	43 (51·80)	41 (48·81)	0·15	0·758
Lipid-lowering drugs	72 (86·74)	70 (83·33)	0·38	0·665

PTCA, percutaneous transluminal coronary angioplasty.

Discussion

The effect of cardiac rehabilitation on health behaviours

Results of this study indicated that the intervention was successful in improving walking performance and step II diet adherence at both three months ($p < 0·001$) and six months ($p < 0·01$). Reasons for such a significant effect might first be attributable to the methodological advantages of the programme. Features of this cardiac rehabilitation programme are: (1) initiation of intervention during the inpatient phase, the time patients had just suffered an acute coronary attack and might be most motivated to learn and change because of the perceived high health risk; (2) providing essential but critical information to motivate and urge patients take action; (3) the follow-up care after discharge followed rigorously the process of goal setting, practice, monitoring, problem solving and reinforcement, with iteration of this process to ensure the achievement of mutually set behavioural goals on a daily basis; (4) using a log record for goal-directed self-reporting, self-monitoring and self-reinforcement of daily rehabilitative behaviours; and (5) mobilization of the family to join the behavioural change and provide appropriate support.

Findings of this study on exercise and dietary behaviour are consistent with the results of several other cardiac rehabilitation/secondary prevention interventions (DeBusk *et al.* 1994, Stanford Coronary Risk Intervention Project Investigators 1994, Allen *et al.* 2002). Other patient education

Table 3 Mean (standard deviation) of the net change scores for walking performance, step II diet adherence, medication adherence between baseline and three months

	Baseline		Three months		Net change			
	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	U	p
Walking performance	2·78 (1·61)	2·68 (1·50)	11·39 (1·39)	8·97 (2·16)	8·61 (2·84)	6·29 (3·37)	−4·73	0·001
Step II diet adherence	81·12 (30·88)	84·52 (25·05)	85·93 (22·87)	69·84 (31·36)	4·81 (23·93)	−14·68 (34·06)	−3·91	0·001
Medication adherence	4·85 (0·35)	4·86 (0·35)	4·70 (0·51)	4·47 (0·71)	−0·15 (0·63)	−0·39 (0·67)	−2·17	0·029*

*$p < 0·05$.

Table 4 Mean (standard deviation) of the net change scores for walking performance, step II diet adherence, medication adherence between baseline and six months

	Baseline		Six months		Net change			
	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	U	p
Walking performance	2·78 (1·61)	2·68 (1·50)	10·63 (2·13)	8·62 (2·98)	7·85 (3·41)	5·94 (3·94)	−3·13	0·002**
Step II diet adherence	81·12 (30·88)	84·52 (25·05)	83·53 (23·02)	71·83 (28·79)	2·41 (29·34)	−12·69 (34·67)	−3·03	0·002**
Medication adherence	4·85 (0·35)	4·86 (0·35)	4·47 (0·62)	4·27 (0·78)	−0·38 (0·69)	−0·59 (0·81)	−1·46	0·143

**$p < 0·01$.

Table 5 Frequency, percentage of quitters at three months

	Quitter *f* (%)	χ^2	*p*
Intervention ($n = 33$)	23 (69·69)		
Control ($n = 38$)	23 (60·52)	0·65	0·464

Table 6 Frequency, percentage of quitters at six months

	Quitter *f* (%)	χ^2	*p*
Intervention ($n = 33$)	17 (51·51)		
Control ($n = 38$)	15 (39·47)	1·03	0·346

programmes also demonstrated a positive effect on dietary and exercise behaviours among CHD patients (Marshal *et al.* 1986, Raleigh & Odotohan 1987, Duryee 1992, Kemenade *et al.* 1994, Moore 1996, Plach *et al.* 1996, Mahler *et al.* 1999). The intensity of intervention in most of these programmes was lower than in this study, some even consisting of just a single two-hour postdischarge education class (Plach *et al.* 1996) or a videotape information intervention before discharge (Mahler *et al.* 1999). Patients in these studies might have had a high level of health-risk motivation as moderate level of intervention was sufficient to initiate behaviour change.

While the above studies, together with this study, found a positive impact of rehabilitation on the dietary and physical exercise behaviours of CHD patients, other studies only found a partial or minor effect. A cardiac risk behaviour modification programme for women after coronary artery bypass grafting (CABG) resulted in a significantly better improvement only in dietary behaviour, but not in exercise behaviour (Allen 1996). The author related the findings to the lack of an accurate evaluation tool and more barriers for female patients to keep regular exercise. The studies of Horlick *et al.* (1984) and Scalzi *et al.* (1980) failed to find significant change in both dietary and exercise behaviour. The investigator postulated that the insignificant changes were related to the lack of individual teaching/counselling and follow-up care for reinforcement.

Regarding medication adherence, as during hospitalization the medication was administered by nurses, the baseline

Table 7 Mean (standard deviation) of the net change scores for TG, TC, HDL, LDL, body weight, BP between baseline and three months

	Baseline		Three months		Net change			
	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	*t*	*p*
TG (mmol/l)	2·13 (0·73)	2·02 (0·64)	1·92 (0·62)	1·90 (0·57)	−0·21 (0·21)	−0·12 (0·18)	−2·66	0·008**
TC (mmol/l)	5·26 (0·81)	5·09 (0·76)	4·72 (0·68)	4·82 (0·71)	−0·54 (0·40)	−0·27 (0·44)	−4·14	0·001
HDL (mmol/l)	1·06 (0·14)	1·02 (0·16)	1·08 (0·13)	1·03 (0·15)	0·02 (0·04)	0·01 (0·05)	1·20	0·232
LDL (mmol/l)	3·29 (0·70)	3·15 (0·71)	2·79 (0·51)	2·93 (0·61)	−0·50 (0·32)	−0·22 (0·40)	−4·96	0·001
Weight (kg)	65·26 (10·45)	66·22 (7·96)	65·32 (9·89)	66·64 (7·41)	0·06 (1·45)	0·42 (1·86)	−1·42	0·157
Systolic BP (mmHg)	128·62 (14·18)	128·06 (13·58)	128·65 (12·33)	130·07 (13·06)	0·03 (5·54)	2·01 (5·41)	−2·33	0·021*
Diastolic BP (mmHg)	77·26 (10·29)	77·10 (9·84)	77·35 (8·41)	78·45 (10·86)	0·09 (3·81)	1·35 (3·63)	−2·18	0·030*

TG, triglyceride; TC, total cholesterol; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; BP, blood pressure. *$p < 0·05$, **$p < 0·01$.

Table 8 Mean (standard deviation) of the net change scores for TG, TC, HDL, LDL, body weight, BP between baseline and six months

	Baseline		Six months		Net change			
	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	Intervention ($n = 83$)	Control ($n = 84$)	*t*	*p*
TG (mmol/l)	2·13 (0·73)	2·02 (0·64)	1·90 (0·56)	1·89 (0·52)	−0·23 (0·24)	−0·13 (0·25)	−2·56	0·011*
TC (mmol/l)	5·26 (0·81)	5·09 (0·76)	4·76 (0·61)	4·92 (0·67)	−0·50 (0·47)	−0·17 (0·47)	−4·46	0·001
HDL (mmol/l)	1·06 (0·14)	1·02 (0·16)	1·08 (0·12)	1·03 (0·13)	0·02 (0·06)	0·01 (0·08)	1·05	0·293
LDL (mmol/l)	3·29 (0·70)	3·15 (0·71)	2·84 (0·58)	3·00 (0·58)	−0·45 (0·41)	−0·15 (0·41)	−4·67	0·001
Weight (kg)	65·26 (10·45)	66·22 (7·96)	65·10 (10·03)	66·61 (7·17)	−0·16 (2·32)	0·39 (2·00)	−1·66	0·099
Systolic BP (mmHg)	128·62 (14·18)	128·06 (13·58)	129·80 (12·12)	130·73 (15·01)	1·18 (7·78)	2·67 (7·81)	−1·24	0·216
Diastolic BP (mmHg)	77·26 (10·29)	77·10 (9·84)	78·30 (8·56)	79·36 (9·89)	1·04 (5·89)	2·26 (4·83)	−1·45	0·148

TG, triglyceride; TC, total cholesterol; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; BP, blood pressure. *$p < 0·05$.

medication adherence levels of both study groups were high. At three months and six months, group comparison indicated a less of a decrease in the mean scores of medication adherence among rehabilitation participants and the effect reached the statistical significance level at three months ($p < 0{\cdot}05$). Explanations for significant better dietary and exercise behaviour of rehabilitation participants might also be applicable to their better medication adherence. Several other studies shared a similar result to this study (Scalzi *et al.* 1980, Marshal *et al.* 1986, Liu *et al.* 1999, Xie *et al.* 2002, Fang 2004). Other studies on medication adherence among cardiac patients unfortunately failed to find such an effect (Guthrie 2001, Laramee *et al.* 2003). The reasons reported were less intensive in intervention for example by postal and telephone reminder (Guthrie 2001) and that the high compliance of the control patients precluded the identification of a group difference (Laramee *et al.* 2003).

Among the four health behaviours investigated, smoking cessation is the weakest area in terms of the significant findings. Given the number of smokers in this study was small (33 vs. 38), the identification of significance might have been obscured by the low statistical power.

The rate of smoking cessation attained in this study (69·69% vs. 60·52% for the control group at three months and 51·51% vs. 39·47% at six months) was lower, compared with other nurse-managed smoking interventions among CHD patients (Taylor *et al.* 1990, DeBusk *et al.* 1994, Miller *et al.* 1996, Dornelas *et al.* 2000). These three studies share some similarities with this study. All involved bedside counselling, an educational pamphlet and follow-up care. The only difference was that the studies of Taylor *et al.* (1990), DeBusk *et al.* (1994) and Miller *et al.* (1996) applied nicotine replacement for those with strong withdrawal urges. The programmes of Taylor *et al.* (1990) and Dornelas *et al.* (2000) were exclusively focused on smoking cessation, which might have grasped the patient's more intense attention on smoking cessation than a programme requiring comprehensive lifestyle change.

The effect of cardiac rehabilitation on cardiac physiological risk parameters

Except for HDL, the intervention was successful in reducing TG, TC and LDL at both three months ($p < 0{\cdot}01$, $p < 0{\cdot}001$) and six months ($p < 0{\cdot}05$, $p < 0{\cdot}001$). Given moderate mean baseline levels, the lipid improvement of this study is impressive, with a reduction of TG, TC and LDL by 9·85%, 10·26% and 15·19% in the intervention group at three months. As 86·74% of patients in the intervention group were taking lipid-lowering drugs at hospital discharge, the lipid effect of this study might be attributed essentially to the medication effect enhanced by medication adherence as well as step II diet adherence of rehabilitation participants. This argument is supported by the demonstrated significantly better dietary and medication adherence of the intervention group.

Several other studies (DeBusk *et al.* 1994, Miller *et al.* 1996, Verges *et al.* 1998, Carlson *et al.* 2000, Senaratne *et al.* 2001, Allen *et al.* 2002, Vale *et al.* 2002, 2003) shared a similar result in lipid change to this study. All of these studies included medication management besides lifestyle intervention except for the study of Carlson *et al.* (2000). Among these studies, four (DeBusk *et al.* 1994, Miller *et al.* 1996, Senaratne *et al.* 2001, Allen *et al.* 2002) involved direct prescription of lipid-lowering medications to patients, such as by a nurse case manager. Their study effect should be more related to the progressive titration of lipid-lowering drug therapy in addition to active lifestyle modification. The other three studies (Verges *et al.* 1998, Vale *et al.* 2002, 2003) did not involve the direct prescribing of drugs, more like this study. As argued by these researchers, their lipid effect was more attributable to the enhanced medication adherence and dietary modification induced by the intervention. Nevertheless, all of the above researchers consistently believed that effective lipid management could not be operated in one dimension. The results might have represented a synergistic effect of medication management by either direct prescription or improved self-management, dietary modification and possibly exercise training and smoking cessation. This explanation should be applicable to the lipid improvement of the rehabilitation participants in this study.

On the contrary, some researchers have reported an insignificant finding or minor effect in serum lipid management (Nikolaus *et al.* 1991, Lavie & Milani 1995, 1997, Yoshida *et al.* 1999). Among these studies, there might have existed the problem of low dietary adherence, but is beyond explanation as these studies did not present dietary information except for Nikolaus *et al.* (1991). Of particular note is that in the above studies, patients taking lipid-lowering drugs were either excluded or no intervention was offered on medication management.

Among the four lipid parameters assessed, HDL was the only one that seems not to have been substantially affected by the rehabilitation intervention. The failure to achieve a significant group difference might be related to the lower efficacy of lipid-lowering drugs in influencing HDL (Stone 1996). The simultaneous HDL increase of the control group might also be part of the reason. A similar phenomenon was also observed in the study of Allen *et al.* (2002) and Vale *et al.* (2002, 2003).

In contrast to serum lipids, body weight appears not to have been significantly affected by the intervention. Moreover, at three months the rehabilitation participants had gained 0·06 kg. The result is rather unexpected because of the significantly better step II diet adherence and walking performance found in the intervention group. One possible reason might be that while reducing their fat and cholesterol intake the patients had paid insufficient attention to restricting carbohydrate intake or even had eaten more.

It was reassuring to find that at six months the rehabilitation participants demonstrated a 0·16 kg weight loss compared with a 0·39 kg weight gain of the control patients. This insignificant but encouraging finding might be associated with better dietary management of fat and cholesterol intake as well as the increased physical activity level. Meta-analysis (Yu-Poth *et al.* 1999) on 37 step I and step II diet interventions among cardiac patients demonstrated that, for every 1% decrease in energy as total fat, there was a 0·28 kg decrease in body weight; dietary interventions with exercise resulted in a significantly greater weight loss than those without exercise.

This study also demonstrated a significantly positive impact of the programme on both systolic and diastolic BP at three months. The result might be associated with better compliance to antihypertensive drugs, BP monitoring and lifestyle modification. A meta-analysis of 16 studies among 650 subjects found that regular walking (2–5 times/week) at moderate intensity was associated with a reduction of 3 mmHg resting systolic BP and 2 mmHg diastolic BP (Kelley *et al.* 2001). Vale *et al.* (2003) reported similar result. By contrast, the studies of Carlson *et al.* (2000) and Ornish *et al.* (1998) failed to produce a significant effect on BP. The study of Carlson *et al.* (2000) was a six-month exercise-only programme. The study of Ornish *et al.* (1998) was focused on intensive lifestyle modification. The fact that their programmes were less comprehensive, particularly the lack of intervention on medication management, might have accounted for the different effect on BP.

At six months, the effect of the intervention on BP was not sustained. This might be associated with the insignificant difference in medication adherence levels of the two study groups at six months, most possibly the anti-hypertensive drug adherence levels, which is beyond the explanation of this study as individual drug compliance was not assessed in this study. The association with physical exercise is unlikely, as the walking level of the intervention group was maintained at three-month follow-up.

Conclusion

The results of this study clearly indicate the benefits of a nurse-led cardiac rehabilitation intervention on health behaviour improvement and cardiac physiological risk reduction of CHD patients. More importantly, through empowering the patient for self-care and the facilitation of daily rehabilitative self-management practice, the programme has contributed to the development of the 'survival' skills of patients with CHD to live with their heart disease, to which the current health care ultimately advocates and pursues. To our knowledge, reports are lacking on the effect of nurse-led cardiac rehabilitation intervention on cardiac risk factors in China. It is believed that findings in this study may be suggestive of the development of evidence-based practice in transitional nursing care as well as for future research.

Implications for practice

Nurses represent the largest proportion of healthcare workforce in China. They are in the most unique and favourable position for assuming the responsibilities of rehabilitative care, as they have the most and continuous contact with the patient and family at all stages of recovery. Unfortunately, nurses in clinical practice do not capitalize fully on this golden opportunity. At present, in most Chinese nurses' minds, rehabilitation is the work of the physiotherapist and the responsibility of the therapy discipline (Guo & Yan 2002). It is rare for them to go beyond the brief discharge instruction to meet the more complex and continuous rehabilitative care needs of patients in their daily practice. The top reasons identified for their failure to take on cardiac rehabilitative care are the lack of recognition for the importance of the role nurses can play in the field, as well as the way to proceed with the process (Guo & Yan 2002).

This study has explored a unique way for nurses to meet the rehabilitative care needs of CHD patients through educating, supporting, supervising and reinforcing their daily rehabilitative self-management practice. The hospital–home bridging nature of the programme also created a model for interfacing the acute care and community rehabilitative care. It can be further adapted and expanded to the transitional care and home management of other chronic patients.

The significant differences in serum lipid and BP management effect between medication-involved studies and those studies paid little or no attention to medication management suggest the importance of the cooperation of lifestyle change with appropriate drug treatment as well as the associated strategies for facilitating adherence. Findings of this study further remind us that cardiac rehabilitation programmes should be multifaceted.

Implications for policy development

In China, no existing policies have been developed by professional nursing organizations concerning nurses' roles and responsibilities in cardiac rehabilitation and secondary prevention. This absence has significantly contributed to the lack of involvement of nurses in cardiac rehabilitation and secondary prevention efforts. In addition, much of the effort of health care in China is placed on acute care. The importance of cardiac rehabilitation in enhancing cardiac recovery and preventing subsequent morbidity, mortality and disability and the associated cost-effectiveness are not fully recognized in Chinese healthcare system (Wang & Qu 2000). This study suggests the roles nurses can play in cardiac rehabilitation and a need to develop an overall policy and positional guidelines for cardiac rehabilitation and secondary prevention for healthcare professionals in China. Nurses should actively take part in this policy-making process and be the integral part of the advisory committee, as has happened in Western countries (Balady *et al.* 2000). Policies or guidelines should also be established at the hospital level to guide professional nursing practice in the domain of cardiac rehabilitation and secondary prevention.

Limitations and suggestions for future research

Findings of this study revealed that, among four health behaviours investigated, smoking seems more resistant to change and medication adherence appears more difficult to maintain. Investigations of factors affecting smoking behaviour change and long-term medication compliance are warranted, as well as the development of more effective intervention strategies.

Medication adherence was assessed as a whole in this study, which makes the explanation on the change of physiological risk parameters such as BP at six months difficult. Evaluation of individual drug compliance is suggested for future studies.

This study only examined the effect of the rehabilitation intervention at six months. It would be beneficial and advantageous to repeat the study by following the participants through a longer time duration so as to test the long-term patient benefits and cost effectiveness of nurse-led rehabilitation programmes and to capture imperative long-term data to establish a nurse-led refresher involving information giving and patient support network that is necessary.

Family involvement is critical in the rehabilitation process and was addressed in this study. However, the outcome measurement of this study was inclusively focused on the patient: what was the effect on family members themselves is beyond the answer of this study, as literature indicates the concordance for the lifestyles and risk factors of married couples. Outcome evaluation of both the patient and their family members is worthy of attention.

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Contributions

Study design: XJ, JWS, TKSW; data analysis: XJ, JWS, TKSW; manuscript preparation: XJ, JWS.

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