Effects of a Problem-based Learning Rehabilitation Program on Physical Activity in Patients With Coronary Artery Disease

Pia R. Tingström, RN, PhD; Ulf Ekelund, PhD; Kitty Kamwendo, PT, PhD; Björn Bergdahl, MD, PhD

- PURPOSE: To evaluate the effects of a problem-based learning (PBL) rehabilitation program on physical activity.
- METHODS: We randomized 207 consecutive patients younger than 70 years, with a recent event of coronary artery disease (CAD), to a PBL group (n = 104) or a control group (n = 103). In addition to standard treatment, the PBL patients participated in a 1-year program with 13 sessions in small groups, where learning needs and behavior change were focused upon. Physical activity was assessed by means of interviews with all patients and by an activity monitor in 69 patients at pretest and in 175 after 1 year.
- RESULTS: Only small differences between groups were found at posttest. Interview data revealed significantly less activity at low-intensity level in the control group, whereas the activity monitor showed no significant differences. No changes were found in total physical activity during the year within the 2 groups. The self-reported physical activity indicating a level of brisk walking was markedly higher than that measured by the activity monitor, the latter indicating that only 35% of the patients achieved a 10-minute period of continued physical activity per day on an adequate level.
- CONCLUSIONS: Our PBL program had no important impact on the physical activity pattern of patients with CAD. The activity monitor is a feasible way of measuring physical activity in these patients, indicating a lower level of physical activity than interview data.

KEY WORDS

cardiac rehabilitation

coronary artery disease

physical activity

problem-based learning

From the Department of Medicine and Care, Division of Cardiology, Faculty of Health Sciences, Linköping University, Linköping (Drs Tingström and Bergdahl); Department of Physical Education and Health, Örebro University, Örebro, Sweden (Dr Ekelund); MRC Epidemiology Unit, Cambridge, UK (Dr Ekelund); and the Department of Caring Sciences, Örebro University, Örebro, Sweden (Dr Kamwendo).

Address correspondence to: Pia Tingström, RN, PhD, Department of Medicine and Care, Division Internal Medicine, Faculty of Health Sciences, Linköping University, SE-581 85 Linköping, Sweden (e-mail: piati@imv.liu.se).

INTRODUCTION

Physical activity is important in secondary prevention for patients with coronary artery disease (CAD).[1] It has been suggested that being physically active reduces total mortality and cardiac mortality by 20% to 25%.[2] Physical activity has also been associated with a 40% to 50% reduction of CAD events for individuals both with and without preexisting CAD.[3] Even a modest increase in physical activity can have a beneficial effect on mortality.[4] Guidelines for cardiac rehabilitation (CR) state that the duration of activity should be 20 to 30 minutes per day on 5 or more days per week, together with increased activity during everyday routines.[5] The activity can be split into shorter periods and accumulated during the day and still be beneficial, as judged from the effects on physical fitness and blood lipid profile.[6,7] Vigorous activity does not appear to be necessary to achieve positive effects. Moderate activity such as brisk walking seems to reduce both all-cause and cardiovascular mortality,[8,9] and frequency seems to be of greater importance than intensity.[10]

To gain positive effects of physical activity, patients need to achieve lasting changes in behavior. However, reviews indicate that CR programs, which focused solely on exercise, were inefficient[5] Instead, a comprehensive, active, and participatory approach to rehabilitation is needed in order to achieve risk reduction.[11] CR should be focused upon patient's own learning needs and the meaning of behavioral changes.[12] Marcus et al[13] suggested small-scale programs with individualized instructions, including a plan for maintenance, in order to strengthen an adopted change.[13] A lifestyle intervention program with a problem-solving approach was shown to be more efficient in comparison to traditionally structured physical exercise.[6] Comprehensive programs have also been proven to reduce cardiac events and readmissions to hospital.[14]

We have developed and validated a CR program built on the problem-based learning (PBL) philosophy.[15] PBL is characterized by problem solving, self-directed learning, and small tutorial groups.[16] The main intentions of our program were to support and encourage the participants in procuring and applying knowledge, with the aims of strengthening adherence to suggested changes in lifestyle and finding tools to master their own disease situation.

A randomized study was carried out to evaluate the effects of the program. The part of the study presented in this article focuses on physical activity. We have evaluated effects of the program on changes in physical activity using an objective assessment of physical activity by means of accelerometry,[17,18] in combination with self-reported data from an interview.

METHODS

An open, randomized, 2-group design was used. During the 1-year period, both groups were offered standard treatment by the rehabilitation team. In addition, the intervention group participated in the PBL program. The standard treatment included 1 or 2 visits to a rehabilitation nurse, and 2 to 4 visits to a cardiologist. All patients were offered participation in weekly, 1-hour exercise groups, supervised by a physiotherapist, and starting 1 to 2 weeks after discharge. Other activities offered were individual counseling from a dietician (1 to 3 times) and smoking cessation groups. Measurements were performed before randomization and at the end of the PBL program, after 1 year. Randomly selected sealed envelopes containing information on group allocation, treatment, or control were used.

Patients

There were 427 consecutive patients aged <70 years, with a recent event of CAD (ie, myocardial infarction and/or treated with percutaneous coronary intervention and/or treated with coronary artery bypass grafting), considered as potentially eligible to participate in the study. Of these, 49 (31 men, 18 women) were excluded due to planned bypass surgery, other severe diseases such as advanced cancer, senility, psychiatric disease, and difficulty in communicating in Swedish. The remaining 378 patients were asked about participation at a regular visit to the rehabilitation nurse, 3 to 6 weeks after discharge. Those who agreed to participate (n = 207) were included within 1.5 to 2 months after the cardiac event. At this visit, pretests were performed and measurement of physical activity by the activity monitor was carried out the following week. When all pretests were completed, patients were randomized to the PBL group (n = 104) or to the control group (n = 103). The activity monitor was not available until half of the patients had been included and therefore 88 patients had physical activity registrations at pretest. Descriptive

Table 1 • BASELINE CHARACTERISTICS OF PATIENTS

Characteristics	PBL Group (n = 104)	Control Group (n = 103)
Age, mean (±SD), y	59.1 (±7.1)	59.4 (±7.2)
Sex, %		
Men	72	75
Woman	28	25
Civil status, %		
Married	82	82
Living alone	15	14
Education level, %		
6–9 year compulsory school	43	49
2–4 year upper secondary school	44	40
University degree	13	11
BMI, mean (±SD)	27.1 (±3.7)	27.7 (±4.3)
Cardiac event, %		
MI	38	43
PCI	13	27
CABG	23	15
MI and PCI	20	15
MI and CABG	6	0
Classification of angina, %		
No angina	73	61
Class I	22	26
Class II	3	5
Class III	1	7
Class IV	1	1

PBL indicates problem-based learning; BMI, body mass index; MI, myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting.

data for all patients are summarized in Table 1. Angina pectoris was graded in accordance to the Canadian Cardiovascular Society.[19] Informed consent was obtained from all participants, and they could withdraw their participation at any time. The ethics committee for human research at the Faculty of Health Sciences, Linköping University, approved the study protocol.

The PBL Program

Groups of 6 to 9 patients and a tutor (nurse, physiotherapist, or dietician from the rehabilitation teams), who had a facilitating and supportive role rather than an educative one, met on 13 occasions for 1.5 hours during a 1-year period, with more frequent meetings during the first 2 months. In order to commence the learning process, different scenarios were used, which usually took the form of a picture, a short text, or an extract from a daily paper illustrating real-life situations. Areas covered were manifestations of CAD and its symptoms, psychological reactions to the disease, psychosocial factors, stress, physical exercise, smoking, metabolic factors such as diabetes and blood lipids, choice of food, alcohol, sex life, revascularization procedures, and drug treatment.

To facilitate the work with the scenarios, a problem-solving process adapted from Schmidt[20] was introduced. The work in small groups aimed at stimulating all participants to be active in the discussions, activate prior knowledge, ask questions, and appraise newly gained knowledge and its applicability to their own lives. The groups were asked to prepare common objectives for further study and to be prepared to discuss them at the next meeting, after individual studies. The participants were also asked to set specific individual goals for lifestyle changes, which were evaluated during subsequent group meetings. A small library was available for patients at the group meetings.

Interview

Patients were asked to describe their physical activity and exercise habits over the last 3 to 4 weeks prior to the interview. The interview was constructed to capture the patients' own perceptions about how physically active they were and also to capture activities performed more seldom than once a week. The questions were open-ended and the amount and intensity of activity was, in accordance with guidelines, structured in minutes per day and by grading how warm and out of breath the participants had felt.[10] The 4 intensity levels were as follows: not at all warm and out of breath, somewhat warm and out of breath, moderately warm and out of breath, or very warm and out of breath.

Measurement by MTI/CSA Activity Monitor

The monitor used is the MTI/CSA (model WAM 7164; Manufacturing Technology, Fort Walton Beach, Fla, formerly Computer Science Application). It is a small (5.1 × 3.8 × 1.5 cm, 43 g) accelerometer designed to detect accelerations in the vertical plane, ranging in magnitude from 0.05 to 2.0 G, with a frequency response from 0.25 to 2.5 Hz. These parameters detect normal body motions and reject motion from other sources, such as vibrations. The output from the monitor was sampled 10 times per second and summated over a 1-minute interval (epoch).[17,21] The monitor was secured at the level of the lower back using an elastic belt. Patients were instructed to wear the monitor for 8 days when awake and only remove it in order to shower or swim. Registrations from the first day were not included in the analysis. Registration files with less than 5 days of registration were excluded. Because the monitor does not appropriately detect cycling, the patients noted periods of cycling and swimming in a diary.

The monitor was validated for use in patients with CAD during treadmill walking in an earlier study.[22] In accordance with findings from this study, diurnal physical activity in the present study was grouped into 5 activity levels expressed as counts/minute. Registrations with zero as count value were considered as no activity, and those between 1 and 100 counts/minute were considered as sedentary behavior, such as sitting and standing. We have previously shown that walking at 3.2 and 4.8 km/h corresponds to an average of 1,208 and 3,258 counts/minute, respectively, in CAD patients.[22] Therefore, registrations between >100 and <1,208 counts/minute were considered to represent low-intensity activity, between ≥1,208 and <3,258 counts/minute as moderate intensity activity, and ≥3,258 counts/minute as vigorous intensity activity. In addition to the possibility of calculating the amount of time (minutes/d) the patients spent on different activity levels, the number of continuous activity periods at a moderate intensity level >10 minutes was analyzed.

Statistical Analysis

Descriptive statistics were used and, where appropriate, values were reported as mean and standard deviation (SD). Differences in age, gender, and cardiac event between participants and those eligible, but not taking part, were analyzed by Student t test and χ^2 test. Between-group analyses of activity monitor and interview data were performed by Student t test on mean change. Within-group comparisons were analyzed using paired t test. All-group comparisons were performed using intention-to-treat analyses, and a probability level of $P < .05$ was used to establish statistical

significance. A statistical software package (SPSS 11.0 for Windows, Chicago, Ill) was used for all statistical analyses.

RESULTS

There were no significant differences between participants and those who decided not to participate in the study regarding age (t = 0.551, P = .758), gender [$\chi^2(1)$ = 0.274, P = .600], and cardiac event [$\chi^2(4)$ = 1.161, P = .837].

Both pre- and posttest data were available in 200 of the 207 patients. Two patients died between baseline and follow-up and 5 dropped out of the study, 3 from the intervention group and 4 from the control group. At pretest, there were 88 patients wearing the MTI/CSA activity monitor, but 15 registrations were excluded due to technical problems or less than 5 days of registration. At posttest, 175 of 200 possible activity monitor registrations were collected. Twelve patients did not want to wear the monitor and 13 were excluded due to technical problems or due to less than 5 days of registration. In all, 69 patients (35 in the PBL group and 34 in the control group) were measured both at pre- and posttest. There were no significant differences in characteristics at pretest between the subgroup (n = 69) and the rest of the group with only posttest registrations (n = 138).

The average attendance in the PBL groups was 9.4 (median 11) out of 13 sessions. Twenty-nine percent (n = 60) of all patients participated in exercise groups at baseline (30 in the PBL group and 30 in the control group). Of those measured by the activity monitor at pre- and posttest, 10 patients in the PBL group and 9 in the control group participated in exercise groups.

There were 197 patients reporting some kind of exercise at baseline, and 10 patients reported that they did not exercise at all, when they were interviewed. Due to the low number of patients reporting activity in each category, the 4 levels of intensity from interview data were summarized in 2 categories: "not at all warm and out of breath" and "somewhat, moderately, or very warm and out of breath." Table 2 presents the duration of exercise at the different self-rated intensity levels. At pretest these were, on average, 75 and 81 minutes per day in the PBL and control groups, respectively. There was a significant difference in mean change (P = .003) between groups at the lower level of reported activity as the control group decreased their activity during the year. No differences in overall change between groups were found. Within-group analyses showed a significant increase over time for the control group at the higher activity intensity level (P = .001), but there were no differences in the total duration of exercise per day.

Table 3 shows the data obtained from the activity monitor. No significant pretest differences were found between the 2 groups (n = 69). Approximately 65% of the patients in the subgroup were not physically active even for one continuous 10-minute period of activity at a moderate level per day at pretest (PBL group 0.8 ten-minute periods of moderate physical activity per day compared to 0.7 periods in the control group). These figures were the same at posttest in the group of 175 patients. Posttest data showed a tendency for patients in the PBL group to be more physically active at the vigorous level, with about 30 minutes per week (P = .050). Within-group analyses revealed that there were no changes in the activity pattern between pre- and posttest. At pretest, 14 patients reported cycling at an average of 3 minutes per day and 2 patients reported swimming. At posttest, 19 patients in the PBL group and 16 patients in the control group reported cycling at an average of 3 minutes per day in each group.

Looking at the whole group, there was a difference between the self-reported physical activity at the higher intensity level and the objectively measured physical activity at the vigorous level. Patients reported on average 52 and 73 minutes, respectively, at pre- and posttest at this level, compared to 9.5 and 12.5 minutes, respectively, as measured by the activity monitor.

Table 2 • MEAN (±SD) FROM INTERVIEW DATA, PRESENTED AS REPORTED ACTIVITY IN MINUTES PER DAY AT PRE- AND POSTTEST

	PBL Group (n = 100)	Control Group (n = 97)	P
Not warm and out of breath (minutes/d)			
Pretest	18 (38)	33 (55)	
Posttest	13 (40)	6 (20)	.003
Warm and out of breath (minutes/d)			
Pretest	57 (64)	48 (66)	
Posttest	66 (71)	80 (120)	.106
Total activity reported (minutes/d)			
Pretest	75 (76)	81 (73)	
Posttest	79 (73)	86 (120)	.916

P values are based on calculated mean change between pre- and posttest.

DISCUSSION

The main finding from the present study is that our PBL program, in addition to standard comprehensive rehabilitation, did not promote any important behavioral change in physical activity in CAD patients. We found a difference between self-reported and objectively measured physical activity. As we included over 55% of all eligible patients, which is a high rate compared to many other rehabilitation programs,[23] our results are fairly representative. The intention to attract as many patients

Table 3 • PHYSICAL ACTIVITY PER DAY (MEAN ± SD), AS MEASURED BY CSA/MTI ACTIVITY MONITOR IN 69 PATIENTS AT PRE- AND POSTTEST AND ON POSTTEST VALUES ON 175 PATIENTS

Activity Level	PBL Group (n = 35)	Control Group (n = 34)	*P*	PBL Group (n = 91)	Control Group (n = 84)	*P*
No activity (minutes)						
Pretest	646 (±102)	668 (±78)				
Posttest	615 (±104)	653 (±78)	.478	650 (±112)	644 (±78)	.672
Sitting standing (minutes)						
Pretest	486 (±77)	470 (±99)				
Posttest	502 (±91)	456 (±80)	.216	470 (±95)	459 (±80)	.421
Low activity (minutes)						
Pretest	251 (±66)	255 (±60)				
Posttest	262 (±69)	277 (±71)	.548	262 (±69)	262 (±1)	.165
Moderate activity (minutes)						
Pretest	45 (±33)	40 (±22)				
Posttest	47 (±29)	48 (±27)	.458	44 (±25)	50 (±30)	.131
Vigorous activity (minutes)						
Pretest	11 (±13)	8 (±10)				
Posttest	15 (±15)	10 (±12)	.478	14 (±16)	10 (±10)	.050
Continued periods of >10 minutes at moderate and vigorous levels						
Pretest	0.8 (±0.8)	0.7 (±0.8)				
Posttest	0.8 (±1.0)	0.7 (±0.7)	.908	0.8 (±0.9)	0.7 (±0.7)	.481
Counts per minute						
Pretest	306 (±134)	291 (±131)				
Posttest	331 (±144)	323 (±128)	.816	330 (±136)	330 (±134)	.979

P values based on the calculated mean change between pre- and posttest and on mean posttest values.

as possible, irrespective of initial fitness, might have influenced our results.

Physical activity assessed by the interview and by the activity monitor gave similar results concerning the effects of our rehabilitation program, even if the absolute levels of activity are not strictly comparable between the 2 methods. The definition of moderate activity by Shephard and Balady[24] (brisk walking at 4.8 km/h) is broadly equal to the vigorous level as measured by the activity monitor. The latter method showed considerably more time accumulated at low and moderate intensity levels compared with self-reported data. Although self-reported data indicated that patients perceived themselves as exercising on an intensity level corresponding with existing recommendations, the activity monitor did not confirm this finding. Thus, our patients seem to have experienced the recommended intensity level of exercise at lower activity levels than anticipated, which may be due to their age and disease. Another possible explanation is that patients might have exaggerated their self-reported physical activity.

The MTI/CSA activity monitor has some limitations. It cannot capture cycling and swimming, but the reported low levels of these activities indicate that the activity monitor, in combination with a diary for swimming and cycling activities, provides a valid measure of the individual's activity pattern. Our results seem to correspond with activity patterns described by Ayabe et al[25] using another type of accelerometer. The total amount of physical activity (ie, counts/minute per day) assessed by the activity monitor is also a valid indicator of energy expenditure associated with physical activity, measured by the doubly labeled water method.[26,27]

Conflicting results of effects of rehabilitation programs on physical activity have been reported, and only a few studies provide evidence of lasting effects on physical activity after interventions in patients with CAD. One reason could be the methodological problems in many studies, as only self-reported data on exercise have been used, intention-to-treat analysis is rarely applied, patients included are highly selected, and CR programs are hard to classify as comprehensive, as they lack detailed descriptions.[13,28,29] Another reason may be that physical activity is hard to influence in general.[30,31] Carlson et al[32] developed a CR program that has shown transient positive effects on exercise behavior. Similarly, positive

long-term results were reported in highly selected men participating in a supervised exercise program.[33] It appeared that only those with an early increase in physical work capacity gained long-term survival benefits. This is in line with results from a subgroup (n = 118) of the patients in the present study. Using the "stages of change" model,[34] we found a tendency for those with an interest in physical exercise to remain unchanged or to improve, whereas individuals who had been physically inactive before the intervention regressed.

Maintaining a lifestyle characterized by physical activity presents a major problem. Dramatic decreases in adherence at 6 months have been reported.[6,35] Scheduling of persistent reinforcement seems to be a key factor for success, and it may take more than 6 months, with weekly supervised exercise sessions, in order to achieve changes.[36] Peer support groups can also have a positive impact on adherence to physical activity.[37] Our program was scheduled to last over the critical period of 6 months, but the number of group sessions during the second 6-month interval was only 2 or 3. The dropout rate in our study was very low (3%) and attendance rate at group sessions was good. Our lack of positive results concerning physical activity may depend on the comprehensive structure of the program covering a number of topics for behavioral change. A PBL program with a greater emphasis on stimulating participation in exercise groups might produce a different outcome. Our study also illustrates the difficulty in finding the balance between a high participation rate and few dropouts on the one hand and a very extensive and economically less feasible CR program with risk for the opposite effects on the other. Further research is needed on patterns of physical activity in CAD patients, using objective methods, as well as on strategies to influence such patterns.

CONCLUSIONS

Our comprehensive PBL program for CAD patients, with 13 group sessions over 1 year, in addition to standard care, did not show any important changes in physical activity behavior, as assessed objectively by an activity monitor and by an interview. Nor did we observe any differences in total activity within groups over the 1-year period. We found differences between self-reported and objectively measured physical activity. The patients experienced their activity as strenuous at low intensity levels as measured by the activity monitor.

Acknowledgments

This study was supported by grants from the Vårdal Foundation, the Swedish Heart and Lung Association, and the Swedish Heart and Lung Foundation.

References

1. Fuster V, Gotto AM, Libby P, Loscalzo J, McGill HC. 27th Bethesda Conference: matching the intensity of risk factor management with the hazard for coronary disease events. Task Force 1. Pathogenesis of coronary disease: the biologic role of risk factors. *J Am Coll Cardiol*. 1996;27:964–976.
2. Forrester JS, Merz CN, Bush TL. 27th Bethesda Conference: matching the intensity of risk factor management with the hazard for coronary disease events. Task Force 4. Efficacy of risk factor management. *J Am Coll Cardiol*. 996;27:991–1006.
3. Wannamethee SG, Shaper AG. Physical activity in the prevention of cardiovascular disease: an epidemiological perspective. *Sports Med*. 2001;31:101–114.
4. Wood D, De Backer G, Faergeman O, Graham I, Mancia G, Pyorala K. Prevention of coronary heart disease in clinical practice. Summary of recommendations of the Second Joint Task Force of European and other Societies on Coronary Prevention. *Blood Press*. 1998;7:262–269.
5. Ades PA, Balady GJ, Berra K. Transforming exercise-based cardiac rehabilitation programs into secondary prevention centers: a national imperative. *J Cardiopulm Rehabil*. 2001;21:263–272.
6. Dunn AL, Marcus BH, Kampert JB, Garcia ME, Kohl HW, Blair SN. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: a randomized trial. *JAMA*. 1999;281:327–334.
7. Murphy M, Nevill A, Neville C, Biddle S, Hardman A. Accumulating brisk walking for fitness, cardiovascular risk, and psychological health. *Med Sci Sports Exerc*. 2002;34:1468–1474.
8. Wannamethee SG, Shaper AG, Walker M. Physical activity and mortality in older men with diagnosed coronary heart disease. *Circulation*. 2000;102:1358–1363.
9. Quell KJ, Porcari JP, Franklin BA, Foster C, Andreuzzi RA, Anthony RM. Is brisk walking an adequate aerobic training stimulus for cardiac patients? *Chest*. 2002;122:1852–1856.
10. Vuori I, Andersen LB, Caville N, Marti B, Sellier P. Physical activity and cardiovascular disease prevention. *Brussels Eur Heart Netw*. 1999:48.
11. Giannuzzi P, Saner H, Bjornstad H. Secondary prevention through cardiac rehabilitation: position paper of the Working Group on Cardiac Rehabilitation and Exercise Physiology of the European Society of Cardiology. *Eur Heart J*. 2003;24:1273–1278.
12. Mullen PD, Mains DA, Velez R. A meta-analysis of controlled trials of cardiac patient education. *Patient Educ Couns*. 1992;19:143–162.
13. Marcus BH, Dubbert PM, Forsyth LH. Physical activity behaviour change: issues in adoption and maintenance. *Health Psychol*. 2000;19:32–41.
14. Hedback B, Perk J, Hornblad M, Ohlsson U. Cardiac rehabilitation after coronary artery bypass surgery: 10-year results on mortality, morbidity and readmissions to hospital. *J Cardiovasc Risk*. 2001;8:153–158.
15. Tingstrom P, Kamwendo K, Goransson A, Bergdahl B. Validation and feasibility of problem-based learning in rehabilitation of patients with coronary artery disease. *Patient Educ Couns*. 2002; 47:337–345.
16. Maudsley G. Do we all mean the same thing by "problem-based learning"? A review of the concepts and a formulation of the ground rules. *Acad Med*. 1999;74:178–185.
17. Trost SG, Ward DS, Moorehead SM, Watson PD, Riner W, Burke JR. Validity of the computer science and applications (CSA) activity monitor in children. *Med Sci Sports Exerc*. 1998;30: 629–633.
18. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. accelerometer. *Med Sci Sports Exerc*. 1998;30:777–781.
19. Campeau L. Grading of angina pectoris [letter]. *Circulation*. 1976;54:522–523.

20. Schmidt HG. Problem-based learning: rationale and description. *Med Educ*. 1983;17:11–16.
21. Computer science and application I. Activity monitor operator's manual. Model 7164 multimode. Release 1.24E. Shalimar, Florida.
22. Ekelund U, Tingstrom P, Kamwendo K, et al. The validity of the Computer Science and Applications activity monitor for use in coronary artery disease patients during level walking. *Clin Physiol Funct Imaging*. 2002;22:248–253.
23. Wenger N, Froelicher E, Smith K, et al. Cardiac rehabilitation. Clinical practice guideline No. 17. Rockville: US Department of Health and Human Service, Public Health Service, Agency for Health Care Policy and Research and the National Heart, Lung and Blood Institute; 1995.
24. Shephard RJ, Balady GJ. Exercise as cardiovascular therapy. *Circulation*. 1999;99:963–972.
25. Ayabe M, Brubaker PH, Dobrosielski D. The physical activity patterns of cardiac rehabilitation program participants. *J Cardiopulm Rehabil*. 2004;24:80–86.
26. Ekelund U, Sjostrom M, Yngve A. Physical activity assessed by activity monitor and doubly labeled water in children. *Med Sci Sports Exerc*. 2001;33:275–281.
27. Ekelund U, Aman J, Westerterp K. Is the ArteACC index a valid indicator of free-living physical activity in adolescents? *Obes Res*. 2003;11:793–801.
28. Bennett P, Carroll D. Cognitive-behavioural interventions in cardiac rehabilitation. *J Psychosom Res*. 1994;38:169–182.
29. Dusseldorp E, van Elderen T, Maes S, Meulman J, Kraaij V. A meta-analysis of psychoeducational programs for coronary heart disease patients. *Health Psychol*. 1999;18:506–519.
30. Newens AJ, McColl E, Bond S. Changes in reported dietary habit and exercise levels after an uncomplicated first myocardial infarction in middle-aged men. *J Clin Nurs*. 1997;6:153–160.
31. Pasquali SK, Alexander KP, Coombs LP, Lytle BL, Peterson ED. Effect of cardiac rehabilitation on functional outcomes after coronary revascularization. *Am Heart J*. 2003;145:445–451.
32. Carlson JJ, Johnson JA, Franklin BA, VanderLaan RL. Program participation, exercise adherence, cardiovascular outcomes, and program cost of traditional versus modified cardiac rehabilitation. *Am J Cardiol*. 2000;86:17–23.
33. Dorn J, Naughton J, Imamura D, Trevisan M. Results of a multicenter randomized clinical trial of exercise and long-term survival in myocardial infarction patients: the National Exercise and Heart Disease Project (NEHDP). *Circulation*. 1999;100:1764–1769.
34. Kamwendo K, Tingstrom P, Bergdahl B, Svensson E. Effect of problem-based learning on stages of change for exercise behaviour in patients with coronary artery disease. *Physiother Res Int*. 2004;9:24–32.
35. Dorn J, Naughton J, Imamura D, Trevisan M. Correlates of compliance in a randomized exercise trial in myocardial infarction patients. *Med Sci Sports Exerc*. 2001;33:1081–1089.
36. Franklin BA, Swain DP, Shephard RJ. New insights in the prescription of exercise for coronary patients. *J Cardiovasc Nurs*. 2003;18:116–123.
37. Hildingh C, Fridlund B. Participation in peer support groups after a cardiac event: a 12-month follow-up. *Rehabil Nurs*. 2003;28:123–128.