Evaluation of a standardized patient education program for inpatient cardiac rehabilitation: impact on illness knowledge and self-management behaviors up to 1 year

Karin Meng¹*, Bettina Seekatz¹, Günter Haug², Gabriele Mosler³, Bernhard Schwaab⁴, Ulrike Worringen⁵ and Hermann Faller¹

¹Department of Medical Psychology, Medical Sociology, and Rehabilitation Sciences, University of Würzburg, D-97070 Würzburg, Germany, ²Rehabilitation Center Bayerisch Gmain, D-83457 Bayerisch Gmain, Germany, ³Rehabilitation Hospital Höhenried, D-82347 Bernried, Germany, ⁴Curschmann Klinik, Rehabilitation Hospital, D-23669 Timmendorfer Strand, Germany and ⁵Department Rehabilitation, German Statutory Pension Insurance Scheme, D-10709 Berlin, Germany

*Correspondence to K. Meng. E-mail: k.meng@uni-wuerzburg.de

Received on March 13, 2013; accepted on November 25, 2013

Abstract

Patient education is an essential part of the treatment of coronary heart disease in cardiac rehabilitation. In Germany, no standardized and evaluated patient education programs for coronary heart disease have been available so far. In this article, we report the evaluation of a patient-oriented program. A multicenter quasi-experimental, sequential cohort design study of patients with coronary heart disease (n = 434) in inpatient cardiac rehabilitation was conducted. Intervention patients received the new patient-oriented program, control patients a traditional lecture-based program (usual care). Primary outcome illness knowledge and secondary behavioral and health outcomes were assessed at admission, discharge and 6- and 12-months follow-up. We found a significant, small between-group intervention effect in both patients’ medical illness and treatment knowledge and behavior change knowledge at discharge (medical: $\eta^2 = 0.013$; behavior change: $\eta^2 = 0.011$) and after 12 months (medical: $\eta^2 = 0.015$). Furthermore, a significant, small effect was observed for physical activity after 12 months ($\eta^2 = 0.011$), but no effects on healthy diet and medication adherence emerged. Superiority of the patient-oriented educational program for patients with coronary heart disease was partially confirmed. The program produced improved illness knowledge and physical activity compared with usual care after 1 year.

Introduction

Patient education is an essential part of the medical rehabilitation of patients with coronary heart disease targeting self-management behavior to reduce risk factors and subsequent cardiac events [1–3]. International meta-analyses provide evidence for the effectiveness of secondary prevention programs, psychological interventions and educational interventions regarding risk factors and mental health, whereas evidence for mortality, myocardial infarction and quality of life is heterogeneous [4–7]. However, transfer of study results on individual programs seems complex because of differences in both interventions and rehabilitation settings. Cardiac rehabilitation in Germany [8] is predominantly offered as comprehensive inpatient treatment lasting for 3 weeks. It is accessible for patients with myocardial infarction, surgery or catheter-based interventions after discharge from acute hospital care or patients with chronic course of disease and subsequent functional impairment. For inpatient cardiac rehabilitation, no standardized and evaluated educational group program for patients with coronary heart disease has so far been available for routine use.

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doi:10.1093/her/cyt107
Moreover, many German patient education programs still lack certain quality requirements, such as the use of manuals, patient-oriented didactics, small-group format and evaluation of effectiveness [9, 10]. Furthermore, theory-based techniques to foster health behaviors [11–13] are only rarely employed. In addition, few studies have compared different educational approaches applied within a multidisciplinary rehabilitation program in an inpatient setting [e.g. 14–16]. Overall, further studies are needed to explore the effects of patient education programs, intervention techniques and subgroups of patients who benefit most.

The aim of our study was to evaluate the short-, intermediate- and long-term effects of a new patient-oriented educational program as compared with a traditional lecture-based program (usual care) for patients with coronary heart disease receiving inpatient medical rehabilitation. As Seekatz et al. [17] reported, the program was developed by an interdisciplinary group of health professionals and scientists and was based on a health education curriculum of the German Statutory Pension Insurance Scheme, which comprises an educational framework and about 25 curricula for specific indications including cardiovascular disease. Both topics and didactics incorporate research evidence, practice guidelines and quality criteria for educational programs and were based on theories of health and illness behavior (such as the Health Action Process Approach [18] and the Common-sense model of illness-representations [19]). Theories were used to design the intervention (determine target constructs and intervention techniques) and to define proximal outcomes. The patient orientation aspect of the program was defined by the active involvement of the patients in the whole educational process. Short-term results reported elsewhere [17] have shown a superior treatment effect as compared with the lecture-based program (usual care) on primary outcome illness knowledge at discharge from inpatient rehabilitation. Furthermore, some short-term effects were observed among secondary outcomes, such as medication beliefs, planning of physical activity after rehabilitation and treatment satisfaction. In this article, we present effects of the program on primary outcome as well as intermediate- and long-term effects on behavioral outcomes up to 1 year. We hypothesized that the patient-oriented program was superior to usual care regarding illness knowledge not only in short-term, but also in intermediate- and long-term. In addition, we expected superior effectiveness of the new program regarding several self-management behaviors, such as physical activity, healthy diet and medication adherence. Moreover, moderator effects of type of rehabilitation—cardiac rehabilitation within 14 days after an acute cardiac index event (aCR) versus cardiac rehabilitation during the chronic course of disease without recent acute index event (cCR)—were explored.

Materials and methods

Study design and data collection

A multicenter quasi-experimental, sequential cohort design study of patients with coronary heart disease (n = 434) in inpatient cardiac rehabilitation was performed to compare the effectiveness of the patient-oriented educational program with a lecture-based program (usual care). First, usual care treatment (control condition) was performed; afterwards the new program was implemented in the clinics and carried out thereafter (intervention condition). Inclusion criterion was a primary diagnosis of coronary heart disease (ICD-10-GM: I20–I25, Z95.1, Z95.5). Exclusion criteria were: inadequate German language ability, age <18 years or >70 years, severe visual or hearing impairment, severe co-morbid psychiatric disorder, cognitive impairment and/or submitted pension application. Data were assessed at admission (t1), discharge (t2) and after 6- and 12-months (t3, t4) with patient-reported questionnaires. Sample size was powered to detect small to medium effects in the primary outcome (d = 0.3, two-sided α = 0.05, 1−β = 0.8). Therefore, 352 persons were required. Power to detect smaller between-group effects on the secondary outcomes may be too low; thus, effect sizes were reported throughout. The study was approved by the Ethics Committee of the Faculty of Medicine, University of Würzburg.
Patients were consecutively recruited for the study in two cardiac rehabilitation hospitals between May 2010 and September 2011; 1 year follow-up was finished in September 2012. Figure I shows the participant flow throughout the study. Inclusion criteria were evaluated at admission by a physician. In total, 679 patients eligible were asked to participate in the study and 471 participated (69%) and signed the informed consent form. About 37 persons had to be excluded (e.g. withdrew consent, did not complete the questionnaire at baseline), finally 434 persons comprised the initial study sample. Follow-up rates exceeded 77% at all time points. Analyses were performed for all persons who participated in at least one follow-up assessment. Non-responder analyses revealed no differences between participants and non-participants for study group, gender and primary diagnosis, but rehabilitants admitted directly after an aCR were less willing to participate ($P < 0.001$). Drop-out analyses for follow-up points were performed for study group, socio-demographic variables, type of rehabilitation (aCR, cCR) and main outcome variables. Results indicated no systematic sample bias because of patient drop-out over time. In particular, no significant differences between completers and drop-outs were found at discharge. However, patients who had not provided data at the 6- and 12-months follow-ups, respectively, were more often single, had more often endorsed aCR, had lower illness knowledge, were more often smokers and showed less physical activity at baseline. The proportions of drop-outs were similar for both study groups and there were no systematic baseline differences between the follow-up samples (data not shown).

**Intervention**

The inpatient multidisciplinary rehabilitation [8] included medical treatment, exercise...
therapy/physical training, health education, psychological support, relaxation and social counseling and covered a 3 weeks period on average. In this trial, two basic educational programs that differed in program content, didactics/methods of delivery as well as group format were compared.

**Intervention group**

Patients in the intervention condition received a new patient-oriented program ‘Curriculum Coronary Heart Disease’ that was determined by a manual and consisted of five patient-oriented interactive sessions of 45 min each, which were held in small groups of a closed format (15 participants or less). The program was interdisciplinary with sessions led by a physician, a psychologist and a physiotherapist, respectively. In each session, patients were actively involved in the educational process using a combination of didactic methods (short lectures, group discussion and individual work). Didactic materials included presentations, flipcharts and a patient booklet. Contents of the lessons included basic knowledge about coronary heart disease (e.g. functioning of the heart, etiology and symptoms, risk factors, coronary intervention/bypass graft surgery and medication and medication adherence) with regard to individual needs of the participants. To foster medication adherence, unintentional and intentional barriers and corresponding management strategies were discussed in addition to information on effects and side-effects. To promote health behavior, particularly physical activity and healthy diet, a theory-based intervention (Health Action Process Approach; [18]) was applied. In the first session, patients were encouraged to select those cardiac risk factors that were relevant for them personally. In the fourth session, recommendations for health-related behaviors for cardiac patients were discussed based on patients’ experience made during the inpatient rehabilitation and participants could reflect on their own goals with regard to their risk profile; goal setting was done as homework. In the last session, participants were instructed on how to make both action plans and coping plans and how to self-monitor behavior after rehabilitation (intervention techniques according to Michie et al. [12]: Technique No. 1, 2, 5–8, 10, 16).

**Control group**

Control condition was the traditional lecture-based educational program as it had been practiced in the hospitals for years (usual care). It consisted of two to four lectures of medical education by a physician with an open format, no limitation of group size and an overall duration of about 180 min. Information was mostly presented in a vertical manner, but patients could ask questions. Contents included basic illness information on epidemiology, anatomy, cardiac disorders, risk factors and medical and behavioral treatment as lifestyle modification.

**Outcomes and measurements**

The primary outcome was patients illness knowledge on coronary heart disease and its treatment. Secondary outcomes included behavioral determinants, health behavior (physical activity and healthy diet), beliefs about medication and medication adherence, health status and treatment satisfaction. This article focuses on the primary outcome and behavioral outcomes—physical activity, healthy diet and medication adherence—that were of main interest at the follow-up time points. Behavioral outcomes were assessed by well-validated measures. To assess illness knowledge a new measure was developed.

**Illness knowledge**

Patients were asked to judge 34 statements about coronary heart disease and its treatment as true or false. Items were summed up to yield two scores: (i) medical illness and treatment knowledge (range: 0–22) and (ii) behavior change knowledge (range: 0–12) with higher scores corresponding to higher knowledge; missing answers were counted as wrong. Item examples: (i) ‘What are risk factors for myocardial infarction: diabetes? physical stress?’ (ii) ‘What are positive effects of physical activity for patients with coronary heart disease: decrease of blood pressure? improvement of lipids?’ The questionnaire was developed based on a pre-test (108 items), with item selection according to item
difficulty ($0.10 \leq P \leq 0.90$), proportion of missings (<15%) and content (content validity).

**Physical activity**
Participants reported how often per week and how long per session they performed strenuous, moderate, and light physical exercise (modified version of the Godin Leisure-Time Exercise Questionnaire; [20]) outside of work duties. A total physical activity score (in minutes per week) was calculated by total number of sessions per week in each domain multiplied by minutes per session in each domain.

**Healthy diet**
A nine-item modified version of the self-report Food List (LML Lebensmittelliste; [21]) was administered. Patients assessed how often per week they were eating healthy (e.g. fruits and salads) or unhealthy (e.g. fried potatoes and ‘fast food’) food on a 5-point scale (1 = seldom or never; 5 = several times a day). Total scores may range from 0 to 33, with higher scores indicating less healthy diet.

**Medication adherence**
Patients completed the German version of the Medication Adherence Report Scale (MARS-D; [22]). The MARS-D is a five-item measure with a 1 (always) to 5 (never) response format that assesses patients’ non-adherence behavior (e.g. forgetting to take a dose or altering the dose). Items were summed up to form a sum score ranging from 5 to 25 points, with higher scores indicating greater medication adherence.

**Statistical analysis**
All statistical analyses were performed using SPSS 18.0 for Windows. Missing data were imputed using a multiple imputation procedure. Missing values due to drop-out were analyzed by pair-wise deletion. Non-response analyses and drop-out analyses were carried out by independent group comparisons using t-tests for continuous variables and chi-square test for categorical variables. Treatment effects (between-group effects) were evaluated separately for each follow-up time point using analysis of covariance (ANCOVA) adjusting for baseline values [23]. Statistical significance ($P < 0.05$, two-sided) and effect sizes ($\eta^2$) were reported for all between-group differences [24]. Bonferroni corrections were done to adjust the significance level for multiple comparisons within outcome domains (illness knowledge, two tests: $P = 0.025$). In addition, within-group effects, including standardized effect sizes (SES) and accompanying 95% confidence intervals (CIs) were reported for both study groups. Moderator analysis was performed by including the moderator variable as an additional factor in the ANCOVA and examining interaction effects. The significance level for interaction effects was not adjusted due to their exploratory nature. When trends to significant interactions emerged ($P < 0.10$), simple effects analyses were performed by subgroups.

**Results**
Sample characteristics are presented in Table I. The initial sample consisted of 434 rehabilitants with coronary heart disease. Patients’ mean age was 54 years (SD = 6.6), 94% were male and 83% reported to live with a partner. The sample mostly consisted of employed persons (82%). The number of sick-leave days within the last 12 months averaged 27 (SD = 57.1, median = 8). At the time of admission, 61% had been declared unable to work. Subjective health status as measured by the SF-12 [25] was reduced compared with the general population. As Table I shows, no systematic differences existed between intervention and control group concerning socio-demographic and medical data as well as type of rehabilitation.

**Primary outcome**
Participants of the intervention group as compared with the control group showed superior illness knowledge (primary outcome) representing a significant, albeit small treatment effect at discharge from inpatient rehabilitation (medical illness and treatment knowledge: $P = 0.024$, $\eta^2 = 0.013$, $\text{SES}_{\text{control group}} = 0.25$, $\text{SES}_{\text{intervention group}} = 0.46$;
behavior change knowledge: \( P = 0.039, \eta^2 = 0.011, \) \( \text{SES}_{\text{control group}} = 0.06, \text{SES}_{\text{intervention group}} = 0.21 \) as well as after 12 months on medical illness and treatment knowledge (\( P = 0.015, \eta^2 = 0.018 \)) but not on health behavior change knowledge; there were no significant effects 6 months after rehabilitation (Tables II and III).

### Intermediate-term effects on secondary behavioral outcomes

Between-group effects as well as within-group effects at 6 months are shown in Table II. Both intervention and control groups showed improvements in healthy diet and the amount of physical activity. However, SESs indicated a rather small effect for physical activity that fails significance in the intervention group. There was no significant increase for medication adherence in both groups that may be due to high baseline scores. Accordingly, between-group analyses (ANCOVA) revealed no significant treatment effects on behavioral outcomes.

### Long-term effects on secondary behavioral outcomes

Between-group effects at 12 months and within-group SES for baseline to 12-months follow-up
Table II. Intermediate-term (6 months) within-group and between-group effects on primary and secondary outcomes

<table>
<thead>
<tr>
<th></th>
<th>Pretreatment</th>
<th>Six months follow-up</th>
<th>Within-group change</th>
<th>Between-group difference ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>SES (95% CI)</td>
<td></td>
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<tr>
<td><strong>n</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Medical illness and treatment knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167</td>
<td>13.47 (3.44)</td>
<td>14.44 (2.70)</td>
<td>0.28 (0.10 to 0.45)</td>
</tr>
<tr>
<td>Intervention</td>
<td>179</td>
<td>13.58 (3.50)</td>
<td>14.39 (3.42)</td>
<td>0.23 (0.08 to 0.38)</td>
</tr>
<tr>
<td><strong>Behavior change knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167</td>
<td>7.87 (1.99)</td>
<td>8.17 (1.68)</td>
<td>0.15 (−0.04 to 0.33)</td>
</tr>
<tr>
<td>Intervention</td>
<td>179</td>
<td>7.96 (2.06)</td>
<td>7.98 (1.88)</td>
<td>0.08 (−0.16 to 0.17)</td>
</tr>
<tr>
<td><strong>Physical activity (minutes per week)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167</td>
<td>213.34 (178.36)</td>
<td>245.07 (174.43)</td>
<td>0.18 (0.01 to 0.34)</td>
</tr>
<tr>
<td>Intervention</td>
<td>179</td>
<td>222.25 (182.07)</td>
<td>247.31 (191.31)</td>
<td>0.14 (−0.02 to 0.30)</td>
</tr>
<tr>
<td><strong>Healthy diet</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167</td>
<td>13.99 (4.62)</td>
<td>11.08 (4.19)</td>
<td>0.64 (0.48 to 0.80)</td>
</tr>
<tr>
<td>Intervention</td>
<td>179</td>
<td>14.12 (4.47)</td>
<td>11.61 (4.23)</td>
<td>0.55 (0.41 to 0.70)</td>
</tr>
<tr>
<td><strong>Medication adherence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>167</td>
<td>23.88 (1.61)</td>
<td>24.02 (1.43)</td>
<td>0.10 (−0.03 to 0.23)</td>
</tr>
<tr>
<td>Intervention</td>
<td>179</td>
<td>24.09 (1.16)</td>
<td>24.15 (1.27)</td>
<td>0.04 (−0.11 to 0.19)</td>
</tr>
</tbody>
</table>

Positive SES represents improvement. Effect size $\eta^2$ (small: $\eta^2 = 0.0099$, medium: $\eta^2 = 0.0588$, large: $\eta^2 = 0.137$).

Table III. Long-term (12 months) within-group and between-group effects on primary and secondary outcomes

<table>
<thead>
<tr>
<th></th>
<th>Pretreatment</th>
<th>Twelve months follow-up</th>
<th>Within-group change</th>
<th>Between-group difference ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>SES (95% CI)</td>
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<tr>
<td><strong>n</strong></td>
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<tr>
<td><strong>Medical illness and treatment knowledge</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Control</td>
<td>158</td>
<td>13.63 (3.22)</td>
<td>13.54 (3.38)</td>
<td>−0.03 (−0.20 to 0.14)</td>
</tr>
<tr>
<td>Intervention</td>
<td>176</td>
<td>13.60 (3.53)</td>
<td>14.35 (3.32)</td>
<td><strong>0.22</strong> (0.07 to 0.37)</td>
</tr>
<tr>
<td><strong>Behavior change knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Control</td>
<td>158</td>
<td>8.06 (1.80)</td>
<td>8.18 (1.91)</td>
<td>0.06 (−0.14 to 0.26)</td>
</tr>
<tr>
<td>Intervention</td>
<td>176</td>
<td>7.93 (2.07)</td>
<td>8.09 (1.90)</td>
<td>0.08 (−0.06 to 0.22)</td>
</tr>
<tr>
<td><strong>Physical activity (minutes per week)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>158</td>
<td>214.72 (170.39)</td>
<td>237.47 (189.55)</td>
<td>0.13 (−0.05 to 0.31)</td>
</tr>
<tr>
<td>Intervention</td>
<td>176</td>
<td>215.85 (184.90)</td>
<td>278.14 (218.56)</td>
<td><strong>0.35</strong> (0.19 to 0.51)</td>
</tr>
<tr>
<td><strong>Healthy diet</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Control</td>
<td>158</td>
<td>14.09 (4.70)</td>
<td>11.92 (4.33)</td>
<td>0.48 (0.30 to 0.66)</td>
</tr>
<tr>
<td>Intervention</td>
<td>176</td>
<td>14.23 (4.31)</td>
<td>12.03 (4.41)</td>
<td>0.49 (0.35 to 0.63)</td>
</tr>
<tr>
<td><strong>Medication adherence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>158</td>
<td>23.82 (1.70)</td>
<td>23.80 (1.87)</td>
<td>−0.01 (−0.14 to 0.12)</td>
</tr>
<tr>
<td>Intervention</td>
<td>176</td>
<td>24.09 (1.17)</td>
<td>24.18 (1.15)</td>
<td>0.06 (−0.11 to 0.22)</td>
</tr>
</tbody>
</table>

Positive SES represents improvement. Effect size $\eta^2$ (small: $\eta^2 = 0.0099$, medium: $\eta^2 = 0.0588$, large: $\eta^2 = 0.137$). Bold figures indicate: (i) regarding within-group effects: SES of the control group is outside the 95% CI of SES of the intervention group or (ii) regarding between-group effects: significant between-group effect (ANCOVA: $P < 0.05$). Italics bold indicate between-group effects of $\eta^2 \geq 0.01$ ($P < 0.10$).
are presented in Table III. One year after rehabilitation, significant increases in healthy diet were maintained among patients of both groups. Furthermore, a significant increase in the patients’ physical activity was evident for the intervention group; SESs indicate that the intervention group improved more than the control group. Again, medication adherence was unchanged at a high level.

ANCOVAs resulted in a nearly significant, small effect in favor of the intervention group for physical activity \( (P = 0.053) \). After adjustment for baseline imbalance, estimated mean physical activity per week in the intervention group was about 40 min longer than in the control group. No significant differences between the two programs were observed for healthy diet and medication adherence, though.

**Moderator analysis**

Rehabilitants after an aCR were significantly different from those without a preceding acute index event but with cCR regarding illness knowledge (aCR < cCR), health behavior (aCR < cCR) and medication adherence (aCR > cCR) as well as mental health (aCR > cCR) and age (aCR < cCR) at baseline.

Moderator analysis showed no significant interaction effects for illness knowledge at any follow-up time (12-months follow-up: ANCOVA medical illness and treatment knowledge: main effect treatment group: \( P = 0.007, \eta^2 = 0.022 \); main effect type of rehabilitation: \( P = 0.889, \eta^2 = <0.001 \); interaction effect treatment group \( \times \) type of rehabilitation: \( P = 0.130, \eta^2 = 0.007 \). ANCOVA behavior change knowledge: main effect treatment group: \( P = 0.492, \eta^2 = 0.001 \); main effect type of rehabilitation: \( P = 0.874, \eta^2 = <0.001 \); interaction effect treatment group \( \times \) type of rehabilitation: \( P = 0.190, \eta^2 = 0.005 \).

However, type of rehabilitation showed a significant interaction for total physical activity after 12 months (ANCOVA; Fig. II). Simple effect analyses indicated a significant between-group effect on physical activity among rehabilitants with aCR, but not among rehabilitants with cCR \( (aCR: P = 0.021, \eta^2 = 0.016, cCR: P = 0.521, \eta^2 = 0.001) \). The aCR rehabilitants taking part in the intervention group reported on average 70 min longer physical activity than their counterparts in the control group \( (\text{adjusted means intervention group}: 299.97, \text{control group}: 230.34) \). In contrast, the cCR rehabilitants participating in either educational program showed similar physical activity levels \( (\text{adjusted means intervention group}: 244.46, \text{control group}: 250.18) \). No interaction effects were found for the other secondary outcomes \( (\text{data not shown}) \).

**Discussion**

In this controlled study we evaluated the short, intermediate- and long-term effectiveness of a patient-oriented educational program compared with a lecture-based program (usual care) for patients with coronary heart disease receiving inpatient medical rehabilitation. We found a significant, but small treatment effect in patients’ illness knowledge at discharge of rehabilitation as well as after 12 months in favor of the new program. Furthermore, with respect to behavioral outcomes a small treatment effect was observed on physical activity after 1 year. There were no significant group differences in these outcomes after 6 months, which might be due to different trajectories of the study groups over time. However, there were no additional effects of the new program on healthy diet or medication adherence. Thus, our primary hypothesis and secondary hypothesis regarding behavioral outcomes were partially confirmed.

We compared the new patient-oriented program with an active control condition that generally differed only with regard to some contents but varied in methods of delivery \( (\text{e.g. strategies for behavior change as action planning and self-monitoring strategies and interactive didactics}) \) and that comprised almost the same amount of time. Therefore, small effects were expected, as opposed to the larger effects that could have been expected if an active treatment would have been compared with a no-treatment condition. In line with this, all effect sizes were small at most. They were, however, in the typical range for self-management interventions.
or other interventions designed to change health-related behaviors [e.g. 26–29]. Moreover, the intervention comprised only a small amount of treatment within additional multidisciplinary rehabilitation treatments that all patients received, including medical, physical, behavioral and vocational rehabilitation components. Thus, significant changes occurred in both groups and the incremented effect of the additional intervention may have been diluted.

Results on behavioral outcomes showed long-term effects on physical activity but not on healthy diet. Similar results have been shown for several interventions with focus on volitional strategies like action planning and self-monitoring aimed to facilitate physical activity initiation and maintenance after discharge from rehabilitation [30–35]. Also, implementation intention training had proven effective for saturated fat intake among patients after myocardial infarction [36]. However, those interventions were only targeting a single behavior. On the other hand, a small-group interactive education targeting multiple behaviors—sports activities, healthy diet and relaxation—showed only effects on diet in long term [15]. Results of meta-analyses on interventions to change physical activity among chronically ill adults or cardiac patients suggest that interventions that target only one behavior were more successful than those attempting to change multiple behaviors [26, 27]. Findings from studies targeting both physical activity and diet suggest that dietary behaviors may be more amenable to change than physical activity behaviors and for combined interventions, change of a single behavior is more frequent [37]. Furthermore, post-intervention effects 1 year after intervention were seldom reported [27, 37]. Hence, the changes found for physical activity in our trial may be judged as a success. Besides, the patient-oriented program was consistent with a ‘global health/behavioral category approach’ [38], promoting a healthy lifestyle for coronary patients as a route to multiple behavioral changes and putting the focus on the

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**Fig. 2.** Total physical activity (mean) at 12-months follow-up by treatment groups and type of rehabilitation (cardiac rehabilitation within 14 days after an aCR and cardiac rehabilitation during the chronic course of disease without recent acute index event (cCR)). Analysis of covariance: main effect treatment group: $P = 0.13$, $\eta^2 = 0.007$; main effect type of rehabilitation: $P = 0.40$, $\eta^2 = 0.002$; interaction effect treatment group × type of rehabilitation: $P = 0.08$, $\eta^2 = 0.009$. 

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issue of choice. Thus, each participant had to decide which strategy of self-management behaviors suited him best and the specific behaviors addressed were heterogeneous between participants. Moreover, the dose of intervention components targeting maintenance of behavior change may not have been powerful enough to generate changes in multiple behaviors. Follow-up prompts or aftercare programs may be required to sustain results [34]. Overall, further research on the mechanisms of multiple behavior change is needed [38, 39].

Neither study program resulted in differences in medication adherence as measured by the MARS-D. However, the measure produced ceiling effects [22] and therefore may not be sensitive to change. But it remains unclear whether high scores were due to high adherence or over-reporting. Though we found treatment effects for medication beliefs in the short- and long-term periods ([17], results not shown), which were moderately related to medication adherence [40].

Treatment effect on physical activity was moderated by type of rehabilitation. In particular, the program worked better for rehabilitants immediate after an acute index event. Meta-analysis of psychological treatment of cardiac patients indicate that effects on mortality were only strong in studies that initiated treatment late (at least 2 months after an event), whereas those that started soon after the event showed little benefit [6]. There were no studies for behavior change which highlight this issue. Our study results pose the question whether patients at different illness stages might benefit from different modes of interventions. It is possible that patients after an acute event with less than ideal health behaviors at the beginning of rehabilitation have a greater need for specific strategies conveyed to them in the new program such as action planning and may apply these strategies in a more efficient manner. On the other hand, patients with late or recurrent rehabilitation and poorer mental health may need more problem-focused programs to deal with special problems of long-term behavior change and coping with distress. However, systematic research into this issue is mostly lacking and future studies should focus on this aspect as well.

Several limitations need to be considered. First, randomization was not possible because of insufficient training rooms, treatment time slots and insufficient staff resources for parallel implementation of both groups in the clinics. But patient samples were comparable with regard to socio-demographic and medical data. Furthermore, baseline scores of outcome parameters were adjusted in the analyses throughout. The proportion of drop-outs was similar for both groups. Factors associated with drop-out were consistent with previous research. Second, the sample had a high proportion of men, as in one rehabilitation hospital only men were recruited (94% male in contrast to commonly 83% within cardiac rehabilitation; [41]). Mean age of 53 years and high proportion of employees is representative of rehabilitants by the German Statutory Pension Insurance [41] but limits generalization to other populations (e.g. older populations with more comorbidity and populations with a higher proportion of women). Due to the sample distribution, no gender-sensitive analysis could be conducted [42]. Third, the primary outcome illness knowledge was assessed with a new study-specific questionnaire as there was no validated knowledge questionnaire for use with cardiac patients available in German language. The questionnaire may not accurately reflect comprehensive heart disease knowledge in other populations, however. Fourth, behavioral outcomes were measured by self-report, albeit with validated instruments. Objective measures would be preferable but would have been difficult to collect in this context. However, self-reports have been shown to be reliable and valid when tested against objective measures [e.g. 43–45]. Finally, the sample size calculation was powered to detect small-to-medium effects, as could be assumed for the primary outcome. Power to detect even smaller effects in the secondary outcomes may have been too low. Therefore, results have been reported based on effect sizes.

**Conclusion**

To the best of our knowledge, this is the first educational program evaluated among coronary heart
disease patients in Germany. The controlled study demonstrated that a patient-oriented program may be more effective in certain outcomes than a lecture-based program in both short- and long-term periods. Therefore, the program should be considered for dissemination within cardiac rehabilitation.

Funding

The German Statutory Pension Insurance Scheme [grant number 8011 – 106 – 31/31.93].

Conflict of interest statement

None declared.

References


