Original Article

Poor Sleep Quality in Patients after Coronary Artery Bypass Graft Surgery: An Intervention Study Using the PRECEDE-PROCEED Model

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Abstract

Background: *Poor sleep quality (SQ) is common among patients after coronary artery bypass graft surgery (CABG). This study attempted to determine the status of SQ following an intervention based on the PRECEDE-PROCEED model in patients with poor SQ after CABG.*

Methods: *This study was a randomized clinical trial. The study sample, including 100 patients referred to the Cardiac Rehabilitation Clinic of Tehran Heart Center, was assigned either to the intervention (recipient of exercise and lifestyle training plus designed intervention based on the PRECEDE-PROCEED model) or to the control group (recipient of exercise and lifestyle training). Eight training sessions over 8 weeks were conducted for the intervention group. Predisposing, enabling, and reinforcing factors as well as social support and SQ were measured in the intervention group before and one month after the intervention and compared to those in the control group at the same time points.*

Results: *The mean age of the patients in the intervention (24% women) and control (24% women) groups was 59.3 ± 7.3 and 59.5 ± 9.3 years, respectively. The results showed that the mean scores of SQ (p value < 0.001), knowledge (p value < 0.001), beliefs (p value < 0.001), sleep self-efficacy (p value < 0.001), enabling factors (p value < 0.001), reinforcing factors (p value < 0.001), and social support (p value < 0.001) were significantly different between the intervention and control groups after the intervention.*

Conclusion: *Adding an intervention based on the PRECEDE-PROCEED model to the cardiac rehabilitation program may further improve the SQ of patients.*

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Introduction

Sleep is a basic need of humans. Sleep quality (SQ) is defined as the subject's satisfaction with sleep experience, integrating domains of sleep initiation, sleep maintenance, sleep quantity, and refreshment upon awakening.[1] Poor SQ is common among patients after coronary artery bypass graft surgery (CABG).[2] The results of a systematic review showed that more than 50% of patients experienced sleep problems through hospitalization and 6 months after heart surgery.[3] Factors that influence sleep disturbance during hospitalization and 6 months after discharge are different. During hospitalization, physical and environmental factors (e.g. pain, cardiac function, and noise) and through 6 months after recovery, psychological factors such as anxiety and mood disturbance affect the SQ of the patients.[3] Poor SQ interferes with the cardiac patients' quality of life.[4]

Sleep disorders require more attention in clinical practice.[5] For all the advantages sleep-related lifestyle training has for heart patients,[6, 7] it has received precious little attention. In a study, Simeit et al.[4] showed that psychological sleep management training, combining relaxation techniques, sleep hygiene, and cognitive techniques, could improve the SQ and quality of life of cancer patients with insomnia. Thomasouli et al.[7] reported that diet, exercise, and lifestyle modification training could help adults with obstructive sleep apnea. The findings of such intervention studies have demonstrated that massage therapy, relaxation training, wearing devices such as earplug and eye mask to bed, and using music-guided imagery could improve SQ in cardiac patients.[2, 8-14]

Additional effort is required to develop theory-based education interventions aimed at improving SQ in patients after CABG. In this study, the PRECEDE model was used as the theoretical framework for developing a tailored intervention. The PRECEDE acronym, which stands for Predisposing (PF), Reinforcing (RF), and Enabling factors (EF) in Educational Diagnosis and Evaluation, demonstrates a diagnostic planning process. PROCEED also stands for Policy, Regulatory, and Organizational factors in environmental and educational development. The PRECEDE-PROCEED model consists of nine phases. The first five steps (including social assessment, epidemiological assessment, behavioral and environmental assessment, educational and ecological assessment, and administrative and policy assessment) are diagnostic and address both educational and environmental issues. The final four steps (including implementation, process evaluation, impact evaluation, and outcome evaluation) correspond to the implementation and evaluation of intervention.[15] This model has been recommended in reducing disorders such as depression and increasing quality of life among cardiac patients.[16]

Given the importance of sleep in the prediction of the quality of life of cardiac patients and the obvious need for developing theory-based interventions in this field, the present study was designed to determine the effect of an educational intervention based on the PRECEDE-PROCEED model on improving SQ among patients following CABG. This study is an essential starting point for more research into theory-based training interventions developed to adopt healthy sleep habits in cardiac patients.

Methods

This randomized clinical trial study selected 100 patients, referred to the Cardiac Rehabilitation Clinic of Tehran Heart Center, 6 weeks after CABG. The patients were randomly assigned to the intervention (recipient of exercise and lifestyle training plus designed intervention based on the PRECEDE-PROCEED model) or the control (recipient of exercise and lifestyle training) groups using the block randomization procedure.

The selection criteria in the present study were: the patient's agreement to participate, patients of both genders between 40 and 80 years of age, CABG-only treatment (not combined with valve replacement surgery), current complaint of poor SQ (score > 5 of the SQ scale), no history of chronic insomnia for at least one year before surgery, body mass index ≤ 35 kg/m^2, no indication of receiving treatments for depression and anxiety, and no history of a major and serious comorbidity except for the risk factors of arthrosclerosis such as diabetes. The study, conducted between March and August, 2013, was approved by the institutional Ethics Committee. Also, all the patients in the two groups were informed about the objectives of the study, and a written consent was obtained from them.

In this study, the PRECEDE-PROCEED model with nine phases was considered as the conceptual framework for planning the intervention. In the first and second phases, a social and epidemiological diagnosis through literature review was performed. The literature showed that cardiac patients' quality of life after CABG influenced their poor SQ[17, 18] and feeling of anxiety was recognized as one of the predictors of sleep problem.[19] During the third phase of the planning process, on the basis of a literature review and three focus groups with the patients, it was found that no body relaxation practice when sleeping as a behavioral factor contributed to the patients' anxiety. In the fourth step, a literature review and focus groups determined the predisposing, reinforcing, and enabling factors that might directly influence the adoption of relaxation behavior. In this context, the predisposing factors included knowledge, beliefs, and self-efficacy related to sleep. The enabling factors consisted of access to educational package regarding relaxation and learning the progressive muscular relaxation (PMR) technique. The reinforcing factors comprised family

social support, encouraging rehabilitation clinic staff, and experiencing positive feelings after practicing PMR. It is worth mentioning that predisposing factors, as antecedents to behavior, can increase or decrease the individual's motivation and rationale for behavior change. Enabling factors are comprised of those new skills and accessible resources or services that can assist or hinder the target behavior or environmental change. Reinforcing factors are regarded as the received intrinsic and extrinsic rewards following behavior change as well.[15] In the fifth phase, essential human and material resources and practical plans were prepared. Also, the policies and circumstances within a cardiac rehabilitation clinic that could facilitate or hinder the target behavior (administrative and policy diagnosis phase) were indentified. In the sixth phase, the developed education intervention was implemented. In the final phases (steps 6-9), process, impact, and outcome evaluation were performed to evaluate the plan developed during the first five phases. According to these phases, tailored instruments were designed and validated, and they were thereafter completed by the patients in both groups prior to the intervention. An education intervention was designed and implemented for the intervention group. It was assumed that the two groups received the routine interventions by the cardiac rehabilitation clinic. Finally, the two groups were followed up for one month after the intervention.

Demographic characteristics and PRECEDE-PROCEED model variables were measured using self-administered questionnaires. The items on knowledge, enabling factors, and reinforcing factors were developed through a literature review and interview of 20 patients to collect their comments concerning sleep problems after CABG. The content validity of the designed instruments was assessed qualitatively. For this purpose, an expert panel of 10 specialists in psychology and health education reviewed the items of the instruments. Then, the 20 patients were asked to comment on the simplicity, clarity, and readability of the items. Finally, based on their comments, the vague questions and minor wording errors were clarified. The reliability of the developed instruments was estimated through test-retest correlation coefficients with the 20 patients (with a 2-week interval between the tests). In this study, the internal consistency of sleep self-efficacy, Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16), Short Form of the Interpersonal Support Evaluation List (ISEL-SF), and Pittsburgh Sleep Quality Index (PSQI) were estimated through Cronbach's α.

Three categories of questions, which included knowledge, beliefs, and sleep self-efficacy, were used for evaluating the predisposing factors regarding sleep. The knowledge of the patients about sleep and insomnia after CABG was measured using a 28-item instrument with two sub-scales: 1) reasons for sleep problems after CABG (sixteen items) and 2) methods of reducing sleep problems and insomnia after CABG (eleven items). For each of the items, the participants selected either Yes or No. Also, the option 'Don't know' was provided to increase the compliance. A global score between 27 and 54 was calculated through summing up the scores of the sixteen items. The test–retest correlation coefficient for this scale was 0.88 (p value = 0.001).

In this study, the DBAS-16 was used to assess sleep-related beliefs. The items of this scale were measured on a Likert-type scale, ranging from 0 = "Strongly disagree" to 10 = "Strongly agree". The psychometric quality of the DBAS-16 is satisfactory.[20] A global score between 0 and 160 was calculated by summing up the scores of the sixteen items. In this study, Cronbach's α for this scale was 0.75.

A self-efficacy instrument should be condition-specific.[21] In this study, self-efficacy was measured using a sleep self-efficacy scale, which included nine items on a five-point Likert-type scale, anchoring from 1 = "Not at all confident true" to 5 = "Very confident". This scale evaluates the confidence of the individual about his/her ability for doing sleep-promoting behaviors. A global score between 9 and 45 was measured by summing up the scores of the nine items. This scale is a valid and reliable instrument (Lacks P. Psychology practitioner guidebooks. New York: Pergamon Press; 1987). In the present study, Cronbach's α for this scale was 0.75.

The enabling factors scale consisted of two sub-scales: 1) developing new skill for improving SQ (one item, "Did you perform Progressive Muscular Relaxation?") and 2) available services and recourses for doing the new skill (four items, e.g. "Did you participate in the training sessions about the strategies of improving SQ?"). The new skill items were measured on a Likert scale ranging from 0 = "never" to 3 = "always". The patients were supposed to select either No (0) or Yes (1) for the available services and recourses items. A global score between 0 and 7 was measured by summing up the two subscale scores. The test–retest correlation coefficient for this scale was 0.89 (p value = 0.001).

In this study, the ISEL-SF as a psychometrically valid tool was used to assess the patients' social support.[22] The ISEL-SF comprises sixteen items covering five subscales on a four-point Likert scale, ranging from 0 = "Definitely false" to 3 = "Definitely true". A global score between 0 and 48 was derived by summing the four subscale scores. In this study, the Cronbach's α for the four sub-scales of appraisal support, tangible assets support, belonging support, and self-esteem support domains, was 0.71, 0.74, 0.81, and 0.78, respectively.

The reinforcing factors scale consisted of six items. Two items of this scale measured received reinforces of health professionals, e.g. "Do the cardiac rehabilitation clinic staff encourage you to do behaviors such as progressive muscular relaxation?". These items were calculated on a five-point Likert-type scale, anchoring from 0 = "Never" to 4 = "Always". Four items measured the intrinsic reinforces of doing behaviors due to improving SQ, e.g. "Performing

progressive muscular relaxation makes me happy.". The participants were supposed to select either No (0) or Yes (1) for these items. A global score between 0 and 12 was measured by summing up the scores of the six items. The test–retest correlation coefficient with 20 patients for this scale was 0.80 (p value = 0.005).

In the present study, the PSQI as a valid tool was used to measure the patients' SQ.[23] This instrument was comprised of seven domains, including quality of subjective sleep, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, daytime dysfunction, and use of medication for sleep over the previous month. The score of the domains ranged from 0 = "No difficulty" to 3 = "Severe difficulty". A total score > 5 was considered to be indicative of poor SQ. A global score between 0 and 21 was derived by summing up the seven subscale scores. Farrahi et al.[24] adapted this scale for use in Persian. In this study, the Cronbach's α of this scale was 0.81. Also, the test–retest correlation coefficient for this scale was 0.79 (p value = 0.002).

The designed educational intervention for the intervention group encompassed eight 45-60 minute training sessions over 8 weeks. The interval between the sessions was one week. The patients were divided into five groups. The purpose of the first session was increasing the knowledge of the patients about sleep problems after CABG. In this session, an introduction to the prevalence of sleep problems after CABG, reasons for the problems, ways of minimizing the problems, and side effects of sleeping pills was presented to the patients. At the end of this session, the subjects were given a booklet about these issues. The aim of the second session was changing faulty beliefs of the patients regarding sleep, helplessness for sleep control, and sleep-promotion practices. In this session, the patients discussed their beliefs, expectations, and experiences about sleep problems. The purpose of the third session was learning the PMR technique (Bernstein and Borkovic cited in Schneider et al.[25]). This session focused on introducing this technique, explaining the rationale, and providing a general description of it. In addition, the technique of relaxing and contracting 16 groups of muscles, involving right hand and forearm, right biceps, left hand and forearm, left biceps, forearm, upper section of cheeks and nose, lower section of cheeks and nose, neck and throat, chest, shoulders and upper part of back, abdominal region and stomach, right thigh, right calf, right foot, left thigh, left calf, and left foot,[21] was taught to the patients. To promote self-efficacy through verbal persuasions, the patients were assured that they could perform PMR regularly. Also, they were requested to practice this technique minimally at home three times a day and reflect on their experiences in specific forms. Moreover, an audio CD which provided a relaxation guide for at-home practice was given to the patients. From the fourth to the eighth sessions, the participants only performed PMR. At the start of each session, at-home practices of the patients were reviewed by the group. Also, those patients who had done late-night PMR regularly shared their experiences with the other members of the group (i.e. vicarious experiences through peer groups). To increase family support, one session of instruction was devoted to the family members of the patients, who learned how to support the patients and prepare the home environment for practicing PMR or other strategies of improving SQ. Finally, they were given a pamphlet about the importance of family support and practical components of this support.

The two groups received the routine care provided at the Cardiac Rehabilitation Clinic of Tehran Heart Center, including exercise training and educational sessions (with a focus on the modification of lifestyle and coping strategies with psychological problems after CABG) 3 days per week for 8 weeks.

The data were analyzed using SPSS (version 17.0, SPSS, Inc., Chicago, IL, USA) software package. The homogeneity of the demographic characteristics of both groups was analyzed using the chi-squared and independent-samples t tests. The normality of the data was calculated through the Kolmogorov–Smirnov test. The differences in knowledge, beliefs, sleep self-efficacy, enabling factors, reinforcing factors, total social support and its domains, and SQ scores before and after the intervention were tested using the Student paired-samples t-test. The differences in knowledge, beliefs, sleep self-efficacy, enabling factors, reinforcing factors, total social support and its domains, and SQ scores between the groups were also tested using the independent-samples t-tests. The correlations between the quantitative and qualitative demographic variables and SQ were analyzed through the Pearson and Spearman rho correlation coefficient in the two groups before and after the intervention. The data are expressed as mean ± standard deviation (SD). A p value < 0.05 was considered significant.

Results

No significant differences were found in any of the demographics characteristics, knowledge (p value = 0.33), beliefs (p value = 0.53), sleep self-efficacy (p value = 0.28), enabling factors (p value = 0.17), reinforcing factors (p value = 0.28), total score of social support (p value = 0.11) and its subscales (p values for appraisal support, tangible assets support, belonging support, and self-esteem support domain were 0.51, 0.12, 0.10, and 0.32, respectively), and SQ (p value = 0.97) scores between the two groups before the intervention. Table 1 depicts the demographic characteristics of the participants in the two groups. Among the demographic characteristics, only gender had a significant association with SQ. In the intervention (p value = 0.02) and control groups (p value = 0.05), the women had poorer SQ than men (Table 2). Following the intervention, the mean scores of knowledge, beliefs, sleep self-efficacy, enabling factors,

reinforcing factors, and SQ were significantly higher in the intervention group than in the control group (Table 3). Also, significant differences were found in the total score of social support and its subscales (with the exception of the tangible assets support domain) between the two groups after the intervention (Table 4).

Table 1. Demographic characteristics of the patients in the two groups*

	Intervention group (n=50)	Control group (n=50)	P value
Age (y)	59.3±7.3	59.5±9.3	0.90
Gender			0.59
Female	12 (24.0)	12 (24.0)	
Male	38 (76.0)	38 (76.0)	
Marital status			0.21
Single	0	1 (2.0)	
Married	49 (98.0)	46 (92.0)	
Divorced	1 (2.0)	3 (6.0)	

*Data are presented as mean±SD or n (%)

Table 2. Correlation between the demographic characteristics and the sleep quality score in the two groups before and after the intervention

	Intervention group (n=50)				Control group (n=50)			
	N1		N2		N1		N2	
	P value	Correlation	P value	Correlation	P value	Correlation	P value	Correlation
Age	0.435	-0.113	0.205	-0.153	0.203	-0.181	0.161	-0.201
Gender	0.010	0.355	0.008	0.369	0.053	0.352	0.031	0.304
Marital status	0.201	-0.184	0.195	0.174	0.965	-0.006	0.990	-0.002
Occupation status	0.084	0.247	0.075	0.245	0.352	-0.134	0.525	-0.092
Education level	0.339	0.138	0.505	0.097	0.897	0.019	0.625	0.071
Hypertension	0.104	-0.233	0.071	-0.253	0.653	0.065	0.361	0.132
Diabetes	0.481	0.105	0.522	0.093	0.294	-0.151	0.492	-0.099

N1, Baseline; N2, Follow-up after intervention

Table 3. Comparison of predisposing, enabling, and reinforcing factors, and sleep quality scores in the two groups before and after the intervention*

Variables	Intervention group (n=50)			Control group (n=50)			P value***
	N1	N2	P value**	N1	N2	P value**	
Knowledge	30.80±8.89	49.56±3.55	< 0.001	32.52±8.92	36.48±8.15	< 0.001	< 0.001
Beliefs	80.01±27.33	91.18±28.14	< 0.001	80.06±27.33	87.60±29.75	< 0.001	< 0.001
Sleep self-efficacy	26.56±9.81	39.62±4.18	< 0.001	28.50±7.52	30.70±7.38	0.181	< 0.001
Enabling factors	0.14±0.60	6.70±1.05	< 0.001	0.02±0.14	0.08±0.34	< 0.001	< 0.001
Reinforcing factors	6.44±2.67	22.18±2.96	< 0.001	7.00±2.50	7.44±2.30	< 0.001	< 0.001
Sleep quality	10.18±3.64	5.90±2.45	< 0.001	10.20±3.41	8.84±3.19	< 0.001	< 0.001

*Data are presented as Mean±SD
**Result of the Student paired-samples t test (within-groups comparison)
***Result of the independent-samples t tests (between-groups comparison)
N1, Baseline; N2, Follow-up after intervention

Table 4. Comparison of the social support total score and its four subscales between the two groups before and after the intervention*

Variables	Intervention group (n=50)			Control group (n=50)			P value***
	N1	N2	P value**	N1	N2	P value**	
Total score of social support	32.58±6.50	42.66±3.93	< 0.001	34.88±6.90	36.82±6.52	< 0.001	< 0.001
Appraisal support	7.76±2.78	10.90±1.14	< 0.001	8.10±2.41	8.76±2.25	< 0.001	< 0.001
Tangible assets support	8.12±2.59	9.60±2.14	< 0.001	8.92±2.60	9.18±2.42	0.082	0.361
Belonging support	9.00±2.10	11.18±1.11	< 0.001	9.70±1.83	10.22±1.56	< 0.001	< 0.001
Self-esteem support	7.70±2.32	10.98±1.39	< 0.001	8.16±2.32	8.66±2.47	< 0.001	0.001

*Data are presented as Mean±SD
**Result of the Student paired-samples t test (within-groups comparison)
***Result of the independent-samples t tests (between-groups comparison)
N1, Baseline; N2, Follow-up after intervention

Discussion

The results of the present study demonstrated that SQ and also most of the PRECEDE variables (except for the tangible assets support domain) significantly increased in the control group after the intervention. These findings showed that the routine care provided by the cardiac rehabilitation clinic had a positive impact on these variables. Dehdari et al.[26] reported that cardiac rehabilitation programs, including exercise training and educational sessions, might improve the quality of life and reduce the anxiety of patients after CABG. An interesting finding of the present study was that the mean scores of these variables were significantly higher in the intervention group following the intervention. This finding may be explained by the greater effects of the designed intervention. To our knowledge, the effectiveness of educational intervention based on the PRECEDE-PROCEED model or other models and theories of behavioral change for improving SQ has not been widely studied. However, our findings are consistent with those of Sabzmakan et al.,[27] who showed that implementing intervention based on the PRECEDE educational model might improve depression and quality of life among cardiac patients.

In this study, it was shown that the intervention group had more sleep self-efficacy compared to the control group after the intervention. Self-efficacy was recognized as one of the cognitive-behavioral mediators to treat sleep disorders. It had a significant impact on performing the behaviors of reducing sleep problems such as controlling racing thoughts in bed. Furthermore, sleep self-efficacy had a negative significant correlation with the SQ of the patients in the intervention group before the intervention. In other words, higher sleep self-efficacy resulted in reduced SQ. Schlarb et al.[28] showed that college students with insomnia had lower self-efficacy than college students without sleep problems. Given that the self-efficacy of the patients in the control group was not increased through usual care, more attention to this variable in cardiac rehabilitation clinics is needed. To enhance the sleep self-efficacy of cardiac patients, strategies such as vicarious learning, verbal persuasion, and motivational interviewing should be implemented. In addition, such patients should be persuaded to practice SQ-improving behaviors such as reducing sleep barriers (e.g. eating light dinner early at night).

It was interesting to find that compared to the control group, the effect of the designed intervention on the mean score of sleep-related beliefs in the intervention group was drastic from baseline to follow-up. Along the same line, Morin et al.[29] showed that combining two methods of pharmacotherapy and cognitive-behavior therapy could more effectively improve beliefs about sleep than only pharmacotherapy or medication placebo. They suggested that maladaptive attitudes and beliefs about sleep could be important targets for the treatment of chronic insomnia.[29]

Following the intervention, the mean score of knowledge in the intervention group was significantly higher than that of the participants in the control group. Although knowledge about sleep and its treatment methods seems lacking, a few studies have investigated sleep-related knowledge. Cain et al.[30] demonstrated that implementing motivational school-based interventions could increase the knowledge of adolescents about sleep problems.

Our results also showed that the mean score of enabling and reinforcing factors significantly increased in the intervention group compared to the control group. These findings are in agreement with those of Sabzmakan et al.[27] and Khorsandi et al.,[31] who reported that implementing intervention using the PRECEDE model could increase enabling and reinforcing factors for doing healthy behaviors. As was mentioned above, in the present study, the PMR technique (as one of the subscales of enabling factors) was taught to the patients in the intervention group.

In the current study, the designed intervention had a significant effect on the total score of social support in the intervention group compared to the control group (Table 4). Social support is one of the social determinants of sleep problems.[32] Troxel et al.[33] showed that more social support was correlated with shorter sleep latencies in older adults with insomnia. Tangible supports may increase the perceived accessibility of individuals to resources, information, and material aid about sleep-related healthy habits;[32] however, the

results of this study showed that the tangible assets support domain did not significantly improve in the intervention group compared to the control group after the intervention. Given that the psychological factors influenced the SQ of the patients over a 6-month period after CABG, it can be argued that emotional supports may be more important than tangible supports. Fisher et al.[34] suggested that when assessing perceived social support in diabetic patients, there is a need to determine which domains of support are suitable to measure in any situation. More studies of social support aspects, especially the tangible assets support domain, among cardiac patients are required.

In our study, the women had poorer SQ than the men in the intervention group before and after the intervention. It can be argued that the poorer SQ of the women may have had consequences in terms of their higher psychological problems and poorer quality of life[35, 36] by comparison to the men after CABG. The relationship between these two factors and insomnia was confirmed in a study by LeBlanc et al.[37] Thus, it is important to evaluate the psychological conditions that influence (e.g. anxiety and depression) the SQ of women after CABG.

Although this study highlights the utility of a PRECEDE-PROCEED-guided framework to develop theory-based interventions regarding sleep problems, it has some limitations. The samples were selected from among patients participating in the third phase of cardiac rehabilitation. Therefore, the obtained results cannot be generalized to the other rehabilitation phases (first, second, and fourth), especially the first phase, and also to those not having referred to these clinics after CABG. It is noteworthy that the physical and environmental factors during the first phase (hospitalization) had a higher impact on the SQ of the patients after heart surgery. Developing and tailoring short educational interventions for these patients are needed. The short duration of the follow-up sessions was the second major shortcoming of the present study.

Conclusion

An educational intervention based on the PRECEDE-PROCEED model, as a framework integrating the recognized mediators of sleep, aimed at designing a tailored and comprehensive intervention for rehabilitation programs in cardiac rehabilitation centers may improve SQ in post-CABG patients. This study can be considered as a starting point for further research projects in this field.

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