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Stages of Physical Activity in Patients after Coronary Artery Bypass Graft Surgery: Application of Trans-Theoretical Model

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Abstract

Aim: Continuous physical activity is required after coronary artery bypass graft (CABG) surgery to prevent recurrence of the disease; however, its amount is not suitable in many patients. The present study aimed to investigate the stages of physical activity in patients after CABG using the Trans-Theoretical Model (TTM).

Methods: In this cross-sectional research, 120 cardiac patients participated; they had CABG surgery and referred to Ekbatan Hospital of Hamadan. Sampling was conducted using a purpose-based approach. Data were collected using a researcher-made questionnaire based on the TTM and analyzed using the SPSS18 software. Descriptive statistics and statistical processes of one-way ANOVA, Tukey's post-hoc, and Chi-square tests were also conducted at a significant level of $p<0.05$.

Findings: The mean age of the participants was 57.87±9.89 years. From the 120 patients under study, 4.2% were in the pre-contemplation phase, 14.2% in the contemplation stage, 58.3% in the preparation stage, 10.8% in the action stage, and 12.5% in the maintenance phase of the physical activity. The results of ANOVA test showed a significant difference between the stages of change in behavior with perceived advantages, perceived disadvantages, perceived self-efficacy, and processes of change ($p <0.001$).

Conclusion: The results showed that many patients did not have regular physical activity after surgery. This makes clear the need for educational interventions based on theoretical models by health educators.

Keywords: Physical activity, Coronary artery bypass graft surgery, Trans-theoretical model

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Introduction

Cardiovascular diseases (CVDs) and in particular coronary artery disease, as a cause of death, impose heavy burden on the health care system of countries worldwide [1]. The prevalence of these diseases in the developing countries is increasing so that according to the recent statistics, three-quarters of the world's deaths and 82% of the total lost years of life were related to coronary artery disease in the countries with low and middle income [2]. The prevalence of this disease in Iran has been reported 20-45% higher than in the western countries [2, 3]. Coronary artery bypass graft (CABG) surgery is one of the best surgical procedures to control and treat symptoms associated with such diseases [4]. Although cardiac function improves after CABG surgery, operation alone is not enough to reverse the illness effects. Even in patients who had CABG, the symptoms of the disease are likely to recur if they do not change their behavior [5, 6]. Regular physical activity is required to achieve the functional benefits of CABG. Orderly exercises improve the disease symptoms and activity limitations; they also promote the physical, psychological, and social statuses of the patients [5]. The recommended level of physical activity for patients with coronary artery disease is 30-60 minutes of aerobic physical activity with moderate intensity for at least 5 days a week; this way, it can increase the heart rate to 60-85% of its maximum [7]. Studies conducted on patients suggest positive effects of physical activity after CABG surgery. In this regard, Moholdt et al. pointed out that post-operative exercises could improve patients' cardiovascular function and functional ability [8]. However, physical problems after this surgery, including pain caused by cutting of chest and leg, loss of appetite, fatigue, and sleep disorders, which are often reported by patients, may prevent physical activity. On the other hand, such patients agree that their rehabilitation in doing house works, shopping, and driving is not possible except with the support of their families [9, 10].

Identification of factors affecting the patients' performance or non-performance of physical activity helps improvement of their life quality after CABG surgery. The trans-theoretical model (TTM) is an integrated and comprehensive model for behavior change that has been widely used to promote physical activity [11]. This model contains four central constructs including stage of change, decisional balance, self-efficacy, and change processes. Stage of change is the central and the only construct that has a time dimension. It consists of five successive stages:

1) The pre-contemplation stage in which the person does not intend to change his/her behavior in the next three to six months.

2) The contemplation stage in which the

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individual thinks of changing his/her behavior over the next three to six months.

3) The preparation stage in which the person plans to change his/her behavior in near future (usually in next 30 days).

4) The stage of action in which one has made clear behavioral actions in his/her life style for the intended behavior.

5) The stage of behavior maintenance in which the individual is trying to maintain a health behavior and prevent return of previous wrong habits.

The decisional balance construct refers to the relative importance of advantages and disadvantages of behavior change for individuals. In fact, a high decision-making balance in the context of a particular behavior means a person's willingness to change that behavior to a more favorable behavior (advancing towards higher stages of change). Self-efficacy construct is attributed to the individual's self-confidence in adhering to the desired health behavior in a variety of challenging situations. The person with more self-efficacy has greater chance for behavior change and advancement towards higher change stages. Change processes involve hidden and explicit cognitive and behavioral activities that people use to progress through the stages of behavior change (from pre-contemplation to contemplation stage, etc.) [12].

Despite several studies conducted on physical activity through a trans-theoretical pattern, the orientations of such researches have more been towards healthy people or other patients of the society [13-15]. To the best of our knowledge, there has been no study dealing with the physical activity stages in cardiac patients after CABG surgery based on health education and health promotion models. Therefore, the present study aimed to investigate the stages of physical activity in patients after CABG surgery based on the TTM.

Materials and Methods

This cross-sectional study was carried out on 120 cardiac patients who had CABG surgery and referred to Ekbatan Hospital of Hamadan (Iran). Considering the assumption that physiological activity in patients after post-operative bypass surgery is reduced to 50%, the level of type I error becomes 5% and the least significant difference is 0.09. The sample size was then calculated as 120. Participants were selected through purposeful sampling method from among the patients referring to Ekbatan Heart Hospital of Hamedan in 2015. The inclusion criteria were reading and writing literacy, signing informed consent, and passing of at least one month from their CABG surgery. The instrument used in this study was a questionnaire for descriptive information and TTM constructs. The stages of change were identified with a question the asking

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participants: "Do you have at least 30 minutes of moderate physical activity (such as walking) for 5 days or more per week"? If the answer was "No", the participants were supposed to select one of the following three options:

1. I do not have enough physical activity at the moment, and I do not intend to do it in the next 6 months (Pre-contemplation stage).
2. I do not have enough physical activity at the moment, but I plan to do this within the next 6 months (Contemplation stage).
3. I do not have enough physical activity at the moment, but I plan to do this in the next 30 days (Preparation stage).

If the answer was "Yes", the patients were required to choose one of these two options:

4. I have been doing regular physical activity for less than 6 months (Action stage).
5. I have been doing regular physical activity for more than 6 months (Maintenance stage).

Spearman's correlation coefficient for this construct was calculated for two weeks ($r = 0.72$ $p = 0.01$). The self-efficacy construct was measured through 4 items (such as, I do physical activity, even if none of my family members accompany me) with a Likert scale of 1 (I'm not sure at all) to 5 (I'm pretty sure). The Cronbach's alpha for this construct was 0.81. The advantages of physical activity included 7 questions with a Likert scale of 1 (I totally disagree) to 5 (I totally agree) about the useful effects of physical activity (e.g., physical activity after surgery reduces anxiety and depression in me). Perceived disadvantages consisted of 8 items (like physical activity makes me tired), which were designed to be answered on a Likert scale of 1 (I totally disagree) to 5 (I totally agree). The Cronbach's alpha for the advantages was 0.91, and for disadvantages was 0.89. The score of decision-making balance construct was obtained from the difference between the scores of perceived advantages and disadvantages.

Finally, the cognitive processes included 13 items (for instance, I am always looking for educational materials that help increase my awareness about postoperative physical activity), and the behavioral processes involved 10 items (for example, I have some friends with whom I can walk or exercise whenever I want). These questions were supposed to be answered on a Likert scale from 1 (completely disagree) to 5 (completely agree), and the Cronbach's alpha for these constructs was 0.79 and 0.77, respectively. The score of change process construct was obtained from the sum of the cognitive and behavioral processes' scores.

To measure the amount of physical activity, the short version of self-reporting International Physical Activity Questionnaire (IPAQ) was used. This version has validity and reliability in all adult people around the world. It records information on the amount of time spent by a

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person on exercising with moderate or high severity in the last seven days [16]. The purpose of study was then explained to the participants and they were assured about the confidentiality of their information. The necessary coordinations were made with the hospital management, and the questionnaires were distributed among the patients with appropriate time (30 minutes). Finally, the collected data were coded and analyzed using the $SPSS_{18}$ software. Descriptive statistics, one-way ANOVA, Tukey's post-hoc, and Chi-square tests were used to analyze the data.

Results

The total of 68 men (56.7%) and 52 women (43.3%) who had CABG surgery with an average age of 57.87±9.88 years participated in this study. On average, 3.41±1.57 months passed since their operation. The investigation on the patients' education level showed that 64 (53.3%) of them had diploma, and others (36.7%) were self-employed. Only 22.5% of the participants had BMI of normal range, 28 (23.3%) were smokers and 84 (70%) had at least another underlying illness. Regarding the underlying illnesses, 8 individuals (6.6%) had diabetes, 50 (41.7%) had high blood pressure, 12 (10%) had high blood lipids, and 14 (11.7%) reported blood lipids and high blood pressure. Table 1 shows the demographic variables among the patients under study.

Table 1: Demographic variables of the patients after CABG surgery

Variable		Number (Percent)
Age group	< 40 year	4 (3.4)
	40-49 year	24 (20)
	50-59 year	44 (36.6)
	≥ 60 year	48 (40)
Gender	Female	68 (56.7)
	Male	52 (43.3)
Educational level	< 12^{th} grade	64 (53.3)
	12^{th} grade	32 (26.7)
	Academic	24 (20)
Occupational status	Housekeeper	36 (30)
	Self-employed	44 (36.7)
	Employee	8 (6.6)
	Retired	32 (26.7)
Cigarette consumption	Yes	28 (23.3)
	No	84 (76.7)
Body Mass Index (BMI)	Normal	27 (22.5)
	Overweight	80 (66.7)
	Obesity	13 (10.8)

Table 2 represents the frequency of physical activity in the patients after CABG surgery. As shown, the majority of the participants (43.3%) had moderate physical activity. The results of

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Chi-square test did not show any significant difference between the two groups of women and men regarding the type of physical activity (p = 0.9).

Table 2: Distribution of the frequency of physical activity levels in the patients after CABG surgery

Gender / Physical activity level	Male number (Percent)	Female number (Percent)	Total number (Percent)
Light	30 (44.1)	22 (42.3)	52 (43.3)
Moderate	26 (38.2)	21 (40.4)	47 (39.2)
High	12 (17.6)	9 (17.3)	21 (17.5)

From the 120 patients under study, 5 (4.2%) were in the pre-contemplation phase, 17 (14.2%) were in the contemplation phase, 70 (58.3%) in the preparation stage, 13 (10.8%) in the action stage, and 15 (12.5%) were in the maintenance stage of physical activity.

Table 3 shows the mean scores and standard deviations of the advantages, disadvantages, decisional balance, and perceived self-efficacy in terms of change stages in the patients' physical activity. The results of one-way ANOVA indicated that with progression of the individuals throughout the stages of change (from pre-contemplation stage to maintenance stage), the mean scores of advantages, decisional balance, and self-efficacy increased, and this relation was statistically significant (p<0.001). The results of Tukey's post-hoc test indicated that the mean score of perceived advantages had a significant increase from pre-contemplation stage to preparation stage (p=0.012), as well as to the action and maintenance stage (p=0.001); it also had a significant increase from contemplation stage to action stage (p=0.038) and preparation stage (P=0.020). Concerning the decisional balance construct, the results of the Tukey's post hoc test showed that the mean score of this construct had a significant increase from pre-contemplation stage to contemplation and preparation stages (p=0.020), as well as to action and maintenance stages (p<0.001). It also had a significant increase from the stage of contemplation to preparation, action, and maintenance stages (p<0.001), and from preparation stage to action and maintenance stages (p<0.001). However, this increase was not significant from action stage to maintenance stage (p=0.020). Concerning the self-efficacy construct, the results of Tukey's post-hoc test showed that the mean score of self-efficacy in the two stages of pre-contemplation and contemplation did not differ significantly (p=0.579). Additionally, the

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greatest difference existed between the two stages of pre-contemplation and maintenance (p=0.01). According to the results of one-way ANOVA, there was a significant decrease in the perceived disadvantages' scores throughout the change stages (p<0.001). The results of Tukey's post-hoc test further represented that the mean score of perceived disadvantages were significantly different in all stages (p<0.001), and the least difference was between pre-contemplation and contemplation stages (p=0.021).

Table 3: Mean and standard deviation of advantages, disadvantages, decisional balance, and perceived self-efficacy in terms of change levels in the patients after CABG surgery

Stage of Change / Variables	Pre-contemplation M± SD	Contemplation M± SD	Preparation M± SD	Action M± SD	Maintenance M± SD	ANOVA test	Tukey's test
advantages	18.60 ± 4.82	24.71 ± 4.49	27.29 ± 6.39	30.77 ± 1.16	31 ± 6.03	0.001<p	PC< P,A,M C< A,M
disadvantages	37.40 ± 1.54	31.47 ± 1.37	22.36 ± 3.83	16 ± 6.70	9.13 ± 1.59	0.001<p	PC> C,P,A,M C> P,A,M P> A,M A> M
Decisional balance	-18.80 ± 4.60	-6.76 ± 4.84	4.92 ± 4.55	14.76 ± 7.23	21.86 ± 6.35	0.001<p	PC< C,P,A,M C< P,A,M P< A,M A< M
Self-efficacy	5 ± 1.01	6.47 ± 1.28	10.50 ± 2.02	14.92 ± 2.78	18.13 ± 1.55	0.001<p	PC< C,P,A,M C< P,A,M P< A,M A< M

PC: Pre-contemplation, C: Contemplation, P: Preparation, A: Action, M: Maintenance

The mean scores and standard deviations of cognitive and behavioral processes based on the stages of physical activity change in the patients after CABG surgery are tabulated in Table 4. The results of one-way ANOVA indicated that the mean score of cognitive processes increased significantly during the stages of change from pre-contemplation to maintenance (p <0.001). Tukey's post-hoc test results showed that the mean scores of this construct were not significantly different between the pre-contemplation and contemplation stages (p = 0.2), and the highest difference was between the two stages of pre-contemplation and maintenance (p<0.001). The findings of one-way ANOVA indicated that individuals' behavioral processes had a significant increase during the stages of change from pre-contemplation to maintenance (p <0.001). Moreover, the results of Tukey's post-hoc test revealed no significant difference between the scores of behavioral processes in the two stages

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of pre-contemplation and contemplation (p=0.3). In the same path, the scores did not differ significantly between the action and maintenance stages (p=0.5). Regarding the construct of change processes, the results of one-way ANOVA showed a statistically significant increase in the mean scores of change processes from pre-contemplation stage to maintenance stage (p <0.001). The results of Tukey's post-hoc test also indicated that the mean score of this construct did not have significant change from pre-contemplation stage to contemplation stage (p=0.176), while it increased significantly from pre-contemplation stage to preparation, action, and maintenance stages (p<0.001). Furthermore, according to the results of this test, the mean score of change processes from contemplation stage to preparation (p=025), action and maintenance stage (p<0.001), and from preparation stage to action and maintenance stages (p<0.001) increased significantly. However, this increase from action stage to maintenance stage was not significant (p =0.086).

Table 4: Mean scores and standard deviations of cognitive and behavioral processes based on the stages of physical activity change in the patients after CABG surgery

Stage of Change / Variables	Pre-contemplation	Contemplation	Preparation	Action	Maintenance	ANOVA test	Tukey's test
	M± SD	M± SD	M± SD	M± SD	M± SD		
Cognitive processes	35.60 ± 2.40	41.47 ± 6.53	45.41 ± 6.35	52.54 ± 6.15	54.67 ± 2.61	0.001<p	PC< P,A,M C< P,A,M P< A,M A< M
Behavioral processes	25.20 ± 5.35	29.65 ± 6.18	33.14 ± 4.56	37.92 ± 3.12	40.60 ± 3.99	0.001<p	PC< P,A,M C< P,A,M P< A,M
Change processes	60.80 ± 5.54	71.11 ± 11.06	78.55 ± 9.44	90.46 ± 8.82	99.26 ± 4.86	0.001<p	PC< P,A,M C< P,A,M P< A,M

PC: Pre-contemplation, C: Contemplation, P: Preparation, A: Action, M: Maintenance

Discussion

The results of the present study showed that despite the importance of performing physical activity after CABG surgery in preventing recurrence of disease, most people did not have regular physical activity after surgery. In other words, more than three months after surgery, only 10.8% of the patients were in action stage and 12.5% were in the maintenance phase of physical activity. It is worth noting that 76.7% of the patients were in the early stages of change. In the study of Huang et al., six months after open-heart surgery, 39.2% of the patients were in action

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stage and 37.7% were in maintenance phase. The mentioned study was conducted within longer duration after surgery and had better results in comparison with the current study [17]. Jue and Cunnigham investigated the adherence of 253 cardiac patients over 60 years to exercise two years after CABG surgery. Their results showed that 67% of the people had a long adherence to continuous physical activity, while 33% were still in the stages of pre-contemplation and contemplation [18]. In the study conducted by Kirk et al. on 85 patients with heart disease and diabetes, 2% were in action stage, 29% were in maintenance stage, and more than 65% of the participants were in two stages of contemplation and preparation [19]. In order to achieve the recommended level of physical activity in cardiac patients, to ensure about their health of heart, and to prevent from symptoms' returning, continuous effort is needed to encourage and persuade these patients for physical activity. This is due to the fact that patients may forget the post-operation educations they received or face with new obstacles after passing of time.

In the current study, perceived advantages, self-efficacy, and perceived disadvantages were significantly correlated with the stages of change. It means that with progress throughout the change processes, perceived advantages and self-efficacy increased, while barriers decreased significantly. The relationship of individuals' self-efficacy and viewpoints about the pros and cons of physical activity with their readiness to accept and perform them has been investigated in various studies. For example, Kirk et al. in their study on cardiovascular and diabetic patients showed that self-efficacy and positive aspects of decisional balance increased during the change stages, and those who were in maintenance phase had higher scores in self-efficacy and benefitted more than those who were in contemplation stage [19]. In addition, Henchoz et al. studied patients with rheumatoid arthritis and reported that those who were in pre-contemplation phase had fewer perceived advantages and more barriers in performing physical activity than patients who were in maintenance stage [20]. In Ronald's study, self-efficacy had a meaningful relationship with the physical activity stages of change, and as a strong predictor, it explains performance of exercise in adults with diabetes from preparation to maintenance phase [21]. Patients' decision to move in the course of physical activity change stages depends on their positive and negative attitudes toward physical activity. Therefore, efforts to promote physical activity behavior in patients after operation need to highlight its benefits and identify the obstacles patients are going to be faced with. Health professionals should

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conduct appropriate interventions and encourage patients who are in stages of action and maintenance to perform physical activities by positive reinforcement and regular follow-ups. Furthermore, by advising and presenting solutions, health professionals can overcome the existing barriers and fight against the patients' negative perceptions about post-operative physical activity. They also can increase the self-efficacy of patients who are in contemplation and pre-contemplation stages and help them to progress towards preparation and higher stages of change.

In the present study, both cognitive and behavioral processes in cardiac patients indicated significant increase during the stages of change from pre-contemplation to maintenance. The constructs of change processes represent cognitive, emotional, and behavioral strategies, and are overt and covert actions that people can use to regulate their behavior. In fact, use of cognitive strategies usually leads people who are moving over different stages of change to preparation stage, and application of behavioral strategies directs them towards the action stage. Scientific evidences have also proved the relationship between the stages of change in a behavior and the particular processes used in those stages [22-24]. Heydari et al. carried out a study on 393 patients with type 2 diabetes and found a positive and significant correlation between the mean score of daily exercise and the constructs of change processes, self-efficacy, and decision-making balance. This means that the scores of these variables increase throughout the change stages with the increase of daily activity [25]. Moodi et al. in their study over a group of university staffs showed that the mean scores of cognitive and behavioral processes increased significantly with progress throughout the stages of change; from pre-contemplation stage to preparation, action, and maintenance stages [26]. Fahrenwald and Walker demonstrated that use of change processes along with self-efficacy would make adults progress and move throughout stages of change for participation in physical activity [27]. Moreover, the results of a study on patients with CVDs and diabetes showed that people who were at higher levels of change stages used change processes, such as increase in awareness, self-freedom, helping relationships, reinforcement management, and counter-conditioning more frequently [19]. Exchanges between stages and processes of change have significant implications in promotion of physical activity. In addition, every process has higher effects in a particular stage of change. Considering these issues, information must be given to individuals by conducting unique interventions that are precisely proportional to the participants' place in stages of change. In this regard, Marcus et

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al. emphasize that measuring and understanding the processes of change for physical activity behavior can help health professionals to design interventions in order that people move more quickly from one stage to another [28].

Conclusion

Generally, the findings of the present study indicated that more than half of the cardiac patients did not have regular physical activity after CABG surgery and were at the early stages of preparation. This can lead to the return of disease symptoms and complications. Thus, physicians, physiotherapists and other professionals working in this area are required to increase the patients' physical activities and improve their health level by using motivating factors within the framework of a proper behavioral pattern such as TTM.

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