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The impact of implementing a nursing care program based on Johnson's model on the behavioral systems of patients undergoing coronary artery bypass graft: a Randomized clinical trial

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Abstract

Background   Coronary artery bypass graft (CABG) is a very important intervention to relieve angina, improve quality of life, or increase life expectancy. This study aimed to determine the effect of implementing a nursing care program based on Johnson's model on the behavioral systems of patients undergoing CABG in Ahvaz teaching hospitals in 2022.

Methods   This is a clinical trial that was conducted from December 2022 to December 2023 on 128 patients undergoing CABG admitted to the cardiac ICU and cardiac surgery department of teaching hospitals in Ahvaz, Iran. The patients were selected based on the inclusion criteria, and they were assigned into intervention and control groups using permutation blocks. In the intervention group, a nursing care program based on Johnson's model was implemented for three weeks. The data collection tool was a researcher-made questionnaire developed based on Johnson's theory. A significance level of $\alpha = 0.05$ was adopted for this study.

Results   Before the intervention, the mean scores of the intervention group in terms of the six subsystems of Johnson's model were as follows: achievement (-98.98 ± 75.77), eliminative (-25.46 ± 33.27), ingestive (-135.67 ± 89.20), dependency (-122.26 ± 45.85), aggressive-protective (-62.18 ± 46.58), and restorative (-163.59 ± 62.03). After the intervention, the mean scores in the intervention group were as follows: achievement (-2.50 ± 71.55), eliminative (19.29 ± 35.61), ingestive (152.75 ± 113.58, dependency (104.60 ± 53.42), aggressive-protective (52.18 ± 53.54), and restorative (198.43 ± 72.28), which shows the positive impact of the intervention ($P > 0.05$). No significant changes were observed in the affiliative and sexual subsystems.

Conclusion   The implementation of a nursing care plan based on Johnson's model positively affected the behavioral systems of patients undergoing CABG. Therefore, this model is recommended to be used as a framework for nursing care.

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Introduction

Coronary artery disease (CAD) is a leading cause of death and disability worldwide. Therefore, coronary artery bypass graft (CABG) is indicated for patients with angina and patients with left main coronary artery stenosis or patients with multi vessel coronary artery disease (MVD) [1]. Previous studies have reported that the life style and quality of life of CABG patients after surgery is not satisfactory in all dimensions, especially physical and emotional well-being [2, 3]. CABG surgery is both physically and psychologically taxing for patients and healthcare providers. Patients who undergo surgery often experience anxiety and even depression due to the fear of permanent disability, sleep disturbance [4], changes in body image [5], reduced mobility, loss of health, slower wound healing, longer hospital stay [6], loss of physical control, loss of ability to work, pain, loss of sexual ability, inability to wake up after anesthesia, and death [3, 7, 8]. Postoperative complications can easily occur with an incidence of 15–30%. Possible complications include stroke, renal failure, prolonged intubation time, sternal wound infection [9, 10], and postoperative pulmonary infections (e.g., atelectasis, pleural effusion, pneumonia, pulmonary edema, cardiogenic pulmonary edema, acute respiratory distress syndrome, pulmonary embolism, phrenic nerve damage, pneumothorax, and mediastinitis) [11].

Studies show that changing behavior and modifying lifestyle after open heart surgery can reduce the risk of complications [12]. However, patients often have difficulty modifying their behaviors and adhering to new behaviors because it is difficult to change behaviors that have already been internalized throughout life. A useful strategy to facilitate behavior modification among patients is their active participation in the care process using interactive nursing theories [13]. Nursing theories create a framework and structure for thinking and thus help nurses to better analyze situations, organize their thinking, and make the best decisions for patient care. Some theories also help to achieve standards of care, reduce health care costs, and improve quality of life [14]. The application of nursing models makes nursing interventions shift from service-oriented activities to client-centered ones. These models not only guarantee a targeted, regular, controlled, and effective care of the patient, but also provide the possibility of high quality care and lead to the development of professional nursing [15]. Nurses are essential in shaping patient behavior and facilitating a harmonious balance (equilibrium) between physical and mental well-being. One important model is the behavior system model of nursing developed by Dorothy E. Johnson who believed that in order to prevent illness, and achieve balance and stability, both in the internal or external environment, there should be efficient and effective behavioral functioning in the patient. Using Johnson 's model expands patient care beyond medical necessities and adopts a holistic approach [16]. Johnson's behavioral system model emphasizes the nurse's crucial role in maintaining equilibrium within human behavioral systems by acting as an external regulator. However, such models have rarely been adopted to investigate behavioral changes in patients undergoing CABG. More particularly, there is limited information about the effects Johnson's model on behavioral changes in CABG patients. Therefore, the present study was conducted to investigate the effects of a care program based on Johnson's behavioral model in patients undergoing CABG.

Theoretical framework

One of the significant models in nursing literature is Johnson's behavioral systems model. This model is derived from Nightingale's premise that the goal of nursing is to help people prevent or recover from illness. Johnson envisioned a nursing client as a behavioral system. An orderly behavioral system includes interrelated and interdependent biological and behavioral subsystems. Johnson's behavioral systems model includes 8 subsystems including: achievement, affiliative, eliminative, ingestive, dependency, aggressive-protective, sexual, and restorative [17]. Dorothy E. Johnson's theory focuses on how individuals adapt to illness and how real or potential stress can impact their adaptability. Nursing, according to this theory, aims to reduce stress to facilitate a smoother healing process. Johnson posits that humans possess two fundamental aspects: biological and behavioral. Nursing's primary goal is to maintain equilibrium within the human behavioral system [18]. These subsystems have similar components, structure, and function. Each of these subsystems has components that distinguish them from each other and make that subsystem definable. Structural components are: drive, set, action, and choice. The first component is the drive of the subsystem, which shows the reason and motivation behind the behavior. Drives that have different meanings are different for different people, they induce different meanings at different times for the same person, and they are not visible. The second component of the structure is set or tendency, which is the regular and normal behavior with which the client prefers to fulfill the goal of the subsystem. The next structural component of a subsystem is choice. Choices

show the set and repository available to a person in order to achieve specific goals [19]. In this model, Johnson divides nursing diagnoses into dominance, incompatibility, insufficiency and discrepancy based on the patient's problems. Nursing practices are the actions that the nurse performs to solve the problem, which in Johnson's behavioral model, are divided into four categories, namely restricting, defending, inhabiting, and facilitating [19].

Methods

Design
This single-blind randomized clinical trial was conducted in Ahvaz, Iran, in 2022–2023.

Sampling
The participants were 144 patients undergoing CABG (on pump) who were admitted to two teaching hospitals affiliated to Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. Patients who were aged between 18 and 75 years, were oriented to time and identity, had the ability to communicate, had undergone CABG (surgical techniques used in the patients were similar), had a companion who knew about their condition, and had a telephone line were eligible to participate in the study. Exclusion criteria included the patient's unwillingness to cooperate at any time of the research, situations that require immediate intervention (e.g., decreased level of consciousness, sudden and progressive drop in blood oxygen saturation, etc.), and death of patients after surgery.

This study adheres to CONSORT guidelines and include a completed CONSORT checklist. The stages of the research are shown in Fig. 1.

Sample size
We calculated the necessary sample size on the basis of our main primary outcome measure, with an expected 38.6 unit increase in the mean change of restorative score (total score). These calculations were based on previous study [17]. To detect this difference with 80% power, typeI error of 5% and $S_1 = S_2 = 77.43$, 64 patients for whom data could be analyzed were needed in each group.

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2 \left(s_1^2 + s_2^2\right)}{(d)^2}$$

$$= \frac{(1.96 + 1.04)^2 \times 2 \times (73.89)^2}{(44.67)^2} \cong 64$$

With an assumption of 10% withdrawals or protocol violations, we aimed to recruit 72 patients in each group.

Randomization
This was a RCT in which 128 patients undergoing coronary artery bypass graft were recruited and randomly divided into two groups of intervention or control using an allocation ratio of 1:1 and the block randomization with a random block size of four, six and eight.

Blinding
Due to the nature of this study, blinding of researchers and participants was not possible, but neither the patients nor the researcher were aware of the allocation order until the commencement of the intervention.

Instruments
The tools used in this study included a demographic information form, patient medical records, and a researcher-made evaluation tool based on Johnson's theory to evaluate the behavioral system of patients undergoing CABG. The content validity of the new tool was verified: CVR > 0.6 and CVI > 0.7 in each subsystem. Also, the alpha coefficient reliability was calculated to be 0.86. The questionnaire used to evaluate the behavioral system of patients was a scale including 37 questions in eight sub-systems: restorative, ingestive, eliminative, aggressive-protective, dependency, sexual, affiliative, and achievement. Each item in each sub-system was answered by the patient according to three aspects. One aspect was related to changes in symptoms or ability to function. The patient responded by indicating an increase or decrease or no change. Then this change was identified as negative or positive. Finally, the magnitude of these changes was scored on a scale of 0-100 and considered positive or negative. A total score was calculated for each subsystem, and the nurse focused on care in the subsystem with the worst score.

Data collection
Data were collected in this study by the lead researcher between December 2022 and December 2023. To this aim, demographic and medical information forms were read to the patients by the lead researcher who then scored the form based on the patient's response. The tool for examining the behavioral system of patients after CABG was completed by the lead researcher at two intervals according to the patient's response: the first time when the patient was hospitalized in the ward and the second time was two weeks after the operation, when the patient was discharged and followed up by phone.

Intervention: a nurse-led care program
All patients were transferred to the ICU after CABG and were admitted to the cardiac ICU for an average of 2 days. After being discharged from the ICU, they were admitted to the cardiac surgery department for an average of
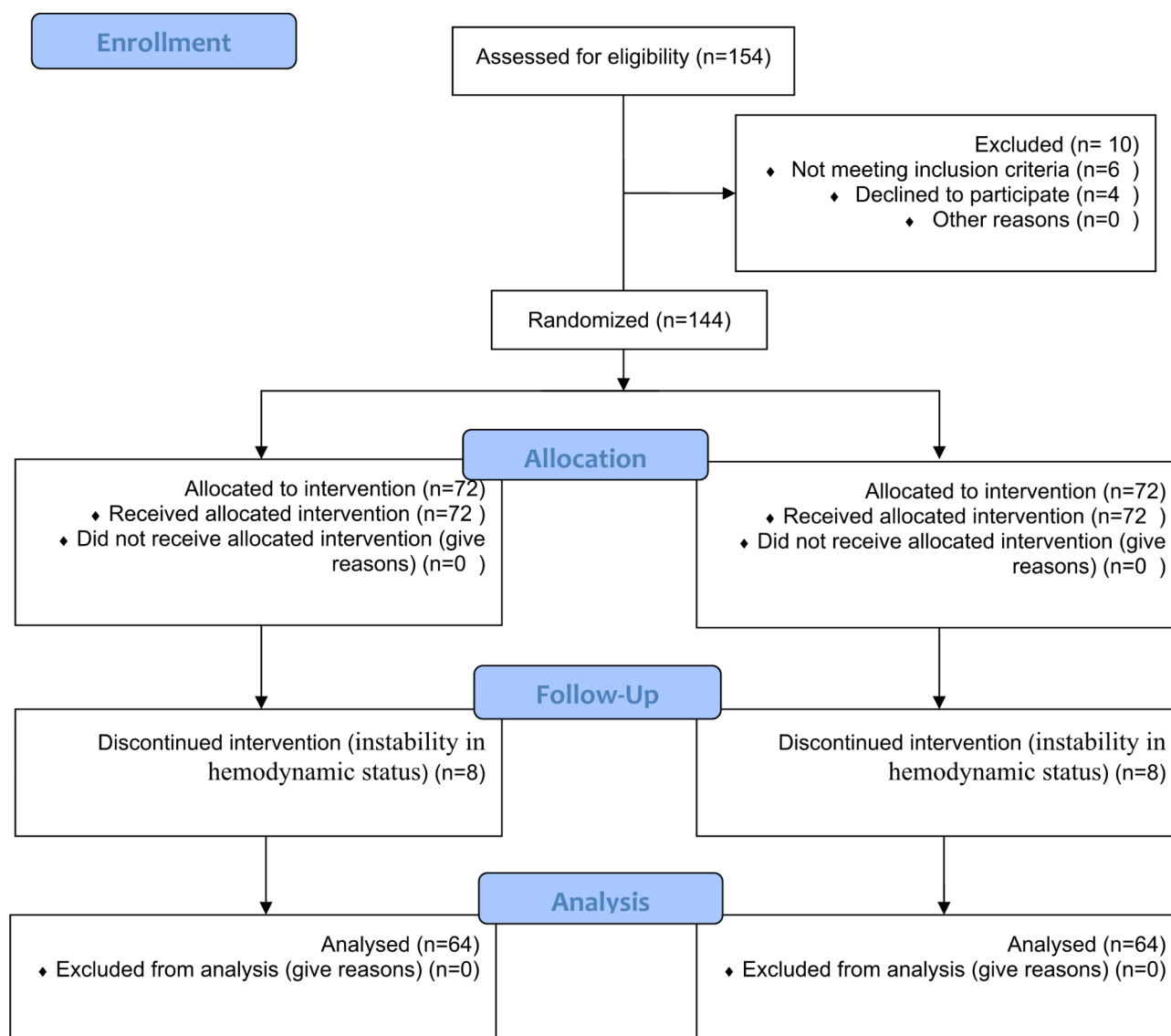
Fig. 1 The flowchart of the study groups

3–4 days, and were discharged from the department in case they had no problems. To this aim, the first step was to assess the existence of problems by analyzing the findings obtained from the behavioral assessment tool. In the evaluation, the performance and purpose of each subsystem was taken into account. Equilibrium state in each subsystem was checked by analyzing: (a) whether there was any change in the structure or function of the subsystem, (b) whether the patient feels the change positively or negatively, and (c) how important this change is for the patient. Based on the overall equilibrium state of each subsystem, the scores were sorted from the lowest to the highest.

The researcher and one of the nurses in the cardiac ICU and cardiac surgery department managed the patients' problems through nursing processes, and then based on

the NANDA system, nursing diagnoses were made. The diagnoses were expressed in two ways: 1- Internal problems in each subsystem: any failure to meet functional requirements or the existence of incompatibility between the structural components of the subsystems. 2- Intersystem problem: the dominance of one or two subsystems in the entire behavioral system or the existence of conflict between two or more subsystems.

In the second step, the lead researcher gave the necessary training to the nurses of the cardiology and cardiac surgery department in three 60-minute sessions. This included information about how to: use Johnson's behavioral system model, evaluate patients using tools designed to examine patients' behavioral systems, write nursing diagnoses, and take the necessary measures to manage patients' problems. The patient's companion

Subsystem	Session 1	Session 2	Session 3	Session 4
Restorative	1- Coughing and deep breathing training 2- Proper sleep training 3- Correct walking training	1- Coughing and deep breathing training 2- Proper sleep training 3- Correct walking training 4- The importance of chest physiotherapy 5- Teaching relaxation techniques and expressing emotions 6- Teaching the use of incentive spirometry	Telephone follow up on previous cares and emphasizing their implementation.	Telephone follow up on previous cares and emphasizing their implementation.
Ingestive	1- The importance of consuming fluids and adequate and appropriate diet 2- Methods of increasing appetite 3- The ability to tolerate food 4- Proper diet training	1- The importance of adequate and proper fluid intake and diet 2- Methods of increasing appetite 3- The ability to tolerate food 4- The importance of daily weighing 5- Providing drug information and drug precautions 6- Proper diet training 7- Teaching active and passive movements in the range of joints 8- Pain control 9- Giving information about recommended sports and rest	Telephone follow up on previous cares and emphasizing their implementation.	Telephone follow up on previous cares and emphasizing their implementation.
Achievement	1- Importance of compliance with diet, medication, and exercise	1- Importance of compliance with diet, medication, and exercise 2- Getting feedback from the patient regarding training related to diet, medication and exercise 3- Teaching how to check blood sugar and blood pressure and get feedback 4- Teaching the correct use of varicose socks 5- Explaining the stress associated with surgery and teaching how to deal with it 6- Giving the patient a chance to freely express their feelings and concerns 7- The correct way of praying	Telephone follow up on previous cares and emphasizing their implementation.	Telephone follow up on previous cares and emphasizing their implementation.
Eliminative	1- Controlling the absorption and excretion of liquids and electrolytes 2- Asking about defecation problems and teaching how to prevent constipation	1- Controlling the absorption and excretion of fluids and electrolytes 2- Asking about defecation problems and teaching how to prevent constipation 3- Fever control 4- Giving the patients the ability to express feelings and motivating them to do simple tasks 5- Requesting the patient's family to support them for the purpose of treatment	Telephone follow up on previous cares and emphasizing their implementation.	Telephone follow up on previous cares and emphasizing their implementation.
Affiliative	1- Emphasizing minimum family visits at first and increasing them over time	1- Emphasis on minimum family visits at first and increasing them over time 2- Giving the patient the ability to communicate with family and friends and encouraging them to express their concerns with family members 3- Emphasizing the importance of daily changing of clothes	Telephone follow up on previous cares and emphasizing their implementation.	Telephone follow up on previous cares and emphasizing their implementation.
Dependency	1- Emphasizing the importance of changing activities upon exhaustion 2- Training on the correct way of bathing and emphasizing its brevity, not using body brushes, and using lukewarm water	1- Emphasizing the importance of changing activities upon exhaustion 2- Telling the patient to avoid heavy work and stressing that in the first days after discharge, the activities allowed should be like at hospital 3- Emphasizing the necessity of a doctor's order to resume work, drive, and travel 4- Correct bathing 5- Providing emotional support to the patient and stating that the feeling of depression is fleeting 6- Emphasizing the importance of having a plan to perform appropriate activities in the first days after discharge 7- Feeling the need for religious activity and encouraging the patient to express religious beliefs, pray, and supplicating	Telephone follow up on previous cares and emphasizing their implementation	Telephone follow up on previous cares and emphasizing their implementation.

Table (continued)

Subsystem	Session 1	Session 2	Session 3	Session 4
Protective	1- Maintaining skin hygiene and the importance of having a dry skin surface and checking body areas under pressure 2- Maintaining the level of mobility and activity 3- Emphasizing the importance of changing position 4- Checking pulse and blood pressure to prevent possible bleeding 5- Chest tube control 6- Emphasizing the importance of wearing appropriate clothes and shoes to prevent falls 7- Keeping feet shoulder width apart while walking	1- Maintaining skin hygiene and the importance of having a dry skin surface 2- Maintaining the level of mobility and activity 3- The importance of changing position 4- Checking pulse and blood pressure to prevent possible bleeding 5- Teaching the correct use of walking aids 6- The correct way to walk to avoid falling 7- Teaching what medicines cause blood pressure drop and the related precautions 8- Encouraging the patient to enjoy music 9- Emphasizing the importance of controlling mental emotions and listening to the patient's problems and strengthening healthy changes 10- Encouraging the patient to do their favorite hobby		
Sexual	1- Sexual activity should be after 2–4 weeks after the operation depending on the patient's ability	1- Avoiding eating heavy food before intercourse 2- Stopping sexual activity upon exhaustion 3- Avoiding putting pressure on the ribs 4- Emphasizing the importance of doing sexual activity in the morning and after a night's rest	Telephone follow-up and care re-education	Telephone follow-up and care re-education

was also included in these sessions. The care model was implemented by the lead researcher in the morning shift and by trained nurses in the evening and night shifts.

The care program for each patient was implemented for two weeks. After discharge, care recommendations were provided over phone. The care program of the patients started about 24 h after the operation when they were able to sit. Patients were examined first, and according to each sub-system, stable and unstable behaviors were determined. Depending on unstable behaviors and nursing diagnoses, interventions were made, and the final evaluation was done by completing the questionnaire. Interventions were performed based on Johnson's behavioral model in eight subsystems. The control group received only routine care.

Statistical analysis

The quantitative variables were reported using mean and standard deviation, and qualitative variables, using frequency (percentage). The normality of the distribution of quantitative variables was assessed by the Shapiro–Wilk test. The comparison of qualitative variables in the two groups, was done using Fisher's exact test or chi-square test. The quantitative variables in the two groups were compared using the independent samples t-test or Mann–Whitney test. Univariate effects of intervention condition on posttest outcome measures after adjustment for age as a confounder were examined using

between-subjects analysis of covariance (ANCOVA), adjusting for pretest scores. The significance level of the tests was considered as 0.05. All tests were two sided. Data analysis was done using SPSS version 26.

Results

In this study, 128 patients undergoing coronary artery bypass graft were recruited were recruited. In Table 1 the demographic and clinical characteristics of the two groups are presented.

The mean familiarity subsystem score reduced from baseline to after intervention in both groups (Table 2). After adjustment for age and pretest score, there was a significant difference between two groups (P-value = 0.0002).

Both the intervention and control groups experienced significant increases in mean scores for dependency, ingestion, elimination, achievement, and energy saving subscales following the intervention. However, the intervention group demonstrated significantly larger and more substantial improvements compared to the control group (P-value < 0.0001).

In the intervention group, the mean score of protection subscale increased from baseline to after intervention. In the control group, the mean score of protection subscale increased was reached to -19.45 throughout the study. However, the pattern of change in this subscale was similar in the two groups, but intervention group had greater

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Table 1 Demographic and clinical characteristics of participants in the intervention and control groups

Variable	Control group	Intervention group	P-value
Age; year	61.78 ± 8.25	57.39 ± 7.57	0.002$^{€}$
Gender; n (%)			0.690
Male	44(8.8)	47(73.4)	
Female	20 (31.3)	17(26.6)	
Education; n (%)			
Illiterate	26(40.6)	17(26.6)	0.160
Primary	19(29.7)	25(39.1)	
Intermediate	2(3.1)	7(10.9)	
High school	3(4.7)	1 (1.6)	
Diploma	6 (9.4)	9 (14.1)	
Academic	8(12.5)	5(7.8)	
Hyperlipidemia; n (%)			0.360
Yes	29 (45.3)	23(35.9)	
No	35(54.7)	41 (64.1)	
Hypertension; n (%)			0.840
Yes	46(71.9)	44(68.8)	
No	18(28.1)	20(31.3)	
Diabetes; n (%)			0.280
Yes	40(62.5)	33 (51.6)	
No	24(37.5)	31 (48.4)	

Table 2 Descriptive statistics and ANCOVA results for the outcome measures

Outcome	Control group	Intervention group	F	¥	P-value
Affiliative			10.49	0.002	0.07
Before	-27.65 ± 39.62	-23.28 ± 34.87			
After	-90.00 ± 47.86	-68.59 ± 33.63			
Restorative			171.056	0.58	> 0.0001
Before	-153.43 ± 92.66	-163.59 ± 62.03			
After	12.89 ± 97.64	198.43 ± 72.28			
Aggressive/protective			70.46	0.362	> 0.0001
Before	-56.40 ± 50.65	-62.18 ± 46.58			
After	-19.45 ± 59.94	52.18 ± 53.54			
Dependency			88.54	0.417	> 0.0001
Before	-90.85 ± 45.59	-122.26 ± 45.85			
After	-22.81 ± 76.93	104.60 ± 53.42			
Eliminative			47.30	0.276	> 0.0001
Before	-38.35 ± 58.71	-25.46 ± 33.27			
After	-16.40 ± 4.53	19.29 ± 35.61			
Ingestive			115.23	0.482	> 0.0001
Before	-128.45 ± 100.59	-135.67 ± 89.20			
After	-51.81 ± 115.16	152.75 ± 113.58			
Achievement			45.70	0.269	> 0.0001
Before	-86.25 ± 76.99	-98.98 ± 75.77			
After	-96.32 ± 82.03	-2.5 ± 71.55			
Sexual			0.049	0.000	0.825
Before	-15.23 ± 39.62	-20.31 ± 39.74			
After	-137.96 ± 67.73	-130.39 ± 68.07			

changes between after intervention (P-value < 0.0001). However, no significant differences were found between the two groups in the affiliative and sexual subscale scores post-intervention (P-value > 0.05).

Discussion

Our results suggest that the use of a nurse-led program based on Johnson's model can improve system equilibrium when individualized comprehensive care is provided even for patients undergoing CABG surgery. According to these results, the intervention based on Johnson's behavioral model reduced the patient's problems in terms of the affiliative sub-system. In their study determining the effect of a nursing care program using Johnson's behavioral system model in heart failure patients in Mashhad hospitals in 2020, Rahmani et al. observed no significant change in the two intervention and control groups as far as the affiliative subsystem was concerned [17], which is not consistent with the results of the present study. This discrepancy could be explained by a number of factors such as different research populations, intervention methods, lengths of intervention, care environments, and patients with different problems.

The intervention in the present study also reduced the patient's problems in terms of the subsystem of aggressive-protective. These results are in agreement with those of Ghanbari Afra and Mohammad Hoseini (2020) who conducted a case study evaluating the effect of Johnson's behavioral system model on the care of a patient with heart failure in a hospital affiliated to Qom University of Medical Sciences. They showed that after using Johnson's model, the patient's unstable behaviors were reduced in terms of the aggressive-protective subsystem [20]. Jose et al. (2022) demonstrated that nursing interventions guided by Johnson's model effectively reduced pain and enhanced functional independence in patients with laryngeal carcinoma. By the eighth day post-intervention, these patients were able to perform activities of daily living, including eating, brushing, and grooming, with adequate strength [21]. Johnson's behavioral system model emphasizes the evaluation of, and intervention with, the individual's behavioral system in a non-invasive manner. Therefore, in order to improve the disease symptoms, nursing interventions such as providing the patient with an opportunity to talk about their anger and using family support can reduce patient problems in this subsystem.

Based on the findings of the present study, there was a decrease in the patient's problems with regard to the dependency subsystem. In line with the results of our study, Karkhah et al. reported improvement in the dependency subsystem as a result of a nursing care program based on Johnson's behavioral model in a patient with hematoma of the wrist joint who was admitted in Poursina Hospital in Rasht, Iran, in 2020 [22]. Lovejoy et

al. suggested that clinicians should conduct a thorough assessment of family dependency subsystems in asthmatic children. By identifying and promoting adaptive dependency behaviors, clinicians may be able to significantly reduce the frequency of asthma attacks [23].Suffering from heart disease is a source of stress for the patient and the family, and as a critical condition, it can disrupt the functioning and dynamics of the individual and the family. The nurse's reaction to the disease has therefore a profound effect on the patient's health and ultimately their recovery.

Our results also showed a reduction in the patient's problems with respect to the eliminative subsystem. In their 2022 study, Jose et al. investigated the impact of a nursing care plan based on Johnson's Behavioral Model on a patient with laryngeal carcinoma. The intervention resulted in significant improvements in appetite, reduced lethargy, and normalized bowel function [21]. Nooredini et al. (2021). studied the effect of a nursing process based on Johnson's behavioral system model in stroke patients, and detected inefficiency in the eliminative subsystem, which was related to the side effects of drugs causing constipation. Their nursing interventions included training on the consumption of laxative foods, increasing fluid intake to 6–8 glasses per day, drinking one glass of water on an empty stomach, walking for 30 min daily, and taking laxatives as prescribed by the doctor. At the end of the two-month period after the nursing intervention, the patient experienced improvement in terms of the eliminative subsystem and was able to control urine and feces [24], which is in line with the results of the present study.

According to the results of this study, the patients' problems regarding the ingestive subsystem were reduced. In Karkhah et al., the interventions performed to diagnose anorexia included the following: checking the patient's nutritional status, water and electrolytes, checking the patient's weight, asking the family for help in decorating the patient's food, and encouraging the patient to frequently consume food in small quantities. Based on their results, the patient's unstable behaviors regarding the ingestive subsystem were reduced following the use of Johnson's behavioral system model [22], which is in line with the results of the present study. Disease-associated malnutrition has detrimental effects on the healing process, leading to an increase in infection, delayed recovery, prolonged hospitalization, increased hospital costs, and mortality. Since the ingestive subsystem is concerned with the patient's ability to drink and eat sufficient liquids and food, have a proper appetite, and obtain dietary and medicinal information [25], it improves the nutritional status of the individual.

Based on the findings of the present study, the patient's problems were improved in terms of the restorative subsystem. Jose et al.'s 2022 study highlights the potential of Johnson's Behavioral Model to address sleep disturbances in patients with laryngeal cancer. By implementing a tailored nursing care plan, they were able to improve sleep quality and overall well-being [21]. Payamani et al. (2023) evaluated a nursing process based on Johnson's behavioral system model in patients with multiple sclerosis. Fatigue related to muscle weakness from doing housework and spasm was diagnosed based on the client's statement. Their nursing interventions included learning to restore energy by resting between daily activities, stopping work before excessive fatigue, not doing heavy work and activities, dividing daily tasks into 24 h, and taking prescribed medications on time. Their results showed that after nursing interventions, the client's muscle weakness and spasm improved [15], which is consistent with the results of the present study. Fatigue is one of the most common and uncomfortable side effects in heart patients, and when it becomes severe, it has an immense impact on daily functioning and quality of life. To manage fatigue, pharmacological and non-pharmacological interventions are performed. Johnson's behavioral system model is widely used as an effective non-pharmacological treatment in heart patients.

The results of our study showed that the patient's problems were also reduced as far as the achievement subsystem was concerned. The results of Rahmani et al.'s (2020) study showed that positive changes in the dependency sub-system in the intervention group were significantly high, which is consistent with the results of the present study. Adherence to treatment, which is defined as the extent to which individuals' behavior conforms to health or treatment recommendations, regular use of medications, and adherence to therapist recommendations, is a complex behavioral process affected by factors such as therapist interaction and health care system. Care models not only guarantee the targeted, regular, controlled and effective care of the patient, but also provide the possibility of high and medium quality care by nurses [17]. Jose et al. (2022) demonstrated that an 11-day nursing care plan based on Johnson's Behavioral Model increased confidence and engagement in healthcare among patients with carcinoma of larynx [21].

Based on the results of this study, our intervention did not have a statistically significant effect on the sexual subsystem. In the study of Nooredini et al. (2021), sexual dysfunction was diagnosed in relation to the complications of the disease (as determined by the patient's statement of decreased libido and sexual desire for the spouse). Their nursing interventions included teaching the clients to communicate verbally and non-verbally with their spouses, facilitating counseling with a clinical psychologist, and counseling with the spouses. Their results showed that at the end of the two-month period after the nursing process, the patient had improved in matters

related to sexual activities, which is not consistent with our results [24]. This discrepancy can be explained by the fact that Nooredini et al.'s study was a case report while ours is a clinical trial. The purpose of the sexual sub-system is to generate expectations in sexual relations, and its task is to expand the self-concept with sexual self-identity. Like all other subsystems, this subsystem changes constantly due to maturity, experience, and learning [26]. In the context of sexual health, Jose et al.'s study involved educating the patient's wife about the disease process, complications, dietary needs, and physical activity guidelines. The patient was also fully informed and conscious of these aspects of their condition [21].

In the current study, the restorative sub-system was affected by the intervention more than other sub-systems. It seems that Johnson's behavioral systems model can help increase the restorative subsystem of patients by performing interventions such as "enhancing the ability to control and manage fatigue", which becomes the basis for regaining their strength. Small's study in America highlighted the effectiveness of Johnson's model as a conceptual framework for evaluating the comprehensive needs of visually impaired children. This model proved to be a practical tool for implementing all stages of the nursing process, considering not only physical needs but also emotional and psychological aspects [27].

It important to note that the present study suffered from a number of limitations including the small sample size and conducting the intervention in only two hospitals, which may affect the generalizability of our findings. Therefore, similar studies using larger sample sizes and being conducted in multiple settings is recommended. Also, the current study was conducted on 18–75 years old people, so it cannot be generalized to the whole society.

Implications for practice

One of the clinical implications that emerged from this study was that nursing care should include support, nurturing, restraint, inhibition, and facilitation, as these improve the behavioral system as a whole. A second clinical implication is to provide care based on the importance and severity of changes in the equilibrium state of each human behavioral subsystem since these changes ultimately affect the entire behavioral system.

Conclusion

This study provides evidence that a program grounded in Johnson's Behavioral System Model can significantly enhance patient outcomes by improving balance in key behavioral subsystems. Specifically, we observed improvements in restorative, ingestive, eliminative, aggressive/protective, dependency, and achievement subsystems. Although no significant changes were noted in

sexual and affiliative subsystems, the study highlights the utility of Johnson's model as a valuable tool for assessing and addressing diverse patient needs.

Data availability
Data may be available by request submitted to the corresponding author.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences, Ahvaz (IR.AJUMS.REC. 1401.201). This study was conducted based on the principles of the revised Declaration of Helsinki, which is a statement of ethical principles used to guide medical researchers who investigate human subjects. Participants were briefed on the purpose of the study and were assured of their freedom to voluntarily withdraw from the study. Then informed consent was obtained from all participants. This study was registered in the Iranian Registry of Clinical Trials (IRCT20220831055838N1).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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