JBACHS
Journal of Basic and Clinical Health Sciences

J Basic Clin Health Sci 2020; 4:168-173
https://doi.org/10.30621/jbachs.2020.1034

Original investigation

Examination of Chronic Fatigue in Patients with Coronary Artery Bypass Graft Surgery

Buse Ogul[1], **Gulbin Ergin**[2]

[1]Dr. Burhan Nalbantoğlu State Hospital, Departmant of Physical Therapy, Nicosia, Cyprus
[2]Izmir Bakircay University, Faculty of Health Sciences, Departmant of Physical Therapy and Rehabilitation, Izmir, Turkey

Address for Correspondence: Gulbin Ergin, **E-mail:** gulbin.ergin@bakircay.edu.tr
Received: 28.01.2020; **Accepted:** 09.04.2020; **Available Online Date:** 15.05.2020

Cite this article as: Ogul B, Ergin G. Examination of Chronic Fatigue in Patients with Coronary Artery Bypass Graft Surgery. J Basic Clin Health Sci 2020; 4:168-173.

ABSTRACT

Purpose: The aim of this study was to examine of chronic fatigue in patients undergoing coronary artery bypass grafting (CABG) surgery.

Methods: The study was carried out with a total of 50 patients undergoing CABG surgery. The questionnaire was filled with socio-demographic characteristics of the patients. The Checklist Individual Strength (CIS) questionnaire for fatigue, The SF-36 questionnaire for the quality of life, the Beck Depression Inventory (BDI) for depression, and the 6 minutes walking (6MWT) test for functional exercise capacity were performed

Results: The mean age of the patients was 63.54±8,86 years and the BMI was 28.83±3,83 kg/ m2. The mean total CIS score of the patients was 46.18 ± 26.25 and 12% of the patients were above the CIS threshold value of 76 points. A statistically significant correlation was found between the ages of the patients and the scores taken from the CIS-motivation ($r = 0.03$, $p < 0.05$). It was found a positive correlation between the scores of the BDI and the CIS-total and a statistically significant relationship between the 6MWT results ($p<0.05$). The age, physical function and mental health subscale scores of the patients were determined to be significantly effective on the CIS total score ($p < 0.05$).

Conclusion: In conclusion, age, physical function and mental health are the factors that most affects late period fatigue in patients undergoing CABG.

Keywords: fatigue, Checklist Individual Strength, coronary artery disease, bypass surgery

INTRODUCTION

Coronary artery bypass graft surgery (CABG) is a standard intervention to improve the quality of life and functional status of people with coronary artery disease by providing heart revascularization. CABG decreases coronary artery disease symptoms, ischemia, subsequent cardiac events and prolongs survival (1).

Postoperative morbidity is frequently associated with many risk factors, and complications such as arhythmia, ventricular dysfunction requiring infection with inotropic disease, infection, gastrointestinal dysfunction, acute lung injury, renal impairment, and non-cardiac aetiology may develop (2). In addition, CABG surgery is associated with psychosocial problems such as fatigue, cognitive disorders, anxiety, depression and social isolation (3).

Fatigue occurs especially after 2–4 weeks postoperatively after CABG (4, 5). Cytokine levels and opioid use cause sleep disturbances and this is considered to be one of the most important causes of acute fatigue after surgery (5, 6). Yamamoto et al. (1997) found that early fatigue after major surgeries, such as CABG, is the result of elevated tryptaphan plasma levels in plasma concentration (7). In another study, it has been reported that fatigue continued for approximately three months from the early period to the first week after CABG (8).

Barnason et al., (2008), investigated prolonged fatigue after CABG, 50% of patients were reported to have fatigue in their normal daily and general activities at 8th week. They also reported that long-lasting fatigue caused patients to be inactive and sustained heart problems (9). The duration of postoperative fatigue is thought to be related to loss of muscle tissue and function, cardiovascular deconditioning to exercise, preoperative fatigue level of the patient and decreased level of cortisol (4, 10).

There is limited number of studies investigating the effects of postoperative fatigue on patients in the acute period (6 weeks) (4, 5, 9, 10). But the study investigating the change in physical and psychosocial functions related to fatigue in the late period is not found in the databases we searched.

The aim of this study was to determine the level of chronic fatigue in patients undergoing CABG and to define the relationship between chronic fatigue levels, muscle strength, functional exercise capacity, quality of life and depression.

METHODS

Design

The study was a cross-sectional study, including patients who underwent coronary artery bypass graft surgery in the Cardiovascular Surgery Unit and who had at least 6 months after discharge.

Setting and Sample

In total 50 patients were evaluated according to inclusion/exclusion criteria. In the study based on Bivariate normal model, the number of samples required for 95% power at 0.5 effect size is 38 patients. As a result of the evaluation of 50 patients in our study, the power value reached at the effect size of 0.5 was 98% (α=0.05). This study was approved by the Ethics Committee (Decision No. 03/02/04/1617/2).

Inclusion Criteria of the Study:

- Having undergone CABG
- At least 6 months after discharge
- Reading and writing skills
- Voluntary participation in the study

Exclusion Criteria of the Study

Having any orthopaedic or neurological condition that may affect the locomotor system of patients.

Data Collection

Socio-demographic characteristics examined by the first author; age, gender, height, weight, level of education, occupation, risk factors (smoking, alcohol), clinical history of the patients and whether patients were given physiotherapy and home program after surgery. The same therapist assessed all patients.

Fatigue was assessed by the Checklist Individual Strength (CIS) questionnaire. Turkish validity and reliability studies were performed by Ergin et al. This questionnaire evaluates chronic fatigue. This scale assesses fatigue in four ways: subjective experience, decrease in motivation, decrease in activity and decrease in concentration (11).

Quality of life of the patients was evaluated by using Short Form 36 (SF-36) questionnaire. SF-36 includes 36 questions, eight subscales; physical function (PF), physical role (PR), pain, general health (GH), vitality, social function (SF), emotional role (ER) and mental health (MH). The first four scales are known as physical component score and the last four scales are known as the mental component score. Questions were answered by considering the last 4 weeks. Individual scores are obtained for each subscale. The scores of the subscales ranged from 0 to 100 and the high score indicates good health status (12).

The depression levels of the patients were evaluated with the Beck Depression Inventory (BDI). It's including the questions to determine levels of depression. This test consists of 21 items related to depressive symptoms such as pessimism, sense of failure, lack of satisfaction, feeling of guilt, restlessness, fatigue, decreased appetite, instability, sleep disturbance, and social withdrawal. Each item includes a four-grade self-assessment that determines behaviour specific to depression. Each question was evaluated by giving a score between 0 and 3 (13).

To determine the functional strength, stability and the ability of the quadriceps muscle to be supported, it was measured objectively using the Hand-Held Dynamometer (HHD) (model 01163; Lafayette Instrument Company, Lafayette Ind., USA). Patients were seated on the edge of the treatment table and placed near their maximal knee extension (0°), proper with clinical muscle testing. The hand-held dynamometer was positioned 2-3cm above the lateral malleolus on the anterior of the tibia. The patients were asked to place their arms across their chest while performing isometric knee extension contractions. Patients were instructed to perform a maximal effort over 1 to 2 seconds. Measurements were performed with 3 repetitions in 60 seconds. The mean values of the measured values were recorded (14).

In the position recommended by the American Association of Hand Therapists, the Jamar Plus Digital Hand Grip Dynamometer (model 563213; Patterson Medical Supply, USA) was used for grip strength. Measurements were performed in 3 replicates and recorded in kilograms. As a result of the evaluation, three measurements were averaged (15).

Functional exercise capacity was assessed by a 6-Minute Walk Test (6MWT). This test is accepted as a submaximal test. The test was performed under the supervision of a physiotherapist on a flat floor of 30 meters in a closed area. Before the test, the physiotherapist gave standardized instructions to the patients on how to perform the 6MWT. Patients were informed to walk as fast as possible but were not allowed to run or jog. Standardized encouragement and the time left of the 6MWT were called out to the patients at per minute mark. Finally, the total distance walked by patients in 6 minutes was calculated and recorded (16).

Data Analysis

Statistical Package for Social Sciences (SPSS) 21.0 data analysis package program was used for statistical analysis of the data. Frequency analysis was performed to determine the distribution of the patients included in the study. Descriptive statistics such as mean, standard deviation, smallest and maximum value of SF-36 and BDI scores were given to age and anthropometric measurements of patients, CIS scores and 6 MWT walking distances, quadriceps muscle strength and grip strength measurements. In order to determine the hypothesis tests to be used in the study, the normal set of data was examined by Kolmogorov-Smirnov and Shapiro-Wilk tests. Accordingly, non-parametric (non-parametric) hypothesis tests were used in the study. Age, anthropometric measurements, muscle and grip strength values, SF-36 and BDI scores were used to determine the correlations between the groups. Age, BMI, quadriceps muscle strength, grip strength, SF-36 and BDI scores of the patients included in the study were performed by regression analysis (17).

Table 1. Descriptive statistics on demographic measurements of patients

	n	Mean	s	Min	Max
Age	50	63.54	8.86	45.00	85.00
Height (m)	50	1.68	0.08	1.50	1.85
Body Weight (kg)	50	82.50	13.26	55.00	115.00
BMI (kg/m²)	50	28.83	3.83	21.48	38.06

BMI: body mass index.

Table 3. Patients' CIS, 6 MWT, Muscle Strength, SF-36, BDI scores

		s	Min	Max
CIS				
Subjective Feeling of Fatigue	18.52	13.77	8	56
Concentration	9.68	7.05	5	35
Motivation	9.56	5.84	4	28
Activity	8.42	5.74	3	21
CIS Total	46.18	26.25	20	134
6 MWT (m)	381.06	70.96	150	495
Quadriceps Force				
Right	4.26	4.87	1.60	34.80
Left	4.04	4.90	1.30	34.90
Hand Grip Strength				
Right	30.30	11.47	3.50	65.90
Left	30.16	10.53	3.50	61.20
SF-36				
Physical Function	85.30	14.19	40	100
Physical Role	76.50	32.89	0	100
Emotional Role	87.33	30.78	0	100
Vitality	79.50	26.21	0	100
Mental Health	83.92	22.01	8	100
Social Function	93.50	19.92	12.5	100
Pain	87.65	22.44	20	100
General Health	77.70	20.28	10	100
BDI	4.42	9.22	0	43

CIS: checklist individual strength; **6 MWT:** 6 minutes walking test; **SF-36:** short form 36; **BDI:** Beck Depression Inventory.

RESULTS

The study was completed with 50 patients who underwent CABG and at least 6 months after the discharge, which meet the inclusion/exclusion criteria. Demographic characteristics and descriptive information of the patients are given in Table 1 and Table 2. CIS, 6 MWT, quadriceps force, grip strength, SF-36 and BDI descriptive information were given in Table 3.

A statistically significant and positive correlation was found between the ages of patients and CIS-motivation subscale scores (p<0.05) (Table 4).

The CIS total score with subscales of the subjective feeling of fatigue and activity had a negative and significant correlation with the 6MWT (p <0.05) (Table 4).

There was a statistically significant and negative correlation between left quadriceps values and CIS-activity subscale scores (p<0.05) (Table 4). There was a statistically significant and negative correlation between right grip force measurement values and

Table 2. Distribution of patients according to their characteristics

	Number (n)	Percent (%)
Gender		
Female	8	16.00
Male	42	84.00
Working Status		
Working	11	22.00
Not Working	4	8.00
Retired	35	70.00
Chronic Disease		
No	12	24.00
Yes	38	76.00
Regularly Used Medicine		
No	2	4.00
Yes	48	96.00
Smoking Status		
Non-smoker	12	24.00
Used to smoke	30	60.00
Smoker	8	16.00
Non-user		
Never Drunk	39	78.00
Used to drink	7	14.00
Regular alcohol consumer	4	8.00
Post-Operative Physiotherapy		
Yes	5	10.00
No	45	90.00

CIS-T and CIS subjective feeling of fatigue scores (p<0.05) (Table 4). There was a statistically significant and negative correlation between left grip strength measurement values of the patients, CIS-T, subjective feeling of fatigue, and activity subscale scores (p<0.05) (Table 4).

When the relationship between the BDI scores and CIS was investigated, it was found that there was a statistically significant and positive correlation between BDI scores and CIS-T with subscales (p <0.05) (Table 4).

The relationship between SF-36 and CIS scores

It was found that there was a negative and statistically significant correlation between the PF and vitality scores of SF-36 and subjective scores of CIS-T, CIS-fatigue, CIS-motivation and CIS-activity (p<0.05) (Table 4). There was a statistically significant and negative correlation between the PR and ER scores s of SF-36 and the scores of CIS-T and CIS subjective feeling fatigue (p<0.05) (Table 4).

There was a statistically significant and negative correlation between the MH and SF scores of SF-36 and the scores of CIS-T, subjective feeling of fatigue and concentration subscales (p<0.05) (Table 4).

There was a statistically significant and negative correlation between the scores of the overall health subscale of the SF-36 and the scores of the CIS-T, subjective feeling of fatigue and activity subscale (p<0.05) (Table 4).

The age, BMI, muscle-grip strength, SF-36 and BDI scores of the patients were found to be significant (p<0.05) and 75% of the total variance was found (Table 4).

Table 4. The relationship between age and demographic measurements of patients and CIS

		CIS				
		Subjective Feeling of Fatigue	**Concentration**	**Motivation**	**Activity**	**CIS Total**
Age	r	0.09	0.02	0.30	0.24	0.25
	p	0.52	0.88	**0.03***	0.09	0.08
Height (m)	r	-0.08	0.04	0.03	0.05	-0.02
	p	0.59	0.79	0.83	0.72	0.91
Weight (kg)	r	-0.07	0.08	0.03	-0.02	-0.06
	p	0.64	0.58	0.83	0.90	0.69
BMI (kg/m²)	r	0.03	0.00	0.01	-0.03	-0.05
	p	0.86	0.98	0.92	0.82	0.71
6 MWT	r	-0.55	-0.21	-0.25	-0.51	-0.56
	p	**0.00***	0.14	0.08	**0.00***	**0.00***
Quadriceps – right	r	-0.11	-0.12	-0.20	-0.14	-0.15
	p	0.46	0.42	0.17	0.34	0.30
Quadriceps – left	r	-0.21	-0.13	-0.24	-0.30	-0.27
	p	0.15	0.37	0.10	**0.04***	0.06
Hand grip strength – right	r	-0.38	-0.10	-0.18	-0.21	-0.29
	p	**0.01***	0.49	0.21	0.14	**0.04***
Hand grip strength – left	r	-0.43	-0.13	-0.21	-0.29	-0.37
	p	**0.00***	0.36	0.15	**0.04***	**0.01***
SF-36/PF	r	-0.67	-0.16	-0.45	-0.45	-0.57
	p	**0.00***	0.26	**0.00***	**0.00***	**0.00***
SF-36/PR	r	-0.52	-0.15	-0.23	-0.21	-0.37
	p	**0.00***	0.28	0.11	0.15	0.01*
SF -36/ER	r	-0.44	-0.21	-0.10	-0.19	-0.34
	p	**0.00***	0.14	0.50	0.20	0.02*
SF -36/Vitality	r	-0.73	-0.18	-0.38	-0.51	-0.64
	p	**0.00***	0.21	**0.01***	**0.00***	**0.00***
SF -36/MH	r	-0.45	-0.39	-0.12	-0.37	-0.43
	p	**0.00***	**0.01***	0.39	**0.01***	**0.00***
SF -36/SF	r	-0.43	-0.42	-0.14	-0.17	-0.35
	p	**0.00***	**0.00***	0.34	0.24	**0.01***
SF -36/Pain	r	-0.52	-0.30	-0.12	-0.25	-0.38
	p	**0.00***	**0.03***	0.40	0.08	**0.01***
SF-36/GH	r	-0.66	-0.22	-0.21	-0.46	-0.58
	p	**0.00***	0.13	0.14	**0.00***	**0.00***
BDI	r	0.61	0.44	0.36	0.41	0.59
	p	**0.00***	**0.00***	**0.01***	**0.00***	**0.00***

*p<0.05

CIS: check list individual strength; **BMI:** body mass index; **6 MWT:** 6 minutes walking test; **SF-36:** short form 36; **PF:** physical function, PR: physical role; **ER:** emotional role; **MH:** mental health; **SF:** social function; **GH:** general health; **BDI:** beck depression inventory.

Table 5. Regression analysis of the results of age, BMI, muscle strength, SF-36 and BDI scores

	Not Standardized Coefficients		**Standardized Coefficients**	**t**	**p**
	B	**Std. Hata**	**Beta**		
Constant	132.95	51.12		2.60	0.01*
Age	0.89	0.39	0.30	2.26	0.03*
BMI	0.36	0.50	0.09	0.71	0.48
Quadriceps – right	2.25	6.70	0.42	0.34	0.74
Quadriceps – left	-2.33	6.67	-0.44	-0.35	0.73
Hand grip strength – right	-0.11	0.41	-0.05	-0.27	0.79
Hand grip strength – left	0.15	0.50	0.06	0.31	0.76
SF-36/PF	-0.65	0.30	-0.35	-2.18	0.04*
SF -36/PR	0.08	0.13	0.10	0.61	0.55
SF -36/ER	0.14	0.14	0.17	0.98	0.33
SF -36/Vitality	0.03	0.27	0.03	0.13	0.90
SF -36/MH	-0.69	0.27	-0.58	-2.58	0.01*
SF -36/SF	-0.32	0.20	-0.25	-1.60	0.12
SF -36/Pain	-0.03	0.19	-0.03	-0.17	0.87
SF -36/GH	-0.35	0.34	-0.27	-1.03	0.31
BDI	-0.48	0.68	-0.17	-0.71	0.48

*p<0.05

CIS: check list individual strength; **BMI:** body mass index; **SF-36:** short form 36; **PF:** physical function; **PR:** physical role; **ER:** emotional role; **MS:** mental health; **SF:** social function; **GH:** general health; **BDI:** Beck depression inventory.

As a result of linear regression analysis, CIS-T score estimation model; *Yi=132.95 + 0.89 x age - 0.65 x physical function - 0.69 x mental health + ei* (Table 5).

DISCUSSIONS

The aim of this study is to determine chronic fatigue levels in patients undergoing CABG and to define the relationship between chronic fatigue levels, muscle strength, functional exercise capacity, quality of life and depression. Findings in our study showed us that, increased fatigue severity is associated with the increase in depression and decrease in handgrip strength, walking distance of 6MWT and quality of life. Age, physical function and mental health were found to be among the determinants of fatigue level.

Fatigue is a concept that has many meanings conceptually and can manifest itself with physical, neuromuscular, emotional, mental or cognitive symptoms (18). According to the literature, the fatigue level of the patients pre-operative, post-operative and after 3 months of the CABG was assessed (5.9). In a study of 236 patients who had undergone CABG at the age of 65 years and older, they evaluated the symptoms occurring in the postoperative period. According to this study 3 weeks after the surgery, fatigue was noted in 53.8% of patients, and this was 30.3% after 6 weeks. (19). Acute fatigue can be seen in the postoperative period, because of the physiological effects of the medications, resting and surgical reasons. Moreover, this fatigue can decrease after the effects of surgery has passed. We did not find any data that we investigated after 6 months postoperatively. In our study, fatigue was found in all patients undergoing CABG. It was determined that the level of pro-inflammatory cytokine increased with age and the high level increased fatigue level and caused sluggishness.

It was determined that the level of pro-inflammatory cytokine increases with age. Increased level of cytokine can increase fatigue level and caused sluggishness. At the same time, the increase of inflammatory markers in the body raises the risk of cardiovascular disease (20). Also, research in the literature showed that comorbidities were associated with age and fatigue (21,22). In our study, it was determined that the one unit increase in the age of the patients caused an increase of 0.81 in the CIS-T score. In patients undergoing CABG, studies are needed to compare the fatigue level between different age groups and develop strategies to reduce the effects of age.

The decrease in physical, social and mental functions of individuals causes a decrease in the quality of life (23). Recent studies have shown that CABG in the postoperative period shows that all parameters of quality of life, especially the sub-dimension of social function, have increased compared to the preoperative period (24, 25). In a study, researchers evaluated the relationship between fatigue and physical activity and psychological functions after CABG. Within 6 weeks postoperatively, the fatigue level of the patients was associated with ER, SF, MH parameters and depression, whereas there was no significant relationship between physical activity variables (9). Treat-Jacobson et al. (2007) evaluated the exercise capacity, quality of life and symptoms in the follow-up period up to 5–6 years after CABG. Patients with long-term chest pain disappeared after CABG, a significant proportion of them had dyspnea and felt tired, which was associated with lower quality of life. However, they stated that they thought that quality of life would be much higher in time (23). Parallel to the literature, it was determined that the quality of life was high and the decrease in physical function and mental health caused an increase in fatigue level.

Fatigue is a common symptom of mood disorders. It is a key symptom for diagnosing major depression. Many patients with chronic fatigue syndrome have depression problem. Furthermore symptoms of fatigue are seen in two-thirds of patients who has depression (18). In a meta-analysis study, it is reported that depression was associated with the development of cardiovascular diseases and increased the risk of heart attack and coronary heart disease (25). In another study, 55% of the patients stated that their fatigue continued until 3 weeks of recovery after CABG, and this state of fatigue increased the levels of depression (9).

In our study, it was observed that the depression levels of the patients were low. Although depression levels were low, depression and fatigue levels were found to be correlated. Our study shows the later assessment of the patients with CABG. Considering that the decrease in symptoms and exercise capacity during the healing process may have positive effects on depression. We believe that more detailed studies that provide further information about depression.

Muscle strength is an important indicator of physical form and health status. A decrease in muscle strength can lead to significant functional limitations (26). Skeletal muscle strength may be a determinant factor in chronic heart failure and different patients. In our study, there was no statistically significant relationship between fatigue and quadriceps muscle strength.

It is known that there is a relationship between muscle strength, age and gender (27, 28). Furthermore, different methodological studies are needed especially to understand age and gender. Grip force can be considered as a valid measure to generalize muscle strength in adults. The reason is that the grip force is associated with the arm, back and leg strength (26). In our study, it was determined that there was a relationship between grip strength and fatigue and quality of life. As the fatigue increases, the grip strength decreases and the physical strength, vitality and general health values increase.

After heart surgery, patients often experience physical health deterioration due to physiological reasons after surgery (16). Many patients experience a reduction in physical activity capacity or a marked reduction in 6 MWT occupations after heart surgery (16). In a study of cancer patients, they evaluated the relationship between functional capacity, performance, fatigue, quality of life, anxiety and depression and reported that fatigue levels decreased as the distance traveled by 6 MWTs increased (29). In the study of 173 patients with heart failure, it was found that depression, fatigue and pain contributed to functional performance and decreased functional performance (3). They defined functional performance

as the ability to perform daily activities, that is, to perform activities of daily living. They found that functional capacity as measured by 6MWT was not associated with fatigue and depression, and that age, gender, and comorbidity were related to functional measurement (3). In our study, it was determined that walking distance decreases with increasing fatigue levels. This result shows us that we have obtained data parallel to the literature.

The limitations of the study were that we did not know the patients' preoperative and postoperative early quality of life, depression, 6 MWT and fatigue level results. In addition, there is no standardization in the treatments they receive during postoperative period and male gender is predominant. Considering that age is an important factor, studies are needed to compare the fatigue level between different age groups in patients undergoing CABG and to develop strategies to reduce the effects of age.

In conclusion, late period fatigue was observed in patients undergoing CABG, and the most important factors affecting this are age, physical function and mental health. The patients should be evaluated in detail after CABG and the fatigue levels should be determined thoroughly.

Informed Consent: The patients

Compliance with Ethical Standards: This study was approved by Ethics Committee of European University of Lefke (Decision No. 03/02/04/1617/2)

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - GE, BO; Design - GE, BO; Supervision - GE, BO; Fundings - GE, BO; Materials - GE, BO; Data Collection and/or Processing - BO; Analysis and/or Interpretation - GE, BO; Literature Search - GE, BO; Writing Manuscript - GE, BO; Critical Review - GE

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Presented In congress: Was presented as a paper at the 1st National Cardiopulmonary Rehabilitation Congress.

REFERENCES

1. Kumar DR, Roy HN. Short Term Outcome in Male and Female Indian Patients Undergoing Cabg at Activity Levels and Quality of Life: Two Years Follow-Up Study. Int J Sci Res 2019;8:56–59. [CrossRef]
2. Paparella D. Cardiopulmonary bypass induced inflammation: pathophysiology and treatment. An update. Eur J Cardiothorac Surg 2002;21:232–244. [CrossRef]
3. Conley S, Feder S, Redeker NS. The relationship between pain, fatigue, depression and functional performance in stable heart failure. Hear Lung 2015;44:107–112. [CrossRef]
4. Rubin GJ, Hotopf M, Papadopoulos A, Cleare A. Salivary Cortisol as a Predictor of Postoperative Fatigue. Psychosom Med 2005;67:441–447. [CrossRef]
5. Gholami M, Najafizadeh H, Teimouri H, Ardalan A, Pooria A, Tarrahi MJ. The combined effect of vitamin C and omega-3 polyunsaturated fatty acids on fatigue following coronary artery bypass graft surgery: a triple-blind clinical trial. J Complement Integr Med 2019;21;16. [CrossRef]
6. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg 2002;183:630–641. [CrossRef]
7. Yamamoto T, Castell LM, Botella J, et al. Changes in the Albumin Binding of Tryptophan During Postoperative Recovery: A Possible Link With Central Fatigue? Brain Res Bull 1997;43:43–46. [CrossRef]
8. Friedman MM, King KB. Correlates of fatigue in older women with heart failure. Hear Lung 1995;24:512–518. [CrossRef]
9. Barnason S, Zimmerman L, Nieveen J, et al. Relationships between fatigue and early postoperative recovery outcomes over time in elderly patients undergoing coronary artery bypass graft surgery. Heart Lung 2008;37:245–256. [CrossRef]
10. Hall GM, Salmon P. Physiological and Psychological Influences on Postoperative Fatigue. Anesth Analg 2002;95:1446–1450. [CrossRef]
11. Ergin G, Yildirim Y. A validity and reliability study of the Turkish Checklist Individual Strength (CIS) questionnaire in musculoskeletal physical therapy patients. Physiother Theory Pract 2012;10;28:624–632. [CrossRef]
12. Kocyigit H, Aydemir O, Fisek G, Olmez N, Memis A. Validity and reliability of Turkish version of Short form 36: A study of a patients with romatoid disorder. J Drug Ther 1999;12:102–106.
13. Ulusoy M, Sahin NH, Erkmen H. Turkish version of the Beck Anxiety Inventory: Psychometric properties. J Cogn Psychother An Int Q 1998;12:163–172.
14. Thorborg K, Petersen J, Magnusson SP, Hölmich P. Clinical assessment of hip strength using a hand-held dynamometer is reliable. Scand J Med Sci Sports 2010;20:493–501. [CrossRef]
15. Mathiowetz V. Comparison of Rolyan and Jamar dynamometers for measuring grip strength. Occup Ther Int 2002;9:201–209. [CrossRef]
16. Wang L-W, Ou S-H, Tsai C-S, Chang Y-C, Kao C-W. Multimedia Exercise Training Program Improves Distance Walked, Heart Rate Recovery, and Self-efficacy in Cardiac Surgery Patients. J Cardiovasc Nurs 2016;31:343–349. [CrossRef]
17. Hopkins WG. Measures of reliability in sports medicine and science. Sports Med 2000;30:1–15. [CrossRef]
18. Lim W, Hong S, Nelesen R, Dimsdale JE. The Association of Obesity, Cytokine Levels, and Depressive Symptoms with Diverse Measures of Fatigue in Healthy Subjects. Arch Intern Med 2005;165:910. [CrossRef]
19. Schulz PS, Zimmerman L, Pozehl B, Barnason S, Nieveen J. Symptom management strategies used by elderly patients after coronary artery bypass surgery. Appl Nurs Res 2011;24:65–73. [CrossRef]
20. Crane PB, Efird JT, Abel WM. Fatigue in Older Adults Postmyocardial Infarction. Front Public Heal 2016;4:55. [CrossRef]
21. Belza BL, Henke CJ, Yelin EH, Epstein WV, Gilliss CL. Correlates of fatigue in older adults with rheumatoid arthritis. Nurs Res 1993;42:93–99. [CrossRef]
22. Koopmans GT, Lamers LM. Chronic conditions, psychological distress and the use of psychoactive medications. J Psychosom Res 2000;48:115–123. [CrossRef]
23. Treat-Jacobson DJ, Lindquist R. Exercise, quality of life, and symptoms in men and women five to six years after coronary artery bypass graft surgery. Heart Lung 2007;36:387–397. [CrossRef]
24. Cleary K, LaPier T, Rippee A. Perceptions of exercise and quality of life in older patients in the United States during the first year following coronary artery bypass surgery. Physiother Theory Pract 2015;4;31:337–346. [CrossRef]
25. Hawkes AL, Nowak M, Bidstrup B, Speare R. Outcomes of coronary artery bypass graft surgery. Vasc Health Risk Manag 2006;2:477–484. [CrossRef]
26. Wind AE, Takken T, Helders PJ, Engelbert RH. Is grip strength a predictor for total muscle strength in healthy children, adolescents, and young adults? Eur J Pediatr 2010;169:281–287. [CrossRef]
27. Bell KE, Snijders T, Zulyniak M, et al. A whey protein-based multi-ingredient nutritional supplement stimulates gains in lean body mass and strength in healthy older men: A randomized controlled trial. PLoS One 2017;12:e0181387. [CrossRef]
28. Stoever K, Heber A, Eichberg S, Brixius K. Sarcopenia and Predictors of Skeletal Muscle Mass in Elderly Men with and without Obesity. Gerontol Geriatr Med 2017;3:2333721417713637. [CrossRef]
29. Tomruk M, Karadibak D, Yavuzşen T, Akman T. Predictors of functional capacity in colorectal cancer patients. Support Care Cancer 2015;23:2747–2754. [CrossRef]