JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN (E-ISSN 2313-1519)
Original Article DOI: https://doi.org/10.23950/jcmk/14971

Correlation between Functionality and Quality of Life in Patients after Cardiac Surgery

İsmail Ceylan[1], Husham Abdulateef Salman Al-Jaddah[2], Raed Qadri Khudhair Al-Janabi[2]

[1]Department of Hand Rehabilitation, School of Physical Therapy and Rehabilitation, Kirsehir Ahi Evran University, Kirsehir, Turkey
[2]Department of Physiotherapy and Rehabilitation, Al-Bitar Cardiac Surgery Hospital, Baghdad, Iraq

Received: 2024-04-08.
Accepted: 2024-06-19.

J Clin Med Kaz 2024; 21(4): 26-32

Corresponding author:
İsmail Ceylan.
E-mail: fztceylan@gmail.com.
ORCID: 0000-0002-6465-0243

Abstract

Aim: Current research seeks to explore the correlation between early mobilisation in physical exercise and the functionality and life quality of patients post cardiac surgery.

Methods: A cohort of 100 patients, aged between 18 and 65, comprising 52 men and 48 women, participated in a program of early physical performance commencing from the first day through the seventh day post - heart surgery. Outcome measures included the 6 Minute-Walk Test (6MWT), the Short Form-International Physical Activity Questionaire (SF-IPAQ), and the Short Form-36 (SF-36). Each assessment was administered on the seventh day following cardiac surgery.

Results: Statistical analysis revealed a significant interrelation ($p<0.001$) with SFIPAQ SF-IPAQ scores and both the 6MWT and SF-36 scores. SF-IPAQ scores were inversely related to pain levels, they exhibited positive associations with energy-fatigue, social function, general health and functionality.

Conclusion: Our findings indicate that post - cardiac surgery patients exhibited improved degrees of physical performance, improved life quality, and enhanced functional ability.

Keywords: cardiac surgery, physical activity, life quality, correlation.

Introduction

Cardio-vascular diseases (CVD) comprise some conditions impacting the heart and vascular structures, containing coronary heart illness, cerebrovascular disorders, and congenital heart pathologies. Cardiovascular diseases account for roughly one-third of global mortality. Globally, CVD stands as the foremost cause of mortality and disability, with indications suggesting its enduring significance in the future [1].

Various issues, including endocarditis, rheumatic heart disease, and circulatory abnormalities, have the potential to impact the cardiovascular system [2]. Behavioral risk components related with cardiovascular disorder consist of, inactivity, smoking, intensive alcohol waste, diabetes, hypertension, elevated blood lipid levels, socioeconomic disadvantage, psychological stress, and genetic predisposition [3]. The primary treatment modalities for cardiovascular disease encompass pharmaceutical interventions, exercise regimens, dietary modifications, and surgical interventions [4].

Functional performance assessment, such as static balance tests or dynamic stability systems, is increasingly recognized as a valuable measure of outcomes in clinical research [5, 6]. It is commonly utilized for diagnosis, prognosis identification, comparison of patient responses to treatment, as well as for verifying and monitoring the guidance capacity performance, and development of therapies by therapists, and prevention of physical disabilities. Physical activity, recognized as a cornerstone health behavior, plays a primer role in the well-being of individuals with heart disease. Consistent and sufficient engagement in regular excercise enhances life quality and mitigates the likelihood of subsequent cardiovascular complications [7]. Diverse articles related postoperative physical activities have indicated that cases who engaged in cardiac rehabilitation or exercised under the guidance of a therapist post-cardiac surgery exhibited enhanced

cardiovascular capacity, reduced duration of hospitalization, and abbreviated overall length of stay [8]. Current studies reported that timely mobilization of patients post-operation should be regarded as a therapeutic approach within these patient cohorts [9, 10]. Nonetheless, contradictory outcomes from recent meta-analyses have revealed that among individuals undergoing cardiac surgery, early mobilization led to enhanced exercise tolerance [11]. However, in accordance with research conducted by Chen and colleagues, this intervention exhibited no impact on either the overall length of hospitalization or the duration in the intensive care service. [12]. This points the ongoing pertinence of studies in this research area [13, 14].

Nevertheless, despite the significance of early physical activity during the initial week following cardiac surgery, limited research has delved into the functional results and life quality, as well as the associated determinants, among patients during this crucial transitional phase [8, 11, 15]. Hence, the objective of current research was to evaluate the functional potential and life quality with cases that underwent cardiac surgery, while identifying factors associated with variations in functionality. Also current study aimed to evaluate evidence based exercise and early mobilization effectiveness on post cardiac surgeries physiological and psychological outcomes.

Material and methods

This prospective study contained patients who had undergone cardiac surgery. A total of 100 cases (52 male, 48 female) were recruited for the investigation. This research was conducted at Al-Bitar Cardiac Surgery Hospital, Baghdad, Iraq. This study approved by the regional ethics commission (897/2023/12/12), and all procedures were managed in according the standards delineated in the Declaration of Helsinki. Inclusion criteria were (1) undergone coronary artery bypass grafting, (2) successfully completed a six minute walk test, (3) aged 18 to 65. Patients were excluded if they had (1) an old cerebrovascular accidents, as others who had mental problems, (2) aged under 18 or over 65, (3) couldn't fill out surveys or do the six-minute walk test.

Interventions

During postoperative days 1 to 2, patients received shoulder-neck mobilization alongside breathing exercises and postural drainage. Subsequently, from postoperative days 3 to 7, the regimen comprised breathing exercises, postural drainage, and supervised walking sessions. The walking sessions involved gradual increments of 2.5 minutes, based on individual tolerance, up to ten minutes (three times per day).

Outcome measurements

All patients who participated in the surgical procedure on the 7th day underwent the administration of the following surveys, assessments, and examinations. The SF-IPAQ was employed to assess the grade of physical performance. The SF-36 questionnaire was utilized to evaluate life quality. Additionally, the 6MWT was conducted to gauge functional capacity.

36-Item Short Form

The SF-36 questionnaire comprises 36 questions derived from 21 components. Each item is allocated a score, that is subsequently ranging from 0 to 100 [16].

Short Form International Physical Activity Questionnaire

SF-IPAQ required participants to report the clinical characteristics of active moderate, and walking functions they engaged in the seven days past. They were put in place to give every activity an indicated metabolic equivalent of task (MET). Participants were categorized into high, moderate, and low physical activity stages based on their SF-IPAQ scores [17].

Six-Minute Walking Test

This test is a universally used, safe, and accepted assessment that may be used to evaluate participants' functional capacity in a range of the medical contexts. For the 6MWT, techniques that are endorsed by the American Thoracic Society were implemented. For this objective, a 30-meter-wide, obstruction-free channel was employed. The evaluation consists of instructing participants to cover a maximum distance of 6 minutes on foot. The greatest distance walked demonstrates a person's ability to move [18].

Sample size assessment

The sample size was determined by a Statistical Software (MediCalc,Belgium). The minimal requisited sample size was determined as 91 cases, guided by a power of 80% and the sample size was subsequently rised to 100 to account for any potential drop outs [19].

Statistical Analysis

Statistical analysis was carried out by SPSS-26 (IBM Co. USA). Numeric data were stated as a mean and standard deviation and analysed with two time points handling the Paired t-test. Pearson's correlation factor was computed to determine the impact of correlation. Linear regression test was employed to evaluate various independent items related with SF-IPAQ scores. A p-value of less than 0.05 was considered statistically significant.

Results

In this research, 100 cases withstanding cardiac surgery were enrolled, with 54%, 38% and 9% of them undergoing Coronary Artery By-pass Graft (CABG), valve replacement, and Atrial Septal Defect (ASD) surgeries, respectively. Male patients slightly outnumbered females, comprising 52% of the sample. The age range was 18 to 67, with a median of 53.15 ± 12.29 years, and the BMI varied from 16 to 46.40 kg/m^2, with a median of 26.81 ± 5.59 kg/m^2 (Table 1).

Table 1 Base level characteristics of the cases

Variables		N	%
Sex	Males	52	52
	Females	48	48
Age (years)	Mean ± SD	53.15 ± 12.29	
BMI (kg/m^2)	Mean ± SD	26.82 ± 5.58	
Marital status	Single	8	8
	Married	92	92
Education	Primary	62	62
	Secondary	8	8
	College	30	30
Smoking status		28	28
Drinking status		9	9
HTN level		58	58
DM level		41	41
Hyperlipıdemia		59	59
Other dıseases		19	19
Type of cardiac surgery	ASD	9	9
	Valve replacement	38	38
	CABG	54	54
Stay time in ICU	Mean ± SD	2.04 ± 0.2	
Surgical history		54	54

BMI: Body mass index, HTN: Hypertensıon, DM: Diabetes mellitus, ASD: Atrıal septal defect, N: Number of patients, ICU: Intensive Care Unit (days), SD: Standard deviation.

There was a significant correlation found with SF-IPAQ scores and walking days per week (r=0.405, p<0.001) and walking duration (r=0.969, p<0.001). In addition, SF-IPAQ score was statistically significant reverse interrelated with age (r=-0.336, p=0.001) and Body mass index (r=-0.248, p=0.013), (Table 2).

There existed a statistically significant positive correlation found with SF-IPAQ scores and both the number of walking days per week (r=0.405, p<0.001) and the duration of walking in minutes (r=0.969, p<0.001). Conversely, SF-IPAQ scores exhibited a significant negative correlation with both age (r=-0.336, p=0.001) and BMI (r=-0.248, p=0.013), (Table 2).

Table 2 Correlation with SFIPAQ and characteristics of the cases

Variables	SF-IPAQ	
	r	P value
Age(years)	-0.336	0.001
BMI(kg/m^2)	-0.248	0.013
Stay duration in ICU (days)	0.014	0.888
Walking (days)	0.405	<0.001
Walking time (min)	0.969	<0.001

r: Pearson's coefficient, Statistical significance at P vale<0.005

In the 6MWT, the SF-IPAQ score demonstrated a significant positive correlation with peripheral oxygen saturation (SpO2), (r=0.247, p=0.013) and a negative correlation with mean arterial pressure, (r=-0.236, p=0.018). Additionally, a meaningful relationship was observed between the SF-IPAQ scores and the distance covered during the Six-minute walk (r=0.839, p<0.001), (Table 3).

Table 3 Correlation with SF-IPAQ and 6MWT scores

Variables	SF-IPAQ	
	r	p
Before 6 MWT		
SpO2 (%)	0.247	0.013
PR(bpm)	0.082	0.42
MAP (mmHg)	-0.236	0.018
After6MWT		
SpO2 (%)	0.167	0.097
PR (bpm)	0.007	0.946
MAP (mmHg)	-0.161	0.109
Distance Walked in 6 min (m)	0.839	<0.001

r: Pearson's correlation coefficient, Statistical significance at p value<0.05

According to regression analysis, Six-minute walk exhibited a significant association with the SF-IPAQ score (p<0.001), increasing 2.1 (95%CI: 1.82 to 2.37) with every 1 unit rise in the SF-IPAQ score. Similarly, in multiple regression analysis, Six-minute walk demonstrated a significant association with the SF-IPAQ score, increasing with 2.12 (95% CI: 1.83 - 2.4) per one unit rise in the SF-IPAQ score (Table 4).

As indicated in Table 5, a significant correlation existed with the SF-IPAQ and all SF-36 scores. Specifically, positive interrelations were observed with functionality (r=0.804, p<0.001), energy-fatigue (r=0.771, p<0.001), emotional wellbeing (r=0.648, p<0.001), social function (r=0.49, p<0.001), general health (r=0.658, p<0.001), and health change (r=0.781, p<0.001), while a negative correlation was found with the pain scores (r=-0.799, p<0.01).

Table 4 Lineer regression analysis of SF-IPAQ and 6-MWT scores

Variables	Univariate			Multivariable		
	Factor	95%CI	p value	Factor	95%CI	p value
After 6 MWT						
SpO2 (%)	13.04	-2.42 to 28.51	0.097	1.76	-7.28 to 10.79	0.7
PR (bpm)	0.09	-2.46 to 2.64	0.946	-0.52	-1.98 to 0.94	0.484
MAP (mmHg)	-2.37	-5.28 to 0.54	0.109	0.65	-1.11 to 2.41	0.466
Distance walked in six minute (m)	2.1	1.82 to 2.37	< 0.001	2.12	1.83 to 2.4	<0.001

CI: Confidence Interval, Statistical significance at P value<0.005

Table 5 Correlation with SF-IPAQ versus subscales of SF-36

Variables	SF-IPAQ	
	r	p
Physical functioning (%)	0.804	<0.001
Energy-fatigue score (%)	0.771	<0.001
Emotional wellbeing score (%)	0.648	<0.001
Social functioning (%)	0.49	<0.001
Pain score (%)	-0.799	<0.001
General health score (%)	0.658	<0.001
Health change score (%)	0.781	<0.001

r: Pearson correlation coefficient, Statistical significance at p value<0.005.

Our univariate regression analysis unveiled significant associations between all categories of SF-36 and the SF-IPAQ as follows: Each one unit rise in functionality, energy-fatigue, emotional wellbeing, social function, health status, and health change scores led to corresponding increases in the SF-IPAQ score, 1383.76 (95%CI: 1178.2 -1589.32), 817.63 (95%CI: 682.69 -952.56), 892.2 (95%CI: 681.56 -1102.85), 503.35 (95%CI: 324.54-682.15), 995.79 (95%CI: 767.02-1224.56) and 1036.25 (95%CI: 870.95 - 1201.55) by p<0.001. In contrast, for each one unit rise in pain, there was a corresponding decrease in the SF-IPAQ scores by -610.13 (95%Confidence Interval:-702.56 to-517.7) with p < 0.001.

According to regression tests, social function, pain and health scores emerged as the unique variables meaningfully related with the SF-IPAQ. Specifically, for every one unit rise in social function and health change score, the SF-IPAQ scores exhibited an increase of 157.62 (95%CI: 42.58- 272.67) and 266.45 (95%CI: 51.08-481.82) respectively, with p values of 0.008 and 0.016. As contrary, each one unit rise in pain scores led to a decrease in the SF-IPAQ scores with 269.43 (95%CI:-384.9 to -153.97), (p<0.001), (Table 6).

Discussion

In this research, we investigated the correlation between functionality, life quality, and physical activity levels among cases who underwent heart surgery, using the SF-IPAQ as a measure. Our findings revealed a significant, positive correlation with functional ability and physical performance, besides physical performance and life quality. Moreover, our results point that increased physical activity is related with improved functional

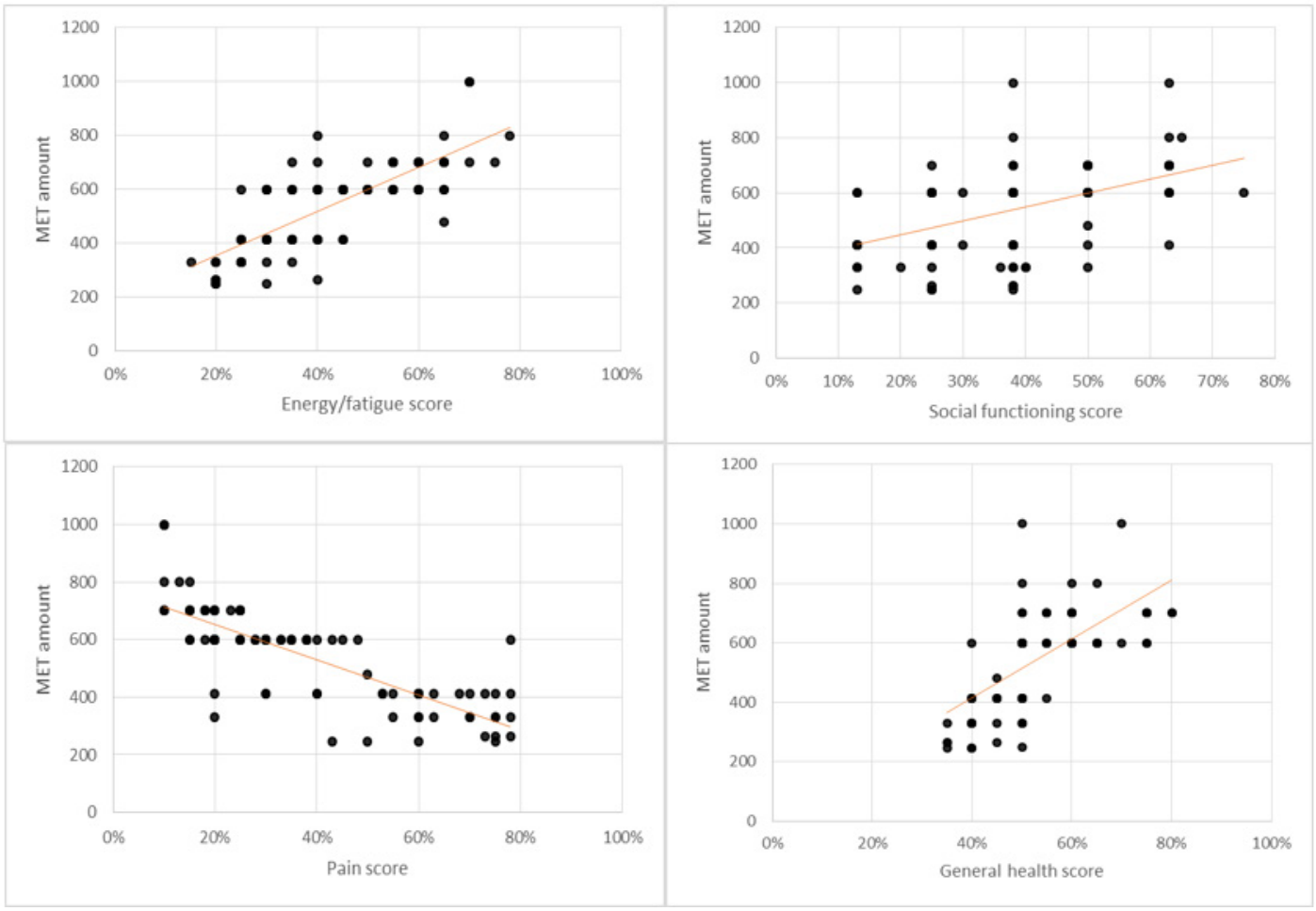

Figure 1 – Indicating the interrelation between energy/fatigue, socıal functionıng, pain, general health and M.E.T measure

Table 6 Linear regressıon analysıs of the relation of SF-IPAQ versus subscales of SF-36

Parameter	Univarıate			Multıvariable		
	Factor	95%Cı	p	Factor	95%Cı	p
Physical function (%)	1383.76	1178.2 to 1589.32	< 0.001	329.22	-15.65 to 674.08	0.061
Energy-fatıgue (%)	817.63	682.69 to 952.56	< 0.001	168.84	-24.7 to 362.38	0.087
Emotional well-beıng (%)	892.2	681.56 to 1102.85	< 0.001	111.35	-81.59 to 304.29	0.255
Socıal functioning scores (%)	503.35	324.54 to 682.15	< 0.001	157.62	42.58 to 272.67	0.008
Paın scores (%)	-610.13	-702.56 to -517.7	< 0.001	-269.43	-384.9 to -153.97	< 0.001
General health status (%)	995.79	767.02 to 1224.56	< 0.001	-100.97	-329.12 to 127.18	0.382
Health change scores (%)	1036.25	870.95 –to 1201.55	< 0.001	266.45	51.08 to 481.82	0.016

CI: Confidence Intrval, Statistical significance at p value<0.05

ability and quality of life. Specifically, among the participants, comprising 37% with low physical activity levels and 63% with moderate levels, heightened physical activity was linked to enhanced functional capacity and life quality. Our research's conclusions suggest that while SF-IPAQ scores were inversely related to pain levels, they exhibited positive associations with energy-fatigue, social function, health, functionality and cognitive well being.

Functional capacity serves as a critical tool in clinical assessments, prognostic classification, and exercise prescription within the realm of cardiovascular diseases. Diminished exercise capacity stands out as a significant precursor in determining mortality. A recent study identified a robust and significant correlation between the resumption of physical activity within thirty days post-heart surgery and the subsequent quality of life [20]. This correlation was reported significantly interrelated with the life quality. While this study assessed the scores of the SF-36 and SF-IPAQ on the 7th day post-operation, they evaluated life quality using the life quality in cardio-vascular surgery test thirty days after surgical procedures. A randomized clinical trial conducted on post-surgery coronary artery patients reported a notable disparity in the average points of all life quality components before and after physical performance intervention in the experimental group [21]. Nevertheless, no difference was reported in the average scores of the 7 life quality components in the control group, both first and 4 months after discharge from surgical procedures. Our study's findings aligned with theirs concerning the test of physical activity and life quality on the 7th day post-surgery within a single group. However, their study evaluated physical activity level and life quality in two groups during the 1st and 4th months post-discharge from surgical procedures.

In a review study, it was reported that increased physical activity during spare time was related with higher scores across health-related quality of life dimensions [22]. These dimensions encompassed physical functioning, mental health, and vitality for both genders, while social functioning was specifically linked to women. Each dimension was assessed independently. Notably, the vitality component exhibited an increase of 0.17 and 0.39 points in men and women, respectively, with every additional hour per week spent in leisure-time physical activity. For the period that their research examined spare time, physical performance and life quality over a 3 years duration following heart surgery, our study identified a strong association with increased physical activity and improved life quality within the initial week post-cardiac surgery. This correlation, albeit modest, aligns with our findings indicating that heightened physical activity is linked to enhanced quality of life. However, a randomized controlled trial stated no meaningful differences in life quality between intervention groups at the day of hospital discharge [23]. These findings contrast with our findings regarding the SF-36 subscale scores, that indicated an increase in SF-36 subscales related with higher SF-IPAQ scores among cases that undergone cardiac surgery. This discrepancy can be attributed to the differences in the therapeutic interventions employed in the two studies. In another study, following cardiac surgery, cases underwent early mobilization facilitated by therapists. These sessions included instruction in breathing-coughing and walking exercises aimed at ensuring optimum oxygenation, secretion clearance, avoidance of respiratory tractus infections, and enhancement of endurance and functionality. However, the outcomes of this research revealed poor life quality results one month after hospital discharge [24]. In contrast, our study found that patients who underwent early rehabilitation achieved satisfactory results in terms of life quality.

Generally, the initiation of cardiac rehabilitation and prevention therapies is delayed to at least four to six weeks following hospital discharge [25]. However, literature indicates that individuals that undergone non-complicated myocardial infarctıon may derive benefits from early commencement of aerobic exercise performing, instantly one week post-discharge, to maximize anti-restructuring advantages. Moreover, it is advised that such patients persist with aerobic training tutoring for over to 6 month [26]. The 6MWT serves as a straightforward approach for evaluating cardio-pulmonary function. The outcome of metaregression analysis failed to demonstrate any notable correlation between alterations in 6MWT and either the onset time or duration. [27]. Hirschhorn et al. demonstrated that both the walking, walking-breathing exercise groups exhibited significantly longer 6MWT distances compared to the usual experimental group upon discharge from the hospital. Furthermore, during the inpatient period following coronary artery bypass grafting, a monitored moderate-intensity walking program overseen by a physiotherapist may augment functional capacity upon hospital departure [28]. This aligns closely with our own findings. In a quasi-experimental study, early implementation of physical activities including pulmoner exercises, incentive spırometer usage, coughing exercises and early mobilisation exercises resulted in meaningful improvements in hemo-dynamic factors and 6-MWT distance among post-heart surgery patients [29]. This finding corroborates our study's results, indicating a positive association between enhanced functional capacity and increased physical activity levels. Notably, our study observed this correlation within one group, assessing functional capacity and physical activity on the seventh day post-surgery, whereas their investigation examined these variables across two groups after the 12th week post-discharge. A potential limitation of our study lies in its focus solely on data from the initial 7 days post cardiac surgery. Expanding the follow-up duration in future research endeavors within this domain would bolster the robustness of our conclusions.

The principal limitations of this research stem from its single-center design and restriction to a single geographic location. Additionally, the exclusion of patients undergoing palliative revascularization may have constrained the breadth of our findings, precluding a comparison of quality of life outcomes between those receiving optimal revascularization and those undergoing palliative procedures. While acknowledging these constraints, it's crucial to state that the findings of our research may not be universally applicable to all cases undergoing CABG surgery in Iraq. Nonetheless, they serve as a foundation for informing the development of therapeutic strategies aimed at enhancing the quality of life for this patient population. Furthermore, within our study, we assessed functional capacity using the 6MWT, a submaximal evaluation method. Incorporating peak oxygen consumption, recognized as the gold standard for assessing exercise capacity, will enhance the objectivity of our presentation regarding changes in functional capacity.

Conclusion

Enhanced physical activity among post-operative cardiac patients is positively influenced by early mobilization and functional exercises. Following cardiac surgery, patients' functional capacity experiences positive effects from early mobilization and engagement in functional exercises. The significant benefits derived by patients who had cardiac surgery from early mobilization and functional exercises underscore the importance of actively encouraging their participation in these activities post-surgery. Early initiation of physical activity contributes to improved quality of life in post-surgical cardiac patients. Our findings suggest a direct correlation with increased physical activity and enhanced life quality alongside improved functionality. Also, this study observed the effectiveness of the early mobilization program on functional capacity, a crucial determinant of mortality among post-cardiac surgery patients.

Author Contributions: Conceptualization, İ.C. and H.A.S.A.; methodology, İ.C., H.A.S.A. and R.Q.K.A.; validation, İ.C. and H.A.S.A.; formal analysis, İ.C. and H.A.S.A.; investigation, İ.C. and H.A.S.A.; resources, İ.C. and H.A.S.A.; data curation, İ.C., H.A.S.A. and R.Q.K.A; writing – original draft preparation, İ.C. and H.A.S.A.; writing – review and editing, İ.C., H.A.S.A. and R.Q.K.A.; visualization, İ.C. and H.A.S.A.; supervision, İ.C. and H.A.S.A.; project administration, İ.C., H.A.S.A. and R.Q.K.A; funding acquisition, İ.C., H.A.S.A. and R.Q.K.A. All authors have read and agreed to the published version of the manuscript.

Disclosures: There is no conflict of interest for all authors.

Acknowledgments: Authors thank Dr. Merve Fırat for review support.

Funding: None.

References

1. Townsend N, Kazakiewicz D, Lucy Wright F, Timmis A, Huculeci R, Torbica A, et al. Epidemiology of cardiovascular disease in Europe. *Nature Reviews Cardiology.* 2022;19(2):133-143. https://doi.org/10.1038/s41569-021-00607-3
2. Arshad, A., & Atkinson, A. J. (2022). A 21st century view of the anatomy of the cardiac conduction system. *Translational Research in Anatomy,* 28. https://doi.org/10.1016/j.tria.2022.100204
3. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. *The Lancet.* 2020;395(10226):795-808. https://doi.org/10.1016/S0140-6736(19)32008-2
4. Coffey S, Roberts-Thomson R, Brown A, Carapetis J, Chen M, Enriquez-Sarano M, et al. Global epidemiology of valvular heart disease. *Nature Reviews Cardiology.* 2021;18(12):853-864. https://doi.org/10.1038/s41569-021-00570-z
5. Çalı A, Özden AV, Ceylan I. Effects of a single session of noninvasive auricular vagus nerve stimulation on sports performance in elite athletes: an open-label randomized controlled trial. *Expert Review of Medical Devices*. 2024;21(3):231-237. https://doi.org/10.1080/17434440.2023.2299300
6. Özüdoğru A, Canlı M, Kuzu Ş, Aslan M, Ceylan İ, Alkan H. Muscle strength, balance and upper extremity function are not predictors of cervical proprioception in healthy young subjects. *Somatosensory & Motor Research.* 2023;40(2):78-82. https://doi.org/10.1080/08990220.2023.2183832
7. Fletcher GF, Landolfo C, Niebauer J, Ozemek C, Arena R, Lavie CJ. Promoting physical activity and exercise: JACC health promotion series. *Journal of the American College of Cardiology.* 2018;72(14):1622-1639. https://doi.org/10.1016/j.jacc.2018.08.2141
8. Mungovan SF, Singh P, Gass GC, Smart NA, Hirschhorn AD. Effect of physical activity in the first five days after cardiac surgery. *Journal of rehabilitation medicine.* 2017;49(1):71-77. https://doi.org/10.2340/16501977-2165
9. Tanriverdi A, Savci S, Kahraman BO, Odaman H, Ozpelit E, Senturk B, et al. Effects of high intensity interval-based inspiratory muscle training in patients with heart failure: A single-blind randomized controlled trial. *Heart & Lung.* 2023;62:1-8. https://doi.org/10.1016/j.hrtlng.2023.05.011
10. Toktarbay B, Khamitova Z, Zholshybek N, Jumadilova D, Rakhmanov Y, Bekbossynova M, et al. The impact of exercise on cardiovascular system: Molecular signaling pathway and cardiac adaptations. *Journal of Clinical Medicine of Kazakhstan*. 2023;20(6):4-11. https://doi.org/10.23950/jcmk/13825
11. Kanejima Y, Shimogai T, Kitamura M, Ishihara K, Izawa KP. Effect of early mobilization on physical function in patients after cardiac surgery: a systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*. 2020;17(19):7091. https://doi.org/10.3390/ijerph17197091
12. Chen B, Xie G, Lin Y, Chen L, Lin Z, You X, et al. A systematic review and meta-analysis of the effects of early mobilization therapy in patients after cardiac surgery. *Medicine.* 2021;100(15):e25314. https://doi.org/10.1097/MD.0000000000018843
13. Honda Y, Takahashi K, Sasanuma N, Itani Y, Nagase M, Uchiyama Y, et al. Predictors of functional decline in activities of daily living at discharge in patients after cardiovascular surgery. *Circulation Journal.* 2021;85(7):1020-1026. https://doi.org/10.1253/circj.CJ-20-0909
14. Jacob P, Gupta P, Shiju S, Omar AS, Ansari S, Mathew G, et al. Multidisciplinary, early mobility approach to enhance functional independence in patients admitted to a cardiothoracic intensive care unit: a quality improvement programme. *BMJ open quality.* 2021;10(3):e001256. https://doi.org/10.1136/bmjoq-2020-001256
15. Gama Lordello GG, Gonçalves Gama GG, Lago Rosier G, Viana PADdC, Correia LC, Fonteles Ritt LE. Effects of cycle ergometer use in early mobilization following cardiac surgery: a randomized controlled trial. *Clinical Rehabilitation.* 2020;34(4):450-459. https://doi.org/10.1177/0269215520901763
16. Firat M, Vardar-Yagli N, Saglam M, Yildirim T, Erdem Y. Quality of life and physical activity level in patients with chronic kidney disease during COVID-19 pandemic. *Psychology, Health & Medicine.* 2023;28(3):640-647. https://doi.org/10.1080/13548506.2022.2119481
17. Al-Bachir M, Ahmad H. Reliability and validity of the international physical activity questionnaire for adults in Syria. *International Journal of Health Promotion and Education.* 2021:1-14. https://doi.org/10.1080/14635240.2021.1989610
18. Kızılırmak AS, Karadibak D, Gultekin SC, Ozsoy I, Yavuzsen HT, Yavuzsen T, et al. Predictors of the 6-min walk test in patients with ovarian cancer. *Supportive Care in Cancer.* 2023;31(4):248. https://doi.org/10.1007/s00520-023-07706-6
19. Schoonjans F, Zalata A, Depuydt C, Comhaire F. MedCalc: a new computer program for medical statistics. *Computer methods and programs in biomedicine.* 1995;48(3):257-262. https://doi.org/10.1016/0169-2607(95)01703-8
20. Bond MMK, Oliveira JLRd, Souza LCBd, Farsky PS, Amato VL, Togna DJD, et al. Quality of life in cardiovascular surgery: elaboration and initial internal validation of a quality of life questionnaire. *Brazilian Journal of Cardiovascular Surgery.* 2018;33:476-482. https://doi.org/10.21470/1678-9741-2018-0108
21. Moreira JMA, Grilo EN. Quality of life after coronary artery bypass graft surgery - results of cardiac rehabilitation programme. *J Exerc Rehabil.* 2019 Oct 28;15(5):715-722. https://doi.org/10.12965/jer.1938444.222.
22. Tessier S, Vuillemin A, Bertrais S, Boini S, Le Bihan E, Oppert J-M, et al. Association between leisure-time physical activity and health-related quality of life changes over time. *Preventive medicine.* 2007;44(3):202-208. https://doi.org/10.1016/j.ypmed.2006.11.012
23. Hirschhorn AD, Richards DA, Mungovan SF, Morris NR, Adams L. Does the mode of exercise influence recovery of functional capacity in the early postoperative period after coronary artery bypass graft surgery? A randomized controlled trial. *Interactive cardiovascular and thoracic surgery.* 2012;15(6):995-1003. https://doi.org/10.1093/icvts/ivs403
24. Pačarić S, Turk T, Erić I, Orkić Ž, Petek Erić A, Milostić-Srb A, et al. Assessment of the quality of life in patients before and after coronary artery bypass grafting (CABG): a prospective study. *International journal of environmental research and public health*. 2020;17(4):1417. https://doi.org/10.3390/ijerph17041417
25. Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. *Annals of internal medicine.* 2005;143(9):659-672. https://doi.org/10.7326/0003-4819-143-9-200511010-00010
26. Haykowsky M, Scott J, Esch B, Schopflocher D, Myers J, Paterson I, et al. A meta-analysis of the effects of exercise training on left ventricular remodeling following myocardial infarction: start early and go longer for greatest exercise benefits on remodeling. *Trials.* 2011;12:1-8. https://doi.org/10.1186/1745-6215-12-92

27. Rasekaba T, Lee A, Naughton MT, Williams TJ, Holland AE. The six-minute walk test: a useful metric for the cardiopulmonary patient. *Internal medicine journal.* 2009;39(8):495-501. https://doi.org/10.1111/j.1445-5994.2008.01880.x
28. Hirschhorn AD, Richards D, Mungovan SF, Morris NR, Adams L. Supervised moderate intensity exercise improves distance walked at hospital discharge following coronary artery bypass graft surgery—a randomised controlled trial. *Heart, Lung and Circulation.* 2008;17(2):129-138. https://doi.org/10.1016/j.hlc.2007.09.004
29. Mohamed A, Hassan MS, Mubarak Y, Gamal LM. Effect of nursing exercise protocol on hemodynamics and functional capacity among patients after cardiac surgery. *Evidence-Based Nursing Research.* 2019;1(3):145-158. : https://doi.org/10.47104/ebnrojs3.v1i3.74