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Depression predicts delayed return to daily activities in patients post-cardiac surgery: a prospective observational study

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Abstract

Background Depression significantly impacts recovery and return to daily activities in cardiac surgery patients. Assessing and managing depressive symptoms before and after surgery are crucial for improving surgical outcomes and timely return to daily activities, including work. The objectives of this study were to examine differences in patients' depression levels in relation to their return to daily activities in the early post-cardiac surgery period, and to assess predictors of delayed return to daily activities.

Methods This single-centered study assessed return to independence, social participation, hobbies, and work in 100 cardiac surgical patients at 2 and 6 weeks post-surgery. Associations between depression levels and return to daily activities scores were evaluated.

Results Higher Center for Epidemiologic Studies Depression Scale (CES-D) scores were significantly associated with delayed return to daily activities in all categories at both 2 and 6 weeks post-surgery. Specifically, higher depression score delayed return to independence and social participation at 2 weeks, and delayed return to independence, social participation, and return to work at 6 weeks.

Conclusion Elevated depression scores are significantly associated with delayed return to daily activities post-cardiac surgery, indicating the importance of evaluating depression in cardiac surgical patients in the postend stage-operative period.

Keywords Return to daily activities, Depression, Post-cardiac surgery

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Introduction

The goal of cardiac surgery today looks beyond post-operative survival, towards improving quality of life by striving to re-integrate patients back into their daily activities, including work [1–3]. The ability of patients to return to daily activities after cardiac surgery is an important indicator of surgical success [1, 4]. However, post-operative depression can hinder the recovery process [2]. This is particularly true in patients with pre-operative depression [5–7], which itself is an independent risk factor for hospital readmission and reduced patient independence [8, 9].

Depression after cardiac surgery is prevalent in the general population [10, 11] and has been linked to increased mortality, re-admission for a cardiac event and adverse health outcomes [12–15]. A meta-analysis of 29 publications found that the risk of mortality is at least 2 times higher in patients suffering from cardiovascular disease and comorbid clinical depression in the 2 years from the time of initial CVD assessment [16].

Furthermore, delayed recovery after cardiac surgery can itself induce depressive symptoms in previously non-depressed patients [17, 18]. Research shows that depressed patients with cardiac disease are more at risk for experiencing major adverse cardiac events, necessitating surgery, compared to their non-depressed counterparts [19].

According to the 2006 paper by the Stay-at-Work and Return-to-Work Process Improvement Committee, the likelihood of returning to work after medical leave decreases dramatically by 50% after 12 weeks, significantly affecting patients social interactions and independence [20].

A review paper from 2022, which included forty-five articles showed that patients typically returned to work following CABG or aortic valve replacement surgery after 30 weeks, with 34% of patients never returning to work [9].

However, some patients may need to resume their daily activities shortly after surgery due to financial, familial and social obligation. Given these considerations, our study focuses on understanding the impact of depression on early return to daily activities in post-cardiac surgical patients and aims to highlight important predictors of delayed return to daily activities, including work.

The objectives of this study were: (1) to examine differences in patients with no depression, mild depression and moderate to severe depression on return to daily activities (work, hobbies, social interaction and level of independence) in the early post-cardiac surgery period; and (2) to assess predictors of delayed return to daily activities.

Methods

Study design

A prospective observational study was conducted to assess patients' return to daily activities at 2 and 6 weeks post-cardiac surgery in the following categories: independence, social participation, hobbies and work (Fig. 1) the association between patients' return to daily activities and socio-demographic, clinical and surgical parameters were examined. This single-centeredstudy was approved by the Helsinki Ethics Committee of Poriya Medical Center, which is affiliated with the Azrieli Faculty of Medicine at Bar-Ilan University. Signed informed consent was obtained from all study participants.

Sample size

Since this is the first study to evaluate early return to daily activities in cardiac surgery patients with different depression categories, and we did not have pilot data, we were not able to calculate sample size.

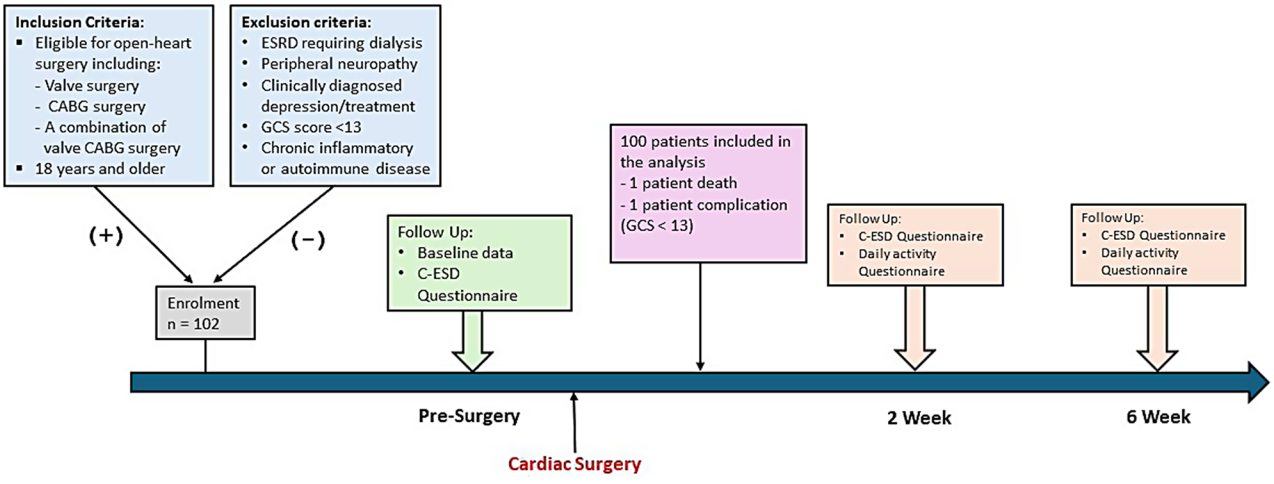

Fig. 1 Study design

Setting

The study was conducted at the cardiology department of Poriya Medical Center, with data collected at 2 and 6 weeks post-surgery during follow-up visits.

Patient cohort

Patients who underwent cardiac surgery at Poriya Medical Center were recruited to the participate in the study. *Inclusion Criteria*: (1) Patients eligible for open-heart surgery, including valve surgery, CABG or a combination of both and (2) Patients aged 18 and older. Exclusion Criteria: (1) Presence of peripheral neuropathy, (2) Glasgow Coma Scale score < 13, (3) Clinically diagnosed depression, (4) Patients with chronic inflammatory and autoimmune diseases and (5) Patients with end-stage renal disease requiring dialysis. End stage renal disease was part of our exclusion criteria as the process of dialysis has strong psychological impact on patients with one of the top concerns amongst this population being the intensive time commitment and social limitations due to the treatment [21] which may affect their return to daily activities.

Variables

The primary outcome was the return to daily activities, categorized into independence, social participation, hobbies, and work, measured at 2 and 6 weeks post-surgery, and the level of depression, measured using CES-D score. Other variables included socio-demographic data (age, sex, residence, BMI, education level, economic status, work status, marital status, family support and shared residency), clinical data (presence of diabetes and smoking status), and surgical data (surgery type and participation in cardiac rehabilitation).

Procedures

Participants' ability to return to daily activities was evaluated using a Likert scale. Participants were asked to respond to each question in terms of the following scale: 5 = no return to activity, 4 = slight return to activity, 3 = half returned to activity, 2 = almost full return to activity, 1 = full return to activity.

Assessment of depression

Depression score was assessed using The Center for Epidemiological Study of Depression (CES-D) questionnaire at 2- and 6-weeks post-surgery. The CES-D questionnaire is a 20-question, self-reported measure of depression using a 5-point Likert scale [22]. The scores range from 0 (lowest) to 60 (highest). Depression scores were divided based on previous research into no depression (CES-D < 15); mild depression (CES-D between 16 and 26); and moderate to severe depression (CES-D > 27) [12, 23] categories. The CES-D questionnaire is acceptable in reliability and validity for use in the general population, the elderly and patients with medical comorbidities [22, 23].

Statistical analysis

Statistical analysis was performed using SPSS (Version 22.0. Armonk, NY: IBM Corp). One-way repeated measure analysis of variance (ANOVA) was performed to assess differences in return to daily activities scores amongst the 3 depression levels in all 4 categories at 2- and 6-weeks post-surgery. An ordinal regression was used to assess association between socio-demographic, clinical and social factors and return to daily activities at 2 and 6 weeks. Multivariable ordinal regressions were performed with covariates with statistical significance of < 0.2 included in the model. A p-value of < 0.05 was considered significant.

Results

In total, 102 patients consented to participate in the study. Two patients were excluded from the analysis due to post-surgery death ($n=1$) and complication leading to Glasgow Coma Scale score < 13 ($n=1$). One hundred participants were included in our analysis and underwent coronary artery bypass grafting (CABG) surgery ($n=52$), valve surgery ($n=30$) or combined CABG and valve surgery ($n=18$). The mean age of participants was 60 ± 10 years; 83.2% of participants were men and 43% were ethnic minorities. Ethnicities includes 54% Jewish, 23% Muslim, 15% Druze, 2% Circassian, and 6% Christian. Participants in the study had no clinically diagnosed depression previously and none of the patients used depression medication.

In our study, we found no differences in depression level at 2- and 6-weeks post-surgery amongst participants with varying socio-demographic factors such as level of education, marital status or family support. Additionally, no patient had major post-surgical complications, including mediastinitis, tamponade, bleeding or other major infections that would have prolonged their recovery.

The mean pre-CES-D scores for patients at 2 weeks post-surgery were 8.7 for patients with no depression, 20.3 for patients with mild depression and 33.5 for patients with moderate to severe depression. The mean pre-CES-D scores for patients at 6 weeks post-surgery were 7.6 for patients with no depression, 21.6 for patients with mild depression and 33.8 for patients with moderate to severe depression.

At 2 weeks 28% of patients with pre-surgery CES-D score < 16, indicating no depressive symptoms, had moderate to severe depressive symptoms after surgery; while 72% of patients with pre-surgery CECD score > 16, indicating depressive symptoms, continued to have depressive symptoms post-surgery.

At 6 weeks 17% of patients with pre-surgery CECD score < 16, indicating no depressive symptoms, had moderate to severe depressive symptoms post-surgery; while 21% of the patients with pre-surgery CECD score > 16, indicating depressive symptoms, continued to have depressive symptoms post-surgery.

In our study, 96% of participants were mobile, while the remaining 4% needed slight help with mobility and no participants needed extensive help or were immobile. At 2 weeks post-surgery, mean independent status score was 2.6, corresponding closely to "half return to activity". At 6 weeks post-surgery, mean independent status was 2.1, corresponding to "almost full return to activity".

Delayed return to daily activities amongst the 3 groups of depression levels at 2 weeks post-surgery

Patients with mild and moderate to severe depression had delayed return to independent status compared to no depression ($p=0.003$, $p<0.001$) (Fig. 2). Patients with moderate to severe depression had delayed return to social participation compared to no depression ($p=0.005$) (Fig. 2). Delayed return to work and hobbies were not significantly different among the depression categories.

Delayed return to daily activities among the 3 groups of depression levels at 6 weeks post-surgery

Patients with mild and moderate to severe depression had delayed return to independent status ($P<0.001$ respectively), social participation ($p<0.001$ respectively) and hobbies ($P<0.001$ respectively) (Figs. 3 and 4). Patients with mild depression also had delayed return to work ($p=0.002$) (Fig. 4).

Predictors of delayed return to daily activities at 2 weeks post-cardiac surgery

Univariable and multivariable predictors of delayed return to daily activities at 2 weeks post-surgery are presented in Table 1.

Female sex 1.285 (95% CI, 0.0185–2.386; $p=0.022$) and high CES-D depression score 0.076 (95% CI, 0.034–0.118; $p<0.001$) predicted delayed return to independent status 2 weeks post-surgery.

High CES-D depression score predicted delayed return to hobbies 0.074 (95% CI, 0.029–0.119; $p=0.001$), return to social participation 0.102 (95% CI, 0.040–0.163; $p=0.001$) and return to work 0.094 (95% CI, 0.013–0.175; $p=0.023$) 2 weeks post-surgery.

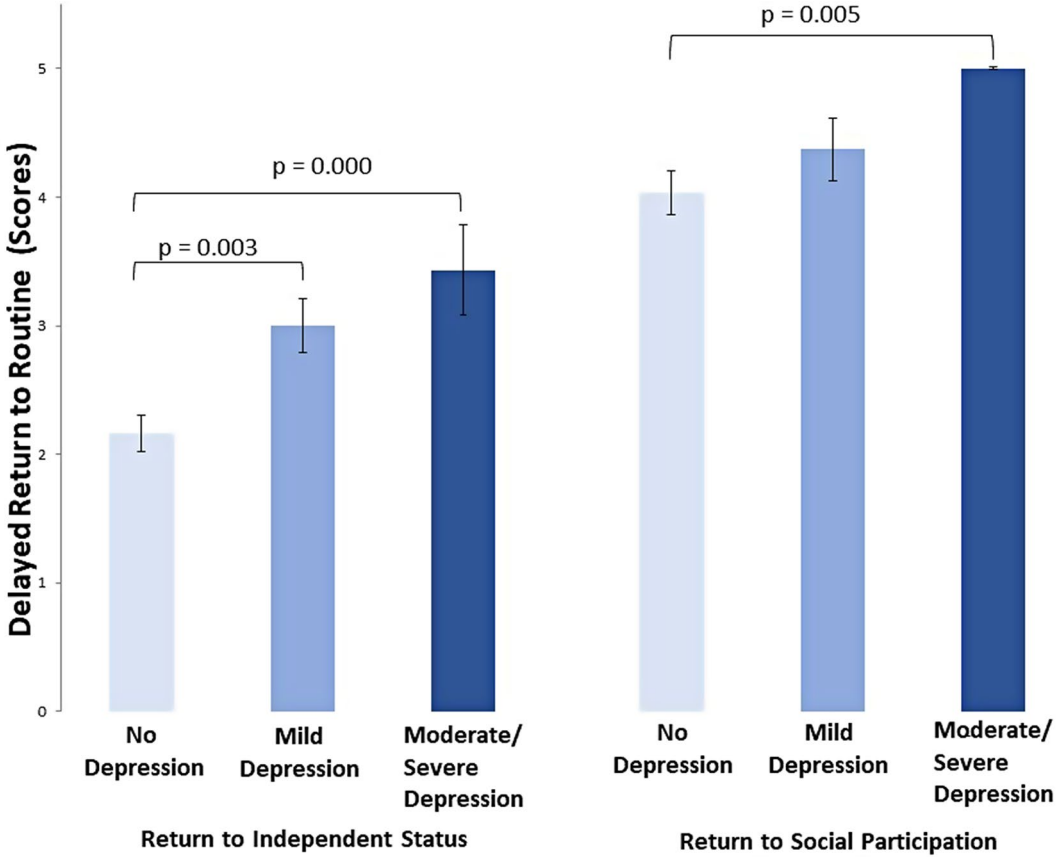

Fig. 2 Delayed return to independent status and social participation scores at 2 weeks post-surgery in patients with mild and moderate to severe depression

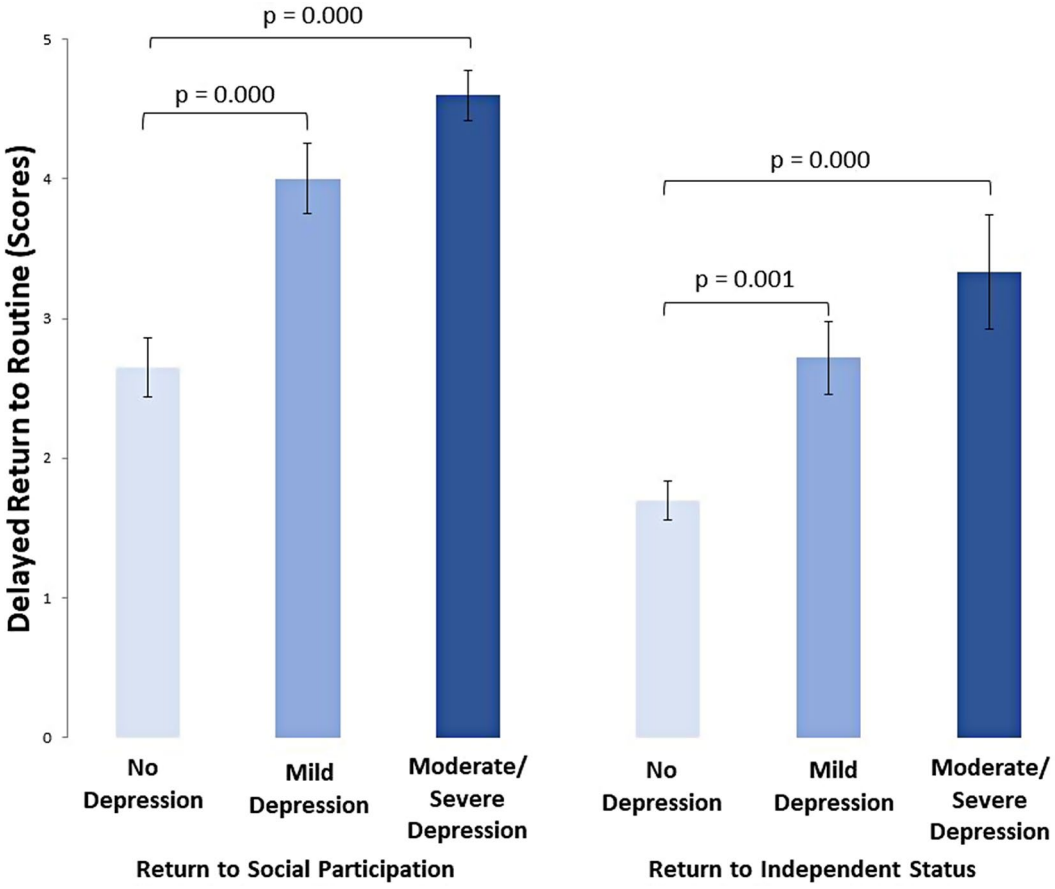

Fig. 3 Delayed return to independent status and social participation scores at 6 weeks post-surgery in patients with mild and moderate to severe depression

Combined CABG and valve surgery −0.651 (95% CI, -1.183-[-0.119]; $p=0.016$) predicted faster return to social participation 2 weeks post-surgery.

Predictors of delayed return to daily activities at 6 weeks post-cardiac surgery

Univariable and multivariable predictors of delayed return to daily activities at 6 weeks post-surgery are presented in Table 2.

Female sex 1.139 (95% CI, 0.023–2.256; $p=0.045$) and high 6-week CES-D depression score 0.106 (95% CI, 0.057–0.154; $p<0.001$) were associated with delayed return to independent status 6 weeks post-surgery.

High 6 week CES-D depression was associated with delayed return to work score 0.068 (95% CI, 0.016–0.121; $p=0.011$), hobbies 0.113 (95% CI, 0.061–0.165; $p<0.001$) and social participation 0.104 (95% CI, 0.054–0.153; $p<0.001$) 6-weeks post-surgery.

Discussion

The major finding of this study was that patients with the highest depression scores post-surgery experienced the longest delays in return to daily activities across all 4 categories. In our study, as well as in the existing literature, mild depression specifically significantly delayed return to all activities categories at 6 weeks post-surgery. Recent research also found mild depression to be associated with worse outcomes in patients with cardiovascular disease [24].

According to a meta-analysis of 28 publications, in the general population, CES-D score of 16 or higher, indicating presence of depression, is 8.8% [22, 23]. An additional study using a shortened 10-item version of the CES-D scale found that in 220 older adults over the age of 65, depression prevalence was 39.1% with mean CES-D scores of 6.6, 7.48, and 9.22 for mild, moderate, and severe depression, respectively [25].

Our study found that 45% of participants had CES-D scores above 16 at 2 weeks post-surgery and 36% had CES-D scores above 16 at 6 weeks post-surgery. This highlights the importance of assessing depression levels both prior to and post-cardiac surgery [26, 25].

Currently, in our institute, post-surgical management does not include education about detection of depression and available psychiatric services. However, the American Heart Association (AHA) recommends routine

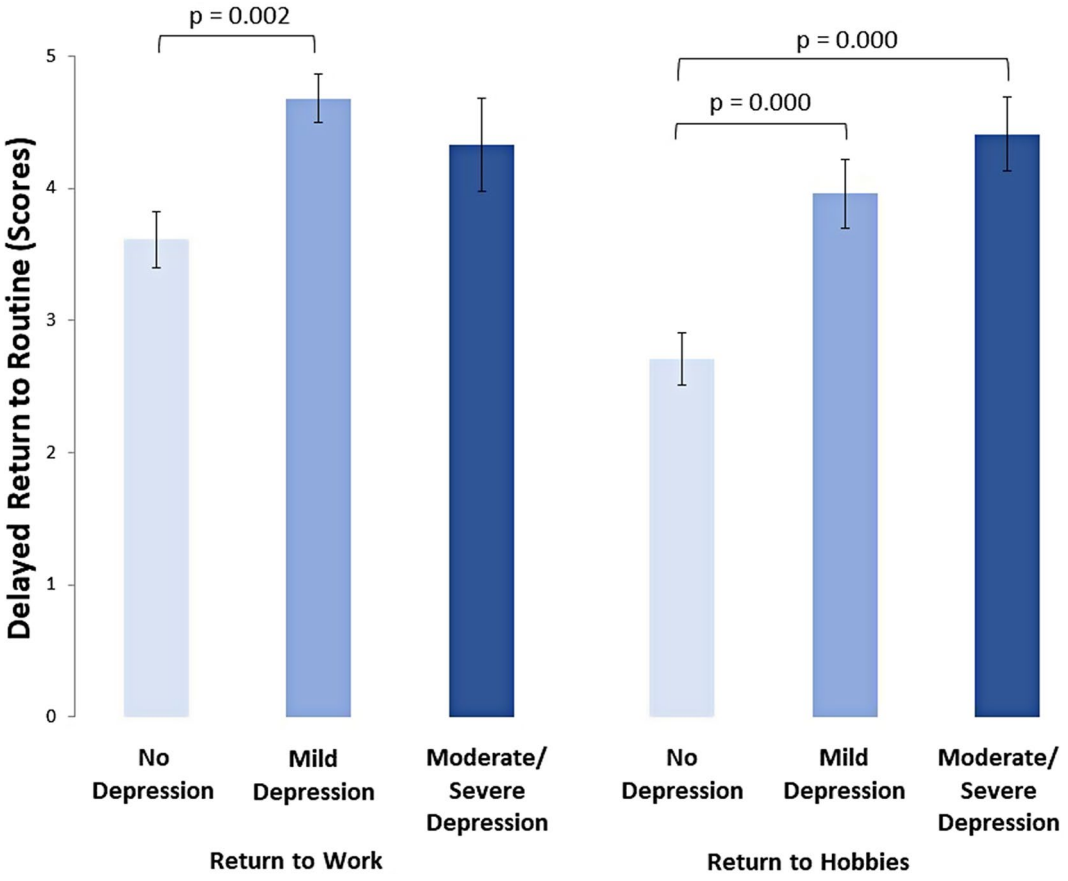

Fig. 4 Delayed return to work and hobbies scores at 6 weeks post-surgery in patients with mild and moderate to severe depression

screening for depression in patients with coronary heart disease, including those post-cardiac surgery [27]. The AHA also suggests using standardized tools such as the Patient Health Questionnaire (PHQ-9) or the Hospital Anxiety and Depression Scale (HADS) to identify depressive symptoms [27]. Patients identified with depressive symptoms should receive a comprehensive evaluation and appropriate management, including referrals to mental health professionals [27]. Our study results also suggest that patients following surgery may benefit from early screening for depression, education, and referral for mental health services.

Recovery from cardiac surgery depends on non-traditional risk factors such as depression [28] along with important socio-demographic, clinical and surgical factors. In addition to depression as a predictor of delayed return to daily activities, our study also found delayed return in female patients as well as faster return in patients undergoing combined CABG and valve surgery.

Female sex of the patient was associated with delayed return to independence at both 2- and 6-weeks post-cardiac surgery. Similar conclusions were found in a recent study reporting that after cardiac surgery, women felt limited by their dependence on others [9, 21] and reported lower scores regarding positive outlook on life and higher scores regarding feelings of fear and loneliness post-surgery [20]. These results highlight the added need for depression screening in female patients post-surgery [9, 20].

In our study, patients undergoing combined CABG and valve surgery had the fastest return to social participation at 2 weeks post-surgery compared to CABG alone ($p=0.008$). A recent study also found that patients undergoing combined CABG and valve surgery had better post-operative outcomes, with lower rates of low cardiac output and atrial fibrillation than patients undergoing CABG surgery alone [29]. Combined surgery may restore perfusion and vascularization, which may allow patients to make a more significant recovery than valve surgery or CABG alone.

Returning to work post-cardiac surgery is especially important given that most patients are of working age [30]. Our short-term study, which focused on early return to daily activities, did not find significant differences in return to work in patients who participated in cardiac rehabilitation programs. However, a 2018 study showed almost 90% of patients were able to return to work 1 year post-surgery with the implementation of a cardiac

Table 1 Delayed return to daily activities 2 weeks post-cardiac surgery in univariable and multivariable regression model

Delayed Return to Routine	**2 Weeks Univariable**			**2 Weeks Multivariable**		
	Ordered log-odds (CI)	**Wald**	***p* value**	**Ordered log-odds (CI) (Estimate)**	**Wald**	***p* value**
Independent Status						
age	-0.001 (-0.41-0.039)	0.002	0.964	----------	----------	----------
Residence	0.490 (-0.23- 1.209)	1.780	0.182	0.297 (-0.475-1.069)	0.568	0.451
sex	1.586 (0.549–2.623)	8.981	0.003	1.285 (0.185–2.386)	5.238	0.022
Surgery Type	-0.059 (-0.475-0.358)	0.076	0.782	----------	----------	----------
Diabetes	-0.593 (-1.343- 0.156)	2.406	0.121	-0.247 (-1.057-0.564)	0.356	0.550
Smoking	-0.194 (-0.928- 0.540)	0.269	0.604	----------	----------	----------
Work Status	0.530 (-0.200- 1.261)	2.027	0.155	0.082 (0.739–0.903)	0.039	0.844
Education	0.328 (-0.028- 0.685)	3.254	0.071	0.123 (-0.259-0.505)	0.397	0.529
Marital Status	0.168 (-0.287- 0.622)	0.525	0.469	----------	----------	----------
Family Support	0.260 (-286-0.806)	0.870	0.351	----------	----------	----------
Recovery	0.395 (-0.344-1.134)	1.098	0.295	----------	----------	----------
Shared Residency	0.482 (-0.351- 1.314)	1.287	0.257	----------	----------	----------
Cardiac Rehabilitation	0.913 (0.048–1.77)	4.275	0.039	0.497 (-0.429-1.422)	1.107	0.293
CES-D 2 weeks	0.094 (0.054–0.135)	21.249	< 0.001	0.076 (0.034–0.118)	12.436	< 0.001
Economic Situation	0.604 (0.266–0.983)	9.77	0.002	0.272 (-0.149-0.694)	1.604	0.205
BMI	0.007 (-0.079- 0.093)	0.028	0.866	----------	----------	----------
Return to Work						
Age	0.005 (-0.058- 0.067)	0.022	0.883	----------	----------	----------
Residence	0.153 (-1.017- 1.323)	0.066	0.797	----------	----------	----------
Sex	0.104 (-1.540- 1.747)	0.015	0.901	----------	----------	----------
Diabetes	0.186 (-1.018- 1.389)	0.091	0.762	----------	----------	----------
Smoking	-0.755 (-2.117- 0.607)	1.182	0.277	----------	----------	----------
Work Status	-0.291 (-1.464- 0.883)	0.235	0.628	----------	----------	----------
Education	0.224 (-0.341-0.789)	0.603	0.437	----------	----------	----------
Marital Status	0.010 (-1.341- 1.361)	< 0.001	0.989	----------	----------	----------
Shared Residency	-0.183 (-0.841- 0.475)	0.297	0.586	----------	----------	----------
Family Support	-0.219 (-1.002- 0.563)	0.302	0.583	----------	----------	----------

Table 1 (continued)

Delayed Return to Routine	2 Weeks Univariable			2 Weeks Multivariable		
	Ordered log-odds (CI)	**Wald**	***p* value**	**Ordered log-odds (CI) (Estimate)**	**Wald**	***p* value**
Recovery	-0.173 (-1.401- 1.055)	0.076	0.782	----------	----------	----------
Cardiac Rehabilitation	0.585 (-0.793- 1.873)	0.791	0.374	----------	----------	----------
CES-D 2 Weeks	0.094 (0.013–0.175)	5.182	0.023	0.094 (0.013–0.175)	5.182	0.023
Economic Situation	-0.040 (-0.619- 0.539)	0.018	0.892	----------	----------	----------
BMI	0.083 (-0.062- 0.228)	1.258	0.262	----------	----------	----------
Surgery Type	-0.062 (-0.742- 0.617)	0.032	0.857	----------	----------	----------
Return to Hobbies						
Age	-0.018 (-0.059- 0.022)	0.792	0.374	----------	----------	----------
Residence	0.691 (-0.063- 1.444)	3.227	0.072	0.678 (-0.173-1.529)	2.439	0.118
Sex	0.542 (-0.492-1.582)	1.044	0.307	----------	----------	----------
Surgery Type	-0.377 (-0.813- 0.059)	2.874	0.090	-0.473 (-0.972-0.026)	3.456	0.063
Diabetes	-0.173 (-0.951- 0.605)	0.190	0.663	----------	----------	----------
Smoking	0.046 (-0.717- 0.810)	0.014	0.905	----------	----------	----------
Work Status	-0.292 (-1.041-0.458)	0.583	0.445	----------	----------	----------
Education	0.058 (-0.304- 0.421)	0.099	0.752	----------	----------	----------
Marital Status	0.231 (-0.267- 0.728)	0.827	0.363	----------	----------	----------
Shared Residency	0.430 (-0.527-1.387)	0.775	0.379	----------	----------	----------
Family Support	0.377 (-0.254-1.008)	1.372	0.241	----------	----------	----------
Recovery	0.587 (-0.183- 1.357)	2.235	0.135	0.575 (-0.292-1.442)	1.690	0.194
Cardiac Rehabilitation	0.493 (-0.381-1.367)	1.222	0.269	----------	----------	----------
CES-D 2 Weeks	0.060 (0.019–0.101)	8.332	0.004	0.074 (0.029–0.119)	10.215	0.001
Economic Situation	0.224 (-0.153- 0.600)	1.355	0.244	----------	----------	----------
BMI	0.095 (0.004–0.186)	4.195	0.041	0.121 (0.015–0.227)	5.001	0.025
Return to Social Participation						
Age	-0.023 (-0.069-0.024)	0.917	0.338	----------	----------	----------
Residence	0.596 (-0.267- 1.459)	1.833	0.176	0.607 (-0.350-1.564)	1.547	0.214
Sex	0.776 (-0.579- 2.130)	1.260	0.262	----------	----------	----------
Surgery Type	-0.653 (-1.140 - [-0.167])	6.933	0.008	-0.651 (-1.183-(-0.119))	5.759	0.016

Table 1 (continued)

Delayed Return to Routine	2 Weeks Univariable			2 Weeks Multivariable		
	Ordered log-odds (CI)	Wald	*p* value	Ordered log-odds (CI) (Estimate)	Wald	*p* value
Diabetes	-0.572 (-1.512- 0.367)	1.427	0.232	----------	----------	----------
Smoking	-0.162 (-1.049-0.725)	0.128	0.720	----------	----------	----------
Work Status	0.035 (-0.824-0.893)	0.006	0.937	----------	----------	----------
Education	0.362 (-0.056-0.780)	2.888	0.089	0.201 (-0.245-0.646)	0.777	0.378
Marital Status	0.051 (-0.495- 0.597)	0.033	0.856	----------	----------	----------
Shared Residency	-0.017 (-0.985-0.951)	0.001	0.972	----------	----------	----------
Family Support	-0.237 (-0.838-0.363)	0.600	0.439	----------	----------	----------
Recovery	0.186 (-0.679-1.050)	0.177	0.674	----------	----------	----------
Cardiac Rehabilitation	0.487 (-0.477-1.451)	0.980	0.322	----------	----------	----------
CES-D 2 Weeks	0.103 (0.044–0.162)	11.576	0.001	0.102 (0.040–0.163)	10.496	0.001
Economic Situation	0.214 (-0.218- 0.645)	0.943	0.332	----------	----------	----------
BMI	0.028 (-0.072- 0.129)	0.307	0.580	----------	----------	----------

rehabilitation program [30, 31], (compared to only 64.9% in a similar study without a rehabilitation initiative [32]. Recent research indicates that cardiac rehabilitation is a major contributor of return to work after hospitalization for a cardiovascular event [31, 33], that a A review of 19 studies indicated that psychological interventions were the least common components of cardiac rehabilitation [34].

The limitations of this study are that it evaluated a small sample size from a single medical center and post-surgery follow up was assessed only until the 6 week mark. The effects of depression duration on return to daily activity should be investigated in future studies, with daily or weekly follow-up. Additionally, due to the small numbers of each ethnic group within the study, we could not compare ethnic differences in return to daily activities after cardiac surgery. Future study should investigate the effects of ethnicity on return to daily activity.

It is also important to note that while the CES-D is a reliable and valid measure for assessing depression [35], the Likert scale used to assess return to daily activities in our study was a series of simple questions referring to extent of return that has not been validated but rather is subject to patients' own perception. This could introduce variability in how patients interpret and respond to the questions.

Our study focused on assessment of early return to daily activities post-cardiac surgery, as there are cases in which patients are self-employed, single income families or have other familial obligations, who may not be able to take extended time off work and other activities after surgery. In addition to circumstantial factors influencing the return to daily activities, other external factors may also have an impact. These include inclement weather, air pollution, pandemics and epidemics, and other significant events.

Furthermore, we did not assess quality of life in our study. Future studies should assess patients' quality of life prior to cardiac surgery, as it may affect the timing of return to daily activities [16].

Lastly, our investigation did not provide an explanation of how depression may affect return to daily activities. The possibility exists that anhedonia may explain the delays seen in return to daily activities in some of the patients in the early post-surgery period.

Conclusion

In patients undergoing cardiac surgery, depression was consistently associated with delayed return to independence, social participation, hobbies and work. Female sex was an additional predictor of delayed return, while combined CABG and valve surgery was associated with

Table 2 Delayed return to daily activities 6 weeks post-cardiac surgery in univariable and multivariable regression model

Delayed Return to Routine	6 Weeks Univariable			6 Weeks Multivariable		
	Ordered log-odds (CI)	Wald	*p* value	Ordered log-odds (CI) (Estimate)	Wald	*p* value
Independent Status						
age	0.018 (-0.023- 0.059)	0.760	0.383	----------	----------	----------
Residence	0.470 (-0.276- 1.217)	1.527	0.217	----------	----------	----------
sex	1.496 (0.449–2.542)	7.846	0.005	1.139 (0.023–2.256)	4.002	0.045
Surgery Type	-0.198 (-0.653- 0.257)	0.725	0.394	----------	----------	----------
Diabetes	-0.950 (-1.724 - [-0.176])	5.785	0.016	-0.627 (-1.513-0.260)	1.921	0.166
Smoking	0.467 (-0.304- 1.238)	1.407	0.235	----------	----------	----------
Work Status	0.471 (-0.283- 1.224)	1.498	0.221	----------	----------	----------
Education	0.451 (0.068–0.834)	5.318	0.021	0.295 (-0.183-0.773)	1.464	0.226
Marital Status	0.196 (-0.263- 0.655)	0.702	0.402	----------	----------	----------
Family Support	0.388 (-0.164- 0.941)	1.895	0.169	0.537 (-0.131-1.206)	0.341	2.481
Recovery	0.402 (-0.366- 1.170)	1.053	< 0.001	0.108 (-0.831-1.047)	0.051	0.822
Shared Residency	0.341 (-0.492- 1.173)	0.643	0.423	----------	----------	----------
Cardiac Rehabilitation	0.647 (-0.274- 1.568)	1.895	0.169	-0.031 (-1.127-1.064)	0.003	0.956
CESD-D 6 Weeks	0.124 (0.079–0.169)	29.103	< 0.001	0.106 (0.057–0.154)	18.105	< 0.001
Economic Situation	0.444 (0.065–0.823)	5.264	0.022	0.266 (-0.189-0.721)	1.316	0.251
BMI	0.078 (-0.015- 0.170)	2.730	0.098	----------	----------	----------
Return to Work						
Age	0.027 (-0.017- 0.071)	1.446	0.229	----------	----------	----------
Residence	0.065 (-0.744- 0.874)	0.025	0.874	----------	----------	----------
Sex	0.181 (-1.021- 1.382)	0.087	0.768	----------	----------	----------
Surgery Type	0.033 (-0.455- 0.521)	0.017	0.895	----------	----------	----------
Diabetes	-0.644 (-1.518- 0.230)	2.085	0.149	-0.327 (-1.322-0.669)	0.414	0.520
Smoking	-0.142 (-0.975- 0.691)	-0.112	0.738	----------	----------	----------
Work Status	0.120 (-0.708- 0.948)	0.081	0.776	----------	----------	----------
Education	0.470 (0.066–0.874)	5.211	0.022	0.307 (-0.139-0.752)	1.822	0.177
Marital Status	-0.120 (-0.612- 0.372)	0229	0.633	----------	----------	----------
Shared Residency	0.123 (-0.842- 1.088)	0.063	0.803	----------	----------	----------

Table 2 (continued)

Delayed Return to Routine	6 Weeks Univariable			6 Weeks Multivariable		
	Ordered log-odds (CI)	**Wald**	***p* value**	**Ordered log-odds (CI) (Estimate)**	**Wald**	***p* value**
Family Support	0.499 (-0.283-1.281)	1.567	0.211	----------	----------	----------
Recovery	0.512 (-0.329-1.354)	1.423	0.233	----------	----------	----------
Cardiac Rehabilitation	0.895 (-0.032- 1.823)	3.578	0.059	0.623 (-0.414-1.660)	1.385	0.239
CES-D 6 Weeks	0.088 (0.037–0.138)	11.488	0.001	0.068 (0.016–0.121)	6.426	0.011
Economic Situation	0.381 (-0.036- 0.798)	3.204	0.073	0.273 (-0.183-0.729)	1.378	0.240
BMI	0.006 (-0.093- 0.105)	0.016	0.900	----------	----------	----------
Surgery Type	0.033 (-0.455-0.521)	0.017	0.895	----------	----------	----------
Return to Hobbies						
Age	-0.005 (-0.044- 0.034)	0.068	0.795	----------	----------	----------
Residence	0.226 (-0.502- 0.954)	0.369	0.544	----------	----------	----------
Sex	1.090 (0.008–2.172)	3.898	0.048	0.458 (-0.762-1.679)	0.542	0.462
Surgery Type	-0.359 (-0.800- 0.081)	2.555	0.110	-0.262 (-0.750-0.226)	1.111	0.292
Diabetes	-0.692 (-1.462- 0.077)	3.113	0.078	-0.470 (-1.356-0.417)	1.078	0.299
Smoking	-0.035 (-0.777- 0.708)	0.008	0.927	----------	----------	----------
Work Status	-0.006 (-0.745-0.733)	< 0.001	0.987	----------	----------	----------
Education	0.324 (-0.035-0.684)	3.137	0.077	0.260 (-0.150-0.670)	1.549	0.213
Marital Status	-0.065 (-0.519-0.389)	0.078	0.779	----------	----------	----------
Shared Residency	0.259 (-0.590-1.107)	0.358	0.550	----------	----------	----------
Family Support	0.120 (-0.433-0.674)	0.182	0.670	----------	----------	----------
Recovery	0.152 (-0.593-0.897)	0.160	0.689	----------	----------	----------
Cardiac Rehabilitation	0.409 (-0.449-1.267)	0.873	0.350	----------	----------	----------
CES-D 6 Weeks	0.121 (0.074–0.168)	25.310	< 0.001	0.113 (0.061–0.165)	18.144	< 0.001
Economic Situation	0.469 (0.086–0.852)	5.771	0.016	0.210 (-0.214-0.633)	0.940	0.332
BMI	0.027 (-0.062- 0.116)	0.359	0.549	----------	----------	----------
Return to Social Participation						
Age	0.015 (-0.025- 0.054)	0.535	0.464	----------	----------	----------
Residence	0.349 (-0.380- 1.078)	0.882	0.348	----------	----------	----------
Sex	1.710 (0.473–0.948)	7.340	0.007	1.206 (-0.108-2.521)	0.671	0.072

Table 2 (continued)

Delayed Return to Routine	6 Weeks Univariable			6 Weeks Multivariable		
	Ordered log-odds (CI)	Wald	*p* value	Ordered log-odds (CI) (Estimate)	Wald	*p* value
Surgery Type	-0.167 (-0.605-0.270)	0.562	0.453	----------	----------	----------
Diabetes	-0.267 (-1.024-0.489)	0.480	0.489	----------	----------	----------
Smoking	0.464 (-0.283-1.210)	1.483	0.223	----------	----------	----------
Work Status	0.384 (-0.359- 1.128)	1.027	0.311	----------	----------	----------
Education	0.235 (-0.124- 0.594)	1.644	0.200	0.070 (-0.316-0.455)	0.126	0.723
Marital Status	-0.040 (-0.498-0.417)	0.030	0.862	----------	----------	----------
Shared Residency	0.544 (-0.391-1.480)	1.300	0.254	----------	----------	----------
Family Support	0.109 (0.451- 668)	0.145	0.704	----------	----------	----------
Recovery	-0.032 (-0.777-0.713)	0.007	0.933	----------	----------	----------
Cardiac Rehabilitation	0.535 (-0.327-1.398)	1.478	0.224	----------	----------	----------
CES-D 6 Weeks	0.121 (0.073–0.169)	24.429	< 0.001	0.104 (0.054–0.153)	16.954	< 0.001
Economic Situation	0.464 (0.088–0.839)	5.856	0.016	0.272 (-0.139-0.682)	1.682	0.195
BMI	0.024 (-0.066- 0.113)	0.271	0.603	----------	----------	----------

faster return to daily activities. These findings indicate the need for peri-operative assessment of depression. As well, special attention in the post-operative stage should be paid to female patients and type of surgery undergone. By addressing the goal of improving cardiovascular surgical outcomes through assessment of the aforementioned predictors, the central goal of cardiac surgery, to improve quality of life, physical functioning [36] and return to daily activities [1, 4] can be achieved.

Author contributions

I.p. wrote the manuscript and prepared figures; L.G.R. wrote the manuscript and analyzed data; N.C.A. collected and analyzed data; A.S. edited the manuscript; S.G. edited the manuscript; J.R. edited the manuscript and prepared tables; W.S.B. edited the manuscript; I.G. edited the manuscript; S.C. confirmed the accuracy of the data analysis and interpretation and approved the final version of the manuscript; A.M. edited the manuscript; E.Y.B. edited the manuscript; E.K. confirmed the accuracy of the data analysis and interpretation, and approved the final version of the manuscript.

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Data availability

Data are available upon request from the corresponding authors.

Declarations

Ethical approval

The study was approved by the Helsinki Ethics Committee of Poriya Medical Center and signed informed consent was obtained from all study participants.

Competing interests

The authors declare no competing interests.

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