



The impact of psychological distress on long-term recovery perceptions in survivors of cardiac arrest

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ABSTRACT

Purpose: To determine the association of depressive and PTSD symptoms with cardiac arrest survivors' long-term recovery perceptions, after accounting for cognitive status, functional independence, and medical comorbidities. **Methods:** Perceived recovery of 78 cardiac arrest survivors at 6-months post-hospital discharge was assessed through the question, "Do you feel that you have made a complete recovery from your arrest?" Psychological symptoms were measured using the Center for Epidemiological Studies-Depression scale (CES-D) and the PTSD Checklist-Specific (PCL-S). Logistic regression was utilized to assess the association between psychological symptoms with positive and negative recovery perceptions, adjusting for demographics, cognitive impairment, functional dependence, and medical comorbidities.

Results: At 6 months, 53% of patients ($n = 41$) had negative recovery perceptions. 32.1% ($n = 25$) of patients screened for depression and 28.2% ($n = 22$) for PTSD. Patients with higher CES-D scores were significantly more likely to have negative recovery perceptions in both unadjusted and adjusted analyses (OR: 1.10, 95% CI [1.03, 1.16], $p < .01$). PCL-S scores were significantly associated with negative recovery perceptions in an unadjusted model (OR: 1.05, 95% CI [1.01, 1.10], $p < .01$), but not after adjustment of covariates.

Conclusions: In contrast with cognitive and functional measures, depressive symptoms were strongly associated with cardiac arrest survivors' negative recovery perceptions at 6-months post-discharge.

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1. Introduction

Innovations in technology and treatment protocols have led to improvements in survival rates after cardiac arrest [1]. With the advent of greater survivability, there has been increased recognition of post-cardiac arrest survivorship as a chronic condition implicated in cognitive, functional, and psychological sequelae secondary to anoxic brain injury [2–4]. Given the overall increase in patients with multiple chronic conditions, value based health care systems [5] have prioritized outcomes deemed important by the patient (i.e. patient reported outcome measures (PROMs)), which can help facilitate shared decision making. Utilization of PROMs has led to improvements in patients' daily lives, such as satisfaction with care [6] and depressive symptoms [7]. Accordingly, identifying underlying factors contributing to an encompassing PROM, such as perceived recovery, could improve the daily and multifaceted challenges faced by cardiac arrest survivors.

Despite the various chronic symptoms that cardiac arrest survivors face, it remains unclear which deficits are most strongly associated with long-term perceived recovery. For example, Steinbusch et al. [8] found that post-arrest patients' perceived cognitive impairments were not indicative of their actual cognitive impairments at 3- and 12-month follow-ups. On the contrary, Juan et al. [9] found post-arrest patients' cognitive impairments, but not depressive symptoms, to be strongly correlated with negative perceptions of recovery at 6-months; however, the incidence of depression in that cohort was low (6%), and the relatively small sample size ($n = 50$) precluded definitive conclusions. In samples of stroke survivors and older adults, subjects' cognitive complaints were correlated with emotional well-being and depressive symptoms, rather than objective measures of cognitive impairment [10,11].

There is strong support linking psychological sequelae with subjective well-being, and potentially perceived recovery, in patients with cardiac disease. For example, the prevalence of posttraumatic stress disorder (PTSD) secondary to a cardiac event has ranged from 0 to 38% (averaging 12%) [12]. This condition has been linked to negative illness perceptions, emotional distress, reduced quality of life, and preoccupation with somatic symptoms [12]. Depressive symptoms also

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pose a challenge for cardiac patients; 20–40% meet criteria for major depressive disorder or experience an increase in chronic and persistent depressive symptoms post-diagnosis [13]. Further, in cardiac patients, depression has been found to be a stronger predictor of quality of life than measures of disease severity including cardiac function, ejection fraction, and ischemia [14].

We recently demonstrated that posttraumatic stress and depressive symptoms, not cognitive or functional impairment, were associated with cardiac arrest survivors' negative recovery perceptions at hospital discharge [15]. The present study aims to extend this work by examining the correlates of perceived recovery in these cardiac arrest survivors at 6 months after their hospital discharge. This is especially important to delineate in order to identify possible modifiable factors for improving perceived recovery, as is vital in value based health care systems. Based on the strong link between cardiac disease-induced psychological symptoms and outcomes of subjective well-being, we tested the hypothesis that depressive and PTSD symptoms are correlated with cardiac arrest survivors' long-term recovery perceptions even after accounting for cognitive status, functional independence, and medical comorbidities. In addition, we examined the stability of recovery perceptions from discharge to 6 months.

2. Methods

2.1. Screening procedure and patient enrollment

Details on the patient screening and enrollment procedure at hospital discharge can be found at Presciutti et al. [15]. Briefly, subjects were included if they were ≥ 18 years of age, resuscitated following either in-hospital or out-of-hospital cardiac arrest, admitted to Columbia University Medical Center, and survived to hospital discharge between September 2015 and September 2017.

As part of research protocol, daily intensive care unit screening identified potential participants per diagnostic codes, who were then approached for consent; participants gave written informed consent. Participation was contingent on having sufficient mental status at hospital discharge, defined as having a Cerebral Performance Category score (CPC) of 3 or less, being alert and oriented to person, place, and date, and having no presence of delirium, agitation, or sedation according to the Confusion Assessment Method for the ICU (CAM-ICU) [16] and the Richmond Agitation-Sedation Scale (RASS) [17]. Patients with significant aphasia or dysarthria were not included.

2.2. Data collection

Demographics and cardiac arrest variables were collected by a trained research coordinator at hospital discharge via chart review. Measures were collected by a trained research coordinator at approximately 6 months (median: 6.6 months, IQR 6.1–9.3) after each patient's hospital discharge date. The main outcome of this study, perceived recovery, was assessed at hospital discharge and at 6 months. Interviews took place either in person or over the telephone for those who were limited by distance or travel issues. The order of collected measures during in-person interviews was as follows: The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) [18], the perceived recovery question, the Center for Epidemiological Studies - Depression (CES-D) scale [19], the PTSD Checklist - Specific (PCL—S) scale [20], and the Lawton Instrumental Activities of Daily Living Scale (M-IADL) [21]. For follow-ups conducted over the telephone, the Telephone Interview for Cognitive Status (TICS) [22] was administered in place of the RBANS.

2.3. Measures

2.3.1. Perceived recovery from cardiac arrest

Perceived recovery was measured using a single item, "Do you feel that you have made a complete recovery from your arrest?" Response options were yes/no. This is an adapted version of a validated question used after stroke [23–27] and cardiac arrest [15,28]. Patients were categorized as having a "negative recovery perception" if they responded "no" to the recovery question. Patients who responded "yes" to the recovery question were categorized as having a "positive recovery perception."

2.3.2. Cognitive status

Cognitive status was measured through the RBANS, a 30-min battery which assesses immediate memory, semantic fluency, attention, visuospatial awareness, and delayed memory. Scores range from 40 to 160, with average scores falling within 80–119 [29]. Results were scored according to the publisher's normative data. Patients that could not attend in-patient follow-ups completed the TICS. TICS scores range from 0 (worst) to 51 (best). Scores ≤ 30 were considered impaired, a cut-off that has discriminated between demented and non-demented patients [30] and corresponded with global cognitive impairment after subarachnoid hemorrhage [31]. In this study, patients were considered cognitively impaired if they had an RBANS score of < 80 , or, for those unavailable for in-person follow-ups, a TICS score of ≤ 30 .

2.3.3. Psychological symptoms

Psychological symptoms were assessed at 6 months via the CES-D and the PCL—S, which are commonly used screeners for depression and PTSD symptoms, respectively. The CES-D queries for depressive symptomatology in the previous week. The CES-D ranges from 0 to 60; a score ≥ 16 indicates significant depression symptoms [19].

The PCL-S queries for PTSD symptomatology in relation to an identified stressful experience in the past month. In this study, PTSD symptoms were queried with reference to the acute cardiac arrest event and subsequent hospitalization. The PCL-S is a 17-item screener (scores ranging from 17 to 85) that relies on the DSM-IV conceptualization of PTSD; we used a suggested diagnostic cut-off of 36 for specialized medical settings [32].

2.3.4. Independence in instrumental activities of daily living

Independence in instrumental activities of daily living (IADLs) at 6 months was assessed through the M-IADL. The M-IADL ranges from 0 to 30, with a score of 0 signifying complete independence IADLs. In this study, patients were considered dependent in IADLs if they had an M-IADL score > 0 .

2.3.5. Medical comorbidities

The Charlson Comorbidity Index (CCI) [33] was used to capture pre-arrest medical comorbidities based on chart review. The CCI has been used extensively to predict outcomes and has been validated across clinical cohorts [34].

2.4. Statistical analyses

Fisher's Exact and Wilcoxon-Rank Sum tests were used to compare differences between respondents in demographics and outcome measures. This same approach was used to compare baseline differences between patients that were included in the study with those lost to follow-up.

Univariate logistic regression models were used to calculate odds ratios (OR) for assessing the strength of associations between single factors and perceived recovery at 6 months (negative vs. positive recovery perception). Selection of variables included in the final multivariable models was based on clinical importance and expected confounders.

Three increasingly adjusted logistic regression models (adjusted for demographics and comorbidities only; further adjusted for cognitive impairment; further adjusted for IADL dependence) were used to calculate adjusted ORs for assessing the strength of associations between PTSD and depressive symptoms, separately, with perceptions of recovery from cardiac arrest. Total scores were used for the CES-D and PCL-S and treated as continuous variables. Cognitive impairment and dependence of IADLs were treated as categorical variables as per criteria discussed above.

In addition to the main cross-sectional analysis, we also examined the extent of stability of patient perceptions from discharge to 6 months. Patients were categorized as either having a “stable negative perception” (negative perception at discharge and negative perception at 6 months), “new negative perception” (positive perception at

discharge changed to a negative perception at 6 months), “stable positive perception” (positive perception at discharge and positive perception at 6 months), or “new positive perception” (negative perception at discharge changed to a positive perception at 6 months).

3. Results

3.1. Participant characteristics

Information on the overall sample enrollment can be seen in Fig. 1. No significant differences were found between those with a negative recovery perception from those with a positive recovery perception in terms of demographic characteristics (Table 1). Patients that were lost to follow-up had significantly shorter length of stays in both the

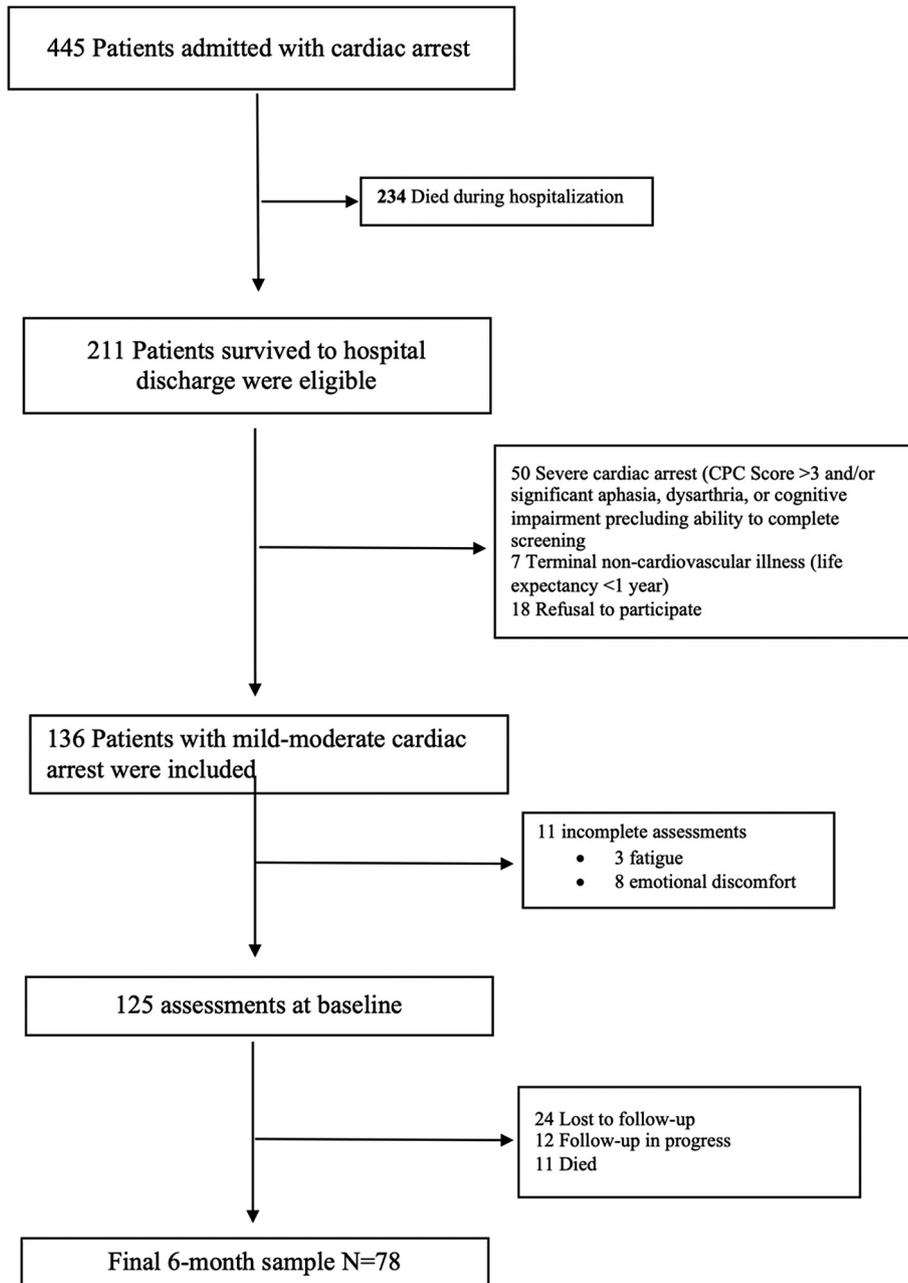


Fig. 1. Flow chart of patient enrollment.

Table 1
Association between demographics, comorbidity, and cardiac arrest factors and recovery perception.

Patient characteristic	Negative recovery perception (53%; n = 41)	Positive recovery perception (47%; n = 37)	P-value
Demographics			
Age, mean ± SD ¹	55.9 ± 16.6	52.3 ± 14.9	0.30
Male, % (n)	60.9 (25)	70.3 (26)	0.47
Race, % (n)			0.27
White	48.8 (20)	59.4 (22)	
Black	17.1 (7)	8.1 (3)	
Hispanic	29.3 (12)	18.9 (7)	
Asian	4.9 (2)	13.5 (5)	
Insurance, % (n)			0.96
Medicare	22 (9)	27.8 (10)	
Medicaid	19.5 (8)	19.4 (7)	
Combined	9.8 (4)	8.3 (3)	
Private	36.6 (15)	36.1 (13)	
Uninsured	12.2 (5)	8.3 (3)	
Annual income, % (n)			0.16
<\$45,000	30 (12)	14.3 (5)	
>\$45,000	70 (28)	85.7 (30)	
Smoking, % (n)			0.73
Never Smoker	48.7 (19)	57.6 (19)	
Former Smoker	36 (14)	27.3 (9)	
Current Smoker	15.4 (6)	15.2 (5)	
Recent alcohol consumption, % (n)	18 (7)	27 (10)	0.41
Comorbidities at time of cardiac arrest			
Obese, % (n) [BMI ≥ 30 kg/m ²]	40 (16)	33.3 (12)	0.64
Charlson Comorbidity Index, median (IQR ²)	2 (1–4)	3 (1–4)	0.25
Premorbid Psychological Diagnosis, % (n)	22 (9)	11.1 (4)	0.23
Premorbid CPC ³ , % (n)			0.17
CPC 1	83 (34)	97.2 (35)	
CPC 2	9.8 (5)	0 (0)	
CPC 3	7.3 (3)	2.8 (1)	
Arrest related factors			
In-hospital Arrests, % (n)	63.4 (26)	55.6 (20)	0.49
CPR ⁴ , % (n)			0.41
No CPR	5 (2)	14.7 (5)	
Bystander CPR	20 (8)	17.7 (6)	
CPR provided by EMS or medical personnel	75 (30)	67.7 (23)	
Defibrillation, % (n)			0.9
No Defibrillation	23.1 (9)	27.3 (9)	
Bystander Defibrillation	2.6 (1)	3 (1)	
Defibrillation provided by EMS or medical personnel	74.4 (29)	69.7 (23)	0.9
Initial Cardiac Rhythm, % (n)			0.89
Ventricular Tachycardia/Fibrillation	48.8 (20)	52.8 (19)	
Pulseless Electrical Activity	24.4 (10)	30.6 (11)	
Asystole	26.8 (11)	16.7 (6)	0.6
Return of Spontaneous Circulation (minutes), median (IQR)	9 (3–18)	6 (3–15)	0.42
Targeted Temperature Management, % (n)	39 (16)	38.9 (14)	0.58
Length of ICU ⁵ Stay (days), median (IQR)	11 (6–20)	10 (4–18)	0.5
Length of Hospital Stay (days), median (IQR)	25 (15–36.5)	23 (10–38)	0.31
Discharge Disposition, % (n)			0.31
Home	36.6 (15)	52.8 (19)	
Inpatient Rehabilitation	53.7 (22)	36.1 (13)	
Skilled Nursing	9.8 (4)	11.1 (4)	

¹ SD Standard Deviation.

² IQR Interquartile Range.

³ CPC Cerebral Performance Category scale.

⁴ CPR Cardiopulmonary Resuscitation.

⁵ ICU Intensive Care Unit.

intensive care unit ($p < .05$) and the hospital ($p < .01$) and were less likely to receive bystander CPR by nonmedical personnel ($p < .05$) compared to those included (Table 1 Supplemental).

3.2. Correlates of perceived recovery at 6-months after cardiac arrest

37.5% ($n = 15$) of patients that received the RBANS had below average cognitive functioning, according to the publisher's normative data. After including patients who received the TICS, 26.9% ($n = 21$) of the total sample were cognitively impaired. There were no significant differences between those with a negative vs positive recovery perception in terms of cognitive status (Table 2).

64.1% ($n = 50$) of patients were dependent in at least one aspect of IADLs based on the M-IADL; patients with a negative recovery perception had a trend towards worse dependence in IADLs compared to those with a positive perception ($p = .06$) (Table 2)

Regarding psychological symptoms, 32.1% ($n = 25$) of patients had probable depression based on the suggested diagnostic cut-off on the CES-D and 28.2% ($n = 22$) had probable PTSD based on the suggested diagnostic cut-off on the PCL—S. Compared to patients with a positive recovery perception, patients with a negative recovery perceptions had worse CES-D ($p < .01$) and PCL-S scores ($p < .05$). Further, 80% ($n = 20/25$) of patients with probable depression and 73% ($n = 16/22$) of patients with probable PTSD had a negative recovery perception, respectively (Table 2).

Greater depressive symptoms (OR: 1.10, 95% CI [1.4, 1.16], $p < .001$) and PTSD symptoms (OR: 1.05, 95% CI [1.01, 1.10], $p < .01$) each demonstrated a significant association with negative recovery perceptions in univariate models. Regression diagnostics showed that depressive and PTSD were highly correlated (Pearson's $r^2 = 0.82$, $p < .001$), with no evidence of an interaction between the two variables ($p = .3$). Due to artifact of the collinearity between these symptoms' scores and the small sample size, two separate sets of three multivariable logistic regression models were created. Greater depressive symptoms remained significantly associated with negative recovery perceptions after adjusting for age, gender, race, CCI, impaired cognition, and dependence in IADLs (OR: 1.10, 95% CI [1.03, 1.16], $p < .01$) (Table 3). In the fully adjusted model, the association of PTSD symptoms with negative recovery perceptions approached, but did not reach, the level of statistical significance (Table 3).

3.3. Stability of perceived recovery

79.5% of patient perceptions remained stable between discharge and 6 months. The breakdown between groups was as follows: 43.5% ($n = 34$) of patients had a stable negative perception, 3.8% ($n = 3$) new negative perception, 35.9% ($n = 28$) stable positive perception, and 16.6% ($n = 13$) new positive perception

4. Discussion

This cross-sectional analysis found that depressive symptoms, not cognitive impairment, functional dependence, or medical comorbidities, were associated with cardiac arrest survivors' recovery perceptions at long-term follow-up. Patients with greater depressive symptoms were more likely to have a negative recovery perception 6-months after hospital discharge from their cardiac arrest. Overall, 80% of patients that screened positive for probable depression and 73% of patients that screened positive for probable PTSD had a negative recovery perception at follow-up. Moreover, there were no significant differences in perceptions of recovery based on cardiac-arrest related medical variables between the two groups. In addition, the vast majority of patients (79.5%) experienced no change in recovery perceptions between discharge and six months.

The incidence of patients screening positive for probable depression in this cohort (32.1%) is comparable to other studies of patients with cardiac arrest and other acute cardiovascular events [4,13,35,36]. The association between depressive symptoms and negative recovery perceptions was expected, as depression in cardiac disease has consistently been shown to be a greater predictor of quality of life than various

Table 2
Association between psychological, cognitive, and functional characteristics and cardiac arrest recovery perception.

Measures	Total Current Sample	Patients per Variable	Negative Recovery Perception	Positive Recovery Perception	p-value
Recovery Perception % (n)	–	78	53 (41)	47 (37)	–
RBANS ¹ below average (<80)*, % (n)	37.5 (15)	40	17.1 (7)	21.6 (8)	0.99
Cognitive impairment [⊗] , % (n)	26.9 (21)	78	26.8 (11)	27 (10)	0.99
Instrumental activities of daily living dependence (>0), % (n)	64.1 (50)	78	73.2 (30)	54.1 (20)	0.06
Depressive symptoms (CES-D) ² , median (IQR) ³	10.5 (3–21)	78	15 (6–25)	4 (2–12)	<0.001
Probable Depression (CES-D ≥ 16) ⁴ , % (n)	32.1 (25)	78	48.8 (20)	13.5 (5)	<0.01
PTSD symptoms (PCL-S) ⁴ , median (IQR)	26 (20–39)	78	30 (22–43)	22 (19–28)	0.01
Probable PTSD (PCL-S ≥ 36) [⊕] , % (n)	28.2 (22)	78	39 (16)	16.2 (6)	0.04

¹ RBANS = Repeatable Battery for Neuropsychological Status.

² CES-D = Center for Epidemiological Studies-Depression.

³ IQR = Interquartile Range.

⁴ PCL-S = Post-Traumatic Stress Disorder Checklist – Specific

* Cut-off for average RBANS score (Randolph, 2012).

⊗ Impairment on RBANS or Telephone Interview for Cognitive Status (TICS) if patient not available for in-person follow-up.

^ Suggested CES-D cut-off (Lewinsohn et al., 1997).

Suggested PCL-S medical setting cut-off (National Center for PTSD, 2012).

important medical predictors [14,37]. From a behavioral standpoint, depressive symptoms such as anhedonia and withdrawal have been shown to influence patients to take a passive role in their post-discharge treatment (i.e. medication nonadherence, lifestyle, and rehabilitation noncompliance) [35,38,39], which can ultimately lead to a worse perceived and actual recovery. Due to low rates of depression in Juan et al. [9], their study could not assess the effect of depressive symptoms on recovery perceptions. Overall, our findings support the notion that, when present, depressive symptomatology holds greater importance in cardiac patients' perceived recovery compared to other recovery domains. Value based health care paradigms, which strongly emphasize PROMs, must take this into account when treating such patients.

Despite 80% of patients screening for PTSD also having a negative recovery perception, PTSD symptoms approached, but did not reach, the level of a statistical association with perceived recovery. Further study examining the overlapping components of PTSD and depression, such as anhedonia and withdrawal, on recovery perceptions may uncover significant results.

This study provides further support for previous findings that cognitive impairment is not indicative of perceived recovery [8,10,11,15] and contrasts those of Juan et al. [9]. A potential explanation for the lack of association between cognition and perceived recovery may be that patients were not fully aware of the true extent of their impairments [8]. Consequent studies of similar methodology should include an insight tool to test this hypothesis.

There were no significant differences in arrest related variables between the negative and the positive perception group. These findings complement those by Agarwal et al. [40] such that arrest related variables are neither predictive of objective nor subjective long-term recovery. This finding is also consistent with the broader literature on PTSD secondary to a cardiac event in that objective measures of cardiac event severity are not associated with psychological outcomes in these patients [41].

Importantly, the vast majority of patients maintained the same recovery perception between discharge and six months. Furthermore, a sizeable percentage of patients experienced stable negative perceptions between the two time points (43.5%). The stability of these perceptions,

Table 3
Multivariable adjusted association between psychological symptoms and recovery perception.

Depression Models	Model 1			Model 2			Model 3		
	Covariates	OR	p-value	95% CI	OR	p-value	95% CI	OR	p-value
CES-D ¹ Total Score	1.10	<.01	1.04-1.16	1.10	<0.01	1.04-1.17	1.10	<0.01	1.03-1.16
Age	0.99	0.54	0.94-1.03	0.97	0.30	0.93-1.02	0.97	0.36	0.93-1.02
Gender	0.96	0.94	0.33-2.80	0.72	0.57	0.23-2.20	0.82	0.73	0.25-2.61
Race	1.12	0.60	0.74-1.68	1.21	0.40	0.78-1.89	1.18	0.47	0.75-1.85
CCI ²	0.94	0.70	0.68-1.30	0.94	0.71	0.67-1.31	0.92	0.61	0.65-1.29
Impaired Cognition				0.40	0.17	0.11-1.50	0.40	0.17	0.11-1.48
Dependent IADLs ³							1.60	0.44	0.48-5.35

¹CES-D = Center for Epidemiological Studies Depression.

²CCI = Charlson Comorbidity Index.

³IADLs = Instrumental activities of daily living.

PTSD Models	Model 1			Model 2			Model 3		
	Covariates	OR	p-value	95% CI	OR	p-value	95% CI	OR	p-value
PCL-S ¹ Total Score	1.05	0.01	1.01-1.10	1.05	0.03	1.00-1.09	1.04	0.06	1.00-1.09
Age	0.99	0.65	0.94-1.03	0.98	0.45	0.94-1.03	0.98	0.52	0.94-1.03
Gender	0.81	0.68	0.29-2.23	0.63	0.39	0.22-1.80	0.73	0.58	0.25-2.18
Race	1.11	0.58	0.76-1.64	1.16	0.48	0.76-1.77	1.13	0.59	0.73-1.72
CCI ²	0.92	0.61	0.68-1.26	0.91	0.58	0.66-1.27	0.88	0.47	0.63-1.23
Impaired Cognition				0.59	0.38	0.18-1.94	.56	0.35	0.16-1.87
Dependent IADLs ³							1.86	0.28	0.60-5.75

¹ PCL-S = PTSD Checklist - Specific

² CCI = Charlson Comorbidity Index

³ IADLs = Instrumental activities of daily living

particularly the negative perceptions, further indicate a need to attend to factors which characterize perceived recovery (i.e. depressive symptoms) as early as possible.

Finally, the use of perceived recovery as a PROM in this study and before [15,23–28], has been validated in cardiac arrest and stroke. Continued use and analysis of this PROM in other chronic populations could reveal important underlying factors that impact a patient's experience of the recovery process.

This study is not without limitations. First, because the *Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition* (DSM-5) was published after the conception of the parent study, the measures we used for posttraumatic stress and depressive symptoms were based on the *Diagnostic and Statistical Manual for Mental Disorders—Fourth Edition (Text Revision)* (DSM-IV-TR) PTSD criteria. Despite this, DSM-IV-TR PTSD symptoms have been found to reliably yield DSM-5 estimates of the disorder [42]. Further, there were minimal alterations between the DSM-IV-TR and DSM-5 for major depressive disorder, without any changes in the core criteria symptoms.

Second, our parent study lacked a comprehensive psychopathology assessment beyond the diagnostic screeners for PTSD and depression. Additionally, despite the high prevalence of anxiety symptoms in cardiac arrest survivors, an anxiety symptom screener was not included in the parent study during the enrollment of these patients and therefore was not included in these analyses. Employing a formal psychiatric evaluation is necessary to accurately capture the prevalence of patients meeting diagnostic criteria for PTSD, depression, and anxiety disorders.

Third, the TICS was used in approximately half of the sample and may be less sensitive than the RBANS. Nevertheless, the TICS remains a robust outcome measure and the cut-off that was used has reliably differentiated between demented and non-demented patients [30] and revealed impairments in other global brain injury models such as subarachnoid hemorrhage [31].

Fourth, given the cross-sectional nature of this study, there remains the possibility that negative recovery perceptions might be an indicator of depression rather than a separate construct. Additionally, we were unable to run a longitudinal analysis between time points due to the low occurrence of patients in the change categories (i.e. new negative perception, new positive perception) which would have resulted in inadequately powered models. However, based on the finding that 79.5% of patients did not experience a change in perception from baseline, intervention may be needed to address factors associated with negative recovery perceptions (e.g. depressive symptoms).

Finally, the cohort in this study was a small convenience sample which experienced a 24% dropout rate between discharge and 6 months. As a result, these findings may not be generalizable to all cardiac arrest survivors discharged with good neurological functioning.

5. Conclusions

In contrast with cognitive and functional measures, depressive symptoms were strongly associated with cardiac arrest survivors' negative recovery perceptions. This study adds to the support that psychological symptoms are intimately tied to subjective recovery in patients with chronic cardiac conditions, and thus cannot be overlooked in the evaluation and management of such patients.

Conflicts of interest

The authors have no relevant conflicts of interest to report.
The following are the supplementary data related to this article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jccr.2018.12.011>.

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