Journal of the American Heart Association

ORIGINAL RESEARCH

Factors Associated With Health-Related Quality of Life 2 Years After Left Ventricular Assist Device Implantation: Insights From INTERMACS

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BACKGROUND: Factors related to health-related quality of life (HRQOL) 2 years after left ventricular assist device (LVAD) implantation are unknown. We sought to determine whether preimplant intended goal of LVAD therapy (heart transplant candidate [short-term group], uncertain heart transplant candidate [uncertain group], and heart transplant ineligible [long-term group]) and other variables were related to HRQOL 2 years after LVAD implantation.

METHODS AND RESULTS: Our LVAD sample (n=1620) was from INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support). Using the EuroQol-5 Dimension Questionnaire (EQ-5D-3L), a generic HRQOL measure, and the Kansas City Cardiomyopathy Questionnaire (KCCQ-12), a heart failure–specific HRQOL measure, multivariable linear regression modeling was conducted with the EQ-5D-3L Visual Analog Scale (VAS) score and KCCQ-12 overall summary score (OSS) as separate dependent variables. Two years after LVAD implant, the short-term group had a significantly higher mean VAS score versus the uncertain and long-term groups (short-term: 75.18 [SD, 20.62]; uncertain: 72.27 [SD, 20.33]; long-term: 70.87 [SD, 22.09], P=0.01); differences were not clinically meaningful. Two-year mean scores did not differ by group for the KCCQ-12 OSS (short-term, 67.85 [SD, 20.61]; uncertain, 67.79 [SD, 19.31]; long-term, 67.08 [SD, 21.49], P=0.80). Factors associated with a worse VAS score 2 years postoperatively (n=1205) included not working; not having a short-term LVAD; and postoperative neurological dysfunction, greater health-related stress, coping poorly, less VAD self-care confidence, and less satisfaction with VAD surgery, explaining 28% of variance (P<0.001). Factors associated with a worse KCCQ-12 OSS 2 years postoperatively (n=1250) included not working; history of high body mass index and diabetes mellitus; and postoperative renal dysfunction, greater health-related stress, coping poorly, less VAD self-care confidence, less satisfaction with VAD surgery, and regret regarding VAD implantation, accounting for 36% of variance (P<0.001).

CONCLUSIONS: Factors related to HRQOL 2 years after LVAD implantation include demographic, clinical, and psychological variables.

Key Words: heart failure ■ left ventricular assist device ■ quality of life

Health-related quality of life (HRQOL) is poor in patients with advanced heart failure (HF) and improves from before to up to 5 years after continuous flow left ventricular assist device (LVAD) implantation.[1–7] Factors related to HRQOL from before to early after LVAD implantation include severity of illness, comorbidities, higher preimplant HRQOL, worse clinical course, and post implant adverse events.[1,8] Factors associated with worse HRQOL from pre-LVAD to 1 year post LVAD implant include higher preimplant HRQOL and post implant hospitalization.[4]

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Supplementary Material for this article is available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.121.021196

For Sources of Funding and Disclosures, see page 11.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- Factors significantly associated with worse health-related quality of life (HRQOL) at 2 years after left ventricular assist device implantation include postoperative adverse events (ie, neurological and renal dysfunction).
- These adverse events can be devastating and affect overall HRQOL and domains of HRQOL (eg, physical function and mental health); thus, assessing HRQOL is especially important in patients with these complications, in order to monitor treatment (eg, physical therapy and psychological consultation) and its potential effect on HRQOL.

What Are the Clinical Implications?

- Psychological factors (ie, greater stress related to health issues, coping poorly, less confidence in ventricular assist device self-care, less satisfaction with the outcome of ventricular assist device surgery, and more decision regret regarding ventricular assist device implantation) are significantly associated with worse HRQOL 2 years after left ventricular assist device implantation.
- These findings inform a discussion of factors that may impact HRQOL for patients considering left ventricular assist device implantation as a treatment option and, additionally, suggest areas to monitor after implant.

Nonstandard Abbreviations and Acronyms

EQ-5D-3L	EuroQol-5 Dimension Questionnaire
HT	heart transplantation
INTERMACS	Interagency Registry for Mechanically Assisted Circulatory Support
KCCQ-12	Kansas City Cardiomyopathy Questionnaire
LVAD	left ventricular assist device
OSS	overall summary score
VAD	ventricular assist device
VAS	Visual Analog Scale

Notably, HRQOL improves similarly from before through 6 to 12 months after LVAD implantation, for patients with a therapeutic goal of bridge to transplant and long-term therapy.[3,9] However, patients who are "moderately likely" of becoming eligible for heart transplantation (HT) (ie, a patient with some potential concerns related to eligibility)[10] or "unlikely" to be eligible for HT (ie, a patient with major eligibility concerns who may most likely have the LVAD as long-term therapy) have a decrement in HRQOL, from baseline to 6 months after surgery.[1] While factors associated with HRQOL early after implant have been identified, factors associated with HRQOL beyond 12 months post LVAD remain unknown. Patients with advanced HF who are considering surgical treatment options may benefit from being informed about HRQOL 2 years after surgery by intended goal of LVAD therapy and other factors.

We sought to determine whether preimplant intended goal of LVAD therapy, based on HT eligibility, and other demographic, clinical, and psychological factors, were related to HRQOL 2 years after LVAD implantation. We defined HRQOL as "the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient."[11]

METHODS

Data are the exclusive property of INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support). Thus, the data, analytic methods, and study materials will not be made available to other researchers.

Sample and Sites

Our sample was drawn from a pool of adult (aged ≥19 years) patients with a continuous-flow LVAD (as a primary implant) implanted between April 2008 and June 2013 with follow-up through June 2015 at sites participating in INTERMACS, a North American registry for patients who receive a Food and Drug Administration–approved mechanical circulatory support device to treat advanced HF. Patients with LVADs were grouped by intended goal of therapy as follows: (1) "short-term" (HT candidate listed with the United Network for Organ Sharing), (2) "uncertain" HT candidacy (possible HT candidate but not listed with United Network for Organ Sharing), or (3) "long-term" (ineligible for HT). Patients on LVAD support with uncertain HT candidacy included 3 subgroups: (1) "HT candidacy likely" (ie, a patient in whom the evaluation has not been completed but no contraindications are anticipated or in whom a current contraindication is anticipated to resolve rapidly); (2) "HT candidacy moderately likely" (ie, a patient undergoing evaluation for HT with some potential concerns that might prevent eligibility); and (3) "HT candidacy unlikely" (ie, a patient in whom major concerns have already been identified, and, at time of implant, the patient may most likely have the LVAD as long-term therapy).[10]

Data Collection

Dependent Variables

INTERMACS self-report data from the EuroQol-5 Dimension Questionnaire (EQ-5D-3L),[12] a generic HRQOL measure, and the Kansas City Cardiomyopathy Questionnaire (KCCQ-12),[13] an HF-specific HRQOL measure, were used in our analyses. Two overall HRQOL scores (the EQ-5D-3L Visual Analog Scale [VAS] score[12] and the KCCQ-12[13] overall summary score [OSS]) were included as separate dependent variables. The VAS score range is 0 to 100 (worse to best imaginable health state). The KCCQ-12 OSS is calculated from 4 domains: physical limitations, symptom frequency, quality of life, and social limitations.[13] Using a 6-point Likert scale, patients rate their health status, with higher scores equaling better health status. Both measures have acceptable psychometric support.[13–15]

Independent Variables

Independent variables from INTERMACS considered in our analyses included demographic characteristics, clinical variables, and psychological variables. Demographic variables included age (<50 years versus ≥50 years), ethnicity (Hispanic versus non-Hispanic), work status (working versus not working), and education level (less than or equal to high school versus greater than high school education). We also considered the following preimplant comorbidities/concerns: advanced age, chronic infections, chronic renal disease, currently smoking, frailty, history of solid organ cancer, high body mass index (BMI), limited social support, severe depression, major stroke, perivascular disease, pulmonary disease, severe diabetes mellitus, history of alcohol abuse, and pulmonary hypertension. Per INTERMACS data collection protocols, comorbidities/concerns represented the results of formal discussion with the medical and surgical transplant team before the decision for device implantation. The definition of these variables may vary by institution. For example, one ventricular assist device (VAD) program may use a formal questionnaire to determine the presence of limited social support, while another VAD program may make this determination via interview. Additionally, programs may differ on the level of social support that is acceptable or a "concern." This same logic applies to other variables (eg, high body mass index and severe diabetes mellitus). These data were collected from patient medical records documenting this discussion. Adverse events within the first 2 years after implant were also included, as listed in Table 1.

Psychological variables, collected via patient self-report, included single questions that identified potential issues regarding adjustment to VAD implantation: stress related to health issues, coping with this stress, confidence in LVAD self-care, satisfaction with the outcome of LVAD surgery, and decision regret regarding LVAD implantation.[10] All questions use 10-point Likert scales, except decision regret, which has a 5-point Likert scale; a lower score equals more regret.

Procedures

Participation in INTERMACS was approved by all site institutional review boards. Not all site institutional review boards required informed consent for patient participation in INTERMACS. If site institutional review boards required written informed consent, it was obtained before patient enrollment in this registry.

All data were from the INTERMACS database. Site INTERMACS coordinators enter both patient self-report data and medical records data (eg, demographic information, laboratory and test results, and information identified in free text from daily notes), on web-based data collection forms. Medical records data were from before through 2 years after LVAD implantation. Patient self-report data (ie, EQ-5D-3L and KCCQ-12) were collected before and 2 years after surgery; data from psychological questions were collected at 2 years postoperatively.

Statistical Analysis

Summary statistics included means±SDs and counts (percentages). We first examined demographic and clinical differences between patients with and without EQ-5D VAS and KCCQ-12 data at 2 years using independent samples *t* tests or chi-square tests when appropriate. Similarly, we examined these demographic and clinical variables by preoperative goal of LVAD therapy group in the larger sample of patients with HRQOL data at 2 years (ie, 1694 patients with either VAS or KCCQ-12 or both) using ANOVA. Bivariate associations between goal of LVAD therapy group and the VAS score and KCCQ-12 OSS were also examined using ANOVA. We conducted post hoc ANOVA to determine whether these 2 HRQOL measures differed among goal of therapy groups within the LVAD group with uncertain HT candidacy stratified by the 3 subgroups (HT candidacy likely, moderately likely, and unlikely). Post implant psychological variables were also compared by goal of LVAD therapy at 2 years in patients with available EQ-5D VAS data using ANOVA.

A series of analyses were conducted to examine correlates of HRQOL at 2 years post implant using independent samples *t* tests or Pearson correlations when appropriate. Demographic, clinical (comorbidities/concerns and adverse events), and psychological variables that were associated with the VAS score or KCCQ-12 OSS at the univariate level ($P<0.05$) were examined in order to determine covariates for subsequent respective analyses. Separate standard least squares multiple linear regression models explored

Table 1. Comparisons of Missing Data by Demographic and Clinical Variables (n=2910)

	Patients With VAS n=1620	Patients Without VAS n=1290	*P* Value	Patients With KCCQ-12 n=1408	Patients Without KCCQ-12 n=1502	*P* Value
Men	78	77	0.51	78	78	0.54
Age group, ≥50 y	77	75	0.26	79	74	<0.01
Non-Hispanic	94	93	0.30	94	93	0.57
Greater than high school education (n=2229)	53	48	0.01	54	49	0.03
Working for income (yes)	13	12	0.69	12	13	0.61
New York Heart Association class IV (n=2909)	73	72	0.32	74	71	0.09
Inotrope therapy	78	79	0.79	78	80	0.42
INTERMACS profile at implant			0.22			<0.01
1	11	14		10	14	
2	37	36		35	37	
3	30	29		32	28	
4 to 7	22	21		22	20	
Preimplant comorbidities/concerns						
Advanced age (yes) (n=2801)	23	20	0.15	25	19	<0.01
Chronic infections (yes) (n=2774)	<1	<1	0.09	<1	<1	0.15
Chronic renal disease (yes) (n=2819)	11	11	0.87	11	11	0.72
Current smoker (yes) (n=2777)	5	7	0.25	6	6	0.48
Frailty (n=2775)	3	4	<0.01	3	4	0.12
History of solid organ cancer (n=2777)	5	4	0.50	5	4	0.06
High BMI (n=2806)	13	12	0.46	13	12	0.61
Limited social support (n=2787)	4	4	0.49	4	4	0.32
Severe depression (n=2774)	<1	<1	0.59	<1	<1	0.51
Major stroke (n=2775)	<1	1	0.23	<1	1	0.44
Perivascular disease (n=2782)	3	3	0.82	3	3	0.57
Pulmonary disease (n=2792)	4	4	0.98	4	5	0.60
Pulmonary hypertension (n=2725)	13	12	0.60	14	11	<0.01
Severe diabetes mellitus (n=2793)	6	3	<0.01	5	4	0.03
History of alcohol abuse (n=2781)	2	2	0.28	2	2	0.68
Adverse events post implant						
Arterial non-CNS thromboembolism	<1	1	0.53	<1	1	0.58
Bleeding	46	47	0.75	47	45	0.27
Cardiac arrhythmia	29	28	0.94	28	29	0.26
Device malfunction	17	17	0.77	15	18	0.04
Hepatic dysfunction	3	3	0.39	3	3	0.72
Infection	52	54	0.24	51	54	0.20
Myocardial infarction	<1	<1	0.08	<1	<1	0.39
Neurological dysfunction	14	18	<0.01	15	17	0.04
Pericardial drainage	4	4	0.58	4	4	0.85

(*Continued*)

Table 1. Continued

	Patients With VAS n=1620	Patients Without VAS n=1290	*P* Value	Patients With KCCQ-12 n=1408	Patients Without KCCQ-12 n=1502	*P* Value
Psychiatric episode	10	9	0.09	10	9	0.19
Renal dysfunction	7	9	0.13	7	8	0.25
Respiratory failure	10	15	<0.01	10	14	<0.01
Venous thromboembolism	6	6	0.68	5	6	0.60
Wound dehiscence	1	<1	0.15	1	<1	0.27

Values are expressed as percentages. BMI indicates body mass index; CNS, central nervous system; INTERMACS, Interagency Registry for Mechanically Assisted Circulatory Support; KCCQ, Kansas City Cardiomyopathy-12 Questionnaire; NYHA, New York Heart Association; and VAS, Visual Analog Scale.

the VAS score and KCCQ-12 OSS as dependent variables with their respective covariates/correlates, as well as goal of LVAD therapy as independent variables. We also conducted 2 sensitivity analyses. In the first sensitivity analysis, we conducted the aforementioned multiple regressions stratified by goal of therapy rather than including it in the models to determine whether predictors differed by group. In the second sensitivity analysis, we conducted the aforementioned multiple regressions excluding psychological variables from the main model to determine whether clinical variables (ie, comorbidities/concerns and adverse events) that were significant in univariate analyses, would emerge as significant in multivariable regression analyses and how this might change explained variance outside of the context of the psychological variables. JMP Pro version 14.0 and SAS (SAS Institute Inc) were used for all analyses. Coauthor/statistician P.F. attests that she had full access to all data in the study and takes responsibility for its integrity and data analyses.

RESULTS

Distribution of Characteristics by Completers Versus Noncompleters and Device Strategy

Our sample was from a pool of 8186 adult patients with LVADs at 141 sites participating in INTERMACS. Two years after implant, 43% (3522 of 8186) of patients with LVAD were alive and with a device; of these, 2910 completed 2-year HRQOL follow-up, of which 1620 and 1408 had EQ-5D VAS and KCCQ-12 data, respectively (Figure). Note that 1334 had both VAS and KCCQ-12 data, while 286 had VAS and no KCCQ-12 data, 74 had KCCQ-12 and no VAS data (thus, 1694 had either or both), and 1216 had neither.

The majority of patients were aged >50 years, male, non-Hispanic, and not working (Table 1). The majority had New York Heart Association class IV HF, on inotropes, and INTERMACS profiles 2 and 3 before LVAD implantation. Of the 1290 patients who were alive and with a device at 2 years after implant but without VAS data, only 4% (n=53) were too sick to complete forms, while the majority were not seen in a clinic or did not complete forms because of administrative or unknown reasons. When noncompleters (n=1290) were compared with completers (n=1620) regarding VAS scores, more completers had greater than a high school education and a lower incidence of frailty and a higher incidence of severe diabetes mellitus before implant. After implant, completers had a lower frequency of neurological dysfunction and respiratory failure adverse events (Table 1). Similarly, of the 1502 patients who were alive and with a device at 2 years after implant but without KCCQ-12 data, only 3% (n=43) were too sick to complete forms, while the majority were not seen in a clinic or did not complete forms because of administrative or unknown reasons. When KCCQ-12 noncompleters (n=1502) were compared with completers (n=1408), more completers were ≥50 years, had greater than a high school education, and a

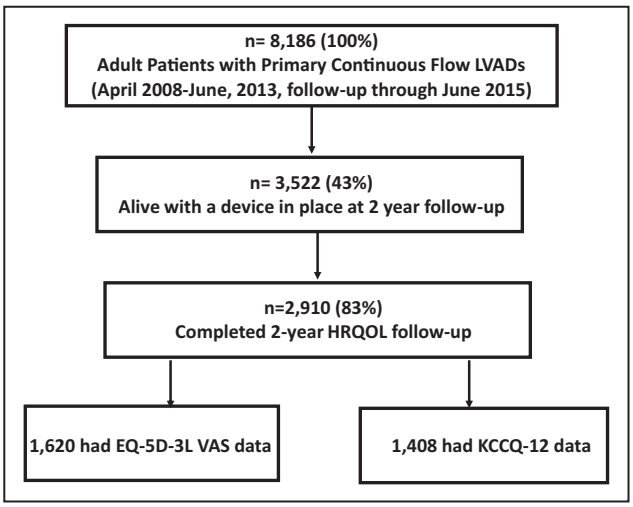

Figure 1. Patient participation flow diagram.
EQ-5D indicates EuroQol-5 Dimension Questionnaire; HRQOL, health-related quality of life; KCCQ, Kansas City Cardiomyopathy Questionnaire; and LVAD, left ventricular assist device.

higher incidence of advanced age, pulmonary hypertension, and severe diabetes mellitus before implant. After implant, completers had a lower frequency of device malfunction, neurological dysfunction, and respiratory failure (Table 1).

The total sample of 1620 patients was divided into 3 groups based on preimplant LVAD goal of therapy specific to HT eligibility, as previously defined: short-term (n=297 of 1620 [18%]), uncertain (n=511 of 1620 [32%]), and long-term (n=812 of 1620 [50%]). The uncertain subgroup sample sizes were: HT candidacy likely (n=304), HT candidacy moderately likely (n=160), and HT candidacy unlikely (n=47). These subgroups did not significantly differ on EQ-5D VAS score or KCCQ-12 OSS, but they did differ on work status and several comorbidities/concerns (Table S1). The HT candidacy unlikely group was less likely to be working and more likely to have more comorbidities/concerns than the other 2 groups (ie, advanced age, frailty, perivascular disease, pulmonary disease, and severe diabetes mellitus). We then compared the uncertain, short-term, and long-term LVAD groups on demographic and clinical variables (Table 2) and found that the long-term VAD group was older, more likely to be male, less likely to be working, and less likely to be have INTERMACS profile 1. The groups also differed by some comorbidities/concerns and adverse events (Table 2). Notably, the long-term LVAD group had more post implant bleeding, infection, and neurological dysfunction than the other 2 groups.

Differences in HRQOL by Preimplant Goal of Therapy 2 Years After Implant

At 2 years after implant, the short-term LVAD group had a significantly higher mean VAS score than the other 2 groups (*P*=0.01) (Table 3). The 2-year scores did not differ by preoperative goal of therapy for the KCCQ-12 OSS (Table 3). However, patients with long-term LVADs reported more physical limitations and yet better HRQOL, when comparing KCCQ-12 domains among the 3 groups.

Differences in Adjustment to VAD Implantation by Group at 2 Years After Implant

When responses to psychological questions were compared among the 3 groups, at 2 years after surgery, no differences were detected (Table 4). All 3 groups similarly had moderate amounts of stress related to health issues, were coping well, were confident in VAD self-care, and were satisfied with the outcome of their VAD surgery (Table 4). Just <2 of 3 of the patients in all 3 groups expressed no regret about having a VAD.

Table 2. Comparisons of Demographic and Clinical Variables by Goal of LVAD Therapy Based on Heart Transplant Eligibility for Full Sample With Either KCCQ-12 Summary Score, EQ-5D VAS Score, or Both (n=1694)

	Uncertain n=528	Short-Term n=304	Long-Term n=862	*P* Value
Men	75	74	82	<0.01
Age ≥50 y	67	64	87	<0.01
Non-Hispanic	94	92	94	0.46
Greater than high school education	39	48	42	0.05
Working for income (yes)	15	17	10	<0.01
New York Heart Association class IV (n=1693)	69	75	77	<0.01
Inotrope therapy	79	85	75	0.02
INTERMACS profile at implant				<0.01
1	17	20	8	
2	37	42	34	
3	28	20	35	
4 to 7	19	17	23	
Preimplant comorbidities/concerns				
Advanced age (yes) (n=1635)	4	0	42	<0.01
Chronic infections (yes) (n=1620)	<1	0	<1	0.39
Chronic renal disease (yes) (n=1649)	9	<1	17	<0.01
Current smoker, (yes) (n=1622)	8	0	6	<0.01
Frailty (n=1621)	3	<1	3	0.02
History of solid organ cancer (n=1621)	4	0	7	<0.01
High BMI (n=1641)	20	<1	14	<0.01
Limited social support (n=1626)	6	0	4	<0.01
Severe depression (n=1620)	<1	0	1	0.09
Other major psychological diagnosis (n=1620)	<1	0	<1	0.15
Major stroke (n=1620)	<1	0	1	0.05
Perivascular disease (n=1624)	2	0	5	<0.01
Pulmonary disease (n=1631)	3	0	7	<0.01
Pulmonary hypertension (n=1587)	14	<1	18	<0.01
Severe diabetes mellitus (n=1632)	4	0	8	<0.01

(*Continued*)

Table 2. Continued

	Uncertain n=528	Short-Term n=304	Long-Term n=862	*P* Value
History of alcohol abuse (n=1625)	4	0	2	<0.01
Adverse events post implant				
Arterial non-CNS thromboembolism	1	<1	<1	0.35
Bleeding	39	41	53	<0.01
Cardiac arrhythmia	30	34	27	0.04
Device malfunction	19	20	15	0.06
Hepatic dysfunction	2	4	3	0.30
Infection	49	47	55	0.02
Myocardial infarction	<1	<1	<1	0.78
Neurological dysfunction	12	12	17	0.02
Pericardial drainage	5	4	4	0.83
Psychiatric episode	11	10	10	0.67
Renal dysfunction	7	8	7	0.84
Respiratory failure	12	9	10	0.22
Venous thromboembolism	6	4	6	0.40
Wound dehiscence	1	<1	1	0.59

Values are expressed as percentages. BMI indicates body mass index; CNS, central nervous system; EQ-5D VAS, EuroQol-5 Dimension Questionnaire Visual Analog Score; INTERMACS, Interagency Registry for Mechanically Assisted Circulatory Support; KCCQ-12 Kansas City Cardiomyopathy-12 Questionnaire; and NYHA, New York Heart Association.

Factors Associated With Worse HRQOL at 2 Years After Implant

EuroQol-5 Dimension Questionnaire Visual Analog Score

All covariates that were associated with the VAS at the univariate level and thus were included in the multivariable model are presented in Table 5. Factors significantly associated with a worse VAS score at 2 years after implant (n=1205, including patients with data for the dependent variable and all independent variables) were not working, not being an HT candidate with LVAD support, and postoperative factors (neurological dysfunction [eg, transient ischemic attack, stroke, intracranial hemorrhage, and encephalopathy], greater stress related to health issues, coping poorly, less confidence in VAD self-care, and less satisfaction with the outcome of VAD surgery), explaining 28% of variance (P<0.001) (Table 5). While preimplant comorbidities/concerns (smoking, high body mass index, and severe diabetes mellitus) and post implant adverse events (infection and psychiatric episode) were associated with HRQOL at 2 years after implant at the univariate level, they did not remain in the multivariable model.

Kansas City Cardiomyopathy Questionnaire

All covariates that were associated with the KCCQ-12 OSS at the univariate level and thus included in the multivariable model are presented in Table 6. Factors associated with worse HRQOL at 2 years after implant, using the KCCQ-12 OSS as the dependent variable (n=1250, including patients with data for the dependent variable and all independent variables) were: not working, preimplant history of high BMI and severe diabetes mellitus, and postoperative factors: renal dysfunction, greater stress related to health issues, coping poorly, less confidence in VAD self-care, less satisfaction with the outcome of VAD surgery, and more decision regret regarding VAD implantation, accounting for 36% of variance (P<0.001) (Table 6). Intended goal of LVAD therapy was not significant. While advanced age and post implant adverse events: infection, psychiatric episode, and bleeding were significantly associated with the KCCQ-12 OSS at the univariate level, they were not in the multivariable model.

Sensitivity Analyses

When models were stratified by goal of therapy group, stress remained significant for the VAS and KCCQ-12. Both long-term LVAD support models retained coping, confidence, and satisfaction. Decision regret remained in the KCCQ-12 OSS model. Neurological dysfunction and severe diabetes mellitus were retained in the EQ-5D VAS and KCCQ-12 models, respectively (Table S2). These sensitivity analyses generally supported our main analyses. When psychological questions were removed from the main models for both the VAS and KCCQ-12, as expected, additional comorbidities/concerns and adverse events became significant, but much less variance was explained in the models. Intended goal of LVAD therapy was no longer significant (Table S3).

DISCUSSION

Two years after implant, HRQOL, measured by a generic health profile, significantly differed between patients with short-term versus long-term LVAD support, favoring patients with short-term support, although notably, the difference was not clinically important (ie, 10 points)[16] and was not detected using an HF-specific questionnaire. Similarly, Goldstein and colleagues[17] reported no significant difference in HRQOL at 2 years after implant, based on preoperative goal of LVAD therapy. However, they compared 2 groups of patients with LVAD: group1 (those who were candidates for HT and those with uncertain HT candidacy) versus group 2 (patients with LVADs who were ineligible for HT), which may have influenced their findings. Nonetheless, our findings and those of Goldstein and colleagues[17]

Table 3. EQ-5D VAS and KCCQ-12 Scores by Goal of LVAD Therapy Based on Heart Transplant Eligibility (n=1694)

	Short-Term	Uncertain	Long-Term	*P* Value
EQ-5D VAS Score	75.18 (20.62)	72.27 (20.33)	70.87 (22.09)	0.01
KCCQ-12 PL	66.15 (24.35)	66.40 (25.10)	60.25 (27.38)	<0.01
KCCQ-12 SF	76.95 (22.18)	78.88 (16.63)	76.12 (22.65)	0.11
KCCQ-12 QL	60.78 (27.39)	60.41 (24.98)	66.82 (25.98)	<0.01
KCCQ-12 SL	67.54 (26.49)	64.44 (26.71)	64.34 (28.53)	0.34
KCCQ-12 OSS	67.85 (20.61)	67.79 (19.31)	67.08 (21.49)	0.80

Values are expressed as mean (SD). EuroQol-5 Dimension Questionnaire Visual Analog Scale (EQ-5D VAS): short-term n=297; uncertain n=511; long-term n=812.

Kansas City Cardiomyopathy-12 Questionnaire (KCCQ) Physical Limitations (PL): short-term n=200; uncertain n=402; long-term n=756.

KCCQ Symptom Frequency (SF): short-term n=203; uncertain n=415; long-term n=788.

KCCQ Quality of Life (QL): short-term n=203; uncertain n=413; long-term n=782.

KCCQ Social Limitations (SL): short-term n=195; uncertain n=393; long-term n=740.

KCCQ-12 Overall Summary Score (OSS): short-term n=203; uncertain n=415; long-term n=790.

of similar overall HRQOL, regardless of intended goal of LVAD therapy, partially supports the recent Centers for Medicare & Medicaid National Coverage Decision to remove intent-to-treat criteria of bridge-to-transplant and destination therapy by removing the requirement that bridge-to-transplant patients must be active on the United Network for Organ Sharing waitlist for HT.

To our knowledge, factors related to HRQOL 2 years after implant have not been identified, which, in our study, included demographic characteristics, pre-implant comorbidities/concerns, adverse events, and psychological adjustment to life with a VAD.

Compared with the amount of variance in HRQOL explained in this article (ie, 28% using the EQ-5D VAS and 36% using the KCCQ-12 OSS), we explained 41% of variance in change in HRQOL (using the EQ-5D VAS) from baseline to 6 months after implant.[1] The somewhat lower explained variance in this study may be attributable to the other variables not included in the INTERMACS database that are associated with HRQOL later after implant.

Goal of LVAD therapy was only related to HRQOL 2 years after implant using a generic health profile. Differences in the relationship between goals of therapy

Table 4. Two-Year Post Implant Psychological Factors by Goal of LVAD Therapy Based on Heart Transplant Eligibility

Post Implant	2 y Post LVAD With EQ-5D Data	Short-Term	Uncertain	Long-Term	*P* Value
Stress related to health issues during prior 1 mo	4.19 (2.69) n=1307	4.43 (2.60) n=194	4.35 (2.65) n=394	4.04 (2.72) n=719	0.08
Coping with stress related to health issues during prior 1 mo	7.96 (2.18) n=1309	7.82 (2.23) n=194	7.94 (2.18) n=395	8.02 (2.18) n=720	0.53
Confidence in VAD self-care	8.65 (1.89) n=1307	8.72 (1.92) n=193	8.68 (1.86) n=394	8.61 (1.90) n=720	0.72
Satisfaction with outcome of VAD surgery	8.89 (1.80) n=1307	8.86 (1.93) n=194	8.86 (1.77) n=394	8.92 (1.78) n=719	0.83
Decision regret regarding VAD: *(If you had it to do all over again, would you decide to have a VAD, knowing what you now know?),* No. (%)	4.46 (0.91) n=1315	4.54 (0.83) n=196	4.43 (0.95) n=394	4.46 (0.91) n=725	0.37
Definitely no	27(2)	2(1)	10(3)	15(2)	0.91
Probably no	38(3)	6(3)	11(3)	21(3)	
Not sure	108(8)	13(7)	37(9)	58(8)	
Probably yes	266(20)	38(19)	78(20)	150(21)	
Definitely yes	875(67)	137(70)	258(65)	481(66)	

Values are expressed as mean (SD) unless otherwise indicated. EQ-5D indicates EuroQol-5 Dimension Questionnaire; LVAD, left ventricular assist device; and VAD, ventricular assist device. Stress: range 1 (no stress) to 10 (very much stress); coping: range 1 (coping very poorly) to 10 (coping very well); confidence: range 1 (not at all confident) to 10 (totally confident); satisfaction: range 1 (not satisfied) to 10 (very satisfied); decision regret: range 1 to 5 (1 [definitely no]; 2 [probably no]; 3 [not sure]; 4 [probably yes]; 5 [definitely yes]).

Table 5. Factors Associated With EQ-5D VAS Score at 2 Years Post Implant in the Multivariable Model (n=1205)

Variables	Estimates (SE)	*P* Value
Goal of LVAD therapy: not a heart transplant candidate	1.83 (0.73)	0.01
Demographic characteristics		
Not working	−2.63 (0.79)	<0.01
Preimplant comorbidities/concerns		
Smoking (no)	0.11 (1.18)	0.93
High BMI (no)	0.99 (0.81)	0.22
Severe diabetes mellitus (no)	1.77 (1.16)	0.13
Adverse events post implant		
Infection (no)	0.03 (0.52)	0.95
Neurological dysfunction (no)	1.61 (0.75)	0.03
Psychiatric episode (no)	1.18 (0.86)	0.17
Psychological questions		
Stress related to health	−2.01 (0.22)	<0.01
Coping with stress related to health	1.26 (0.30)	<0.01
Confidence in VAD self-care	1.30 (0.33)	<0.01
Satisfaction with VAD outcome	1.37 (0.36)	<0.01
Decision regret	1.01 (0.65)	0.12

BMI indicates body mass index; EQ-5D Visual Analog Scale; LVAD, left ventricular assist device; SE, standard error; VAD, ventricular assist device; and VAS, Visual Analog Scale. R^2=0.28; adjusted R^2=0.27; F=35.27; P<0.001; model degrees of freedom, 13; error degrees of freedom, 1191; and total degrees of freedom, 1204.

Table 6. Factors Associated With KCCQ-12 Overall Summary Score At 2 Years Post Implant in the Multivariable Model (n=1250)

Variables	Estimates (SE)	*P* Value
Goal of LVAD therapy: not a heart transplant candidate	−0.28 (0.69)	0.68
Demographic characteristics		
Not working	−1.88 (0.73)	0.01
Preimplant comorbidities/concerns		
Advanced age (no)	0.22 (0.58)	0.71
High BMI (no)	1.71 (0.75)	0.02
Severe diabetes mellitus (no)	4.37 (1.06)	<0.01
Adverse events post implant		
Infection (no)	0.55 (0.48)	0.25
Psychiatric episode (no)	0.56 (0.79)	0.48
Bleeding (no)	0.63 (0.48)	0.19
Renal dysfunction (no)	2.00 (0.93)	0.03
Psychological questions		
Stress related to health	−2.36 (0.20)	<0.01
Coping with stress related to health	1.30 (0.27)	<0.01
Confidence in VAD self-care	1.75 (0.30)	<0.01
Satisfaction with VAD outcome	0.94 (0.33)	<0.01
Decision regret	1.60 (0.59)	<0.01

BMI indicates body mass index; KCCQ, Kansas City Cardiomyopathy-12 Questionnaire; LVAD, left ventricular assist device; SE, standard error; and VAD, ventricular assist device. R^2=0.36, adjusted; R^2=0.35; F=45.77; P<0.001; model degrees of freedom, 15; error degrees of freedom, 1234; and total degrees of freedom, 1249.

and overall HRQOL using a generic versus HF-specific measure may be because of instrument characteristics. Lack of a relationship between the KCCQ-12 OSS and goals of therapy may be the result of improvement in all KCCQ-12 domains (ie, fewer symptoms, fewer physical and social limitations, and better QOL) from before to 2 years after implant, regardless of therapeutic intent, as demonstrated by our previous findings.[5] The relationship between goals of therapy and the EQ-5D VAS (ie, not being an HT candidate with LVAD support was related to worse HRQOL) may be because of the VAS being a single independent item (rather than a composite of domains).

Comorbidities (ie, morbid obesity and severe diabetes mellitus) were related to HRQOL 2 years after VAD implant. In the general population, HRQOL has also been shown to be decreased in severely obese patients, caused by weight and health issues, which affect physical, mental, social, and economic domains of life.[18–20] Similarly, severe diabetes mellitus is generally associated with poor HRQOL, especially in patients with complications of diabetes mellitus.[21–23]Not working was also related to worse 2-year HRQOL. The proportion of patients who worked in our study was low 2 years after implant (range, 10%–17%). In a previous study, 43% to 51% of patients with LVAD reported problems with usual activities, including work, at 2 years post implant.[5] Using a large transplant registry, rates of employment were higher in HT candidates with LVAD support versus those awaiting HT without an LVAD, although rates for both groups were <10%.[24] Factors related to return to work long-term after HT include fewer comorbidities and less physical and psychosocial functional disability, which may inform rates of return to work after device implant.[25] Further research is needed to better describe rates of working and factors related to return to work after LVAD implantation.

We have previously reported that adverse events, including neurological and renal dysfunction, were related to HRQOL early after implant.[1] Thus, it is no surprise that these 2 adverse events (ie, neurological and renal dysfunction) continue to negatively affect HRQOL 2 years after implant. Neurological dysfunction can be particularly devastating. In studies of long-term outcomes of patients with stroke, higher levels of anxiety, depression, cognitive dysfunction, and disability were associated with lower HRQOL.[26,27] Similarly, overall and domain-specific HRQOL is poor in patients with chronic kidney disease, including those on dialysis.[28,29]

Our finding of a relationship between adjustment to VAD implant and HRQOL 2 years after surgery via

single psychological questions is novel. Overall, patients in all 3 goals of LVAD therapy groups reported moderate amounts of stress, good coping, confidence in VAD self-care, and relatively high satisfaction with the outcome of their VAD surgery. The majority of surviving patients who responded to questionnaires reported having no regret about getting a VAD. We previously reported a relationship between HRQOL and health-related stress, coping, and treatment satisfaction in patients who awaited HT with a first-generation pulsatile VAD, both early and at 1 year after implant.[30,31] A few studies have reported psychological distress in patients with continuous-flow pumps.[32,33] We also reported that health-related stress, coping, and satisfaction with treatment were related to HRQOL early and long-term after HT.[34,35] Confidence in disease- and treatment-related self-care are also related to HRQOL.[36,37] The relationship between VAD implant decision regret and HRQOL is an important finding. We asked the same question of patients who underwent pulsatile VAD implantation and noted similar satisfaction with decision-making early after implant.[30] Similar to our findings, Stahl et al[38] reported no significant differences in decision regret by goal of LVAD therapy, but did find that decision regret increased long-term after implant. Our inclusion of these psychological questions suggests important future directions for a closer examination of constructs related to psychological adjustment after VAD implantation in the current era.

Implications for clinical practice can be derived from our findings. Informed patient decision-making regarding LVAD implantation as a treatment option must include not only a discussion of survival but also HRQOL and adjustment to living with an LVAD. Our 2-year post implant findings contribute information to a discussion of HRQOL, adjustment to life with a device, and factors that may influence HRQOL (including comorbidities, work, and postoperative adverse events). Additionally, our findings suggest opportunities to monitor and treat modifiable factors, (eg, stress and coping). Periodic postoperative check-ins (eg, clinic visits) with VAD team members who have mental health expertise, including social workers and psychologists, may facilitate adjustment on an individual level.

Limitations were identified. Notably, only patients alive at 2 years with an implanted LVAD who had complete HRQOL data were included in multivariable analyses, and 30% of HT candidates with LVADs underwent transplant by then, which may bias our findings. To partially address this issue, we compared cohorts with and without missing data and performed sensitivity analyses. Furthermore, regarding patients who were alive with an LVAD in place at 2 years after implant, the majority of missing data were missing at random (eg, missed clinic visits and administrative reasons), which does not influence findings, and few data were missing not at random (eg, too sick to complete forms), which can influence findings. However, some of the reasons for missing data were "unknown," which, if these data were missing not at random (eg, patients were too sick to complete questionnaires), could contribute to overestimation of HRQOL. Additionally, our cohort of patients with continuous-flow LVAD did not include patients with more recent Food and Drug Administration-approved LVADs. However, prior studies comparing HRQOL in patients with earlier continuous-flow LVADs and current LVADs did not find significant differences in patient HRQOL between devices over time, which supports our findings.[2] Also, comorbidities and concerns lacked precise definitions and were determined by formal discussion within the programmatic medical and surgical transplant teams before the decision for device implantation. Last, the psychological questions were single items rather than longer validated questionnaires or qualitative semistructured interviews, which, within the context of a registry, is appropriate, given that increased data collection and data management activities required for multiple questionnaires and interviews may increase burden on sites and registry participants and potentially result in substantial amounts of missing data. Our intent in including psychological questions was to identify areas of adjustment to living with an LVAD that may require potential clinical monitoring and treatment and may also provide guidance in opportunities for future research.

CONCLUSIONS

Factors related to HRQOL 2 years after LVAD implantation include demographic and preimplant and post implant clinical variables and variables specific to psychological adjustment. Understanding relationships between person- and health-centered factors and HRQOL 2 years after LVAD implantation provides guidance to facilitate shared decision-making when considering treatment options and postoperative enhancement of HRQOL.

ARTICLE INFORMATION

Received February 5, 2021; accepted May 24, 2021.

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Sources of Funding

This project was funded in part with federal funds from the National Heart, Lung, and Blood Institute; the National Institutes of Health; and the Department of Health and Human Services under contract number HHSN268201100025C.

Disclosures

Dr Grady is a consultant for Amgen, Inc. Dr Kirklin has financial activities outside of the submitted work with personal fees for Society of Thoracic Surgeons and Xeltis. The remaining authors have no disclosures to report.

Supplementary Material

Tables S1–S3

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SUPPLEMENTAL MATERIAL

TABLE S1. COMPARISONS OF KCCQ-12 OSS*, EQ-5D VAS† and DEMOGRAPHIC and CLINICAL VARIABLES by GOAL OF LVAD‡ THERAPY FOR PATIENTS WITH UNCERTAIN HEART TRANSPLANT CANDIDACY, (n=528)

	HT§ Candidacy Likely n=312	HT Candidacy Moderately Likely n=167	HT Candidacy Unlikely n=49	p value
Sex, % male				
Age group, % 50+	65%	68%	80%	0.12
Ethnicity, % non-Hispanic				
Education, % >high school	41%	38%	33%	0.48
Working for income, % Yes	19%	11%	6%	**0.02**
NYHA‖ class IV %	69%	68%	65%	0.86
Inotrope therapy %	81%	78%	69%	0.21
INTERMACS# profile at implant (%)				0.54
1	17%	17%	16%	
2	34%	32%	33%	
3	28%	33%	24%	
4-7	21%	17%	27%	
Pre-implant comorbidities/concerns (% yes)				
Advanced age (n=505)	2%	4%	17%	**<0.01**
Chronic infections (n=505)	<1%	1%	0%	0.42
Chronic renal disease (n=513)	6%	13%	15%	**0.02**
Current smoker (n=506)	7%	9%	9%	0.67
Frailty (n=504)	1%	3%	15%	**<0.01**
History of solid organ cancer (n=504)	3%	6%	4%	0.17
Large BMI (n=511)**	17%	27%	15%	**0.01**
Limited social support (n=505)	4%	7%	13%	0.06
Severe depression (n=504)	<1%	0%	0%	0.50
Other major psychiatric diagnosis (n=504)	<1%	0%	0%	0.71

Major stroke (n=504)	<1%	<1%	0%	0.81
Perivascular disease (n=506)	1%	1%	7%	**0.02**
Pulmonary disease (n=510)	3%	1%	11%	**<0.01**
Pulmonary hypertension (n=500)	11%	19%	18%	**0.04**
Severe diabetes mellitus (n=505)	1%	6%	15%	**<0.01**
History of alcohol abuse (n=505)	2%	5%	9%	0.07
Adverse events post-implant (% yes)				
Arterial non-CNS[††] thromboembolism	<1%	3%	0%	0.07
Bleeding	36%	44%	41%	0.27
Cardiac arrhythmia	29%	30%	29%	0.98
Device malfunction	19%	17%	24%	0.48
Hepatic dysfunction	2%	2%	2%	0.99
Infection	47%	54%	43%	0.20
Myocardial infarction	<1%	0%	0%	0.35
Neurological dysfunction	13%	12%	8%	0.65
Pericardial drainage	4%	4%	10%	0.17
Psychiatric episode	10%	13%	12%	0.72
Renal dysfunction	7%	8%	4%	0.66
Respiratory failure	12%	13%	14%	0.84
Venous thromboembolism	5%	6%	6%	0.96
Wound dehiscence	<1%	2%	0%	0.52
VAS score (n=511) Mean(SD)	72.62 (20.23)	71.99 (19.90)	70.89 (22.66)	0.85
KCCQ-12 OSS (n=415) Mean(SD)	68.43(19.34)	66.77 (18.81)	67.66(21.25)	0.72

[*]Kansas City Cardiomyopathy-12 Questionnaire overall summary score; [†]EQ-5D Visual analog scale;
[‡]left ventricular assist device; [§]heart transplantation; [‖]New York Heart Association Class; [#]Interagency Registry for Mechanically Assisted Circulatory Support; [**]body mass index; [††]non-central nervous system

TABLE S2. SENSETIVITY ANALYSES FOR EQ-5D VAS[*] AND KCCQ-12 OSS[†] REGRESSIONS STRATIFIED BY GOAL OF LVAD[‡] THERAPY BASED ON HEART TRANSPLANT ELIGIBILITY

	DEPENDENT VARIABLE: EQ-5D VAS					
	Short-term		**Uncertain**		**Long-term**	
VARIABLES	**Estimates (SE)**	**p value**	**Estimates (SE)**	**p value**	**Estimates (SE)**	**p value**
Demographic characteristics						
Not working	-3.29 (1.73)	0.06	-3.44 (1.29)	**<0.01**	-1.47 (1.26)	0.25
Pre-implant comorbidities/concerns						
Smoking (No) (see footnote)	--	--	-1.46 (1.71)	0.40	1.24 (1.64)	0.45
Large BMI[§] (No)	3.96 (6.41)	0.54	1.26 (1.16)	0.28	0.83 (1.14)	0.47
Severe diabetes mellitus (No) (see footnote)	--	--	3.60 (2.37)	0.13	1.21 (1.38)	0.39
Adverse events post-implant						
Infection (No)	0.12 (1.40)	0.93	-0.40 (0.90)	0.66	0.11(0.75)	0.89
Neurological dysfunction (No)	-0.05 (2.32)	0.98	1.05 (1.34)	0.43	2.32 (1.01)	**0.02**
Psychiatric episode (No)	-0.13 (2.22)	0.95	-0.04 (1.43)	0.98	2.25 (1.26)	0.08
Psychological questions						
Stress related to health	-1.81 (0.55)	**<0.01**	-2.11(0.39)	**<0.01**	-2.03 (0.32)	**<0.01**
Coping with stress related to health	0.45 (0.74)	0.54	0.97 (0.52)	0.06	1.68 (0.43)	**<0.01**
Confidence in VAD[ǁ] self-care	1.72 (0.96)	0.07	1.52 (0.59)	**0.01**	1.14 (0.46)	**0.01**
Satisfaction with VAD outcome	1.21 (0.97)	0.21	1.34(0.63)	**0.03**	1.31 (0.51)	**0.01**
Decision regret	3.63 (1.96)	0.07	1.79 (1.03)	0.08	-0.13 (0.93)	0.89
Model Statistics	R^2=0.29, adjusted R^2=0.25, F=7.17, p<0.001, Model DF=10, Error DF =179, Total DF=189		R^2=0.29, adjusted R^2=0.27, F=11.96, p<0.001, Model DF=12, Error DF =349, Total DF=361		R^2=0.28, adjusted R^2=0.26, F=20.56, p<0.001, Model DF=12, Error DF =640, Total DF=652	
Note: no patients in the short-term group were current smokers or had severe diabetes, thus these were excluded from the model						
	DEPENDENT VARIABLE: KCCQ-12 OSS					
	Short-term		**Uncertain**		**Long-term**	
VARIABLES	**Estimates (SE)**	**p value**	**Estimates (SE)**	**p value**	**Estimates (SE)**	**p value**

Demographic characteristics						
Not working	-3.94 (1.65)	**0.02**	-1.71 (1.21)	0.16	-1.34 (1.12)	0.23
Pre-implant comorbidities/concerns						
Advanced age (No) (see footnote)	--	--	0.94 (2.14)	0.66	0.14 (0.68)	0.84
Large BMI (No)	-5.74 (8.70)	0.51	1.10 (1.12)	0.32	2.46 (1.04)	**0.02**
Severe diabetes mellitus (No) (see footnote)	--	--	6.49 (2.28)	**<0.01**	3.57 (1.23)	**<0.01**
Adverse events post-implant						
Infection (No)	-2.78 (1.31)	**0.04**	0.81 (0.86)	0.35	1.16 (0.67)	0.08
Psychiatric episode (No)	2.38 (2.13)	0.27	-1.19 (1.33)	0.37	1.26 (1.14)	0.27
Bleeding (No)	0.45(1.29)	0.73	0.09 (0.89)	0.92	0.92 (0.66)	0.17
Renal dysfunction (No)	3.80 (2.60)	0.15	3.21 (1.69)	0.06	0.89 (1.26)	0.48
Psychological questions						
Stress related to health	-2.69 (0.52)	**<0.01**	-2.40 (0.37)	**<0.01**	-2.22 (0.28)	**<0.01**
Coping with stress related to health	0.49 (0.66)	0.43	0.86 (0.48)	0.07	1.70 (0.38)	**<0.01**
Confidence in VAD self-care	1.47 (0.89)	0.11	1.64 (0.55)	**<0.01**	1.96 (0.40)	**<0.01**
Satisfaction with VAD outcome	0.55 (0.92)	0.55	0.91 (0.60)	0.13	1.07 (0.45)	**0.02**
Decision regret	4.40 (1.90)	**0.02**	1.49 (0.97)	0.13	0.89 (0.82)	0.28
Model Statistics	R^2=0.37, adjusted R^2=0.33, F=9.55, p<0.001, Model DF=11, Error DF =177, Total DF=188		R^2=0.32, adjusted R^2=0.30, F=13.17, p<0.001, Model DF=13, Error DF =356, Total DF=369		R^2=0.39, adjusted R^2=0.38, F=33.04, p<0.001, Model DF=13, Error DF =677, Total DF=690	
Note: *no patients in the short-term group were of advanced age or had severe diabetes, thus these were excluded from the model						

*EQ-5D Visual analog scale; †Kansas City Cardiomyopathy-12 Questionnaire overall summary score; ‡left ventricular assist device; §body mass index; ‖ventricular assist device

TABLE S3. SENSITIVITY ANALYSES FOR EQ-5D VAS[*] and KCCQ-12 OSS[†] REGRESSIONS WITHOUT PSYCHOLOGICAL QUESTIONS

	DEPENDENT VARIABLE: VAS	
VARIABLES	**Estimates (SE)**	**p value**
Goal of LVAD therapy: Not a heart transplant candidate	0.80 (0.69)	**0.23**
Demographic characteristics		
Not Working	-2.44 (0.79)	**<0.01**
Pre-implant comorbidities/concerns		
Smoking (No)	3.20 (1.19)	**<0.01**
Large BMI[‡] (No)	2.22 (0.82)	**<0.01**
Severe diabetes mellitus (No)	3.31 (1.21)	**<0.01**
Adverse events post-implant		
Infection (No)	0.78 (0.54)	**0.15**
Neurological dysfunction (No)	1.96 (0.76)	**0.01**
Psychiatric episode (No)	3.80 (0.88)	**<0.01**
R^2=0.05, adjusted R^2=0.04, F=9.54, p<0.001, Model DF=8, Error DF =1539, Total DF=1547		
	DEPENDENT VARIABLE: KCCQ-12 OSS	
VARIABLES	**Estimates (SE)**	**p value**
Goal of LVAD Therapy: Not a heart transplant candidate	-0.51 (0.81)	0.53
Demographic characteristics		
Not working	-2.17 (0.85)	**0.01**
Pre-implant comorbidities/concerns		
Advanced age (No)	-1.26 (0.68)	0.07
Large BMI (No)	2.68 (0.89)	**<0.01**
Severe diabetes mellitus (No)	6.31 (1.26)	**<0.01**
Adverse events post-implant		
Infection (No)	1.22 (0.57)	**0.03**
Psychiatric episode (No)	3.79 (0.92)	**<0.01**
Bleeding (No)	1.45 (0.57)	**0.01**

Renal dysfunction (No)	1.88 (1.09)	0.08
R^2=0.07, adjusted R^2=0.06, F=11.05, p<0.001, Model DF=9, Error DF=1326, Total DF=1335		

*EQ-5D Visual analog scale; †Kansas City Cardiomyopathy-12 Questionnaire overall summary score; ‡body mass index