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AGE AND GENDER DIFFERENCES AND FACTORS RELATED TO CHANGE IN HEALTH-RELATED QUALITY OF LIFE FROM BEFORE TO 6 MONTHS AFTER LVAD IMPLANTATION: FINDINGS FROM INTERMACS

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Abstract

Background—Gaps in the literature exist regarding health-related quality of life (HRQOL) early after left ventricular assist device (LVAD) surgery. The purposes of our study were to

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describe HRQOL over time, by age and gender, and identify risk factors for poor HRQOL early after LVAD implant.

Methods—Patients (n=7,353) from INTERMACS received a continuous flow LVAD as a primary implant at 133 U.S. hospitals. Of these, 5,640 patients had pre LVAD HRQOL data, and 3,353 patients had 6 month post LVAD HRQOL data. There were 2,748 patients with data at both time periods. HRQOL was measured using the EQ-5D-3L instrument. Data were collected pre-implant and 3 and 6 months post-operatively. Statistical analyses included chi square, t-tests, Pearson correlation coefficients, and multiple regression.

Results—Overall HRQOL and dimensions of HRQOL improved from before to 6 months after device implant when examined by age and gender. However, younger patients and women reported significantly more problems regarding all dimensions before implant and significantly more problems regarding pain/discomfort and anxiety/depression at both 3 and 6 months after implant. An increase in overall HRQOL from before to 6 months after implant was related to pre implant INTERMACS level 1. Factors related to a decrease in HRQOL from before to 6 months after implant were listed for heart transplant before surgery, co-morbidities, better preoperative HRQOL, adverse events within 6 months after implant, and bridge to transplant moderately likely and unlikely, and NYHA class 4 at 6 months post LVAD (R^2=41%).

Conclusions—Overall HRQOL and dimensions of HRQOL improve in subgroups of patients from before to 6 months after surgery, although differences in improvement exist. Adverse events are risk factors for decreased HRQOL across time and support the ongoing need to improve device technology with the aim of reducing adverse events.

Left ventricular assist device (LVAD) implantation alters the disease trajectory of advanced heart failure and contributes to improved survival and health-related quality of life (HRQOL) for as long as 2+ years after implant.[1–6] Understanding of HRQOL in LVAD patients has increased, yet gaps persist in understanding HRQOL by subgroups (e.g., age and gender) and risk factors for poor HRQOL outcomes. Adamson et al.[7] compared outcomes in a small sample of older versus younger patients implanted with continuous flow LVADs for bridge to transplant or destination therapy and reported improved overall HRQOL in both groups from before to 6 months after surgery. We reported improvement in HRQOL in older and younger continuous flow LVAD patients implanted for destination therapy from before to 12 months after surgery, noting that HRQOL was better at both time periods in the oldest cohort.[8] In a study of gender-based outcomes, Bogaev et al.[9] reported similarly improved overall HRQOL in both men and women 6 months after bridge to transplant continuous flow LVAD implant. Dimensions of HRQOL were not examined in two of the above studies.[7,9]

Risk factors for decreased survival after adult primary continuous flow LVAD implantation include age, gender, INTERMACS levels 1 and 2, right heart dysfunction, kidney dysfunction, and history of cardiac surgery or stroke.[1] Risk factors for decreased HRQOL after implant are largely unknown, but may include factors similar to those which contribute to decreased survival. We recently reported that re-hospitalization was related to a decrement in HRQOL from before to 1 year after implant for destination therapy.[8] Re-hospitalization was, most likely, a proxy for adverse events.

Understanding pre and post implant risk factors for poor post implant outcomes may inform selection criteria for device implantation and reinforces the ongoing need to improve device technology, in order to reduce rates of adverse events. Furthermore, when patients consider the option of LVAD implantation, it is important to inform them about risks for poor post-operative outcomes, including HRQOL.[10] Understanding differences in HRQOL by subgroups may assist clinicians to target monitoring of HRQOL in higher risk patients and tailor HRQOL-specific care.

The purposes of this study were to (1) identify differences in overall HRQOL and dimensions of HRQOL across time by age and gender, and (2) identify pre and post implant factors related to change in overall HRQOL from before to 6 months 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] Overall HRQOL and dimensions of HRQOL (mobility, self-care, usual activities, anxiety/depression, and pain/discomfort) were measured.[12, 13] We focused on the early post implant time period (i.e., < 6 months post implant) because it is a time period within which patients are adjusting to "life on a device" physically, mentally, and socially, while potentially dealing with early post implant adverse events.[14]

METHODS

Theoretical Framework

The theoretical framework which guided these analyses is modified from the framework of Spilker and Revicki[11] which demonstrates the effect of disease and treatment on HRQOL (figure 1). As per the framework, MCS is directed toward relieving heart failure and is associated with benefits and adverse events and also directly influences overall HRQOL. Demographic characteristics, heart failure and co-morbidities, and MCS-related clinical benefits and adverse events also directly influence HRQOL. Variables in INTERMACS were identified within each group of factors thought to influence HRQOL, including demographics, pre implant heart failure and co-morbidities, MCS (including implant strategy and type of support), post implant clinical benefits, and adverse events. We did not analyze relationships among these factors, but rather focused only on how these factors are related to overall HRQOL.

Sample

Subjects were enrolled in the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS).[15] Adult patients (>19 years) in this INTERMACS cohort received an FDA-approved continuous flow LVAD as a primary implant. LVAD patients were from a total pool of 7,353 patients implanted at 133 U.S. hospitals between June, 2006 and March, 2013 with follow-up through September, 2013. Of these, 5,640 patients had pre LVAD HRQOL data, and 3,353 patients had 6 month post LVAD HRQOL data. There were 2,748 patients with data at both time periods. Our age cut-off for some analyses is derived from the gerontology literature, which defines old age by subgroup as follows: 60–69=young-old, 70–79=middle-old, and 80+=old-old. We combined the subgroups (young-old, middle-old and old-old) and thus define old as 60+.[16]

Data collection

HRQOL was measured using the EQ-5D-3L, a generic, self-report instrument which includes a brief health profile and single measure of health status.[12, 13] Five dimensions of HRQOL (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) are assessed. The response format has three levels: no problems, some or moderate problems, and extreme problems. Patients also rate their overall HRQOL (i.e., health status) on a graduated (0–100), 20 cm vertical visual analog scale (VAS), with 0 = worst imaginable health state and 100 = best imaginable health state. Psychometric support for this instrument has been previously reported, including in patients with cardiovascular disease.[17, 18]

Pre and post implant medical records data were collected including demographic and behavioral data, medical and surgical history, co-morbidities, implant strategy, INTERMACS profile, hospital length of stay, re-hospitalization, survival, tests (laboratory and procedures), and device-related adverse events.

Procedures

The INTERMACS registry was approved by the Institutional Review Boards of participating institutions. Patients were consented prior to device implant or as soon as possible post-implant. For this report, EQ-5D and medical records data were collected pre-implant and at 3 and 6 months post-operatively until device removal, transplant, or death. Data were also collected regarding reasons for EQ-5D non-completion. Data were entered electronically into the INTERMACS database and analyzed at the INTERMACS data coordinating center, University of Alabama, Birmingham, AL.

Statistics

Data were analyzed using SAS software, version 9.1 (Carey, NC). Overall HRQOL was examined for the entire cohort; overall HRQOL and dimensions of HRQOL were examined by age (<60 years vs > 60 years) and gender, using mean + standard deviation for the VAS and frequencies for the five dimensions. Statistical analyses included chi square, t-tests, Pearson correlation coefficients, and forward stepwise multiple linear regression. For all analyses, level of significance was set at $p<0.05$. All available data were analyzed for each time point. Subsequently, paired t-tests and chi square were used to test the robustness of our analyses for patients with complete data pre and 6 months post implant. Change in the VAS score was also examined over time and a priori, a change of > 10 units was considered to be clinically important. This decision was based on the cancer literature, which estimates a change of 8–12 in VAS scores as a “minimally important difference (MID)” for self-rated health status among cancer patients.[19] We did not find MIDs for VAS scores in other disease states in the literature.

A VAS rating of 0 was assigned to patients too sick to respond, which increased the size of the patient group with complete data. This rating was assigned based on the spread of scores for patients who responded in a previous report on HRQOL by INTERMACS profile, wherein patients with profile 1 (i.e., critical cardiogenic shock) had pre implant VAS scores of <10.[6] Sensitivity analyses, not including patients assigned a VAS rating of 0, were conducted regarding the regression analyses.

A response level of “Extreme problems” was assigned to patients too sick to respond for the dimensions of mobility, self-care, and usual activities to reduce the potential for overestimation of HRQOL in patients who were most severely ill. Notably, 95–99% of pre implant patients with INTERMACS profile 1 reported having problems with mobility, self-care and usual activities and approximately 90%–95% of these patients reported “extreme problems” in a previous INTERMACS report.[6] No assignment of responses was made for too sick patients for the pain/discomfort and anxiety/depression dimensions, as being too sick does not necessarily indicate extreme problems regarding pain or negative emotions.

The dependent variable for the HRQOL multiple regression analysis was change in the mean VAS score from before to 6 months post LVAD implantation (n=2,748). Independent variables included the pre implant VAS, demographic characteristics (age [continuous variable], gender, race, and marital status), NYHA class, behavioral variables (current smoker and alcohol abuse), pre implant clinical variables (INTERMACS patient profile, implant strategy, co-morbidities [previous cancer, pre chronic obstructive pulmonary disease, diabetes, stroke, ascites, coronary artery disease, congenital heart disease, and history of coronary artery bypass grafting and valve surgery], interventions before implant [inotropes, dialysis, ventilator support, and implantable cardioverter defibrillator]), left ventricular ejection fraction, laboratory variables (creatinine, INR, cholesterol, and blood type), and post implant variables (adverse events [, bleeding, infection, neurological dysfunction, device malfunction, hemolysis, hepatic dysfunction, hypertension, psychiatric episode, cardiac arrhythmias, pericardial drainage, myocardial infarction, renal dysfunction, respiratory failure, right heart failure, arterial non-CNS thromboembolism, venous thromboembolism, and would dehiscence], 6 month NYHA class, and implant strategy, and resource variables [intensive care length of stay and rehospitalization]).

RESULTS

Descriptive analyses

Demographic and clinical characteristics—Characteristics of patients are described in table 1. INTERMACS patients who completed the pre-implant EQ-5D (n=5,640) were typically middle-aged, white males. Most patients were INTERMACS profile[20] 2 (i.e., progressive decline on inotropic support) or 3 (i.e., stable but inotrope dependent) at implant and listed as a bridge to transplant, likely to be listed, or destination therapy. The vast majority of patients who completed an EQ-5D pre implant were NYHA class IV. As compared to pre implant patients who completed the EQ-5D (n=5,640), non-completers (n=1,713) were significantly more likely to be non-white, less educated, and less acutely ill (e.g., lower frequency of inotrope use, ventilator support, and other VAD support) (Table 1). Regarding resource use and adverse events at 6 months after implant, patients who completed the EQ-5D survey (n=4,174) had higher rates of neurological dysfunction than non-completers (n=1,757) (Table 1).

EQ-5D-3L questionnaire completion rates—Of the 7,353patients who received continuous flow LVADs, completion rates for the EQ-5D were as follows: pre implant=77%,

3 months post implant=56%, and 6 months post implant=57% (Table 2). Reasons for EQ-5D non-completion across time are listed in table 2.

HRQOL from before to after LVAD implantation

Overall HRQOL (i.e., mean VAS score) improved significantly for the entire cohort, using all available data, from before to 6 months after LVAD implantation (Figure 2a). Pre LVAD, the majority of patients (76%) had VAS scores <50 while at 6 months post LVAD, the majority of patients (78%) had VAS scores >50 (Table 3). The majority of patients (69%) with pre and 6 mo post LVAD data (n=2,748) increased their VAS scores by >10 points, while 10% increased their VAS scores by < 10%, and 21% of patients had no change or decreased their VAS scores (Table 3). We considered a change in VAS score of >10 points as the minimal clinically important difference.[19]

Comparisons of HRQOL by age and gender

Change over time in overall HRQOL and for dimensions was similar by demographic characteristics, using all available data. Overall HRQOL improved significantly (pre to 6 months post implant) for older and younger patients (Figure 2b). Older and younger patients reported significantly fewer problems from before to 6 months after LVAD implantation for all dimensions (Figures 3–7). Similarly, men and women reported significantly improved overall HRQOL (pre to 6 months post implant) (Figure 2c) and significantly fewer problems from before to 6 months after LVAD implant for all dimensions (Figures 8–12).

Rates of problems for HRQOL dimensions were also compared cross-sectionally for age and gender within each time period, using all available data. Before LVAD implant, younger patients reported significantly more problems than older patients for all dimensions (Figures 3–7). At both 3 and 6 months after device implant, older patients reported significantly more problems than younger patients for mobility, but fewer problems regarding pain/discomfort and anxiety/depression. Prior to LVAD implantation, women reported significantly more problems for all dimensions, than men (figures 8–12). Women also reported significantly more problems than men at both 3 and 6 months after implant for usual activities, pain/discomfort, and anxiety/depression.

Sensitivity analyses

Sensitivity analyses for overall HRQOL were conducted using paired t-tests (n=1981 [excluding patients assigned a VAS score of 0]). Overall HRQOL, including by age and gender, significantly improved between pre and 6 months post implant (data not shown). Using Chi square, and paired data, (excluding patients assigned “extreme problems” if too sick to respond) significant improvement also occurred for all dimensions by both age and gender from pre to 6 months after implant (data not shown). These analyses support our findings using all available data.

Multivariable analyses

Multiple regression analyses were conducted to identify factors related to change in mean VAS score from before to 6 months after LVAD implant for patients with complete data at both time periods (including patients assigned a VAS score of 0, n=2,748) (Table 4). Pre

implant INTERMACS level 1 (i.e., critical cardiogenic shock) was associated with an increase in VAS score from before to 6 months after LVAD implant. Variables associated with a decrease in VAS score from before to after device implant were: listed for heart transplant at implant, chronic obstructive pulmonary disease, ascites, alcohol abuse, higher VAS score at implant, adverse events within 6 months of implant (renal dysfunction, respiratory failure, neurological dysfunction, and infection), and bridge to heart transplant moderately likely and unlikely and NYHA class 4 at 6 months post LVAD (R^2=41%, p<0.0001).

We plotted the effect of adverse events on change in VAS scores over 6 months by INTERMACS profiles. As per figures 13–16, greater improvement in VAS scores occurred in patients with lower INTERMACS profiles (i.e., higher severity of illness) and fewer post-operative adverse events. Patients were at approximately the same level of VAS score at 6 months after implant.

Sensitivity analyses

Sensitivity analyses (for patients with complete data at both time periods, excluding patients assigned a VAS score of 0, n=1981) were conducted regarding change in VAS score over time, using the same multiple regression approach, as the original analyses (Table 5). INTERMACS level 1 remained significantly associated with an increase in VAS score over time, and INTERMACS level 2 (progressive decline on inotropic support) also became significant, as did age and white race (not significant in the original regression analyses). A higher pre implant VAS score and bridge to transplant moderately likely at 6 months remained significantly associated with a decrease in VAS score from before to after implant; however, co-morbidities, bridge to heart transplant unlikely and NYHA class 4 at 6 months post LVAD were no longer significant. Regarding post implant adverse events, respiratory failure and neurological dysfunction were similarly significant; however, renal dysfunction and infection were no longer risk factors, while right heart failure, which was not significant in the original regression analyses, became significant in the sensitivity analyses. While the sensitivity analyses had fewer significant risk factors and some of them were different, the sensitivity analyses, none-the-less support our original regression analyses, as severity of illness, pre implant VAS score, clinical course, and post implant adverse events were significant variables in both analyses.

DISCUSSION

Advanced heart failure patients experienced improvement in overall HRQOL and dimensions of HRQOL from before to after LVAD implantation which was sustained through 6 months postoperatively, with no significant differences by age and gender. Before implant, younger patients and women reported significantly more problems in HRQOL dimensions than older patients and men. After implant, frequencies of problems differed for some dimensions by age and gender. As described within our theoretical framework, per Spilker and Reviciki,[11] change in HRQOL from before to 6 months after implant was significantly related to clinical variables, including pre implant INTERMACS level and co-morbidities, and post operative adverse events.

Our finding of improved HRQOL across time, by age and gender, from before to after implant, is similar to other reports in the VAD literature.[7–9] Our cross-sectional findings by subgroup deserve additional comment. Older patients reported more problems with mobility, as compared to younger patients, early after implant. This finding is similar to findings regarding physical function and activities of daily living after heart transplantation[21, 22] and in other chronic illness populations who undergo cardiac surgery[23] or procedures.[24, 25] We previously reported more disability in older heart transplant patients compared to younger patients regarding ambulation and work at 1 year[21] and ambulation and body care/movement at 5–10 years[22] after heart transplantation. Older dialysis patients also have worse physical function than younger dialysis patients.[24, 25] Older age was related to decline in physical function > 6 months after cardiac surgery.[23] Our current report of increased anxiety/depression in younger versus older patients before and within 6 months after implant is supported by our previous findings of more depression in younger versus older patients after heart transplantation,[26] and more anxiety and depression in younger patients in the cardiac surgical[27] and heart failure[28] literature.

We also found that women reported more problems with usual activities, pain/discomfort, and anxiety/depression than men before and at both time periods after LVAD implant. We similarly reported that women reported worse physical functional disability overall and regarding ambulation, mobility, self-care and home management, as compared to men, at 1 year after heart transplantation.[21] Long-term after heart transplantation, we also found that female gender was associated with more overall physical functional disability, and disability related to ambulation, mobility, and body care/movement than male gender.[22] Reports of differences in physical function, favoring men, have also been reported in the general cardiac surgical literature.[29, 30] Differences in anxiety/depression by gender are also supported by the literature, early and later after heart transplantation,[26, 31, 32] after cardiac surgery,[33, 34] and in patients with heart failure.[35] Our findings suggest an opportunity to focus attention on subgroups of patients to maximize HRQOL before and after device implantation.

We addressed an important gap in the VAD literature by identifying factors related to change in HRQOL from before to early after implant. In support of these findings, we previously reported that adverse events after heart transplantation are related to HRQOL both early[36] and later[37] after heart transplantation. Similarly, post-operative complications were related to HRQOL early[38, 39] and later[40] after myocardial revascularization. Lastly, the relationship between the pre implant VAS score and change in the VAS score after implant has also been demonstrated in the cardiac surgical literature. Patients with worse preoperative HRQOL had higher gains in HRQOL than patients with better preoperative HRQOL after myocardial revascularization.[41, 42]

Our report on HRQOL from INTERMACS has limitations. Survivorship bias may have contributed to overly optimistic findings. Also, lack of questionnaire completion before and after LVAD implantation limits interpretation and generalizability of our findings. However, our post hoc assignment of scores, in patients too sick to respond, enhanced completion rates and may have reduced overestimation of HRQOL across time. Additionally, we used a generic health profile rather than a heart failure specific HRQOL instrument which may not have captured disease-specific concerns. Anxiety and depression were also combined as one

question in the EQ-5D, which may be better understood as separate questions. Finally, there are variables, not collected in INTERMACS, which may have been related to MCS HRQOL, such as symptoms and specific coping mechanisms.

CONCLUSION

Overall HRQOL and dimensions of HRQOL improve in older and younger patients, as well as in men and women, from before to 6 months after LVAD implantation. Importantly, while dimensions of HRQOL improve from before to early after implant, approximately 1/3 to 1/2 of all patients report some problems after implant, which must be addressed while patients adjust to living with mechanical circulatory support. Patients who are 'sickest' have the greatest opportunity for major improvement in HRQOL after implant. Patients with co-morbidities that prevent listing for heart transplantation may have limited HRQOL improvement, although notably, we have previously reported that HRQOL also improves from before to after implant for destination therapy.[8] Adverse events have a major detrimental effect on HRQOL at 6 months. Reducing adverse events should be a central focus in efforts to further improve HRQOL. These findings support the ongoing need to evaluate co-morbid risks before implant and improve device technology to enhance post LVAD HRQOL.

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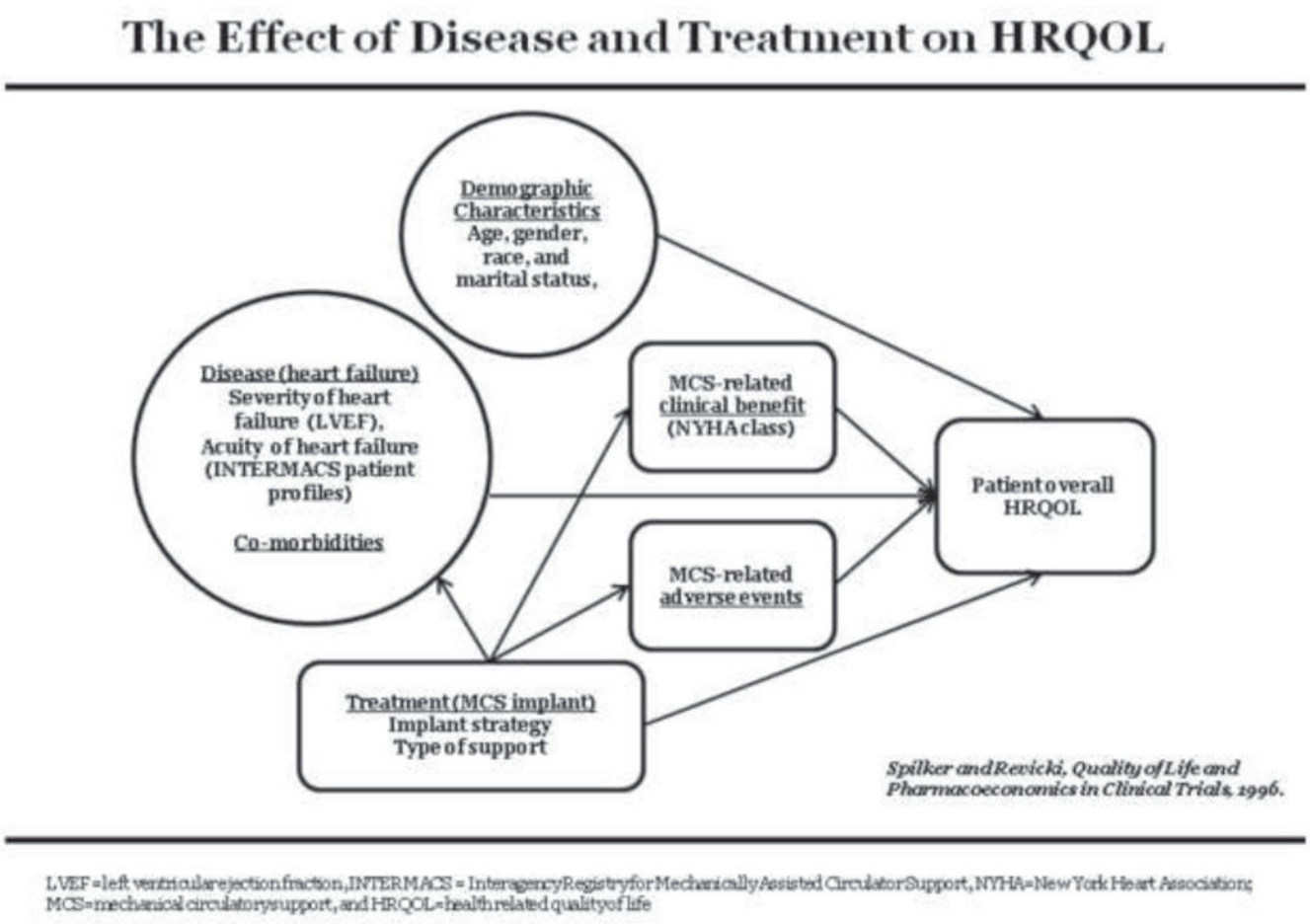

Figure 1.
Theoretical Framework of the Effect of Disease and Treatment on HRQOL, modified

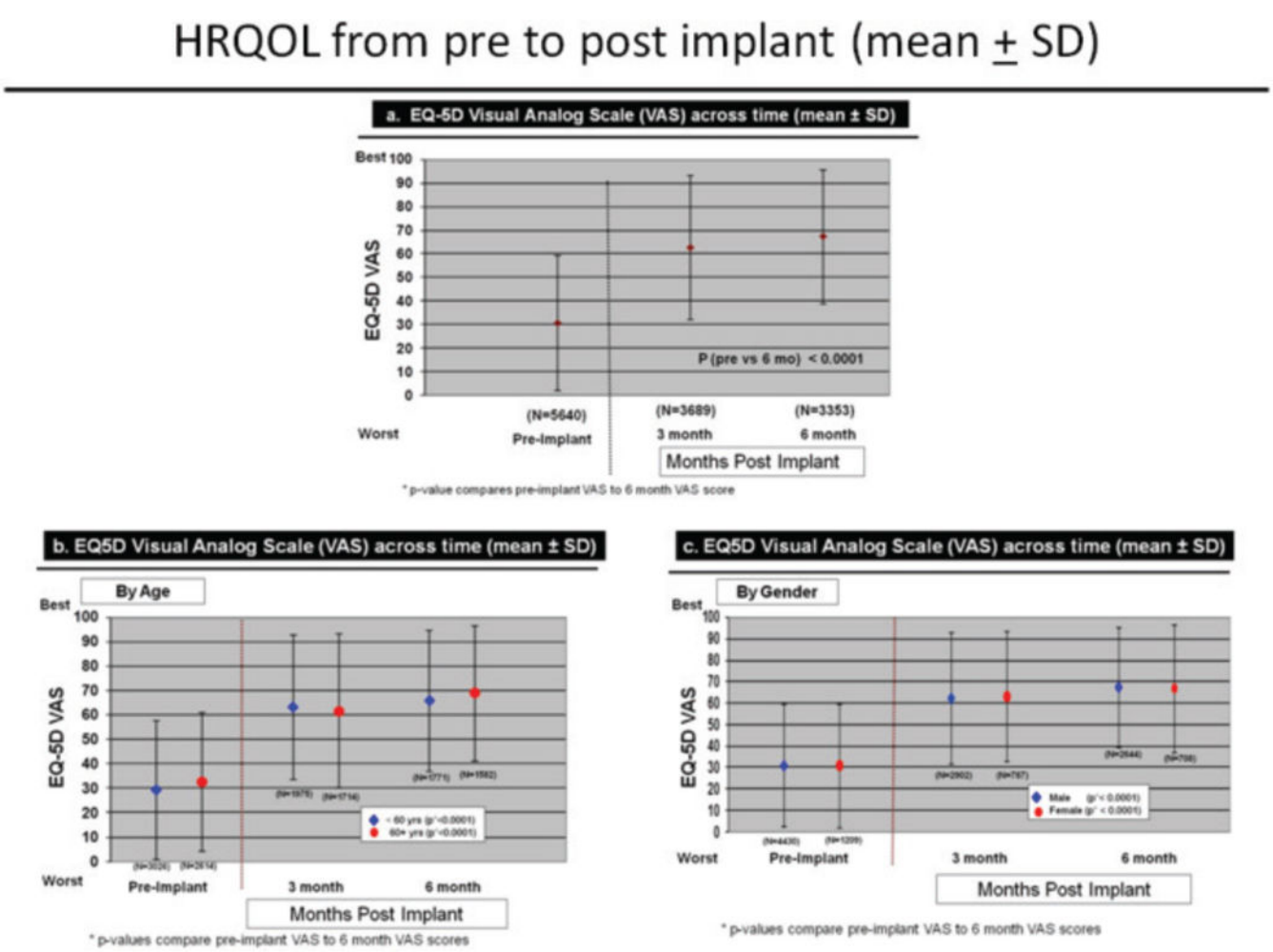

Figure 2.
Change in HRQOL Dimensions Across Time by Age

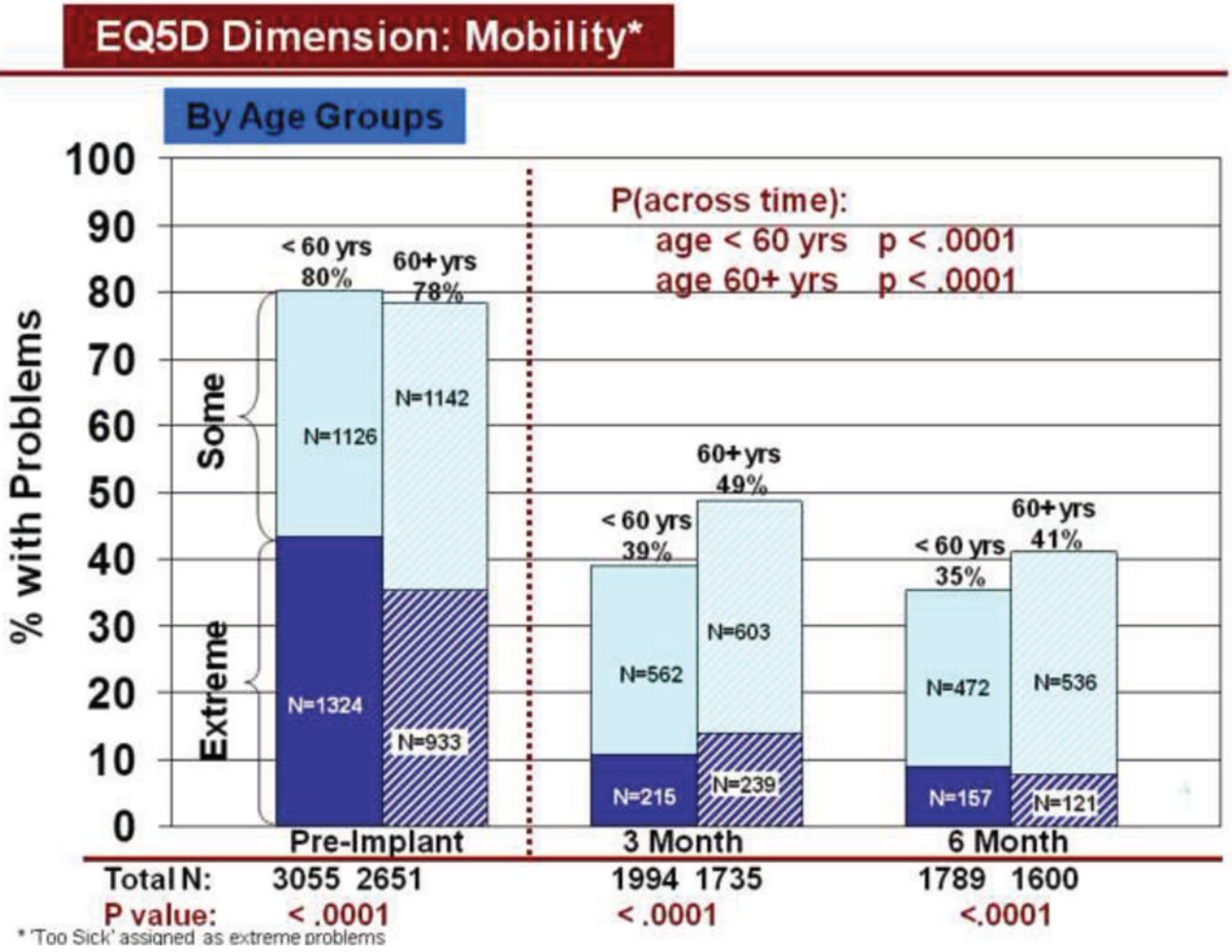

Figure 3.
Change in Mobility Across Time by Age

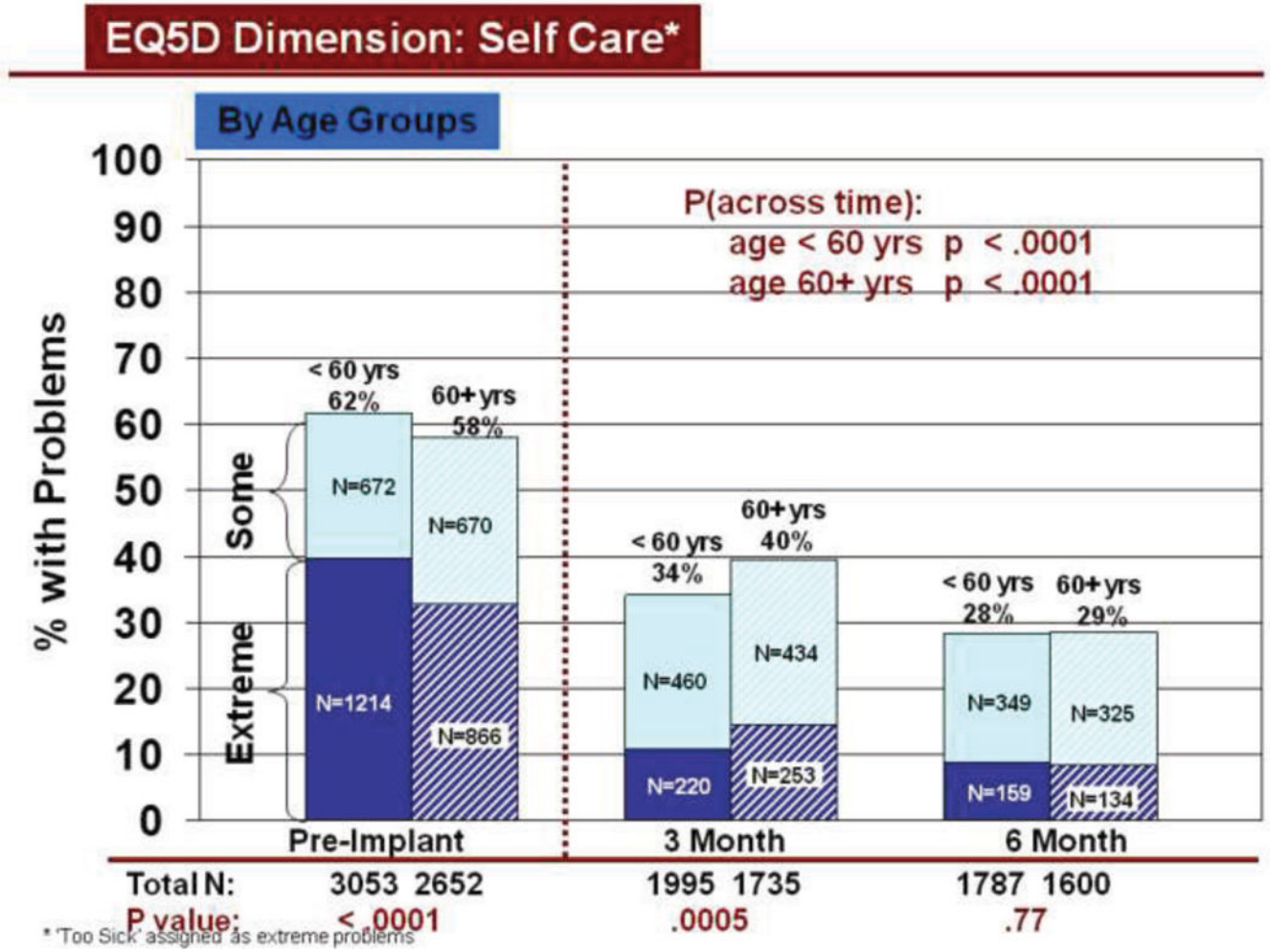

Figure 4.
Change in Self Care Across Time by Age

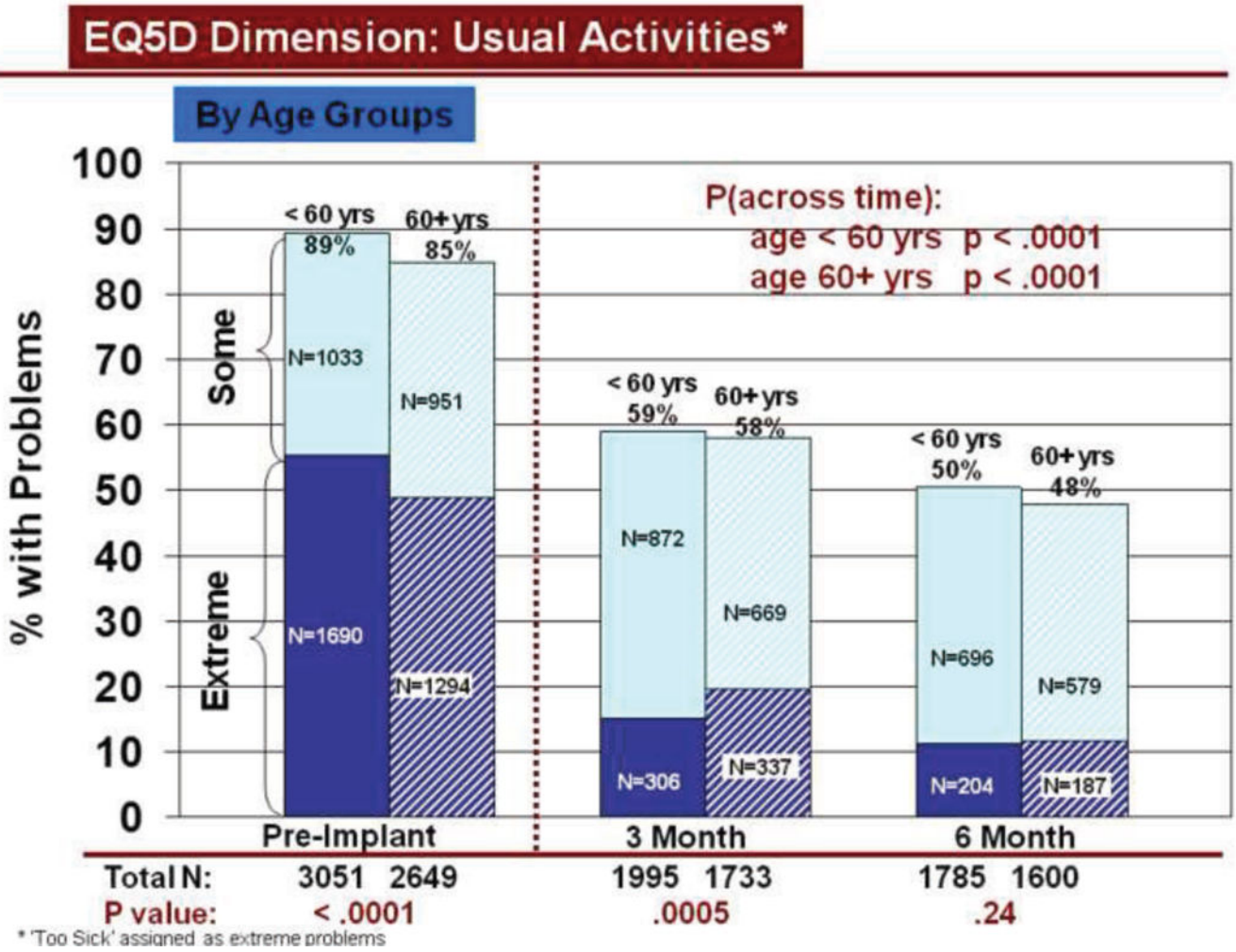

Figure 5.
Change in Usual Activities Across Time by Age

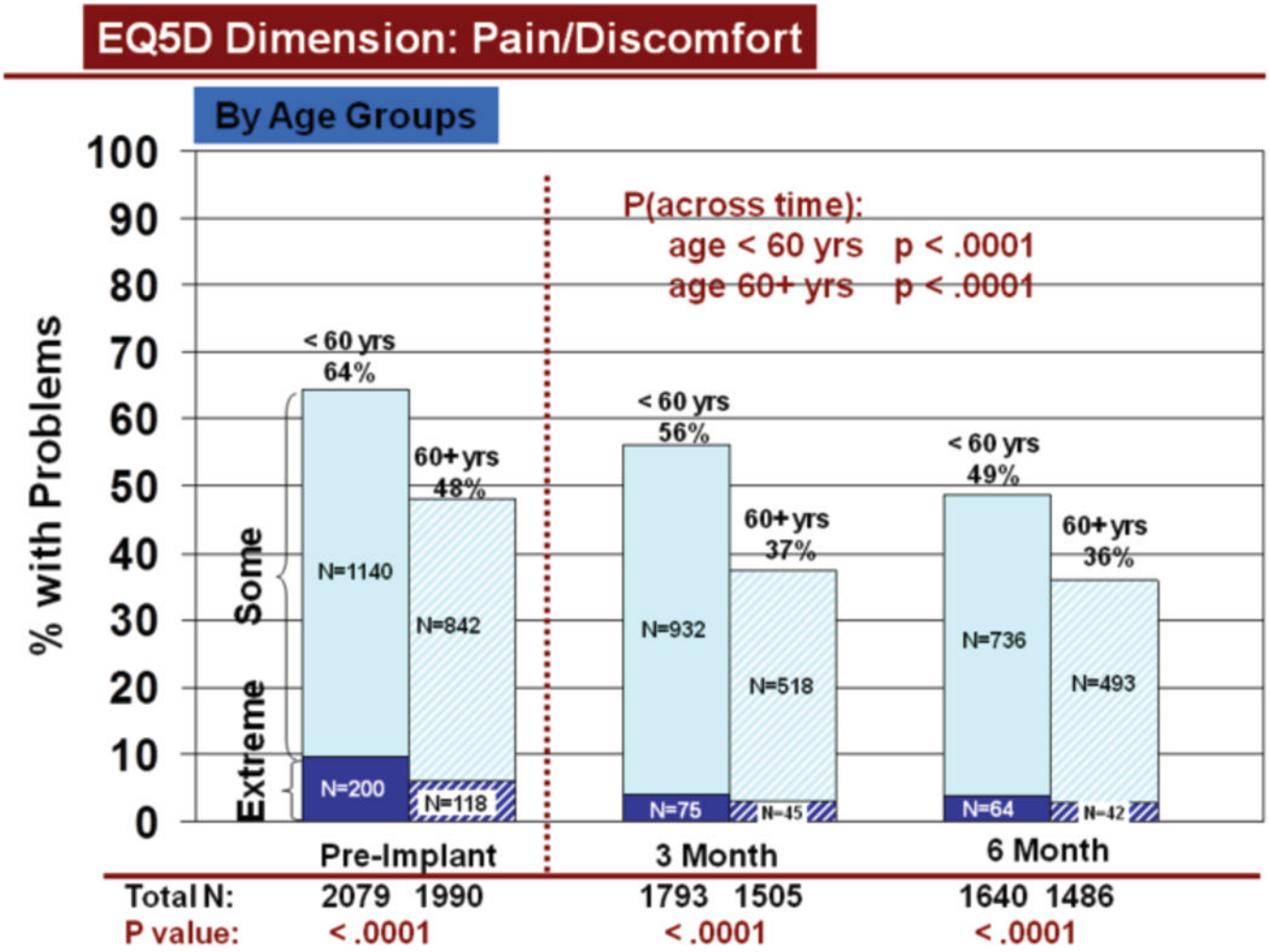

Figure 6.
Change in Pain/Discomfort Across Time by Age

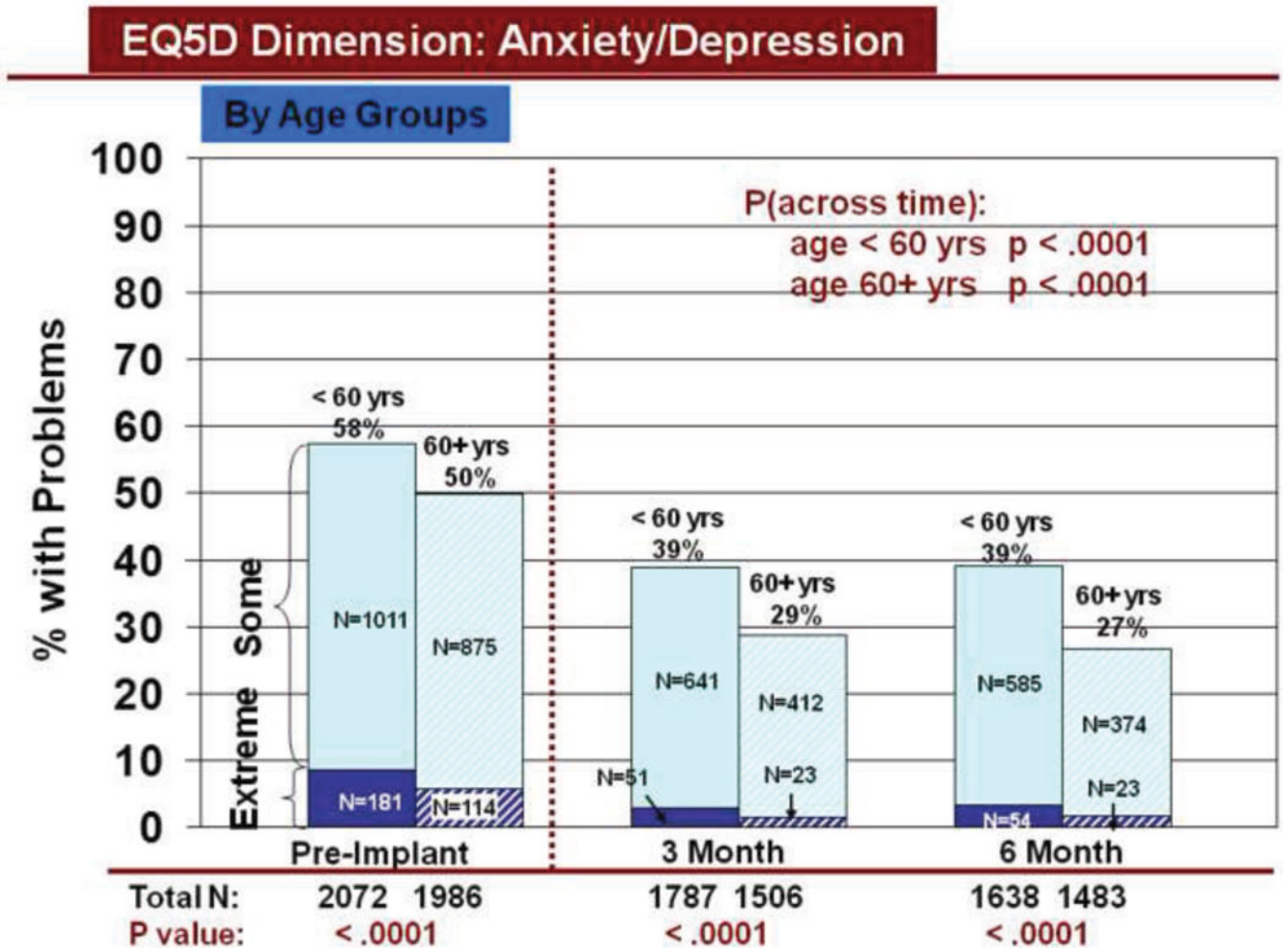

Figure 7.
Change in Anxiety/Depression Across Time by Age

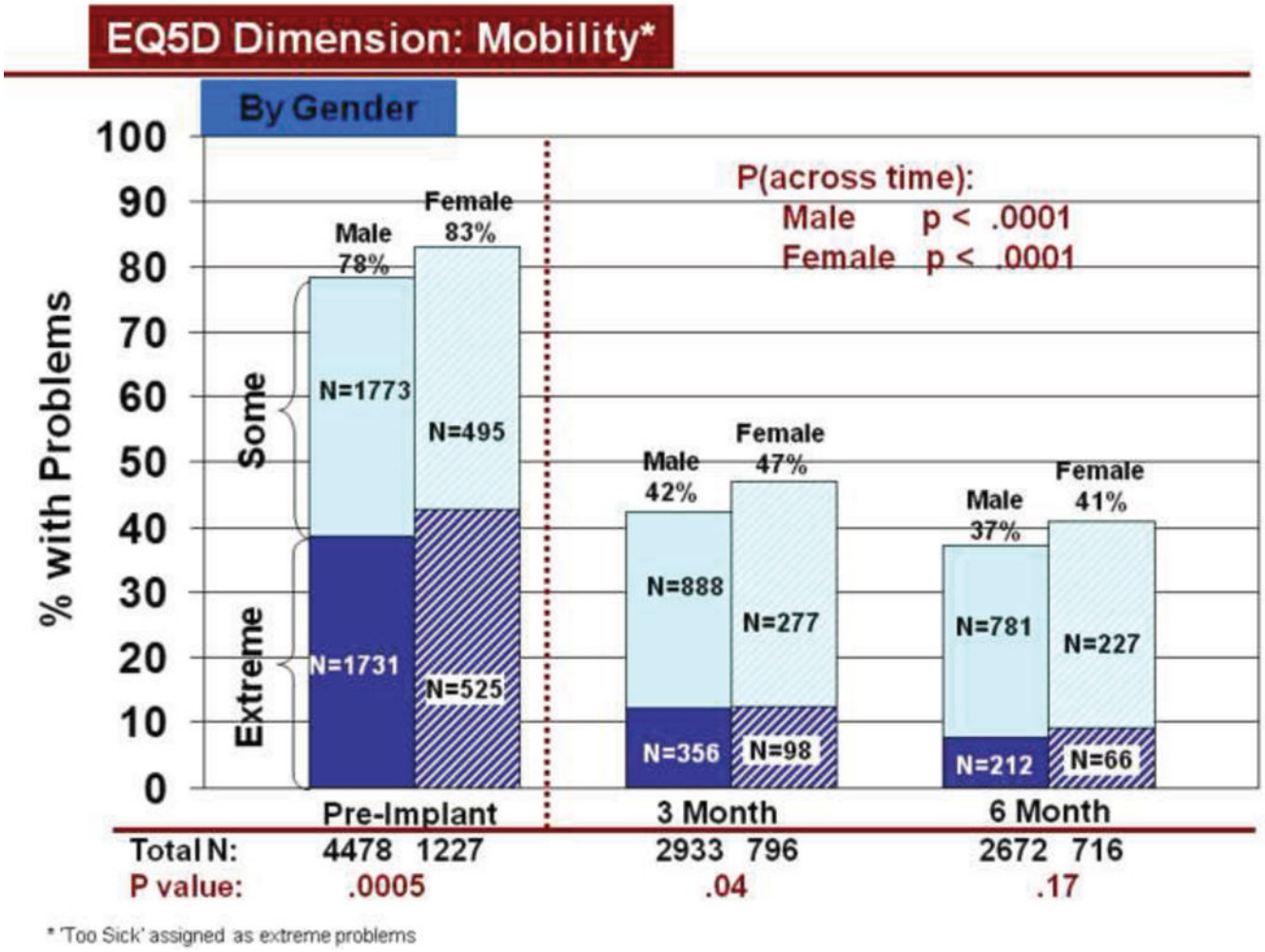

Figure 8.
Change in Mobility Across Time by Gender

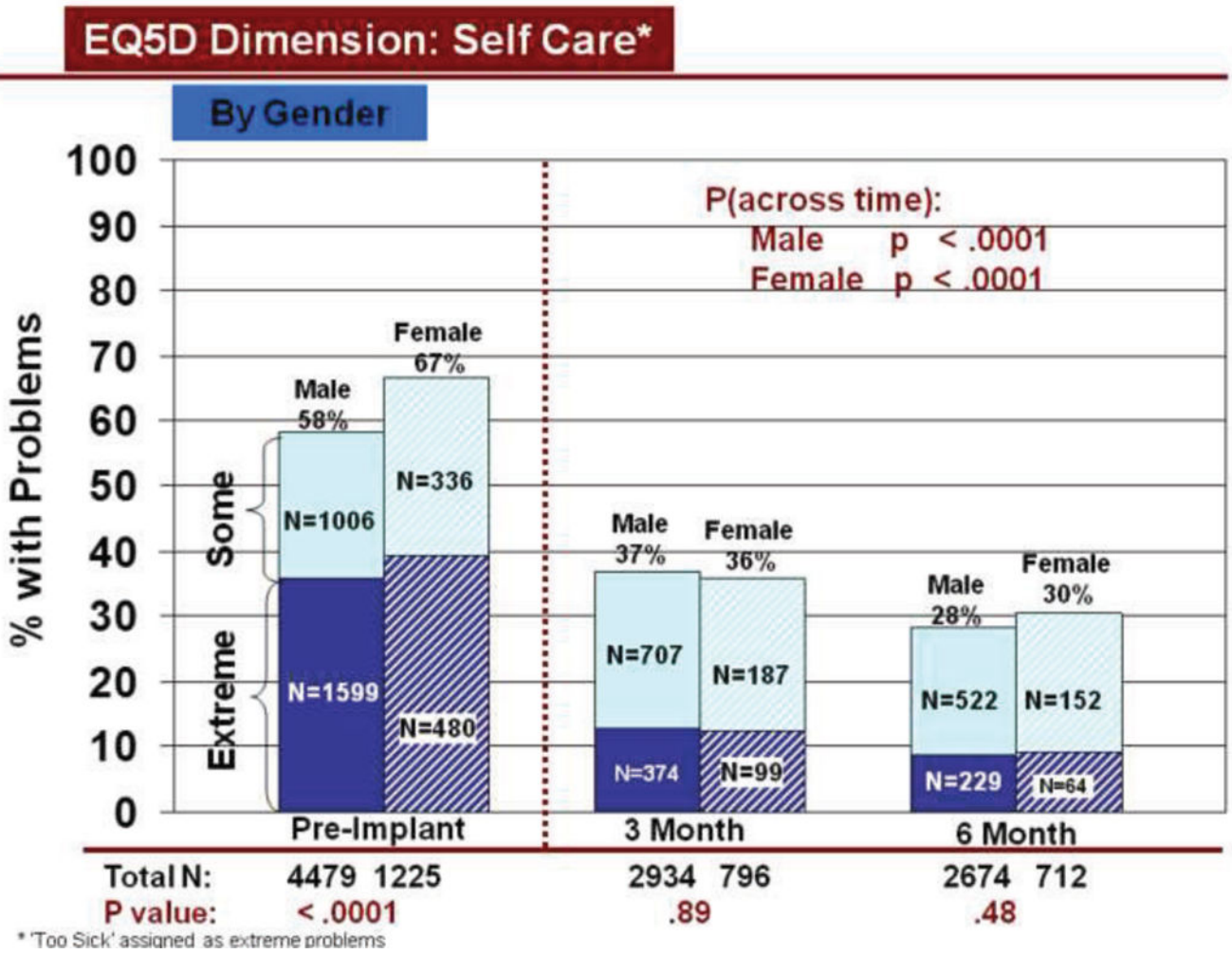

Figure 9.
Change in Self Care Across Time by Gender

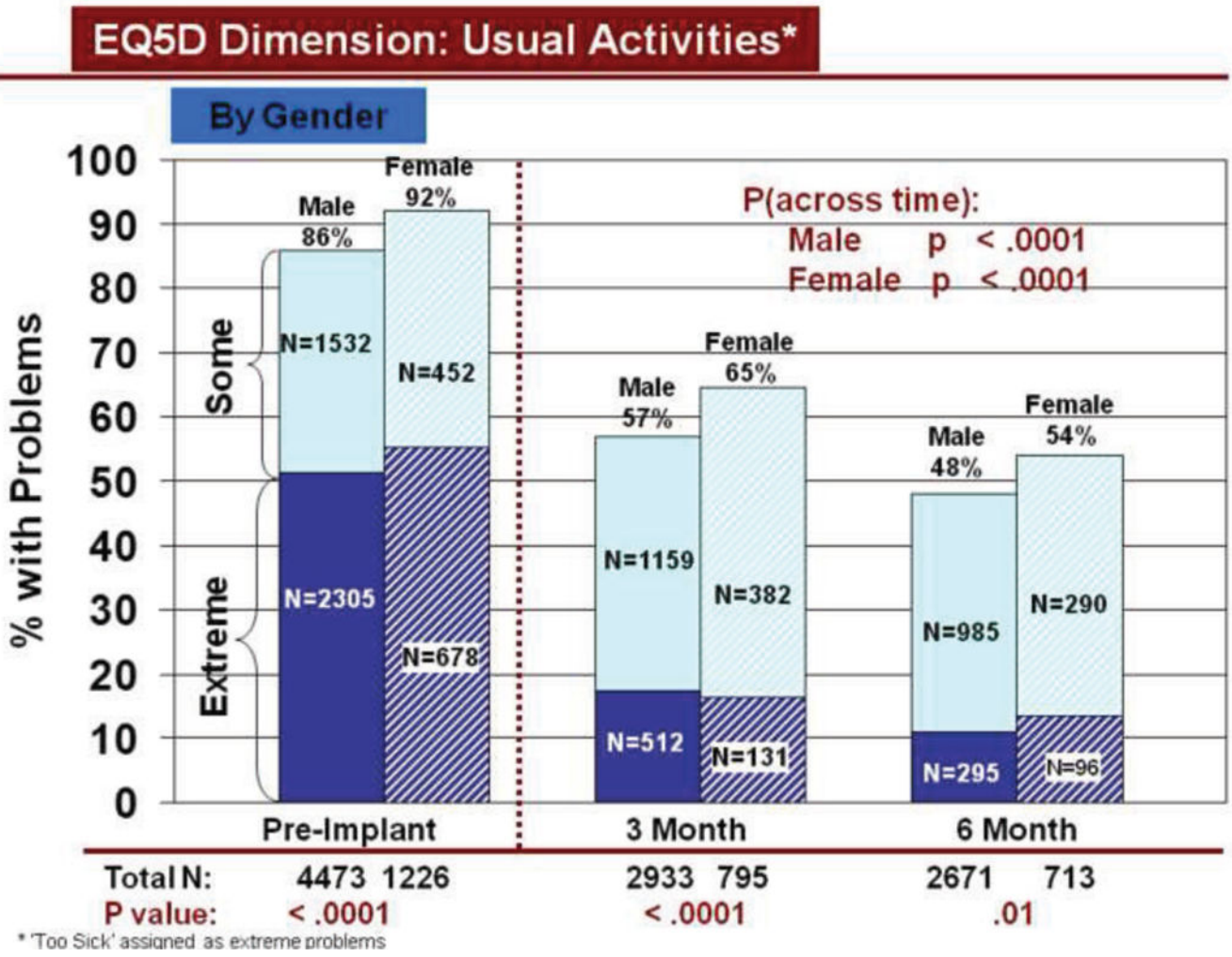

Figure 10.
Change in Usual Activities Across Time by Gender

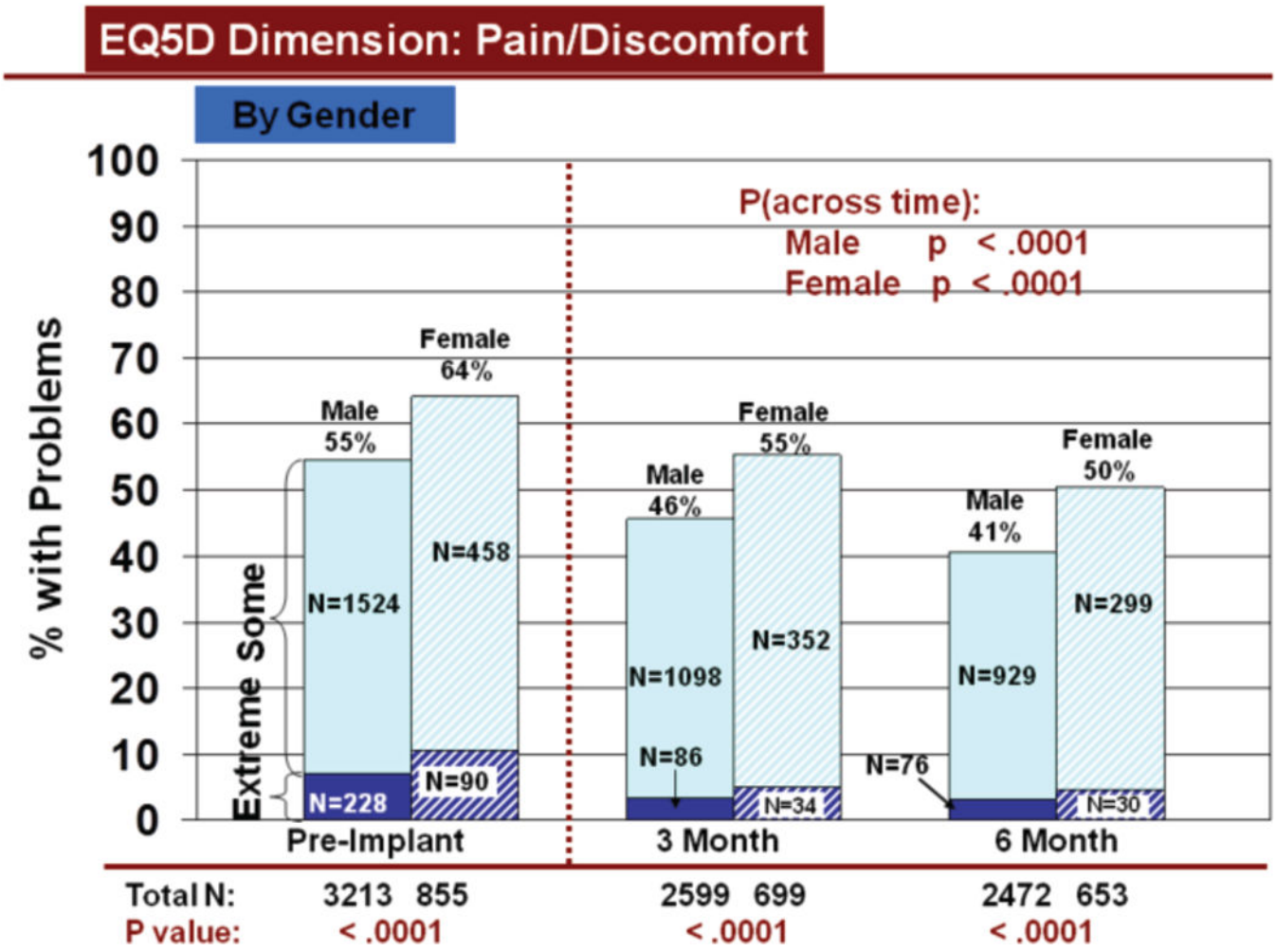

Figure 11.
Change in Pain/Discomfort Across Time by Gender

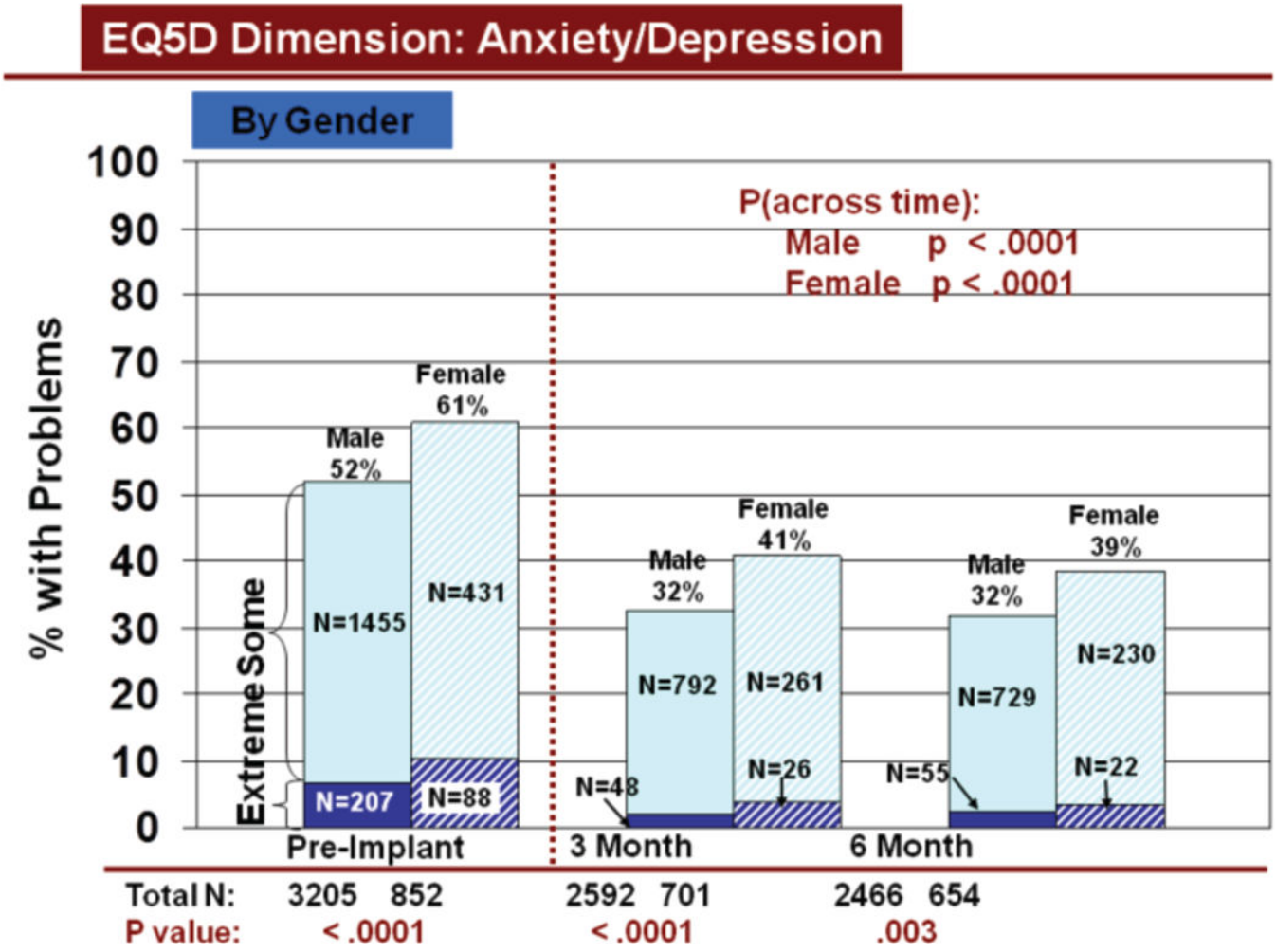

Figure 12.
Change in Anxiety/Depression Across Time by Gender

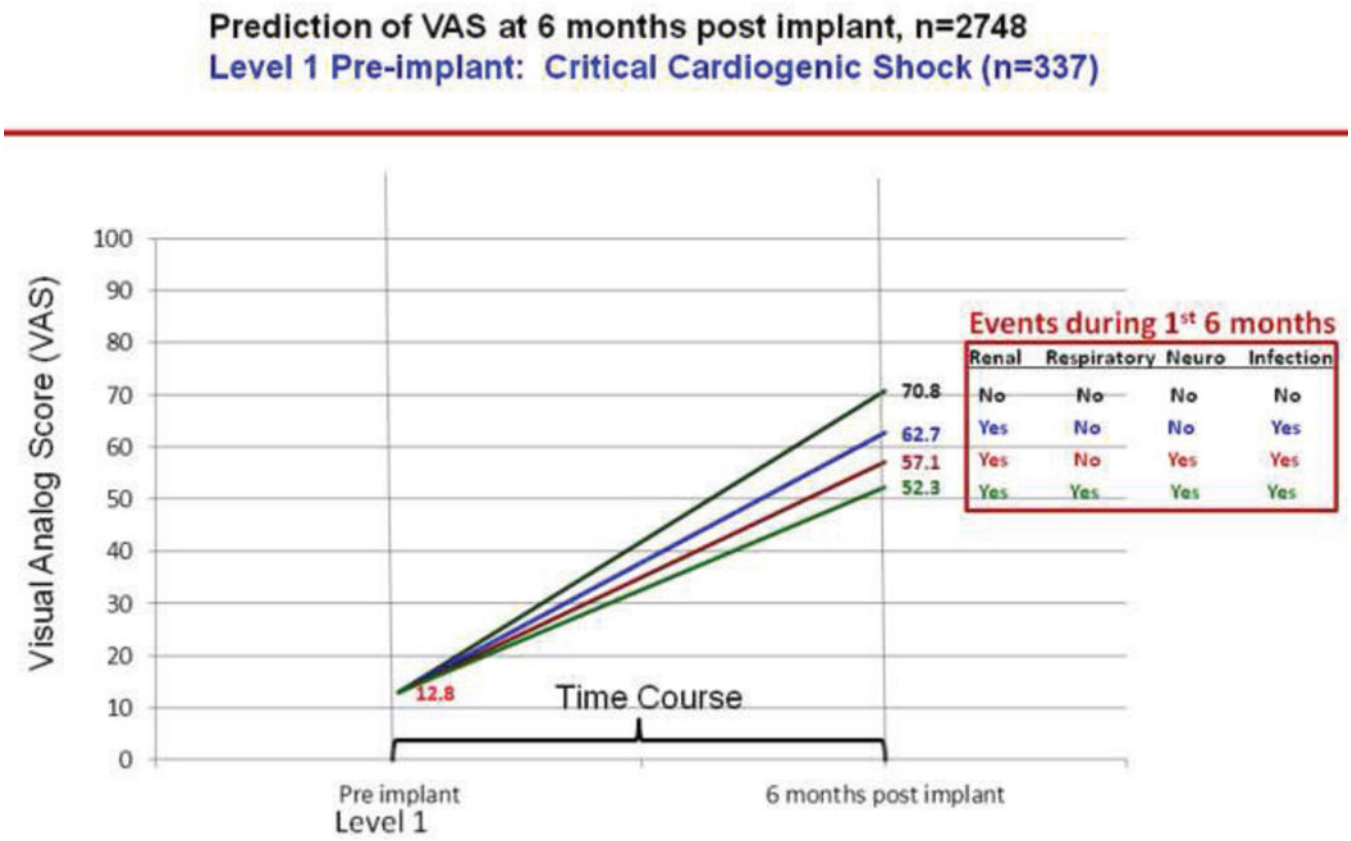

Figure 13.
Predictions of post implant VAS score by pre implant INTERMACS profile 1

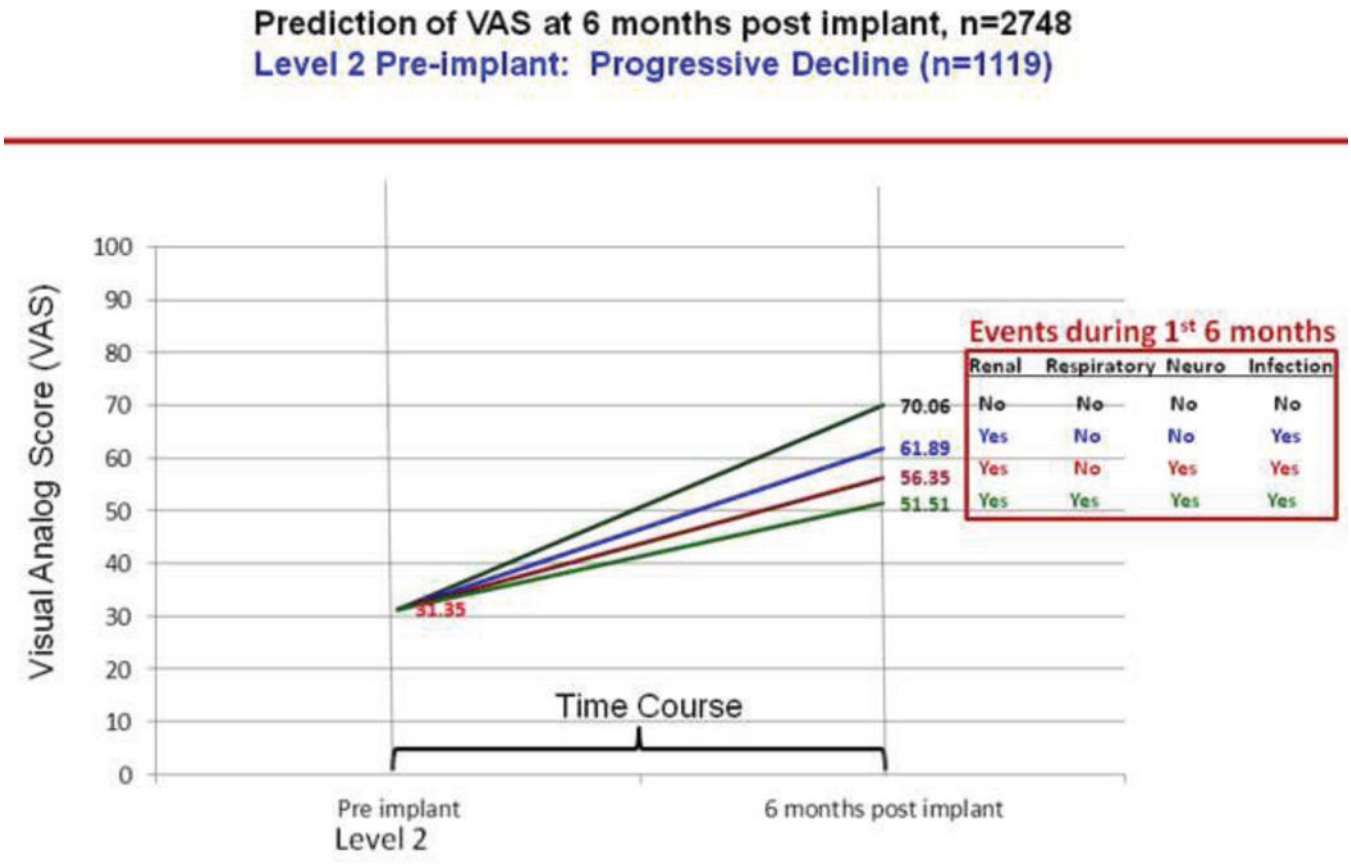

Figure 14.
Predictions of post implant VAS score by pre implant INTERMACS profile 2

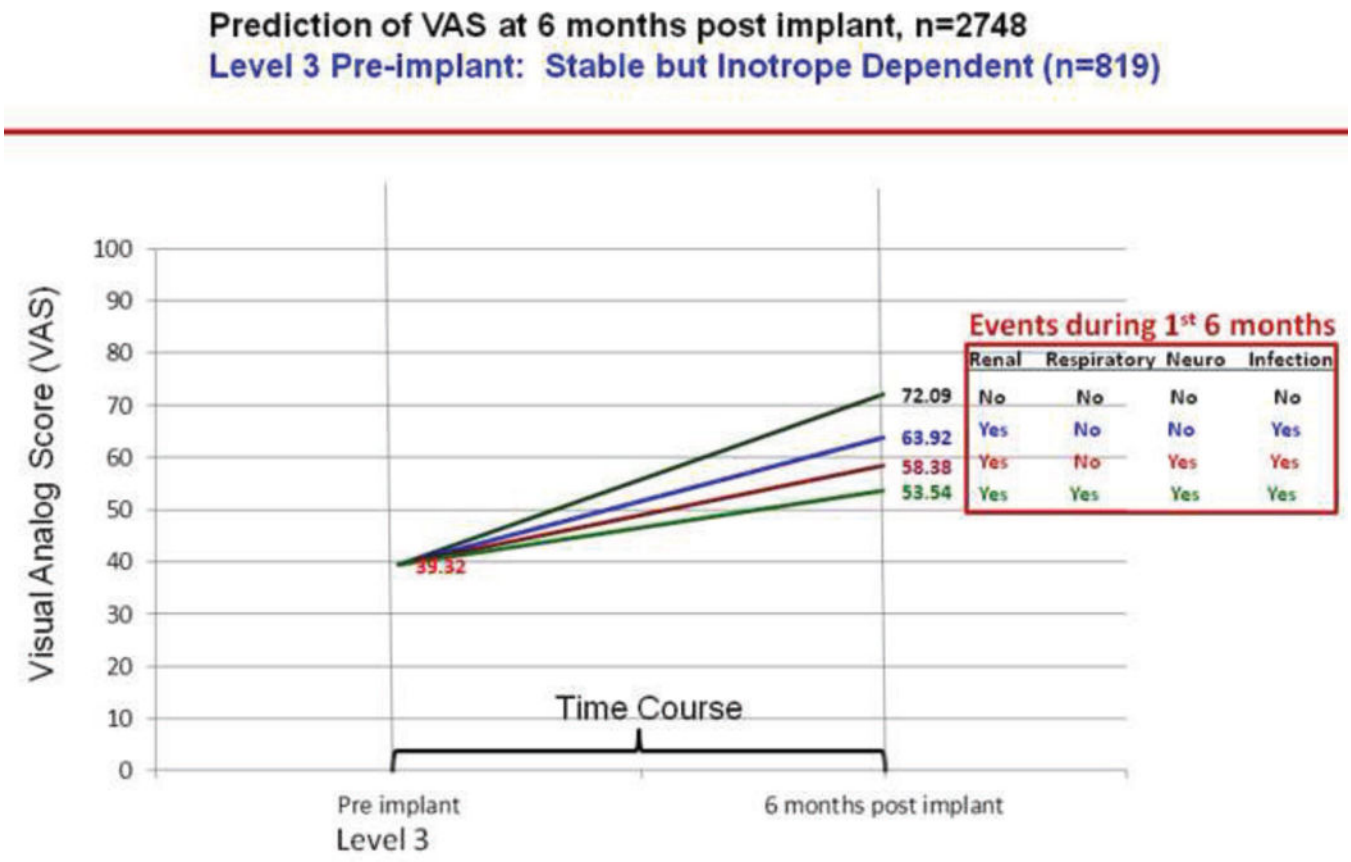

Figure 15.
Predictions of post implant VAS score by pre implant INTERMACS profile 3

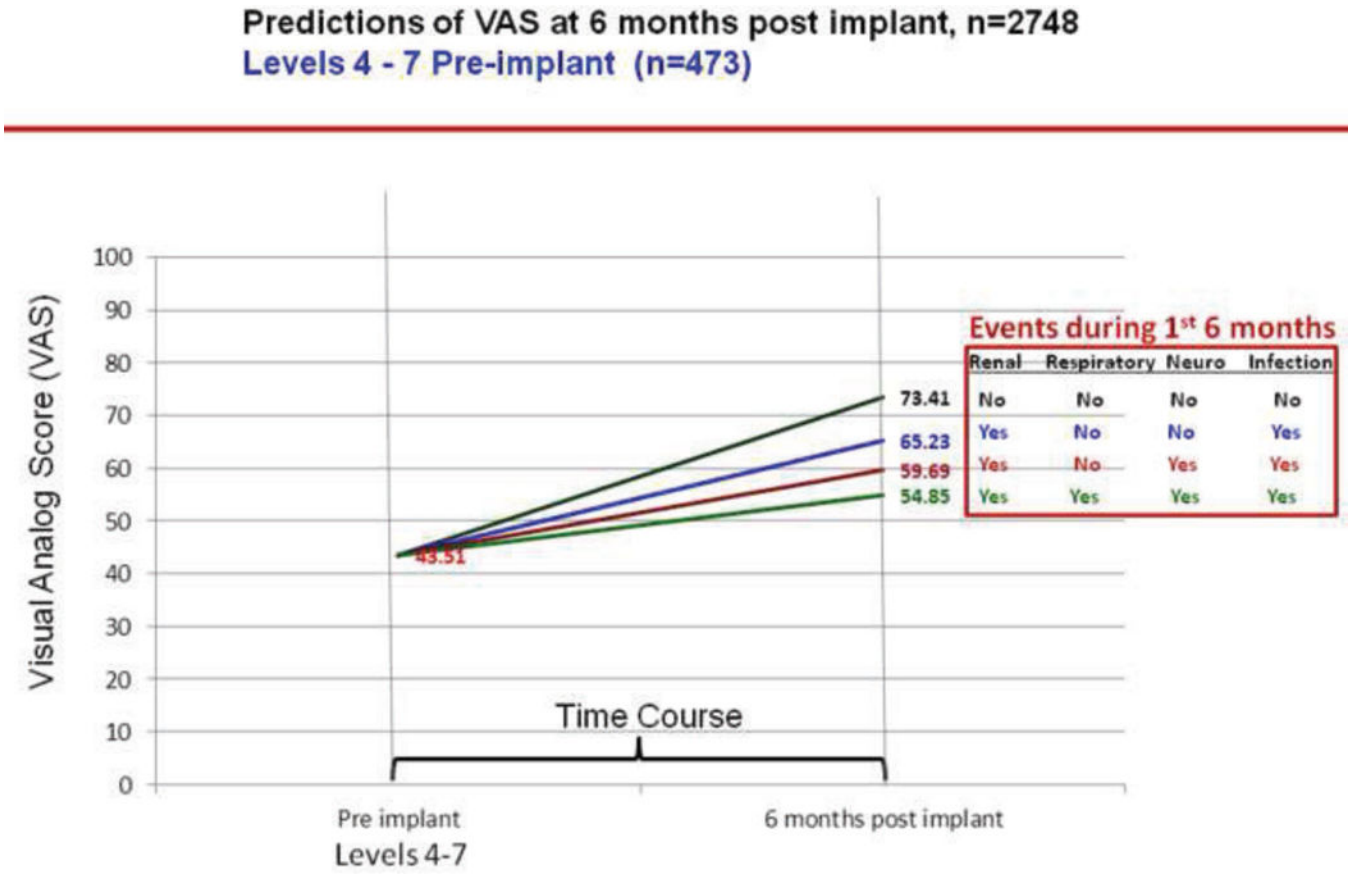

Figure 16.
Predictions of post implant VAS score by pre implant INTERMACS profiles 4–7

Table 1

Characteristics of Continuous Flow LVAD Recipients at Pre and 6 months Post Implant

Pre-Implant Characteristics	Pre-implant LVAD recipients with EQ-5D data (n=5640)	Pre-implant LVAD recipients without EQ-5D data (n=1713)	p-value
Demographic and behavioral characteristics			
Age at implant (mean years + SD)	56.7 (± 12.86)	57.1 (± 13.01)	0.22
Male (%)	78.6	80.8	0.05
Race (% white)	70.5	67.7	0.02
Married at time of implant (%)	66.9	65.3	0.22
> High school education (%)	53.4	48.6	0.004
Current smoker (%)	8.6	6.0	0.0006
Current alcohol abuse (%)	11.0	8.4	0.003
Current drug abuse (%)	1.6	1.1	0.10
Pre implant clinical characteristics			
Primary cardiac diagnosis (%)			
Ischemic cardiomyopathy	40.3	40.8	0.69
Dilated cardiomyopathy	47.8	50.0	0.21
Other	11.9	9.6	0.01
NYHA class = IV (%)	80.6	73.7	<0.0001
Inotrope therapy (%)	82.5	74.6	<0.0001
Intra aortic balloon pump (%)	28.5	27.0	0.23
Ventilator (%)	6.8	4.1	<0.0001
Other ventricular assist device (%)	1.9	0.7	0.0008
Implantable cardioverter defibrillator (%)	81.5	83.9	0.03
RVEF (%)	19.3	19.4	0.95
INTERMACS profile at implant (%)			
1	15.3	10.8	< 0.0001
2	40.8	35.8	0.0002
3	27.2	26.4	0.55
4	12.4	18.9	< 0.0001
5	2.3	4.8	< 0.0001
6	1.3	2.0	0.04
7	1.2	0.7	0.04
Device strategy (%)			
Bridge to transplant – listed	27.9	24.7	0.01
Bridge to transplant – likely to be eligible	22.8	27.1	0.0002
Bridge to transplant – moderately likely to be eligible	10.2	9.4	0.34
Bridge to transplant-unlikely to become eligible	3.2	3.6	0.50
Destination Therapy	34.8	36.0	0.88
Bridge to Recovery	0.6	0.6	0.81

Pre-Implant Characteristics	**Pre-implant LVAD recipients with EQ-5D data (n=5640)**	**Pre-implant LVAD recipients without EQ-5D data (n=1713)**	**p-value**
6 Month Post Implant Characteristics	**6 month post implant LVAD recipients with EQ-5D data (n=4174)**	**6 month post implant LVAD recipients without EQ-5D data (n=1757)**	**p-value**
6 month post implant clinical characteristics			
Implant hospital length of stay (days + SD)	25.4 ± 23.1	24.4 ± 24.8	0.14
Discharge to home (%)	77.1	75.5	0.21
Re-hospitalization within 6 months of discharge (%)	55.5	56.2	0.51
Most common adverse events through 6 months post implant (%)			
Bleeding	32.9	31.2	0.21
Infection	33.3	34.9	0.24
Cardiac Arrhythmia	23.4	22.7	0.59
Renal Dysfunction	6.1	5.5	0.37
Neurological Dysfunction	10.0	7.8	0.007
Respiratory Failure	12.3	11.2	0.23

NYHA=New York Heart Association; RVEF=right ventricular ejection fraction; INTERMACS=Interagency Registry for Mechanically Assisted Circulatory Support

Table 2

EQ-5D Completion Rates and Reasons for Non-completion

Status	Pre-implant (n=7353)	3 months (n=6599*)	6 months (n=5931*)
EQ-5D Completed	4005 (54%)	3258 (49%)	3088 (52%)
Too Sick**	1635 (22%)	431 (7%)	265 (5%)
Total 'Completed'	5640 (77%)	3689 (56%)	3353 (57%)
Incomplete reasons			
Coord did not contact/Admin	752	471	333
Unable to obtain F/U	—	348	410
Patient unavailable	36	22	10
Pt unwilling or unable	191	—	—
Pt not seen in clinic/hospital	315	205	199
Pt seen in clinic/hospital but EQ5D not done (due)	—	1277	1188
Other	77	155	34
Unknown	342	532	404
Total	1713 (23%)	2910(44%)	2578 (43%)

* number of patients with the opportunity for follow-up where the patient has not died, been transplanted or recovered.

** completed forms includes patients who filled out the EQ-5D and also those patients captured as 'too sick' to complete the EQ-5D. 'Too sick' patients were assigned a value of 0 for the VAS and 'extreme problems' for the 3 physical dimensions of *Mobility, Self Care and Usual Activities*

Table 3

VAS Scores pre and post implant & Change in VAS Scores Over Time

VAS	Pre-implant (n=5640**)	6 months (n=3353**)	
0 – 25	2714 (48.1%)	404 (12.1%)	
26 – 50	1589 (28.2%)	347 (10.3%)	
51 – 75	908 (16.1%)	974 (29.0%)	
76 – 100	429 (7.6%)	1628 (48.6%)	
Total	5640 (100%)	3353 (100%)	
Change in VAS(n=2748*)		n	%
Increase			
>20		1637	59.6%
11 – 20		254	9.2%
1 – 10		274	10.0%
Decrease (or no change)			
0 – 10		396	14.4%
11 – 20		62	2.3%
> 20		125	4.6%

* Only includes paired data (patients with both pre and post 6 months completed EQ-5D)

** completed forms includes patients who filled out the EQ-5D and also those patients captured as ‘too sick’ to complete the EQ-5D. ‘Too sick’ patients were assigned a value of 0 for the VAS and ‘extreme problems’ for the 3 physical dimensions of *Mobility, Self Care and Usual Activities*

Table 4

Factors Associated with Change in HRQOL Pre-implant – 6 months post implant

Risk Factors	Estimates (SE)	p value
Pre-implant conditions		
INTERMACS Level 1	5.1 (1.6)	0.002
BTT: Listed	−3.7 (1.2)	0.002
Pre COPD	−10.4 (2.67)	0.0001
Ascites	−3.7 (2.3)	0.10
Alcohol abuse	−4.4 (1.7)	0.01
Pre-implant VAS Score	−0.78 (0.02)	< 0.0001
COPD * Pre-implant VAS score interaction	0.17 (0.06)	0.008
Clinical Course		
BTT: Unlikely at 6 months	−9.9 (2.9)	0.0006
BTT: Mod likely at 6 months	−4.7 (1.9)	0.01
NYHA 4 at 6 months	−15.3 (2.9)	< 0.0001
Events within first 6 months		
Renal Dysfunction	−5.3 (2.5)	0.03
Respiratory Failure	−4.8 (1.8)	0.008
Neurological Dysfunction	−5.6 (1.9)	0.004
Infection	−2.8 (1.1)	0.01

Intercept = 65.0, R^2 = 41% n=2748, p < 0.0001

HRQOL=health-related quality of life; INTERMACS=interagency Registry for Mechanically Assisted Circulatory Support; BTT=bridge to transplant; COPD=chronic obstructive pulmonary disease; VAS=visual analog scale

Negative coefficients indicate the decrement in change

The Intercept indicates the amount of change (improvement) for a patient with no ‘risk factors’

Table 5

Factors Associated with Change in HRQOL Pre-implant – 6 months post implant *(Sensitivity Analyses)*

Risk Factors	Estimates (SE)	p value
Demographic		
Age (log)	6.2 (1.7)	0.0002
White race	3.6 (1.1)	0.0009
Pre-implant conditions		
INTERMACS Level 1	10.9 (2.1)	< 0.0001
INTERMACS Level 2	4.5 (1.2)	0.0002
Pre-implant VAS Score	−0.82 (0.02)	< 0.0001
Clinical Course		
BTT: Mod likely at 6 months	−3.3 (1.6)	0.04
Events within first 6 months		
Respiratory Failure	−5.1 (1.6)	0.002
Neurological Dysfunction	−4.2 (1.7)	0.01
Right Heart Failure	−2.9 (1.4)	0.04

Intercept = 38.6, R^2 = 53.1%, n=1981, p < .0001

HRQOL=health-related quality of life; INTERMACS=interagency Registry for Mechanically Assisted Circulatory Support; BTT=bridge to transplant; VAS=visual analog scale

Negative coefficients indicate the decrement in change

The Intercept indicates the amount of change (improvement) for a patient with no ‘risk factors’