Published in final edited form as:

Clin Transplant. 2020 October ; 34(10): e14056. doi:10.1111/ctr.14056.

Evaluating Resilience as a Predictor of Outcomes in Lung Transplant Candidates

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Abstract

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Conflict of interest: None of the authors have any conflict of interest. All authors have reviewed and contributed to this manuscript.

Background: Resilience represents the capacity to adapt to adversity. Resilience can improve following behavioral interventions. We examined lung transplant candidates' resilience as a novel predictor using the Connor-Davidson Resilience Scale (RISC-10).

Methods: Waitlisted candidates at six centers were mailed questionnaires from 9/16/2015 – 10/1/2019. Follow-up surveys were collected annually and post-transplant. Outcomes were recorded through February 17, 2020. Primary outcome was pre-transplant death/delisting. Analyses included t-test or Chi-square for group comparisons, Pearson's correlation coefficients for strength of relationships, and Cox proportional-hazard models to evaluate associations with outcomes, adjusting for age, sex, and mood.

Results: Participation was 55.3% (N=199). Baseline RISC-10 averaged 32.0 ± 5.6 and did not differ by demographics, primary transplant diagnosis, or disease-severity markers. RISC-10 did not correlate to the commonly utilized Psychosocial Assessment of Candidates for Transplant [PACT] or Stanford Integrated Psychosocial Assessment for Transplantation [SIPAT] tools. Scores < 26.3 (representing >1 standard deviation below population average) occurred in 16% and were associated with pre-transplant death or delisting, adjusted Hazard Ratio of 2.60 (95% Confidence Interval 1.23 – 5.77; $p=0.01$).

Conclusion: One in six lung candidates had low resilience, predicting increased pre-transplant death / delisting. RISC-10 did not correlate with PACT or SIPAT; resilience may represent a novel risk factor.

Keywords

Lung Transplantation; Psychological Resilience; Mental Health

INTRODUCTION

Psychosocial factors are a core component of lung transplant candidacy evaluation as post-transplant care requires an ability to adhere to a complex medical regimen.¹ Transplant centers often use standardized assessment tools, such as the Psychosocial Assessment of Candidates for Transplantation (PACT) or Stanford Integrated Psychosocial Assessment for Transplant (SIPAT),^{2,3} which may be completed with input from both social work and psychiatry to evaluate a candidate's psychosocial fitness for transplant. Careful psychosocial evaluation is further justified due to multiple studies illustrating the important relationship of psychosocial factors with important lung transplant outcomes. For example, persistent depression has been associated with an increased risk of mortality following lung transplant.^{4,5} A low initial PACT score (indicating poor psychosocial candidacy for transplant) has been associated with increased mortality following transplant regardless of subsequent PACT score improvement prior to listing.⁶ Likewise, a history significant for an adverse childhood event is associated with impaired coping ability and worse survival following lung transplant.⁷

Increasingly, novel psychosocial predictors are being explored as possible determinants of outcomes in lung transplant candidates. Recently, a negative affect --defined as an individual's tendency towards negative emotions (e.g. fear, distress) versus a tendency towards more positive emotions (e.g. hope, enthusiasm)-- was shown to be associated with

an increased risk for death on the lung transplant waiting list (N = 169).⁸ Similarly, in a mixed observational cohort (N = 76) that included 22 lung transplant candidates, pre-transplant optimism predicted post-transplant mental health as measured by the Medical Outcomes Study Short Form (SF-36).⁹ Improved understanding of novel psychosocial factors that contribute to emotional health and stability would both enhance lung transplant candidate selection and potentially help identify candidates for pre-transplant interventions with the aim of optimizing well-being and outcomes.

As the focus on positive psychology increases—that is, the promotion of well-being rather than only the reduction of suffering¹⁰—resilience has been identified as a critical factor in mental health promotion.¹¹ Resilience has been described by researchers as a protective factor in psychological vulnerability and distress.^{12,13} Resilience can be defined as the mechanism by which patients adapt to and recover from adverse experiences.^{14,15} Factors that contribute to resilience include adaptability, self-esteem, coping, and tolerance of negative affect. The experience of lung transplantation represents a significant stressor;¹⁶ intrinsic positive attributes like resilience may help patients adapt more effectively. Following lung transplantation, resilience has been associated with lower levels of depression and post-traumatic stress disorder (PTSD).¹⁷ Interventions to enhance resilience are available¹⁸ and provide opportunities to potentially optimize lung transplant candidacy and alleviate distress. Resilience in candidates prior to lung transplantation has not been well studied, although it has been gaining attention in other solid-organ transplant fields.^{19–22}

The objectives of our study were to describe resilience in adult lung transplant candidates on the waiting list, describe changes in resilience while listed and following transplantation, and to examine resilience as a potential predictor of important lung transplant-related outcomes.

METHODS

This study was approved by the Mayo Clinic Institutional Review Board (IRB) under IRB 15–005378 and follows the ethical standards of the Helsinki Declaration of 1975. Collaborating centers also received approval from their respective centers' IRBs.

Study Population

Adult patients on the lung and/or heart-lung transplant waiting lists of six participating United States transplant centers located in Minnesota, Florida, Ohio, Texas, and Washington (from September 16, 2015 to October 1, 2019) were considered for inclusion. Patients who did not speak English were not included as we licensed the English language version of the RISC-10 questionnaire. Those without a domestic United States address were not included due to concerns about participant confidentiality in mailing questionnaires across international boundaries. Non-Mayo Clinic sites obtained patients' consent prior to disclosing names and contact information for the purposes of this study; only those individuals who consented were approached by mail for possible inclusion.

Survey Procedures

The Mayo Clinic in Rochester Minnesota served as the central site for coordinating survey administrations and data collection. Surveys were mailed to eligible participants. As

previously described, non-responders received a duplicate survey at monthly intervals for a total of three mailings prior to declaring the patient a non-responder⁸. Participants received annual follow-up questionnaires while on the waiting list and an additional post-transplant survey between three and twelve months following transplant. A secured, web-based Research Electronic Data Capture (REDCap) was used to house survey responses.²³

Data Collection

Demographic and comorbidity data were collected by self-reported questionnaires. Transplant-related data was abstracted by the primary institution from the electronic medical record and entered into REDCap. Use of PACT and SIPAT psychosocial assessment tools was not required by this study's protocol. PACT or SIPAT scores were collected from the medical record as possible.

Survey Instruments

The surveys were de-identified paper and pencil surveys that included the following:

RISC-10.—The Connor-Davidson Resilience Scale-10 (RISC-10) is a 10-item tool used to measure resilience (Cronbach's α 0.85).²⁴ The scale addresses qualities such as adaptability, humor, coping, perseverance, and self-esteem.²⁴ RISC has been extensively validated in different populations and languages, including English language, adult populations.^{25–28} Scores range from 0–40, with higher scores indicating higher levels of resilience. The minimal clinically important difference (MCID) is 2.9.²⁹ Although the original RISC scale is 25 questions, the ten-question scale was chosen for our study as the RISC-10 is shorter, has excellent agreement with the original scale (intra-class correlation coefficient > 0.85), and has the best combination of reliability and validity.^{24,30}

GAD-2.—We utilized the Generalized Anxiety Disorder Scale-2 (GAD-2) to screen for anxiety symptoms (Cronbach's α 0.82).³¹ By convention, we considered scores of ≥ 3 as positive.³²

PHQ-2.—We used the Patient Health Questionnaire-2 (PHQ-2) to screen for depressive symptoms (Cronbach's α 0.88).³³ By convention, we considered scores of ≥ 3 as positive.³⁴

CRQ.—Health-related quality of life (HRQOL) was assessed using the 20-item Chronic Respiratory Disease Questionnaire (CRQ). The questionnaire consists of dyspnea, fatigue, emotional function, and mastery subscores (Cronbach's α 0.82),³⁵ with higher scores indicating better HRQOL. The MCID for CRQ is 0.5.³⁶

Outcomes/Definitions

Our primary objective was to describe resilience in lung transplant candidates (including changes in resilience while listed and after lung transplantation) and the relationship of resilience to important outcomes. Our primary predictor included resilience scores at the time of study enrollment adjusted for sex, age, and mood (using GAD2 and PHQ2). Given a lack of a conventional cut-off value to define a low RISC-10 score, we defined a low score as > 1 standard deviation (SD) below expected norms. Secondary predictors included

presence of a low RISC-10 score. Primary outcomes included a composite outcome of pre-transplant death or delisting. Secondary outcomes included post-transplant death, post-transplant HRQOL as measured by CRQ or new positive screen for depression on PHQ-2 or anxiety on GAD-2 following transplant. We defined patients with either positive PHQ-2 screens, positive GAD-2 screens, PACT < 2, or SIPAT > 40 as a group of patients with increased psychosocial risk. We evaluated the correlation of RISC-10 scores to these other markers of psychosocial risk. We used pre-transplant CRQ dyspnea scores and lung allocation score (LAS) as two separate proxies for disease severity.

Data Analysis

We used SAS version 9.4 (SAS Institute Inc.; Cary, NC, USA) for data analysis. Baseline variables were summarized as mean $\pm$ SD, median and interquartile range (IQR) as appropriate, or count and percent as appropriate. RISC-10 scores were summarized as mean $\pm$ SD, and change in RISC-10 was analyzed using paired t-test. We used t-tests or Chi-square to compare groups. We compared RISC and CRQ scores using the Wilcoxon rank sum and two-sample t-tests, as appropriate. We used Pearson's correlation coefficient to assess the strength of relationships. We used Cox proportional-hazard models to evaluate associations between RISC-10 scores and our outcomes of interest, adjusting for age, sex, and mood (using GAD2 and PHQ2). Outcomes were censored as of February 17, 2020. We considered *P*-values ≤ 0.05 statistically significant.

Missing Data Strategy

Only study participants who had completed the RISC-10 survey at baseline were included.

RESULTS

Patient Demographics

We approached 360 lung or heart-lung candidates with at least one mailed questionnaire and of those 199 (55.3%) candidates participated. Our per-protocol participation rate was 68.4%, as 69 patients (19.2%) either declined participation or were declared non-responders after three contact attempts. The other 92 patients (25.6%) were transplanted, delisted, or died prior to consenting, refusing consent, or receiving three contact attempts. (Figure 1) A majority of the participants were female (51%), Caucasian (93%), with a mean age of 59 ± 9 years old (see Table 1).

Psychosocial Risk Assessments

The majority of participants were married (71%), with spouses serving as primary caregiver in 65% of cases and the majority of participants had an educational level of high school graduate or higher (94%). Not all patients had PACT or SIPAT scores available. Scores were missing from 48 patients at centers that utilize one of the scoring tools; two centers used neither psychosocial assessment tool representing an additional 46 patients. PACT scores were less than 2 (indicating poor psychosocial risk for transplant) in 5 of 103 participants (4.9%). SIPAT scores were greater than 40 (the threshold for poor psychosocial risk) in 0 of 73 participants (0%). At baseline, 17% (34/199) of patients screened positive for anxiety symptoms on GAD-2, 14% (28/199) screened positive for depressive symptoms on PHQ-2,

and 9% (18/199) were positive for both. In total, 24% (48/199) of participants had one or more markers of increased psychosocial risk at baseline as defined above.

RISC-10

The average baseline RISC-10 score was 32.0 ± 5.6 (comparable to expected population norms [mean of 32.1 ± 5.8]).³⁷ However, 31 participants (16%) had RISC-10 scores that were greater than one SD below the expected population norm (< 26.3). RISC-10 scores did not differ significantly according to race, sex (females 31.1 ± 5.9 ; males 32.7 ± 5.3), age, wait time, or primary diagnosis (obstructive 30.8 ± 1.2 ; restrictive 33.4 ± 1.6 ; pulmonary vascular 31.8 ± 3.9 ; bronchiectasis/cystic fibrosis 35.5 ± 3.9) (see Table 1). RISC-10 was not associated with PACT or SIPAT psychosocial assessment tool scores (p-values 0.50 and 0.15, respectively). Furthermore, RISC-10 scores did not differ by low PACT score (0 or 1) or high SIPAT scores (> 40). As expected, RISC-10 scores were significantly lower in those that screened positive on PHQ-2 (27.3 ± 7) or GAD-2 (28.3 ± 6.4) compared to those that screened negative (32.3 ± 5.4 and 32.4 ± 5.5 , respectively; $p = 0.01$). Using pre-transplant CRQ dyspnea scores as a proxy for disease severity, baseline CRQ dyspnea scores did not correlate with baseline RISC-10 scores ($r=0.11$; $p=0.122$).

Likewise baseline LAS, when available, did not correlate with baseline RISC-10 scores ($r=0.022$; $p=0.8204$; $N = 105$).

The distribution of participants' RISC-10 answers is described in Appendix 1. Upon analysis of the single items in the questionnaire, question 4 (whether coping with stress builds) averaged a significantly lower score at $3.8 (\pm 0.95)$ than other questions (range 4.0 to 4.4; $p < 0.01$), with the exception of question 7 (ability to focus under pressure). Following transplant, stress remained a problem (according to question 4) for 36% of respondents ($N = 35$).

The median duration of time on the waiting list was 5.6 (IQR 1.9 to 12.7) months and the median follow-up time (to delisting, death, or last follow-up post-transplant) was 15.2 (IQR: 6.7 to 25) months. Forty-three patients were on the waiting list for greater than one year and completed an annual pre-transplant follow-up questionnaire. The RISC-10 did not change significantly with a mean change of 1.2 (95% confidence interval [CI] 0.4 to 2.7; $p = 0.14$). Over the course of the study, 116 participants underwent lung transplantation, 26 participants were delisted, 17 participants died while on the waitlist, and 40 participants remained on the waitlist as of February 17, 2020. The median (IQR) time from baseline questionnaire to lung transplantation was 120 days (45, 277.5). Twenty of the transplanted participants died following transplant. Of survivors, 79 participants completed post-transplant surveys. After transplant, surviving participants' RISC-10 scores increased significantly by a mean of 1.9 (95% CI 0.86 to 3.0; $p < 0.01$). This number, however, is less than the MCID of 2.9.

Baseline RISC-10 scores were not associated with the composite endpoint of increased waitlist death or delisting, hazard ratio (HR) of 0.98 (95% CI 0.93 to 1.03; $p = 0.42$) unadjusted or 0.95 (0.89 to 1.01; $p=0.10$) adjusted for age, sex, and mood (see Table 2). However, those with a RISC-10 score lower than one SD below expected population ($<$

26.3) had a non-significant increased hazard of delisting or death on the waiting list HR 1.68 (95% CI 0.83 to 3.44; $p = 0.15$) by univariate analysis. Following adjustment for age, sex and mood, the risk of waiting list death or delisting was significantly increased, adjusted HR 2.60 (95% CI 1.23 to 5.77; $p = 0.01$; C-statistic 0.67).

Neither overall baseline RISC-10 scores nor low baseline RISC-10 scores were predictive of post-transplant HRQOL as measured by the CRQ dyspnea, CRQ mastery, CRQ fatigue, or CRQ emotional function.

New GAD-2 or PHQ-2 3 occurred in only 4 patients following lung transplant preventing any analysis exploring associations with RISC-10.

DISCUSSION

Resilience is representative of our abilities to respond and adapt to difficult situations. The experiences of waiting for a lung transplant and undergoing transplant surgery can present significant challenges. The ability to emotionally adapt to these challenges, or one's resilience, may affect overall well-being. Our findings show that, in general, resilience scores in lung transplant candidates were comparable to the scores of the average population. However, about 1 in 6 candidates approved for the transplant waiting list in our multi-center cohort scored more than one SD below the average population scores. These low resilience patients had an associated increased hazard of death on the waiting list or delisting when adjusted for age, sex, and mood. The RISC-10 scores did not differ by the commonly utilized pre-transplant psychosocial assessment tools (SIPAT or PACT) nor did they correlate to markers of disease severity (CRQ dyspnea score or LAS), suggesting the RISC-10 would identify a unique population of transplant candidates at risk. Of note, pre-transplant RISC-10 scores did not significantly change while waiting and surprisingly post-transplant RISC-10 scores did not show clinically significant improvements despite receiving new lungs. This suggests that if clinicians wish for their lung transplant candidates to improve their resilience to stress or adversity, active interventions may be needed.

Our results support emerging data regarding resilience in lung transplant patients. In a mixed sample of pre-lung transplant candidates and lung transplant recipients ($N = 56$), Cohen *et al.* found lung transplant patients were considered resilient by the RISC-25.¹⁷ Higher resilience following lung transplant correlated to lower depressive or post-traumatic stress disorder symptoms.¹⁷ Post-transplant resilience did not correlate to post-transplant anxiety, cognition, or quality of life (QOL). In contrast, our study found pre-transplant resilience correlated with both anxiety and depression symptoms in the pre-transplant period. In another study, Rudasill *et al.* postulated pre-transplant employment status could be used as a surrogate measure of pre-transplant resilience using a 17,778 patient cohort from the United Network for Organ Sharing registry database. After controlling for potential confounders, pre-transplant employment ($N = 1700$) was associated with decreased post-transplant five-year mortality rates.³⁸ We did not collect employment status data for our cohort so we cannot assess correlation to pre-transplant resilience of this surrogate predictor.

Our data contributes to previous data suggesting there are potential benefits to the intrinsic factors contributing to “positive psychology” in lung transplant patients. Previously, positive psychology intrinsic factors such as optimism or higher positivity ratio (balance of positive affect traits and negative affect traits in the same individual) prior to lung transplant have been shown to correlate with improved post-transplant mental health by SF-36⁹ and waiting list survival by Positive and Negative Affect Schedule (PANAS),⁸ respectively. Conversely, increased negative affect was associated with increased waitlist mortality in lung transplant candidates.⁸ Similarly, higher symptoms of distress (by General Health Questionnaire) post-transplant was associated with increased post-transplant mortality.⁵

Resilience has also been studied in liver, kidney, and hematopoietic stem cell transplantation. In liver transplant candidates factors positively associated with resilience included physical functioning, perceived social support, and active coping, whereas maladaptive coping was negatively associated with resilience.³⁹ In another study in liver transplant candidates, RISC-10 correlated with cognitive ability, depression, anxiety, age, QOL, and social support.²⁰ Similarly, higher resilience was associated with decreased psychological distress following kidney transplant.²¹ In addition, the Immunosuppressant Therapy Adherence Scale (ITAS), a measure of adherence in transplant, positively correlated to resilience scores (as measured by a 15-item Resilience Scale) in solid organ transplant recipients.⁴⁰ Resilience has been more extensively studied in the field of hematopoietic stem cell transplantation, where higher levels of resilience correlated with higher life satisfaction,⁴¹ lower levels of psychiatric symptoms,⁴² and less severe chronic graft-versus-host disease.¹²

Our results add to the literature regarding resilience in lung disease. Similar to our findings, patients with chronic obstructive pulmonary disease (COPD) have average resilience scores by RISC-25 similar to the United States population.⁴³ Resilience was important to QOL and to both pulmonary rehabilitation referral and its completion in COPD patients.⁴⁴ Resilience factors such as coping and self-esteem were also found to be positively related to medication adherence in COPD patients.⁴⁴ This suggests that poor resilience may be a barrier to lifestyle changes needed for COPD management.⁴⁴ Additionally, resilience was highlighted as an important factor in the need for professional mental support in patients with pulmonary arterial hypertension.⁴⁵ Furthermore, resilience in patients with lung cancer has had positive associations with support and its utilization as well as negative associations with anxiety and depression.⁴⁶ Another study suggested a greater correlation between resilience and QOL in patients with lung cancer as compared to those with gastric and colorectal cancer.⁴⁷

Several prior studies have examined resilience as a potentially modifiable factor. In a systematic review of randomized resilience interventions in chronic diseases (cancer, diabetes, or heart disease; N=17 studies), most interventions were successful in improving participant resilience.⁴⁸ The interventions varied from two to fourteen sessions and included coaching, physical activity, stress management, resilience training, online support, and/or positive psychology in the interventions. A number of resilience interventions have been employed to empower adaptive responses to traumatic events.⁴⁹ Strategies include positive psychology, pre-trauma training, and enhancing relaxation and sense of self-efficacy.⁴⁹ Intervention studies have also been attempted in transplant and lung disease cohorts. In an inpatient cohort of adolescents with cystic fibrosis (N=10), a pilot intervention focused on

promoting resilience in stress management (PRISM) was both acceptable and feasible with an 80% completion rate.⁵⁰ Stonnington *et al.* piloted a six-week mindfulness-based resiliency training class for pre-and post-solid organ and stem cell transplant patients (N=31) and their caregivers (N=18); results showed a trend towards end-of-study improvement in RISC scores (mean increase =3, $p=0.085$).¹⁸ The resilience intervention demonstrated improvements in patients' QOL and positive affect with reductions in stress, anxiety and depression.¹⁸ A therapeutic music video intervention in adolescents undergoing stem cell transplantation improved resilience-related outcomes such as coping and social integration.⁵¹ In lung transplant candidates, coping skills training has been effectively delivered via telephone, reducing negative emotional measures and enhancing mental health functioning.⁵² Studies demonstrating that improvement in resilience also improves transplant or lung disease-related outcomes, however, are lacking.

Limitations

Our observational study cannot establish a causal link between resilience and our composite endpoint of death on the waiting list or delisting. Further studies should be performed to validate these findings in subsequent lung transplant cohorts. Between-centers variations in psychosocial practices may represent an unmeasured confounding variable. Likewise, it is unknown if nutritional or physical frailty factors contributed to our findings as we lacked granular serial data on factors such as body mass index or six minute walking distance performance. Our cohort, despite being the largest to examine resilience as measured by the RISC-10 in the lung transplant population and a multi-center study, had low racial and ethnic diversity. We excluded 23 potential participants as they were non-English speaking and our RISC-10 questionnaire license was for the English language RISC-10. The generalizability of these findings to diverse population should be examined in future studies conducted in minority and non-English speaking populations. In addition, resilience was measured using a patient-reported outcome survey; therefore, lung transplant candidates with the highest disease burden may not be fully represented due to reduced abilities to fill out surveys. An additional limitation of our study was the decreased opportunity to recruit patients with expedient transplantations either due to higher LAS or inherent variabilities of research participation between transplant centers. Survey responses were de-identified to minimize social desirability bias; however, a response bias cannot be ruled out due to the nature of self-reported questionnaires. Some of the participants' diagnoses were unreported or unverified. Although we do not expect our cohort to differ from nationally reported values our inclusion of restrictive lung disease may be lower than expected nationally.

Implications for future research

Findings in our study provided a characterization of resilience in lung transplant candidates. As a factor that can potentially be modified, resilience is well-positioned for potential impact on the psychosocial aspects of lung transplantation. Further research would be valuable to confirm the relationship between low RISC-10 scores and delisting or death and to delineate whether enhancing resilience can also improve lung transplant outcomes. Future studies should delineate causes for delisting and death on the waiting list to further understand this potential risk factor. We did not see an association between resilience and post-transplant mortality in our study but outcomes were limited to 20 post-transplant deaths such that this

analysis was likely underpowered. Conducting longer-term follow-up would be helpful to increase the power of our post-transplant analyses. Potential next steps could also involve evaluating the impact of previously studied resilience interventions on transplant-related outcomes such as completion of pulmonary rehabilitation or adherence.

CONCLUSIONS

Resilience is a factor that can influence patients' adaptations to obstacles along the transplant journey. In lung transplant candidates, resilience scores were comparable to overall population norms. On the other hand, about one in six patients had low resilience scores that were associated with increased death on the waiting list or death, when adjusted for age, sex, and mood, suggesting a role for pre-transplant interventions to improve resilience in at-risk patients. RISC-10 appeared to identify a unique group of patients at risk as it did not correlate to disease severity or to standard psychosocial assessment tools of PACT and SIPAT.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Financial Support:

This work was supported by the Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, Mayo Clinic, Rochester, MN and NHLBI grant K23 HL128859 (Dr. Kennedy PI) and K24 HL138150 (Dr. Benzo PI) from the National Institutes of Health. The project utilized REDCap for data management. REDCap was supported by NIH/NCRR/NCATS CTSA Grant Number UL1 TR002377. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

Abbreviations:

PACT	Psychosocial Assessment of Candidates for Transplantation
SIPAT	Stanford Integrated Psychosocial Assessment for Transplant
N	Number
SF-36	Medical Outcomes Study Short Form
PTSD	Post-Traumatic Stress Disorder
IRB	Institutional Review Board
REDCap	Research Electronic Data Capture
RISC-10	Connor-Davidson Resilience Scale, 10 questions
MCID	Minimal Clinically Important Difference
RISC-25	Connor-Davidson Resilience Scale, 25 questions
GAD-2	Generalized Anxiety Disorder Scale-2
PHQ-2	Patient Health Questionnaire-2

HRQOL	Health-related Quality of Life
CRQ	Chronic Respiratory Questionnaire
SD	Standard Deviation
LAS	Lung Allocation Score
IQR	Interquartile Range
CI	Confidence Interval
HR	Hazard Ratio
QOL	Quality of Life
PANAS	Positive and Negative Affect Schedule
ITAS	Immunosuppressant Therapy Adherence Scale
COPD	Chronic Obstructive Pulmonary Disease
PRISM	Promoting Resilience in Stress Management

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Figure 1.
Flow diagram illustrating study enrollment

TABLE 1.**Patient Baseline Demographics**

Characteristic	Low RISC-10^{24,42} Score[*] (N=31)	Other RISC-10 Score^{**} (N=168)	Total (N = 199)
Female, %	63.3	48.4	50.8
Age, years; mean ($\pm$ SD)	56.4 (9.0)	59.4 (9.2)	59.0 (9.2)
Race, %			
Caucasian	96.8	91.7	92.5
Other	3.2	3.0	3.0
Unknown	0.0	5.4	4.5
Marital Status, %			
Single	12.9	6.5	7.5
Married	74.2	70.2	70.9
Widowed/Separated/Divorced	12.9	22.6	21.1
Unknown	0.0	0.6	0.5
Primary Diagnosis, %			
Obstructive Lung Disease	41.9	39.3	39.7
Restrictive Lung Disease	19.4	26.2	25.1
Pulmonary – Vascular	6.5	3.6	4.0
Bronchiectasis/Cystic Fibrosis	9.7	3.0	4.0
Other	0.0	1.2	1.0
Education, %			
Less than High School Diploma	6.5	6.0	6.0
High School Diploma Only	19.4	19.0	19.1
Some College or Above	74.2	75.0	74.9
CRQ: ³⁵ Dyspnea , mean ($\pm$ SD)	3.4 (1.4)	3.8 (1.4)	3.7 (1.4)
LAS ⁵³ mean ($\pm$ SD) ^{***}	40.8 (14.1)	37.3 (7.8)	37.9 (9.2)

Abbreviations: RISC-10: Connor-Davidson Resilience 10-question scale; N: Number; SD: Standard Deviation; CRQ: Chronic Respiratory Questionnaire; LAS: Lung Allocation Score

^{*} Low RISC-10 Score: Participants with RISC-10 questions score < 1 SD from the general population mean

^{**} Other RISC-10 Score: Participants with RISC-10 score $\geq$ 26.3

^{***} N for calculating LAS proportions were 18 for low RISC-10, 87 for RISC-10 $\geq$ 26.3 and 105 for total cohort.

TABLE 2.Analysis of Mortality Prior to Transplant or Delisting by RISC-10 Score^{24,42}

	Univariate Models			Models Adjusted for Age, Sex, GAD2, and PHQ2		
	HR (95% CI)	P-Value	C-Stat	HR (95% CI)	P-Value	C-Stat
RISC-10 Score	0.98 (0.93, 1.03)	0.42	0.50	0.95 (0.89, 1.01)	0.10	0.66
RISC-10 Score < 26.3[*]	1.68 (0.83, 3.44)	0.15	0.52	2.60 (1.23, 5.77)	0.01	0.67

Number enrolled 199. Over the course of the study, 26 participants were delisted and 17 participants died while on the waitlist. Abbreviations: RISC-10: Connor-Davidson Resilience Scale-10 question questionnaire; HR: Hazard Ratio; CI: Confidence Interval; SD: Standard Deviation; GAD2: Generalized Anxiety Disorder-2 Questionnaire; PHQ2: Patient Health Questionnaire-2

^{*} RISC-10 expected population mean was 32.1 (± 5.8), with <26.3 representing a group with scores a full SD below expected means (N=31).