Published in final edited form as:
J Nerv Ment Dis. 2020 December ; 208(12): 966–973. doi:10.1097/NMD.0000000000001236.

Preoperative Optimism Related to Low Anxiety in Patients 1 Month After Open Heart Surgery

Amy L. Ai, PhD[*], **Colleen A. McMullen, MA, MBA**[†], **Susan S. Smyth, MD, PhD**[†]

[*]Institute of Longevity, Colleges of Social Work (CSW), Medicine (COM), and Nursing (CON), Florida State University, Tallahassee, Florida

[†]Department of Cardiology, The Gill Heart and Vascular Institute, University of Kentucky, Lexington, Kentucky.

Abstract

Anxiety can contribute to poor prognosis in cardiac patients. Few studies have examined the role of optimism in anxiety after open heart surgery (OHS). This study investigated the influence of preoperative optimism on post-OHS anxiety, adjusting cardiac indices used by cardiac surgeons. Data were collected before and 1 month after OHS in 481 patients (58% men; age, 62.4 ± 11.94 years). Optimism was measured using the Life Orientation Test. Anxiety was measured using the Trait Anxiety Inventory. Medical and cardiac indices were retrieved from the Society of Thoracic Surgeon's national database. Multiple regression analyses showed that greater pre-OHS optimism was associated with lower levels of post-OHS anxiety ($F[6, N = 306] = 50.18$, $p < 0.001$, $R^2 = 0.502$). No other factors showed similar protection. Pre-OHS anxiety, younger age, and minority status were associated with anxiety in the critical recovery month. The findings demonstrate the potential benefit of optimism against post-OHS anxiety, which may have clinical implications for improving disease management.

Keywords

Anxiety; heart disease; open heart surgery; dispositional optimism; minorities

Psychologists and behavioral scientists have recognized anxiety as a comorbid mental health risk that contributes to poor prognosis in heart disease (HD), including mortality, as do other medical comorbidities (Benjamin et al., 2018; Davidson et al., 2018; Dornelas and Sears, 2018; Stoney et al., 2018). In recent research on patients with HD, anxiety contributed to future symptoms, higher care costs, lower quality of life (Palacios et al., 2016), physical functioning decline (Shen et al., 2011), and all-cause mortality and cardiovascular-related readmissions after myocardial infarction (MI) (Roest et al., 2012). Meta-analysis reviews also associated anxiety with increased major cardiac events or mortality (Celano et al., 2015; Roest et al., 2010a, 2010b; Tully et al., 2014). In patients scheduled for open heart surgery (OHS), the months before and after OHS are both highly stressful and associated with

Send reprint requests to Amy L. Ai, PhD, Florida State University, 2570 University Center Building C, Tallahassee, FL 32306. amyai8@gmail.com.

The authors declare no conflict of interest.

anxiety, even though OHS can serve as a life-saving intervention (McCormick et al., 2006). Such psychological distress compromises patients' health-related quality of life (HQOL) (Ekici et al., 2014; Grewal et al., 2011; McCabe, 2010; Nekouei et al., 2014), thereby augmenting the burden of illness and impeding outcomes as noted above.

The present study aimed to investigate the association of dispositional optimism, assessed preoperatively, with post-OHS anxiety after controlling for pre-OHS anxiety and medical confounders. In positive psychology, optimism presents one's positive attitude about the future toward one's advantage, as an indicator of the character strength (CS) *hope*, undersubsuming the virtue *transcendence* (Peterson, 2000). Optimism is also defined as positive expectation and confidence about the future, whereas dispositional optimism is considered a stable attribute of personality (Scheier and Carver, 1985; Scheier and Carver, 2018). Health psychologists posit the direct health benefit of this positive trait or expectation based on its connection with motivation in pursuing desired goals, values, and actions (*e.g.*, health-related behaviors) (Bouchard, 2018; Carver et al., 2010). A small-sample prospective study found that preoperative negative expectations had a detrimental impact on recovery and HRQL 1 year after cardiac surgery (Holmes et al., 2016). Conversely, a correlational study associated uncertainty with hospital anxiety in cardiac patients, but positive appraisal was inversely related to the symptom (Giammanco and Gitto, 2016).

Research found that this personality trait predicted desirable physical health, including cardiac health (Rasmussen et al., 2009; Roest et al., 2010a, 2010b; Scheier and Carver, 2018). Impressively, in population studies, optimism contributed to lower HD incidence and lower odds of congestive heart failure (CHF) (Giltay et al., 2006; Kubzansky et al., 2001; Matthews et al., 2004; Tindle et al., 2009), lower cardiovascular disease–related and total mortality (Galatzer-Levy and Bonanno, 2014; Kim et al., 2017; Tindle et al., 2009), and lower odds of CHF, and reduced mortality in the elderly (Anthony et al., 2016; Fry and Debats, 2009; Kim et al., 2014). Furthermore, research suggests that optimists tended to use problem-based coping that could mitigate the detrimental impact of stress but were less likely to use emotional or avoidant coping (Bouchard, 2018; Carver et al., 2010). In addition, optimists may have the capacity to build social networks to lessen the negative influence in the face of adversities (Bouchard, 2018; Carver et al., 2010). A major limitation of population surveys is the inability to adjust medical, especially HD-specific, confounders, because they may not account for the participants' health before study participation or inability to access participants' medical records.

The shortcoming in the literature has considerably limited the implications for clinical cardiac medicine (Giammanco and Gitto, 2016). Alongside, another major gap lies in the fact that only a few clinical studies have examined the influence of dispositional optimism, as positive expectation, on post-OHS outcomes, adjusting medical and surgical confounders. In a small study from 30 years ago, dispositional optimism was related to better quality of life and less likelihood of perioperative MI in patients undergoing coronary artery bypass graft (CABG) surgery (Scheier et al., 1989). Ten and 20 years thereafter, only two other studies showed that optimism predicted fewer cases of rehospitalization 6 months after CABG surgery, respectively (Scheier et al., 1999; Tindle et al., 2012). No study has yet explored the relationship between optimism and anxiety within the post-OHS month. This investigation is a broadly impactful clinical topic for cardiac patients, as aforementioned, burgeoning research over the past 10 years has revealed the detrimental long-term impact of anxiety in cardiac diseases (Benjamin et al., 2018; Celano et al., 2015; Davidson et al., 2018; Dornelas and Sears, 2018; Palacios et al., 2016; Roest et al., 2010a, 2010b, 2012; Shen et al., 2011; Stoney et al., 2018; Tully et al., 2014). Persistent anxiety existing after OHS could indicate a negative trait that has been built into the psychological characteristics of cardiac patients, which could exert prospective detrimental influence on recovery after an expensive intervention.

Furthermore, the period of 30-day post-OHS is critical for cardiac recovery and a window of multidisciplinary intervention. In particular, the risk of potential post-OHS mortality is high during recovery from significant surgical trauma and inflammatory responses, known as postoperative “systemic inflammatory response syndrome,” after considerable physical wounds (Ai et al., 2009). This is one of several reasons that “30-day mortality” is listed as an important medical index in the Society of Thoracic Surgeons (STS) national database. The investigation of anxiety after surgery is important because anxious OHS patients could engage in off-task thinking, have negative mood states, or simply give up on recovery efforts, leading to poor outcomes. On the other hand, optimists are more likely to take actions that make the future more successful (Scheier and Carver, 2018), and this CS could play a role counteracting anxiety. Should pre-OHS optimism demonstrate a counteracting role against anxiety in cardiac patients, clinicians could enhance patient care practices in the time when patients receive the high attention from the health system.

To advance the literature, we used a prospective cross-disciplinary study to determine preoperative contributors to post-OHS anxiety. An earlier report already associated optimism and hope, alongside older age and a diagnosis of MI, with lower levels of pre-OHS anxiety (Ai and Carretta, 2019). On the other hand, patients with advanced HD were more anxious before operation if they had a diagnosis of left main disease of 50% or greater or experienced greater impacts of disease on psychosocial well-being. Highly anxious patients were also likely to use positive religious coping. In the current analysis, we sought to ascertain if dispositional optimism and other psychosocial factors were related to low post-OHS anxiety in the critical recovery month.

To meet the aforementioned gap, we adequately controlled for pre-OHS anxiety, general health, behavioral and cardiac risk factors, and, particularly, HD-specific confounders available in the STS. The selected latter two sets of medical confounders are important for medical providers because they are tested predictors for cardiac prognosis and outcomes. We also controlled for competing protective psychosocial factors (*i.e.*, social support as a well-established health protector) and another CS indicator (*i.e.*, hope). Based on the literature, we hypothesized that pre-OHS dispositional optimism would be associated with low anxiety in the month after a life-altering procedure, after controlling for pre-OHS anxiety and subjective and objective medical indices. In a post hoc analysis, we examined the relation between optimism and coping strategies, as well as the link between coping and post-OSH anxiety based on the assumed relationship in the literature (Bouchard, 2018; Carver et al., 2010).

METHODS

Procedures

The patient data were collected in 1999 and 2003. Before the presurgical assessment, every patient received a general information packet containing a subject recruitment letter from the cardiac surgeon informing the patient of the opportunity to participate in this project. On the date of the medical assessment, a nurse screened the patient for availability and eligibility. Eligibility criteria included a) aged 35 years or more; b) scheduled for nonemergent, nontransplant OHS within the subsequent 8 weeks; c) able to speak fluently and understand the English language; d) cognitively and physically capable of providing informed consent; e) not pregnant; f) having provided informed consent; and g) permitted to participate in the study by the surgeon.

Patients were recruited on an ambulatory presurgical clinic assessment day that included a complete physical examination, blood and urine tests, and first interview for the present study at approximately 2 weeks before OHS. Of the approached 705 patients, 481 (74%) completed interview 1. Most attrition was due to emotional distress or unspecified reasons, 10 cases canceled surgery, and 11 cases died before OHS. Table 1 presents attrition analyses, showing no differences in age and race between consenters and nonconsenters, but there was a marginally higher proportion of female consenters than nonconsenters ($p = 0.06$).

After receiving the consent form, a trained interviewer conducted the first face-to-face interview 1 to collect information on medical history, socioeconomic background, general health and health behaviors, functioning, and pre-OHS anxiety symptoms at the cardiac clinic of admission to the University of Michigan Health System (UMHS). Interview 2, by telephone, took place around 48 hours before OHS, assessed CS factors and perceived social support, and was completed by 426 patients (89% of the original sample).

Interview 3 was conducted on average 36 days after OHS, reassessed post-OHS anxiety symptoms, and was completed by 335 patients (70% of the initial sample). The UMHS Heart Center is a specialty cardiac center that serves a high volume of patients with advanced cardiac diseases (*e.g.*, CHF) referred from surrounding states. At follow-up, some patients had moved to nursing homes, other states, or even abroad. The remaining dropouts were primarily due to outdated contact information or refusal to participate in the follow-up, although detailed reasons were not specified. After all waves of survey data were collected, the UMHS Heart Center provided us with the patients' medical, cardiac, and surgical data. All procedures in the initial and follow-up studies were approved by the UMHS's Institutional Review Board.

Sample Characteristics

A trained team recruited patients with advanced HD requiring nonemergency, nontransplant OHS (*e.g.*, CABG, aneurysm repair, and valve repair or replacement) at the UMHS. Most of the sample (age, 62.4 ± 11.94; range, 35–89) were men (58%), Caucasian (90%), and married with spouse present (72%). Average education was 14 years (range, 1–20), whereas mean annual family income was $53,228 (range, $0–$400,000), and nearly 33% of the sample was employed.

Measures

Outcome Variable—Both pre-OHS and post-OHS anxiety symptoms were measured using the 20-item Trait Anxiety Inventory (STAI Form X-2) (α = 0.92) (Spielberger, 1983). STAI assessed symptoms experienced in the past 7 days, scored on a four-level scale (preoperative: M = 36.57, SD = 10.84, Cronbach's α = 0.91; postoperative: M = 35.32, SD = 10.33, α = 0.88).

Demographics and General Health Conditions—Survey interviews included the following: age (calculated by date of operation – birthday), sex (1 = male, 2 = female), race (1 = non-White, 2 = White), marital status (1 = others, 2 = married with spouse present), education (*e.g.,* 1 = no formal education, 5 = post graduate), and family income (1 = less than $20K, 4 = greater than $50K). The number of medical comorbidities was assessed with the sum of self-reported confirmation on a checklist of 17 chronic conditions, often seen in geriatric clinics (*e.g.*, diabetes, arthritis). Body mass index (BMI) was computed from height and weight (weight in kilograms/height in meters squared) measured before interview 1 in the cardiac clinic.

Key Medical and Cardiac Indices—Using the STS, we identified eight factors as general health and behavioral or cardiac risk factors: smoker (54.4%), hypertension (58.4%), hypercholesterolemia (38.7%), diabetes (19.1%), and renal failure (6.7%) (all coded with 1 = yes, 2 = no), as well as chronic lung diseases (10.2%) (1 = no, 2 = mild, 3 = moderate, 4 = severe), plus the aforementioned medical comorbidities and computed BMI. Next, eight HD-specific and surgical indices were selected to indicate disease severity: diagnoses of angina (35.6%), arrhythmia (16.6%), CHF (45.9%), MI (23.7%), left main disease 50% or greater (5.4%), CABG (35.4%) (all coded with 1 = yes, 2 = no), number of diseased coronary arteries, perfusion time (indicating OHS complexity, using the total number of minutes on cardiopulmonary bypass machine), and New York Heart Association (NYHA) classification (indicating the stages of heart failure).

Pre-OHS Psychosocial Factors—Among pre-OHS CSs, optimism/hope was indicated by dispositional optimism, assessed with the 12-item Life Orientation Test (Scheier and Carver, 1985) and scored on a five-level scale (M = 22.38, SD = 4.27, α = 0.76; *e.g.*, "In uncertain times, I usually expect the best."), and hope, assessed with the 12-item Hope scale and scored on a six-level scale (M = 31.12, SD = 4.10, α = 0.79; *e.g.*, "There are lots of ways around any problem") (Snyder et al., 1991). Perceived social support was assessed with the 12-item Multidimensional Scale of Perceived Social Support, scored on a five-level scale (M = 62.21, SD = 7.80, α = 0.90; *e.g.*, "I can talk about my problems with my family") (Zimet et al., 1990).

Analytic Strategy

We entered all waves of survey data using computerized double-entry system with a final checking by two research team leaders. A specialized cardiac data analyst at the heart center routinely managed the computerized STS database. Because missing values were rare and not appropriate to fix in patient samples, we did not impute any of them. However, chi-square and *t*-test statistics were performed to investigate the differences between consented patients who participated in interview 2 and the post-OHS follow-up versus those who dropped out from these waves (drop = 0, in = 1). The normality of the data was examined for all measured continuous variables. Departure from normality was determined in terms of skewness (<1.5) and kurtosis (<4). All tests were two tailed with significance level set at $p < 0.05$. Collinearity statistics were inspected for multivariate analyses, using a conservative value of variance inflation factors (VIF) of 2.

We conducted hierarchical multiple linear regression analyses to identify pre-OHS associates with post-OHS anxiety symptoms as the main outcome. To determine the direct effect of different factor sets (*e.g.*, sex, HD-specific confounders, and potential CS predictors), several blocks of independent variables were estimated after preplanned steps. Types of factors in these blocks were primarily a) key demographics; b) general health and behavioral and cardiac risk factors, alongside pre-OHS anxiety symptom, as controls; c) HD-specific indices; and d) CS factors as potential protective factors. Because of a relatively small sample aligned with a relatively large pool of independent variables, a variable would be removed from the block before entering the next block if it was not even close to generate a marginal effect ($p = 0.10$) on anxiety, unless it is clinically important (*e.g.*, sex and age). In the final step, we took a trimmed model with only variables at least at the marginally significant level ($p = 0.10$). The step was to ascertain if the statistical significance of the predictors in step 4 was inflated by a higher ratio of predictors to cases (overparameterization).

RESULTS

Descriptive Analyses

A paired *t*-test showed the improved symptom levels between pre- and post-OHS anxiety (mean-pre-OHS = 35.77, SD = 10.06; mean-post-OHS = 34.63, SD = 10.08; $t = -2.47$, $p < 0.05$). Attrition analyses between interviews 1 and 2 indicated only slight differences between consented patients who participated in interview 2 versus those who did not complete these two pre-OHS waves (Table 1). Of note, there were higher levels of pre-OHS anxiety symptoms ($p < 0.05$) and more smokers ($p < 0.01$) among those who did not complete interview 2, compared with participants in interview 2. No statistical differences were found in the demographics, self-report health indicators, and objectively assessed medical and cardiac indices in the STS database between participants in interview 2 and dropouts.

Concerning the post-OHS follow-up data, analyses showed further differences in pre-OHS optimism (mean of dropouts = 21.00, SD = 4.66; mean of participants = 22.20, SD = 4.47; $t = -2.40$, $p < 0.05$) and pre-OHS anxiety (mean of dropouts = 40.29, SD = 11.80; mean of participants = 35.76, SD = 10.07; $t = -4.32$, $p < 0.001$). However, there were no differences in pre-OHS hope between the dropouts and participants in the follow-up.

As expected, a *t*-test indicated that, compared with men, women had significantly higher levels of post-OHS anxiety symptoms (mean-female = 36.40, SD = 9.91; mean-men = 33.47, SD = 10.04; $t = -2.62$, $p < 0.01$). Table 2 shows the correlation of sex and age with HD-specific and surgical indices as well as scores of both pre- and post-OHS anxiety.

Post-OHS anxiety symptoms correlated positively with female sex ($r = 0.14$, $p < 0.01$) and medical comorbidities ($r = 0.18$, $p = 0.001$). There were no correlations of the other general health and behavioral risk factors or HD-specific indices with sex and age. Anxiety was inversely correlated with race ($r = -0.12$, $p < 0.05$), married status ($r = -0.13$, $p < 0.05$), income ($r = -0.13$, $p < 0.05$), optimism and hope (rs = −0.47 and −0.35, ps < 0.001), and social support ($r = -22$, $p < 0.001$).

Table 3 incorporates hierarchical multiple regression results in steps 1 to 5, predicting post-OHS anxiety from blocks of variables entered into the equation after the predetermined steps. In step 1, post-OHS anxiety symptoms were regressed on demographics. Significantly positive predictors included female sex ($B = 0.12$, $p < 0.05$), minority race ($B = -0.12$, $p < 0.05$), and living along (i.e., not married with spouse present; $B = -0.12$, $p < 0.05$). In step 2, eight general health and behavioral and cardiac risk factors and pre-OHS anxiety symptoms were entered into the analysis, alongside sex, age, race, and marital status (not shown in Table 3 to reduce the length). This entry nullified the role of female sex and living alone, but minority race remained to be a significant predictor. Among all step 2 measures, only BMI ($B = -0.10$, $p < 0.05$) had an inverse relationship with post-OHS anxiety, whereas the chronic lung disease ($B = 0.11$, $p < 0.05$) was positively related. Not surprisingly, pre-OHS anxiety had the strongest association with post-OHS anxiety ($B = 0.65$, $p < 0.001$).

In step 3, the entry of eight HD-specific and surgical indices did not alter the association of sex, age, and the four persistent predictors (minority race, pre-OHS anxiety, BMI, and chronic lung disease) with post-OHS anxiety. Among the newly entered, number of diseased arteries and absent left main disease 50% or greater were positively associated with post-OHS anxiety, whereas NYHA classification was inversely related. However, the new relationships were only marginally significant.

In step 4, entry of CS indicators eliminated the role of BMI and of all three HD-specific indices. Among the CS factors, only dispositional optimism was inversely associated with post-OHS anxiety ($B = -0.14$, $p < 0.01$). After removing all the nonsignificant factors, the influence of age became significant ($B = 0.07$, $p < 0.05$), but sex remains not influential and so was removed in the final step. Finally, the trimmed model (Table 3) showed persistent four predictors (minority race, pre-OHS anxiety, chronic lung disease, and dispositional optimism) as well as age. The final model ($F[6, N = 306] = 50.18$, $p < 0.001$, $R^2 = 0.502$) was significant and accounted for nearly half of the variance in post-OHS anxiety.

All regression models mentioned above and all R^2 changes between block entry were significant (ps < 0.001). Accordingly, OHS patients who scored higher on dispositional optimism before operation reported low levels of post-OHS anxiety. Conversely, those who were characterized by older age, minority status, higher scores on pre-OHS anxiety, and more severe chronic lung disease had higher levels of post-OHS anxiety. However, none of the cardiac-specific and surgical indices were associated with anxiety.

DISCUSSION

The present study investigated the role of optimism before a life-altering surgery in post-OHS anxiety, after adequately accounting for influences of pre-OHS anxiety, social support, general health, behavioral and cardiac risk, and HD-specific confounders in the STS database. The finding lends support for our hypothesis that patients who scored higher on preoperative dispositional optimism (Scheier and Carver, 1985, 2018) would report lower levels of anxiety within the critical recovery month (Benjamin et al., 2018; Celano et al., 2015; Davidson et al., 2018; Palacios et al., 2016; Roest et al., 2012; Shen et al., 2011; Stoney et al., 2018; Tully et al., 2014). Although levels of anxiety reduced after OHS, the new evidence corroborates existing literature demonstrating the advantage of this positive expectation or attitude in both general and cardiac populations (Anthony et al., 2016; Fry and Debats, 2009; Giltay et al., 2004, 2006; Kubzansky et al., 2001; Matthews et al., 2004; Tindle et al., 2009). Our recent study linked dispositional optimism with pre-OHS anxiety (Ai and Carretta, 2019). An earlier study has also shown an inverse relationship between dispositional optimism and anxiety at the 30-month follow-up of OHS patients (Ai et al., 2010). Together, these findings suggest the plausible ongoing role of optimism counteracting against medical anxiety in patients with advanced HD. The present study adds new information to the existing literature with its sizable clinical sample, prospective design, and objective medical and HD-specific indices. With medical confounders adequately controlled, the findings may be more reliable and convincing for cardiac care providers concerning the potential health benefit of dispositional optimism for OHS patients.

Because optimism is related to pursuing desirable health-related goals, values, and actions (Bouchard, 2018; Carver et al., 2010), this role may help patients fulfill optimal long-term recovery. During the critical post-OHS month, however, regular rehabilitation (*e.g.*, exercise) may not have begun for patients with advanced HD. The potential benefit of optimism, then, could be primarily based on psychosocial rather than action-based means. Research has shown that optimistic older patients with HD were more resilient compared with others (Galatzer-Levy and Bonanno, 2014). Regarding goal-directed efforts, optimists are more likely to be at ease with or even disengage from unattainable goals and replace lost activities with alternative goals (Bouchard, 2018; Carver et al., 2010). This flexible thinking approach is essential for individuals to meet complex challenges in the face of personally uncontrollable circumstance (Hanssen et al., 2013), such as the intensive recovery process in the post-OHS month. These related characteristics may help explain why optimistic patients in this cohort report lower levels of anxiety. Moreover, a recent study found that trait optimism mediates the protective role of the orbitofrontal cortex gray matter volume against anxiety (Dolcos et al., 2016). More interdisciplinary investigation is warranted to reveal the mechanism underlying the effect of optimism in cardiac anxiety.

Furthermore, research suggests that optimists also use problem-based coping that could mitigate the detrimental impact of the stressor and were less likely to use emotional or avoidant coping (Bouchard, 2018; Carver et al., 2010). Based on their capacity to build social networks, optimists' social capital may assist them in decreasing the negative influence of adversity (Bouchard, 2018; Carver et al., 2010), such as a major operation. Supporting the previous assumptions, in this cohort, optimism was indeed correlated with use of more cognitive and behavioral coping but not anger and avoidant coping in a post hoc analysis. Patients who scored high on this personality trait had greater social support in our bivariate analysis, although none of these related factors are associated with the outcome, post-OHS anxiety, or altered the final solution in regression models. In addition, we did not find similar functions of any other psychosocial factors in the multivariate analyses after controlling for medical indices. Interestingly, hope, as another indicator of the CS *hope*, was not related to post-OHS anxiety as one might expect. In addition, participants in post-OHS follow-up showed higher levels of pre-OHS optimism than those who did not complete interview 2, but there is no difference in hope between the two subgroups. In particular, this personality strength has a stronger relationship with low anxiety than hope at the critical recovery 30 days after the life-altering operation. Accordingly, optimism may be a more sensitive measure than hope in OHS patients.

None of the general heath, behavioral and cardiac risks, and HD-specific indices, except chronic lung disease, were associated with post-OHS anxiety in this cohort, but minority status was predictive of increased anxiety. Curiously, some HD severity conditions were found to be related to pre-OHS anxiety (Ai and Carretta, 2019). Some patients with more complex OHS, as indicated by the longer perfusion time, did not complete interview 2. This could account for some of the differences between correlations of pre- and post-OHS anxiety levels. As for health disparity–related disadvantage in minority patients, bivariate analyses indicate that they were younger but were less wealthy than their White counterparts. These major differences could deplete their resources during recovery from a major operation and add additional stress to an already difficult period for post-OHS recovery. However, both above assumptions need further nuanced investigation should the study be replicated in the future.

The limitations of the present study include a convenience sample with limited generalizability. As a related matter, patients who declined their participation in the study had slightly higher levels of anxiety. However, the representativeness of OHS patients at the UMHS could be elevated because of a) the lack of demographic differences between consenters in this study and the initial dropouts, and b) no statistical differences observed in demographics, self-reported health indicators in interviews, and objectively assessed medical and cardiac indices in the STS database between the participants in pre-OHS interview 2 and the dropouts. A limitation is that the data were collected over a decade ago, which may also impact the generalizability and the interpretability of the findings given the changing practices in cardiac surgery and anxiety intervention. However, the current study is not focusing on the medical treatment of anxiety or operative outcomes, but rather on a personality strength that has been overlooked with other internal characteristics before the time of patient-centered care beginning in 2012. Even today, this type of investigation in this particular patient population (OHS) remains rare.

The pre- and post-OHS scores in anxiety are correlated at a moderately high level, which may result from the use of a popular trait measure of anxiety (Emons et al., 2019). It is also likely that the uncertain time in the waiting month and critical post-OHS recovery month are both stressful. The aim of this study was to determine the role of pre-OHS optimism on post-OHS anxiety. This limitation, however, suggests that a longer follow-up period is necessary in future investigations. Although the survey data involved three waves, the average 6-week period between the first and last waves in this cohort could be too small of a period. Importantly, between the second and third waves, there can be a life-altering event that could substantively change the overall conditions of these patients. The first wave was in the history- and-examination day, the only time interviewers could conduct a personal interview before the event, whereas the last wave was at the end of the critical recovery month based on the STS. The analyses also reveal that those who were less optimistic and/or had greater pre-OHS anxiety did not return for the follow-up interview. The evidence suggests that our findings request further support from replication in other samples of OHS patients with very high levels of anxiety preoperatively. Finally, unlike a randomized controlled trial, an observational study design cannot eliminate the impact of unmeasured factors.

Notwithstanding these shortcomings, the present study appropriately controls for pre-OHS anxiety, standardized health risk factors, and HD severity indices. We also provided information on comparisons between the dropouts versus those who stayed in the study at each survey stage, showing relatively limited impacts of health, medical, and cardiac indicators on the detected differences. The findings, thus, add new and more dependable knowledge about associations between pre-OHS psychosocial factors and post-OHS anxiety and about a mortality health disparity in patients with advanced HD (Celano et al., 2015; Roest et al., 2010a, 2010b; Tully et al., 2014). In particular, the finding of the potentially positive influence of dispositional optimism is salient given the adequate control for pre-OHS anxiety and objective clinical factors.

The study also suggests that health providers may need to be more attentive to nonmedical conditions such as negative mood state and general positive expectations about the future in post-OHS life. As already indicated in the literature on non-OHS cardiac patients, these conditions could have long-term influence on health and HQOL outcomes. Should the finding be replicated, for example, surgeons and nurses at cardiac clinics, who are the only medical professional to meet patients on pre-OHS history-and-examination day, may address these issues with simple questions regarding the patients' anxious mood state. Because trait anxiety may indicate a long-term psychopathology, primary care physicians, cardiologists, health psychologists, psychiatric nurses, and other mental health professionals in the health and community setting should also be attentive to such symptoms. To improve the outcome of expensive OHS in adult patients, multidisciplinary health providers may assist cardiac patients and their family or other supportive members with boosting patients' positive attitudes based on the principle of patient-centered care. At a minimum, causes of or factors contributing to their pre-OHS anxiety and passive attitudes should be discussed. In addition, they should pay attention to the disadvantages that female, living alone, and/or minority OHS patients' face, which could be related to their post-OHS poor outcomes. Taken together, the present findings may offer certain implications for interdisciplinary pre-OHS care for patients with advanced HD, pending support from future investigations.

DISCLOSURE

Awards from the National Institutes of Health (R03 AG015686-01 and R03 AG060212-01A1) were receieved by Amy L. Ai, PhD, to collect the existing data and to enable current analysis.

REFERENCES

Ai AL, Carretta H (2019) Optimism/hope associated with low anxiety in patients with advanced heart disease controlling for standardized cardiac confounders. J Health Psychol. doi: 10.1177/1359105319864633.

Ai AL, Ladd KL, Peterson C, Cook CA, Shearer M, Koenig HG (2010) Long-term adjustment after surviving open heart surgery: The effect of using prayer for coping replicated in a prospective design. Gerontologist. 50:798–809. [PubMed: 20634280]

Ai AL, Seymour EM, Tice TN, Kronfol Z, Bolling SF (2009) Spiritual struggle related to plasma interleukin-6 prior to cardiac surgery. Psychol Relig Spiritual. 1:112–128.

Anthony EG, Kritz-Silverstein D, Barrett-Connor E (2016) Optimism and mortality in older men and women: The Rancho Bernardo Study. J Aging Res. 2016:5185104. [PubMed: 27042351]

Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, Chiuve SE, Cushman M, Delling FN, Deo R, de Ferranti SD, Ferguson JF, Fornage M, Gillespie C, Isasi CR, Jiménez MC, Jordan LC, Judd SE, Lackland D, Lichtman JH, Lisabeth L, Liu S, Longenecker CT, Lutsey PL, Mackey JS, Matchar DB, Matsushita K, Mussolino ME, Nasir K, O'Flaherty M, Palaniappan LP, Pandey A, Pandey DK, Reeves MJ, Ritchey MD, Rodriguez CJ, Roth GA, Rosamond WD, Sampson UKA, Satou GM, Shah SH, Spartano NL, Tirschwell DL, Tsao CW, Voeks JH, Willey JZ, Wilkins JT, Wu JH, Alger HM, Wong SS, Muntner P, American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee (2018) Heart disease and stroke statistics–2018 update: A report from the American Heart Association. Circulation. 137:e67–e492. [PubMed: 29386200]

Bouchard LC, Carver CS, Mens MG, Scheier MF (2018) Optimism, health, and well-being. In Dunn DS (Ed), Positive psychology: Established and emerging issues (pp 112–130). New York, NY: Routledge.

Carver CS, Scheier MF, Segerstrom SC (2010) Optimism. Clin Psychol Rev. 30:879–889. [PubMed: 20170998]

Celano CM, Millstein RA, Bedoya CA, Healy BC, Roest AM, Huffman JC (2015) Association between anxiety and mortality in patients with coronary artery disease: A meta-analysis. Am Heart J. 170:1105–1115. [PubMed: 26678632]

Davidson KW, Alcantara C, Miller GE (2018) Selected psychological comorbidities in coronary heart disease: Challenges and grand opportunities. Am Psychol. 73:1019–1030. [PubMed: 30394780]

Dolcos S, Hu Y, Iordan AD, Moore M, Dolcos F (2016) Optimism and the brain: Trait optimism mediates the protective role of the orbitofrontal cortex gray matter volume against anxiety. Soc Cogn Affect Neurosci. 11:263–271. [PubMed: 26371336]

Dornelas EA, Sears SF (2018) Living with heart despite recurrent challenges: Psychological care for adults with advanced cardiac disease. Am Psychol. 73:1007–1018. [PubMed: 30394779]

Ekici B, Ercan EA, Cehreli S, Tore HF (2014) The effect of emotional status and health-related quality of life on the severity of coronary artery disease. Kardiol Pol. 72:617–623. [PubMed: 24526556]

Emons WH, Habibovic M, Pedersen SS (2019) Prevalence of anxiety in patients with an implantable cardioverter defibrillator: Measurement equivalence of the HADS-A and the STAI-S. Qual Life Res. 28:3107–3116. [PubMed: 31230167]

Fry PS, Debats DL (2009) Perfectionism and the five-factor personality traits as predictors of mortality in older adults. J Health Psychol. 14:513–524. [PubMed: 19383652]

Galatzer-Levy IR, Bonanno GA (2014) Optimism and death: Predicting the course and consequences of depression trajectories in response to heart attack. Psychol Sci. 25:2177–2188. [PubMed: 25298294]

Giammanco MD, Gitto L (2016) Coping, uncertainty and health-related quality of life as determinants of anxiety and depression on a sample of hospitalized cardiac patients in Southern Italy. Qual Life Res. 25:2941–2956. [PubMed: 27245776]

Giltay EJ, Geleijnse JM, Zitman FG, Hoekstra T, Schouten EG (2004) Dispositional optimism and all-cause and cardiovascular mortality in a prospective cohort of elderly Dutch men and women. Arch Gen Psychiatry. 61:1126–1135. [PubMed: 15520360]

Giltay EJ, Kamphuis MH, Kalmijn S, Zitman FG, Kromhout D (2006) Dispositional optimism and the risk of cardiovascular death: The Zutphen Elderly Study. Arch Intern Med. 166:431–436. [PubMed: 16505263]

Grewal K, Gravely-Witte S, Stewart DE, Grace SL (2011) A simultaneous test of the relationship between identified psychosocial risk factors and recurrent events in coronary artery disease patients. Anxiety Stress Coping. 24:463–475. [PubMed: 21271407]

Hanssen MM, Peters ML, Vlaeyen JW, Meevissen YM, Vancleef LM (2013) Optimism lowers pain: Evidence of the causal status and underlying mechanisms. Pain. 154:53–58. [PubMed: 23084002]

Holmes SD, Fornaresio LM, Miller CE, Shuman DJ, Ad N (2016) Development of the Cardiac Surgery Patient Expectations Questionnaire (C-SPEQ). QualLife Res. 25: 2077–2086.

Kim ES, Hagan KA, Grodstein F, DeMeo DL, De Vivo I, Kubzansky LD (2017) Optimism and cause-specific mortality: A prospective cohort study. Am J Epidemiol. 185:21–29. [PubMed: 27927621]

Kim ES, Smith J, Kubzansky LD (2014) Prospective study of the association between dispositional optimism and incident heart failure. Circ Heart Fail. 7:394–400. [PubMed: 24647117]

Kubzansky LD, Sparrow D, Vokonas P, Kawachi I (2001) Is the glass half empty or half full? A prospective study of optimism and coronary heart disease in the normative aging study. Psychosom Med. 63:910–916. [PubMed: 11719629]

Matthews KA, Raikkonen K, Sutton-Tyrrell K, Kuller LH (2004) Optimistic attitudes protect against progression of carotid atherosclerosis in healthy middle-aged women. Psychosom Med. 66:640–644. [PubMed: 15385685]

McCabe PJ (2010) Psychological distress in patients diagnosed with atrial fibrillation: The state of the science. J Cardiovasc Nurs. 25:40–51. [PubMed: 19935428]

McCormick KM, Naimark BJ, Tate RB (2006) Uncertainty, symptom distress, anxiety, and functional status in patients awaiting coronary artery bypass surgery. Heart Lung. 35:34–45. [PubMed: 16426934]

Nekouei ZK, Yousefy A, Doost HT, Manshaee G, Sadeghei M (2014) Structural model of psychological risk and protective factors affecting on quality of life in patients with coronary heart disease: A psychocardiology model. J Res Med Sci. 19:90–98. [PubMed: 24778660]

Palacios JE, Khondoker M, Achilla E, Tylee A, Hotopf M (2016) A single, one-off measure of depression and anxiety predicts future symptoms, higher healthcare costs, and lower quality of life in coronary heart disease patients: Analysis from a multi-wave, primary care cohort study. PloS one. 11:e0158163. [PubMed: 27463115]

Peterson C (2000) The future of optimism. Am Psychol. 55:44–55. [PubMed: 11392864]

Rasmussen HN, Scheier MF, Greenhouse JB (2009) Optimism and physical health: A meta-analytic review. Ann Behav Med. 37:239–256. [PubMed: 19711142]

Roest AM, Martens EJ, de Jonge P, Denollet J (2010a) Anxiety and risk of incident coronary heart disease: A meta-analysis. J Am Coll Cardiol. 56:38–46. [PubMed: 20620715]

Roest AM, Martens EJ, Denollet J, de Jonge P (2010b) Prognostic association of anxiety post myocardial infarction with mortality and new cardiac events: A meta-analysis. Psychosom Med. 72:563–569. [PubMed: 20410247]

Roest AM, Zuidersma M, de Jonge P (2012) Myocardial infarction and generalised anxiety disorder: 10-Year follow-up. Br J Psychiatry. 200:324–329. [PubMed: 22403086]

Scheier MF, Carver CS (1985) Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. Health Psychol. 4:219–247. [PubMed: 4029106]

Scheier MF, Carver CS (2018) Dispositional optimism and physical health: A long look back, a quick look forward. Am Psychol. 73:1082–1094. [PubMed: 30525784]

Scheier MF, Matthews KA, Owens JF, Magovern GJ Sr., Lefebvre RC, Abbott RA, Carver CS (1989) Dispositional optimism and recovery from coronary artery bypass surgery: The beneficial effects on physical and psychological well-being. J Pers Soc Psychol. 57:1024–1040. [PubMed: 2614656]

Scheier MF, Matthews KA, Owens JF, Schulz R, Bridges MW, Magovern GJ, Carver CS (1999) Optimism and rehospitalization after coronary artery bypass graft surgery. Arch Intern Med. 159:829–835. [PubMed: 10219928]

Shen BJ, Eisenberg SA, Maeda U, Farrell KA, Schwarz ER, Penedo FJ, Bauerlein EJ, Mallon S (2011) Depression and anxiety predict decline in physical health functioning in patients with heart failure. Ann Behav Med. 41:373–382. [PubMed: 21181518]

Snyder CR, Harris C, Anderson JR, Holleran SA, Irving LM, Sigmon ST, Yoshinobu L, Gibb J, Langelle C, Harney P (1991) The will and the ways: Development and validation of an individual-differences measure of hope. J Pers Soc Psychol. 60:570–585. [PubMed: 2037968]

Spielberger CD (1983) Manual for the State-Trait-Anxiety Inventory: STAI (form Y). Palo Alto, CA: Consulting Psychologists Press.

Stoney CM, Kaufmann PG, Czajkowski SM (2018) Cardiovascular disease: Psychological, social, and behavioral influences: Introduction to the special issue. Am Psychol. 73:949–954. [PubMed: 30394774]

Tindle H, Belnap BH, Houck PR, Mazumdar S, Scheier MF, Matthews KA, He F, Rollman BL (2012) Optimism, response to treatment of depression, and rehospitalization after coronary artery bypass graft surgery. Psychosom Med. 74:200–207. [PubMed: 22286847]

Tindle HA, Chang YF, Kuller LH, Manson JE, Robinson JG, Rosal MC, Siegle GJ, Matthews KA (2009) Optimism, cynical hostility, and incident coronary heart disease and mortality in the Women's Health Initiative. Circulation. 120:656–662. [PubMed: 19667234]

Tully PJ, Cosh SM, Baumeister H (2014) The anxious heart in whose mind? A systematic review and meta-regression of factors associated with anxiety disorder diagnosis, treatment and morbidity risk in coronary heart disease. J Psychosom Res. 77:439–448. [PubMed: 25455809]

Zimet GD, Powell SS, Farley GK, Werkman S, Berkoff KA (1990) Psychometric characteristics of the multidimensional scale of perceived social support. JPersAssess. 55:610–617.

TABLE 1.

Attrition Analyses

	All (N = 481)	Wave 2 Participants	Wave 2 Dropouts
	M (SD)/*n* (%)	*M* (SD)/*n* (%)	*M* (SD)/*n* (%)
Demographics			
Sex			
Men	281 (58.4%)	241 (56.8%)	40 (70.2%)
Women	200 (72.7%)	183 (43.2%)	17 (29.8%)
Age	62.18 (12.04)	62.28 (12.86)	62.33 (12.73)
Race			
Non-White	47 (9.8%)	241 (9.7%)	40 (10.5%)
White	434 (90.2%)	283 (90.3%)	51 (89.5%)
Marital status			
Living alone	131 (27.3%)	119 (28.1%)	12 (21.1%)
With spouse or others	349 (72.7%)	304 (71.9%)	45 (78.9%)
Education, yrs	14.03 (3.30)	14.02 (3.22)	14.06 (3.91)
Family income, $	56,728 (56,197)	56,571 (51,754)	58,650 (58,669)
Psychological risk			
Pre-OHS anxiety	35.77 (10.06)	36.06 (12.61)	38.67 (12.37)*
Overall health factors			
Medical comorbidities	2.97 (2.33)	2.97 (2.30)	2.96 (2.57)
BMI	27.26 (5.40)	27.31 (5.48)	26.94 (4.75)
STS medical indices			
Cardiac risk factors (1 = yes, 2 = no)			
Smoker	262 (54.8%)	220 (52.0%)	42 (76.4%)**
Diabetes	92 (19.2%)	81 (19.1%)	11 (20.0%)
Hypercholesterolemia	186 (38.9%)	164 (38.8%)	22 (40.0%)
Hypertension	281 (58.8%)	250 (59.1%)	31 (56.4%)
Renal failure	32 (6.7%)	26 (6.1%)	6 (10.9%)
Chronic lung disease			
No	429 (89.7%)	380 (89.8%)	49 (89.1%)

	All (N = 481)	Wave 2 Participants	Wave 2 Dropouts
	M (SD)/*n* (%)	*M* (SD)/*n* (%)	*M* (SD)/*n* (%)
Mild	33 (6.9%)	30 (7.1%)	3 (5.5%)
Moderate	9 (1.9%)	7 (1.7%)	2 (3.6%)
Severe	7 (1.5%)	6 (1.4%)	1 (1.8%)
HD-specific indices (1 = yes, 2 = no) (except the last two items)			
Angina	171 (35.8%)	147 (34.8%)	24 (29.0%)
Arrhythmia	80 (16.7%)	73 (17.3%)	7 (43.6%)
Left main disease >50%	26 (5.7%)	21 (5.2%)	5 (9.1%)
MI	114 (23.8%)	99 (3.4%)	15 (27.3%)
CHF	221 (46.2%)	198 (46.7%)	23 (41.8%)
CABG	169 (35.4%)	144 (34.0%)	25 (44.5%)
No. diseased coronary vessels			
None	252 (54.3%)	223 (54.5%)	29 (52.7%)
One	57 (12.3%)	50 (12.2%)	7 (12.7%)
Two	42 (9.1%)	39 (9.5%)	3 (5.5%)
Three	113 (24.4%)	97 (23.7%)	16 (29.1%)
NYHA classification			
I	179 (37.6%)	156 (37.0%)	23 (42.6%)
II	167 (35.1%)	145 (34.4%)	22 (40.7%)
III	115 (24.2%)	107 (25.4%)	8 (14.8%)
IV	15 (3.2%)	14 (3.2%)	1 (1.9%)

* $p < 0.05$.

** $p < 0.01$.

TABLE 2.

Bivariate Correlations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Male *vs.* Female	1											
2. Age	0.013	1										
3. Non-White *vs.* Whites	0.008	0.104*	1									
4. Others *vs.* married with Sb	−0.234**	−0.111*	0.055	1								
5. Education	−0.209**	−0.195**	0.028	0.121**	1							
6. Income level	−0.264**	−0.187**	0.146**	0.385**	0.431**	1						
7. Medical comorbidity	0.216**	0.154**	−0.059	−0.149**	−0.178**	−0.246**	1					
8. BMI	−0.017	−0.108*	0.025	0.075	0.009	0.002	0.105*	1				
9. Optimism	−0.035	0.100*	0.048	0.145**	0.207**	0.129**	−0.150**	−0.017	1			
10. Hope	−0.123*	0.011	0.044	0.141**	0.296**	0.282**	−0.163**	−0.046	0.527**	1		
11. Social support	−0.004	−0.035	0.018	0.234**	0.082	0.126*	−0.116*	0.056	0.308**	0.379**	1	
12. Post-OHD anxiety	0.143**	−0.028	−0.120*	−0.133*	−0.098	−0.128*	0.181**	−0.015	−0.472**	−0.350**	−0.224**	1
13. Pre-OHD anxiety	0.168**	−0.189**	−0.118**	−0.081	−0.087	−0.106*	0.276**	0.084	−0.509**	−0.387**	−0.143*	0.649

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Sb, spouse present.

TABLE 3.

Standardized Coefficients for Regression Models of Post-OHS Anxiety

Variable	Step 1 β (p)	Step 2 β (p)	Step 3 β (p)	Step 4 β (p)	Step 5 β (p)
Male *vs.* female	0.120 *	0.020	0.030	0.046	0.047
Age	−0.047	0.062	0.063	0.074	0.094 *
Non-White *vs.* White	−0.126 *	−0.097 *	−0.107 *	−0.115 **	−0.094 *
Others *vs.* married with spouse	−0.123 *	−0.068			
Education	−0.088				
Annual income	0.007				
Pre-OHS anxiety		0.671 ***	0.653 ***	0.566 ***	0.563 ***
Medical comorbidity		−0.009			
BMI		−0.097 *	−0.089 *	−0.069	
Smoker		0.003			
Diabetes		0.015			
Hypercholesterolemia		−0.044			
Hypertension		−0.014			
Renal failure		−0.055			
Chronic lung disease		0.106 *	0.136 *	0.133 **	0.105 *
Congestive heart failure			−0.018		
NYHA classification			−0.085	−0.074	
Arrhythmia			−0.043		
Angina			−0.071		
MI			0.052		
Left main disease >50%			0.080	0.058	
No. diseased coronary vessels			0.117	0.061	
Coronary artery bypass			0.032		
Perfusion time, min			0.043		
Optimism				−0.138 **	−0.207 ***
Hope				−0.058	

	Step 1	Step 2	Step 3	Step 4	Step 5
Variable	***β* (*p*)**	***β* (*p*)**	***β* (*p*)**	***β* (*p*)**	***β* (*p*)**
Social support				−0.065	
R^2	0.067	0.481	0.487	0.520	0.486
F (no. independent variables, *df*)	22.612** (13,317)	3.565*** (6305)	19.003*** (15,300)	25.674*** (12,284)	50.176*** (6306)

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.