Psychosocial Predictors of Cardiopulmonary Mortality and Morbidity

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Abstract

Cardiopulmonary health problems affect millions of Americans each year. There is evidence to believe that psychosocial variables influence health outcomes for these patients. It was hypothesized that cardiopulmonary patients with high levels of depression, anxiety, anger, emotional guardedness, and low levels of social support would be more likely to be deceased approximately two years following rehabilitation. Psychosocial variables were assessed in a sample of 51 patients participating in a cardiopulmonary rehabilitation program. Patients completed rehabilitation and were contacted approximately two years later to follow up on their cardiopulmonary health. Contrary to the hypothesis, statistical analyses revealed that the patients who were deceased had reported significantly lower levels of depression during rehabilitation than those patients who lived. Anxiety, anger, and social support were significantly related to reports of cardiovascular morbidity at follow-up. The results of this study suggest that further evaluation of psychosocial variables may help health care professionals better understand and treat patients with cardiopulmonary diseases.
Psychosocial Predictors of Cardiopulmonary Mortality and Morbidity

Cardiovascular and pulmonary disease are two major causes of death in the United States and globally. In the US alone, over 12 million people suffer from Chronic Obstructive Pulmonary Disease (COPD; National Heart Lung and Blood Institute, 2007) and nearly 700,000 people die from heart disease in the US each year (Centers for Disease Control, 2007). Both cardiovascular disease and COPD are chronic and disabling conditions that affect millions of patients and their caregivers. Although both conditions are chronic, there is research to suggest that psychological and social variables affect outcomes for patients with cardiovascular and pulmonary diseases. Risk factors for cardiopulmonary disease and the effects of psychosocial variables on health-related outcomes are reviewed below.

**Cardiovascular Disease**

Coronary heart disease, also known as coronary artery disease, is the most common cause of death in the United States today (Centers for Disease Control and Prevention, 2007). The disease occurs when the blood vessels leading to the heart become blocked and the heart is deprived of oxygen and nutrients. The disease is the result of years of fatty plaque particles building up in the blood vessels, a condition called atherosclerosis. Chest pain, known as angina, is a common symptom of coronary heart disease, as is myocardial infarction or “heart attack” (National Heart Lung and Blood Institute, 2007; Matthews, 2005).

Lifestyle changes, surgery, and cardiac rehabilitation are all possible treatment options for cardiovascular disease. Changes in diet and exercise regimen may help slow or stop the progression of heart disease, but in many cases this is not enough. Bypass surgery, also known as coronary artery bypass graft (CABG), is performed in order to increase blood flow to the heart in patients with severe blockages (American Heart Association, 2007). Patients may be referred
to cardiac rehabilitation after surgery, in order to learn how to manage their illness and to maintain or improve their quality of life (American Heart Association, 2007; National Heart Lung and Blood Institute, 2007).

Risk Factors for Heart Disease and Cardiovascular Events

A number of medical and psychosocial risk factors for the development of cardiovascular disease have been studied. Medical risk factors include hypertension, hyperlipidemia, waist circumference, obesity/body mass index, diabetes, insulin resistance and age (American Heart Association, 2008; Matthews, 2005; Player, King, Mainous, & Geesey, 2007). Lifestyle-related factors include sedentary lifestyle, smoking, low socioeconomic status, and life satisfaction (Matthews, 2005; Player, et al. 2007). Psychosocial risk factors include long-term stress, marital problems, depression, anxiety, social isolation and hostility (Berry, Lloyd-Jones, Garside, Wang, & Greenland, 2007; Matthews, 2005; Player, et al. 2007).

Psychosocial Risk Factors for Cardiovascular Death

Many studies suggest that psychosocial variables such as depression, anxiety, hostility, social support, and emotional guardedness influence whether or not a patient will die from coronary heart disease or a related health problem. This section will review the literature on psychosocial risk factors for cardiovascular-related mortality.

Depression

Several studies suggest that depression is linked to cardiovascular morbidity and mortality. After following a sample of asymptomatic men and women for twelve years, Ahto, Isoaho, Puolijoki, Vahlberg, & Kivela (2006) reported that depression was found to be linked to incidence of myocardial infarction and coronary heart disease-related deaths. Schumacher and Herrman-Lingen (2004) conducted a meta-analysis of 20 studies and found that coronary heart
disease patients with depressive symptoms were twice as likely to die within two-years of initial assessment as nondepressed patients. Burg, Benedetto, and Soufer (2003) reported that two years after coronary artery bypass graft surgery depressed men were much more likely to die than non-depressed men.

Anxiety

There is some disagreement among researchers about the influence of anxiety on outcomes for cardiovascular patients. In a study of 440 patients undergoing coronary artery bypass surgery, Tully, Baker, & Knight (2008) found that anxiety was a strong predictor of mortality at follow-up (average follow-up 5 years and 10 months). However, in a review of the literature, Everson-Rose and Lewis (2005) found that some studies point to a strong relationship while others may show that anxiety is in some way protective against future morbidity.

Anger/Hostility

Hostility may also be a predictor of cardiac mortality. In a study of more than 900 coronary artery disease patients, Boyle and colleagues found that high levels of hostility were associated with cardiovascular disease-related deaths (Boyle, Williams, Mark, Brummett, Siegler, Hemls, et al., 2004). There is research to suggest that reducing anger and hostility may decrease medical risk factors for cardiovascular mortality and morbidity. Gidron, Davidson, and Bata (1999) found that teaching male coronary heart disease patients how to manage their anger led to lower resting diastolic blood pressure in just two months, reducing their risk for further cardiac events.

Social Support/Avoidance

Research in animals has shown that isolation leads to an increase in depression and anxiety- like behaviors as well as increased cardiac reactivity (Grippo, Lamb, Carter, & Porges,
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2007). This suggests the effects of social support on heart health. Lache, Meyer, and Herrman-Lingen (2007) found that patients with implanted cardiac defibrillators were more likely to recovery normally from psychological stress if they reported higher levels of social support in their lives. This finding shows that the presence of social support can decrease risk factors for cardiovascular events. In a study of over 2,000 post-myocardial infarction patients, Lett and colleagues found that perceived social support only had an effect on non-depressed patients (Lett, Blumenthal, Babyak, Catellier, Carney, Berkman, et al., 2007). Perhaps this suggests that the extent to which social support helps a patient recover is linked to how depressed they are. Moser and Dracup (2004) reported that quality of the marital relationship did not affect patients’ psychosocial health as much as the spouse’s anxiety did. This suggests that emotions and activities of the people around the patient have an effect on the patient’s recovery.

*Emotional Guardedness*

Denollet and colleagues found that negative affect, an aspect of depression, was associated with increased mortality only when patients did not express their negative feelings (Denollet, Sys, & Brutsaert, 1995; Denollet, Sys, Stroobant, Rombouts, Gillebert, & Brutsaert, 1996; Denollet, Pederson, Vrints, & Conraads, 2006). They found that, if a person is experiencing negative emotions and not expressing them, their risk for cardiac mortality increases. They also found that low tolerance for exercise paired with this personality type led to a four-fold increase in cardiac mortality (Denollet, et al, 1996).

*Cardiac Rehabilitation*

Cardiac rehabilitation is a comprehensive and multidisciplinary program monitored by health professionals. The goals of cardiac rehabilitation include reducing patients’ risk factors for further cardiovascular events and helping patients maintain active lifestyles (Balady,
Williams, Ades, Bittner, Comoss, Foody, et al., 2007). Patients in the program participate in regular exercise routines and learn to eat a heart-healthy diet. They also experience counseling about their new medications and how to deal with their condition (American Heart Association, 2007; Centers for Disease Control and Prevention, 2008).

Not all patients who experience MI or undergo heart surgery attend cardiac rehabilitation. A survey of nearly 130,000 Americans found that only about 35% of patients who experienced MI went to a rehabilitation program afterwards. Men, married people, and older people were more likely to go through cardiac rehabilitation. Level of education and household income also influenced whether or not a person went to rehabilitation. Health insurance coverage and occupation did not seem to influence whether or not a patient participated in an outpatient rehabilitation program (Centers for Disease Control and Prevention, 2008).

According to Denollet and Brutsaert (2001), cardiac rehabilitation is associated with decreased risk of mortality. They found that after nine years, the group of patients who completed a comprehensive rehabilitation program had a much lower death rate (4% as compared to 17%) than patients receiving only standard medical follow-up care. In a randomized controlled study of 93 patients who had undergone a recent percutaneous transluminal coronary angioplasty (PTCA), Lisspers and colleagues found that rehabilitation did not significantly decrease life stress or stress management but did decrease patients’ “type A attitudes.” Patients in the rehabilitation group reported exercising more frequently, improving their diets, more weight loss, and more reductions in smoking compared to the control group (Lisspers, Sundin, Hofman-Bang, Nordlander, Nygren, Rydén, et al., 1999). However, this study found no differences between the rehabilitation and control groups in the number of coronary events in the year following PTCA.
Women and all patients reporting high levels of depression are less likely to finish a cardiac rehabilitation program, but research suggests that they can achieve the same benefits as others if the program is completed (Caulin-Glaser, Maciejewski, Snow, LaLonde, & Mazure, 2007).

**Chronic Obstructive Pulmonary Disease**

Chronic obstructive pulmonary disease (COPD) refers to two lung conditions: bronchitis and emphysema. COPD results from damage to the lungs. Smoking is the most common cause of COPD (National Heart Lung and Blood Institute, 2007). COPD is the fourth most common cause of death in the United States and internationally (National Heart Lung and Blood Institute, 2007). In COPD, the alveoli, or air sacs in the lungs, lose their elasticity and the walls between them are broken down or thickened, reducing the lung’s ability to mobilize oxygen. Too much mucus is often another problem caused by COPD, making it difficult to breathe (National Heart Lung and Blood Institute, 2007).

**Risk Factors for COPD-Related Mortality**

Not as much research is available about COPD as there is for heart disease, and not all COPD studies assess health-related quality of life variables (Doll & Miravitlles, 2005). In a study measuring the number of COPD-related hospital readmissions, Cao, Ong, Eng, Tan, and Ng (2006) reported that duration of disease, poorer lung function, use of psychotropic medications, and vaccinations were associated with more hospital readmissions for acute respiratory exacerbations. Univariate analyses suggested that men may be at higher risk for acute exacerbations than women (Cao, et al., 2006). Crockett, Cranston, Moss, and Alpers (2002) found that in patients with severe COPD who were prescribed long-term oxygen therapy, poor emotional functioning was a predictor of mortality in women but not men. Lung capacity
and Body Mass Index (BMI) were also predictors for women, whereas only arterial partial pressure of oxygen predicted mortality in men. In a study of 49 patients with severe COPD, Stage, Middelboe, and Pisinger (2005) followed patients for a mean of 2.2 years. They reported that depression may actually have a protective effect because all 12 of their depressed patients were alive at follow-up.

_Pulmonary Rehabilitation_

Like cardiac rehabilitation, pulmonary rehabilitation is a program designed to help patients live a healthier lifestyle. Programs include exercise and counseling for patients with lung problems (National Heart Lung and Blood Institute/National Institutes of Health, 2006) and may decrease incidence of breathing difficulties (Kyung & Chin, 2008). There is mixed evidence on the effects of pulmonary rehabilitation for COPD patients. In a small randomized study by Güell and colleagues, patients who received pulmonary rehabilitation fared significantly better than controls at follow-up 16 weeks later (Güell, Resqueti, Sangenis, Morante, Martorell, Casan, et al., 2006). As measured by the Symptoms Checklist-90- Revised (SCL-90-R), the rehabilitation group was significantly less depressed, anxious, and hostile than the control group. The rehabilitation group also scored better on the SCL-90-R global severity score, positive symptoms distress indices, somatization, psychoticism, and positive symptom domain scores than the control group. These patients also had better physical health outcomes. In addition to better performance on a six minute walk distance task, patients who completed 16 weeks of pulmonary rehabilitation also showed less fatigue. After conducting a meta-analysis of the current literature, Wilt, Niewoehner, MacDonald, and Kane (2007) suggested that physicians prescribe pulmonary rehabilitation for COPD patients experiencing bothersome symptoms. According to their research, rehabilitation helps control symptoms of COPD.
In contrast, a literature review conducted by Taylor, Candy, Bryar, Ramsay, Iubertus, Vrijhoef, et al., (2005) found no significant benefits of pulmonary rehabilitation. According to Taylor, et al. (2005), there is no evidence that nurse-led pulmonary rehabilitation programs affect health-related quality of life, psychological well-being, pulmonary function, degree of disability, COPD-related hospital readmissions, or mortality at 12 month follow-up.

**Hypotheses and Research Questions**

It was hypothesized that cardiac patients would have a higher rate of mortality than pulmonary patients based on the assumption than cardiac patients tend to be sicker than pulmonary patients in rehabilitation (Koening, 2006 as cited in Wilson, Brookings, Eichenauer, & Feltz, 2007).

Because patients with COPD tend to report poorer physical functioning and less health competence (Arnold, Ranchor, DeJongste, Koeter, Ten Hacken, Aalbers, et al., 2005), it was predicted that COPD patients would have a greater rate of morbidity than cardiac patients as indicated by a greater number of hospitalizations and procedures. For this research, morbidity was measured by myocardial infarction, angina, number of hospitalizations, number of days spent in the hospital, cardiac catheterizations, angioplasty, stent, and open-heart surgery reported at follow-up.

Depression, as measured by the Beck Depression Inventory-II (BDI-II; Beck, 1996) and the Psychosocial Risk Factors Scale Depression subscale (PRFS; Eichenauer & Feltz, 2006) at the beginning of rehabilitation, was expected to be associated with morbidity and mortality at follow-up for both cardiac and pulmonary patients (Ahto, et al., 2006; Barth, Schumacher, & Herrmann-Lingen, 2004; Burg, Benedetto, & Soufer, 2003). Higher levels of depression were
also expected to be associated with not finishing the rehabilitation program (Caulin-Glaser, Maciejewski, Snow, LaLonde, & Mazure, 2007).

Anxiety, as measured by the Beck Anxiety Inventory (BAI; Beck, 1990) and PRFS Anxiety subscale (Eichenauer & Feltz, 2006) at the beginning of rehabilitation, was expected to be associated with greater morbidity and mortality at follow-up for both cardiac and pulmonary patients (Tully, Baker, & Knight, 2008).

Hostility, as measured by the State-Trait Anger Expression Inventory (STAXI; Spielberger, 1999) and PRFS Anger subscale (Eichenauer & Feltz, 2006) at the beginning of rehabilitation, was expected to be associated with morbidity and mortality at follow-up for both cardiac and pulmonary patients (Boyle, et al., 2004).

Low levels of social support, as measured by the Life Stressors and Social Resources Inventory—Adult Form (LISRES-A; Moos & Moos, 1994) and PRFS Social Support subscale (Eichenauer & Feltz, 2006) at the beginning of rehabilitation, were expected to be associated with morbidity and mortality at follow-up for both cardiac and pulmonary patients (Berry, Lloyd-Jones, Garside, Wang, & Greenland, 2007; Lache, Meyer, & Herrmann-Lingen, 2007).

High levels of emotional guardedness, as measured by the Marlowe-Crowne Social Desirability Scale (Marlowe & Crowne, 1960) and PRFS Emotional Guardedness scale (Eichenauer & Feltz, 2006) at the beginning of rehabilitation, were expected to be associated with morbidity and mortality at follow-up for both cardiac and pulmonary patients (Denollet, Sys, & Brutsaert, 1995; Denollet, Sys, Stroobant, Rombouts, Gillebert, & Brutsaert, 1996; Denollet, Pederson, Vrints, & Conraads, 2005).

Men were expected to have higher risk for mortality than women (van Jaarsveld, Ranchor, Kempen, Coyne, van Veldhuisen, Ormel, et al., 2006). Age was expected to influence
morbidity and mortality, with older patients being more likely to report health problems or be deceased at follow-up (Tully, Baker, & Knight 2008). Completion of more rehabilitation sessions was expected to be associated with fewer health problems reported at follow-up (American Association of Cardiovascular and Pulmonary Rehabilitation, 2003).

Methods

Subjects

Subjects included 51 patients (22 men, 29 women) who were enrolled in cardiopulmonary rehabilitation at Mercy Hospital in Springfield, OH between December 2004 and July 2006. Average age of the participants was 66.65 ± 11.01 years. The youngest participant was 37 years old, and the oldest participant was 88 years old. About half of the participants were enrolled in rehabilitation for heart problems (n =29), and about half were enrolled for lung problems (n =22). Diagnosed heart problems included coronary artery bypass graft surgery (CABG), percutaneous transluminal angioplasty (PTCA), stable angina, myocardial infarction (MI), and stent implant. Lung problems were mostly COPD. All participants gave informed consent to participate in a study to assess the effectiveness of the Psychosocial Risk Factors Survey (Eichenauer & Feltz, 2006) for measuring risk factors for cardiovascular events.

Measures

At the beginning of rehabilitation, participants were given a number of self-administered assessments. The assessments used by the present study include the BDI-II (Beck, 1996), BAI (Beck, 1990), STAXI-2 (Spielberger, 1999), Marlowe Crowne Social Desirability Scale (Crowne & Marlowe, 1960), LISRES-A (Moos & Moos, 1994), and PRFS (Eichenauer & Feltz, 2006).

**BDI.** The Beck Depression Inventory-II (BDI-II, Beck, 1996) is a 21 item self-report questionnaire that assesses symptoms of depression. For each item, the participant assesses four
statements and chooses the one that best describes how he or she has been feeling over the past two weeks. Sample items include thoughts of suicide and loss of interest in sexual activity. When administered to an outpatient population, the BDI-II has high internal consistency, Cronbach’s $\alpha = 0.92$, and high test-retest reliability, $r = 0.93$, $p < 0.001$. The BDI-II is significantly correlated with scales of hopelessness and suicidal ideation scales (Beck, 1996).

**BAI.** Anxiety was measured by the Beck Anxiety Inventory (BAI, Beck, 1990), a 21 item self-report questionnaire. Participants are to read through a series of statements and rate, on a Likert scale, the extent to which they have felt each symptom during the past week. Sample items include, dizziness, indigestion, and nervousness. The BAI has high levels of internal consistency, Cronbach’s $\alpha$ between 0.92 and 0.94, and moderately high test-retest reliability, $r = 0.75$, $p < 0.001$. The BAI is moderately correlated with the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The BAI is also significantly correlated with the BDI (Beck, 1990).

**STAXI-2.** The State-Trait Anger Expression Inventory-2 (STAXI-2, Spielberger, 1999) was used to assess anger. This assessment contains six scales and five subscales for a total of 57 items that assess state or trait anger. The STAXI-2 is a self-administered questionnaire which requires participants to rate themselves on a one to four scale on the intensity and frequency of their anger. State anger refers to the current, subjective, and relatively temporary mindset of the participant, whereas trait anger is more a measure of temperament that is relatively stable over time. Internal reliability is high for all subscales of the STAXI-2. All subscales have $\alpha \geq 0.84$ except the T-Anger/R (Angry Reaction) Subscale which has an $\alpha$ value between 0.73 and 0.76 when administered to a normal adult population. Scores on the Buss-Durkee Hostility Inventory and the Hostility and Overt Hostility Subscales of the Minnesota Multiphasic Personality Inventory are significantly correlated with scores on the Trait Anger Scale of the STAXI. State
Anger is positively correlated with anxiety, psychoticism, and neuroticism (Spielberger, 1999). The State-Anger, Trait-Anger, and Anger Expression Index scales were examined in the present study. According to Spielberger (1999), high scores on the Anger Expression Index indicate a higher risk for medical problems.

*Marlowe Crowne Social Desirability Scale.* The Marlowe Crowne is a 33 item, self-report instrument designed to assess a person’s need for approval and acceptance. Half of the items on the Marlowe Crowne are socially acceptable but untrue statements. The other half of the items are most likely true but not socially desirable. Participants are to mark each statement as true or false. The Marlowe Crowne has high internal validity (Cronbach’s $\alpha = 0.88$) and high test-retest reliability ($r = 0.88$). Scores on the Marlowe Crowne are not strongly related to personality variables or pathology assessed by the Minnesota Multiphasic Personality Inventory (Crowne & Marlowe, 1964). The Marlowe Crowne is a well-accepted measure of how truthful a person is about their behaviors and emotions.

*LISRES-A.* Participants completed the Life Stressors and Resources Inventory-Adult Form (LISRES-A, Mooos & Moos, 1994) to assess sources of stress and support in their lives. The LISRES-A is a self-report measure containing 200 items. The assessment contains items that require participants to choose yes/no answers as well as items asking participants to rate the frequency of an occurrence in their own lives. The eight domains addressed by the LISRES-A aim to assess a person’s overall life situation. Variables of importance include physical health, financial situation, work/job, home environment, and relationships. The LISRES-A contains scales to assess stressors and scales to assess resources in a person’s life. Such factors have been known to influence recovery from medical problems (Moos & Moos, 1994). The Life Stressor Scales of the LISRES-A have high internal validities ($\alpha \geq 0.64$, mean $\alpha = 0.80$). The Social
Resources Scales also have moderate to high internal validities (mean $\alpha = 0.79$). Scores on
many of the Life Stressors and Resources Scales are significantly negatively correlated,
suggesting a relationship between stressors and resources (Moos & Moos, 1994).

**PRFS.** The Psychosocial Risk Factor Survey (PRFS; Eichenauer & Feltz, 2006) is a 70-
item self-report questionnaire designed specifically for assessing psychosocial risk factors in
cardiac and pulmonary patients. The PRFS includes five subscales: Depression, Anxiety,
Anger/Hostility, Social Interaction, and Emotional Guardedness. The Depression subscale of the
PRFS is significantly correlated with the Beck Depression Inventory ($r = 0.77$, $p < 0.001$) and
the PRFS Anxiety subscale is significantly correlated with the Beck Anxiety Inventory ($r = 0.57$,
$p = <0.001$). The Anger/Hostility subscale of the PRFS is significantly related to both the State-
Trait Anger Expression Inventory’s Trait Anger and Anger Expression Index scores ($r = 0.73$
and $r = 0.63$ respectively, $p <0.001$). The Social Interaction subscale is significantly related to
the Spouse, Child, Family, and Friend Resource scales of the Life Stressors and Resources
Inventory-Adult (LISRES-A; Moos & Moos, 1994). The Emotional Guardedness subscale is
significantly correlated with responses on the Marlowe Crowne Social Desirability Scale
(Marlowe & Crowne, 1960).

**Procedure**

Participants completed the BDI, BAI, Marlowe Crowne, LISRES-A, and PRFS at the
beginning of rehabilitation. They then participated in the outpatient cardiopulmonary
rehabilitation program at Mercy Hospital in Springfield, OH. Participants in rehabilitation for
cardiac problems completed an average of 30.86 sessions, and pulmonary patients completed an
average of 23.84 sessions. Participants were contacted by telephone approximately two years
after initial assessment to follow up on their cardiopulmonary health. After giving informed
consent (See Appendix A), patients were asked a series of questions about their cardiovascular health since they completed rehabilitation (See Appendix B). Dependent variables of interest included mortality and further cardiac or pulmonary events and hospitalizations. Independent variables included sex, diagnosis, and scores on the self-administered psychosocial assessments.

Results

Descriptive Statistics

At the beginning of the study, the average age of participants was 66.65 years. The youngest participant was 37 years old, and the oldest participant was 88 years old when the study began. Average age of cardiac patients was 66.70 years, and average age of pulmonary patients was 66.59 years. Ages of cardiac and pulmonary groups were not statistically significantly different from one another, \( t(50) = 0.04, p = \text{n.s.} \). Participants were contacted approximately two years after beginning a cardiopulmonary rehabilitation program. Mean length of time between initial evaluation and follow-up was 23.56 ± 5.94 months.

Differences between Cardiac and Pulmonary Patients

Psychosocial measures taken at the beginning of the study were compared for differences between cardiac and pulmonary patients. Mean scores for cardiac and pulmonary patients are given in Table 1. There were no differences between groups on the BDI, \( t(50) = -0.62, p = \text{n.s.} \), Trait Anger, \( t(49) = 0.23, p = \text{n.s.} \), State Anger, \( t(49) = -1.61, p = \text{n.s.} \), Anger Expression Index, \( t(49) = -1.26, p = \text{n.s.} \), Marlowe-Crowne, \( t(49) = -0.59, p = \text{n.s.} \), stress from friends, \( t(48) = 0.87, p = \text{n.s.} \), or stress from children as measured by the LISRES, \( t(44) = -0.14, p = \text{n.s.} \).

Pulmonary patients reported significantly more anxiety at the start of the study as measured by the BAI, \( t(50) = -2.25, p = 0.03 \), but not the PRFS anxiety subscale, \( t(47) = 0.22, p = \text{n.s.} \). Pulmonary patients reported more stress from spouse, \( t(39) = -3.10, p = 0.004 \) and
family, \( t(48) = -3.21, p = 0.002 \) as measured by the LISRES but no difference between cardiac and pulmonary patients was significant as measured by the social support subscale of the PRFS, \( t(46) = -0.35, p = \text{n.s.} \).

**Relationships between Scales**

Self-reported anxiety as measured by the BAI was significantly correlated with the PRFS anxiety subscale, \( r(47) = 0.47, p = 0.001 \). Self-reported depression as measured by the BDI and the PRFS depression subscale were strongly correlated, \( r(44) = 0.74, p = 0.01 \). The anger subscale of the PRFS was strongly related to the Anger Expression index of the STAXI, \( r(45) = 0.62, p = 0.00 \), and to trait anger as measured by the STAXI, \( r(45) = 0.63, p = 0.00 \), but not to state anger, \( r(45) = 0.25, p = \text{n.s.} \). The emotional guardedness subscale of the PRFS was significantly correlated with scores on the Marlowe-Crowne, \( r(45) = 0.31, p = 0.04 \). Correlations between the LISRES-A and PRFS social support subscales were non-significant but the PRFS subscale and support from spouse as measured by the LISRES-A approached significance, \( r(36) = 0.32, p = 0.051 \).

**Age**

**Demographics and outcomes**

**Mortality.** A \( t \) test revealed that older age was associated with increased rate of mortality, \( t(48) = 2.97, p = 0.005 \). Mean age of patients who were deceased at follow-up was 78.17 ± 5.00 years, and mean age of surviving patients was 64.89 ± 10.71 years.

**Morbidity.** At follow-up, two participants had experienced subsequent myocardial infarction. A \( t \) test revealed no age differences between those participants with recurrent MI and participants without recurrent MI, \( t(42) = -1.40, p = \text{n.s.} \). Angina-related symptoms (chest pain, difficulty breathing, and nausea) were not associated with age. Morbidity as measured by the
instance of further cardiac catheterizations, angioplasty, stent implantation, defibrillator implantation, pacemaker implantation, bypass surgery, and heart valve surgery were not significantly associated with the age of participants. Age was not correlated with number of hospitalizations or days spent in the hospital due to heart or lung problems at follow-up. Age was also not correlated with number of rehabilitation sessions completed, or amount or hours of oxygen used.

Sex

Mortality. Of the participants who had passed away by follow-up, four were women and two were men. Chi squared analyses revealed that this was not a statistically significant difference, \( \chi^2(2, N = 51) = 1.09, p = \text{n.s.} \)

Morbidity. Men and women did not differ in the number of rehabilitation sessions they completed, \( t(46) = 1.55, p = \text{n.s.} \), or amount of oxygen they used at follow-up, \( t(42) = -1.44, p = \text{n.s.} \). At follow-up, men and women did not differ in number of hospitalizations for heart or lung problems, \( t(42) = -0.40, p = \text{n.s.} \).

Medical Condition

Cardiac patients completed significantly more rehabilitation sessions than pulmonary patients, \( t(46) = 2.70, p = 0.01 \). Participants in rehabilitation for cardiac problems completed an average of 30.86 sessions, and pulmonary patients completed an average of 23.84 sessions. The number of hospital stays and days spent in the hospital after completing rehabilitation were not significantly different between cardiac and pulmonary patients. At follow-up, four pulmonary patients and two cardiac patients had died. This difference was not statistically significant, \( \chi^2(2, N = 51) = 2.43, p = \text{n.s.} \).

Number of Rehabilitation Sessions
Number of rehabilitation session completed was significantly related to mortality. Participants who completed more than 25 sessions were much less likely to have died at follow-up $\chi^2(6, N = 51) = 11.96, p = 0.003$. Number of sessions was related to breathing problems at follow-up, with those participants who completed more sessions reporting less breathing trouble, $\chi^2(6, N = 51) = 17.16, p = 0.01$.

Participants who were depressed at the beginning of the rehabilitation program were less likely to complete all sessions. Strong negative correlations exist between BDI score and number of sessions completed, $r(47) = -0.42, p = 0.01$, BAI score and number of sessions completed, $r = -0.50, p = 0.01$, and State Anger and number of sessions completed, $r(46) = -0.36, p = 0.05$.

**Further Hospitalizations**

High scores on the examined psychosocial measures were not significantly related to high number of heart or lung-related hospitalizations reported at follow-up. Contrary to what was expected, the Anger Subscale of the PRFS was negatively correlated with number of hospitalizations, $r(39) = -0.34, p = 0.05$. More stress from one’s children was statistically significantly related to more frequent hospitalizations $r(37) = 0.36, p = 0.05$. Number of hospitalizations was negatively correlated with number of rehabilitation sessions completed, $r(43) = -0.48, p = 0.01$.

**Psychosocial Risk Factors and Health Outcomes**

Psychosocial variables were analyzed in order to determine whether or not there were any differences between participants who experienced further cardiopulmonary illness. Psychosocial variables were also examined to see if any were associated with increased mortality. See Table 2 for mean scores on psychosocial measures for living and deceased patients.
Depression. At the time participants completed the psychosocial assessments, cardiac and pulmonary patients did not differ in self-reports of depression. Depression, as measured by the BDI, was statistically significantly associated with lower rate of mortality, \( t(21) = -2.78, p = 0.01 \). Those who reported less depressive symptoms at the beginning of the study were significantly less likely to have passed away at follow-up.

Depression was not associated with higher rate of MI in subjects, \( t(42) = 0.60, p = \text{n.s.} \) (BDI), \( t(38) = -0.18, p = \text{n.s.} \) (PRFS). Depression, as measured by the PRFS, was not significantly related to breathing problems at follow-up, but there was a notable trend toward this relationship, \( t(38) = 1.94, p = 0.06 \). The relationship between the PRFS Depression Subscale and reports of chest pain at follow-up approached statistical significance, \( t(38) = 1.92, p = 0.06 \). Depressive symptoms measured by the BDI at the beginning of the study were not significantly related to angina-related nausea at follow-up, \( t(42) = 1.85, p = \text{n.s.} \).

Anxiety. Self-reported anxiety, as measured by both the BAI, \( t(48) = -0.50, p = \text{n.s.} \), and Anxiety Subscale of the PRFS, \( t(45) = 0.16, p = \text{n.s.} \), was not found to be associated with increased rate of mortality.

Anxiety, as measured by the BAI but not the PRFS, was significantly associated with MI at follow-up, \( t(42) = 4.59, p = 0.00 \). More anxiety, as measured by the BAI, at the beginning of the study was significantly related to breathing trouble at follow-up, \( t(42) = 3.42, p = 0.002 \). When measured by the Anxiety Subscale of the PRFS, self-reported anxiety was significantly associated with chest pain at follow-up, \( t(40) = 2.19, p = 0.03 \). Higher scores on the BAI at the beginning of the study were strongly associated with reports of angina-related nausea at follow-up, \( t(42) = 2.89, p = 0.01 \).
Anger. At the time participants completed the psychosocial assessments, cardiac and pulmonary patients did not differ in self-reports of anger as indicated by the State Anger Subscale of the STAXI, Trait Anger Subscale of the STAXI, Anger Index of the STAXI, or the Anger Subscale of the PRFS. Scores on the Anger Subscale of the PRFS were significantly correlated with Trait Anger, $r = 0.62, p = 0.01$. Anger, as measured by both the STAXI and the Anger Subscale of the PRFS, was not associated with increased mortality rate.

No differences in state or trait anger were found between participants who experienced MI at follow-up and those who did not. Anger was not related to breathing trouble at follow-up. Anger was not related to reports of chest pain at follow-up. High scores on the PRFS Anger Subscale were significantly related to angina-related nausea at follow-up, $t(38) = 2.64, p = 0.01$.

Social Support. At the time participants completed the psychosocial assessments, cardiac and pulmonary patients did not differ in social resources. They did differ on measures of social stressors. Pulmonary patients reported more stress from their spouses, $t(39) = -3.10, p = 0.004$, and families, $t(48) = -3.21, p = 0.002$, than did cardiac patients. Social resources were not statistically associated with rate of mortality. Social stressors were not significantly associated with rate of mortality.

Social resources, as measured by the LISRES-A, did not differ between participants who did and did not experience MI at follow-up. Stress from one’s children was not significantly related to breathing problems at follow-up, but there was a trend in this direction, $t(35.35) = 1.98, p = 0.06$. Social support was not related to reports of chest pain at follow-up. Less support from a spouse was associated with more frequent reports of angina-related nausea at follow-up, $t(34) = -3.44, p = 0.002$. Stress attributed to a spouse was also significantly related to nausea, $t(34) = 2.54, p = 0.02$. Having friends as a resource was significantly linked to less
nausea at follow-up, \( t(41) = -2.32, p = 0.02 \). However, support from friends was linked to subsequent cardiac catheterizations, stents, and angioplasty.

**Emotional Guardedness.** Cardiac and pulmonary patients did not differ on measures of emotional guardedness as indicated by similar scores on the Marlowe-Crowne, \( t(49) = -0.58, p = \text{n.s.} \), and Emotional Guardedness Scale of the PRFS, \( t(46) = 0.38, p = \text{n.s.} \). Emotional guardedness, as measured by both the Marlowe-Crowne and the Emotional Guardedness Subscale of the PRFS, was not significantly related to mortality, \( t(47) = 0.60, p = \text{n.s.} \), and \( t(44) = 0.26, p = \text{n.s.} \), respectively.

Emotional guardedness, as measured by both the Marlowe-Crowne and PRFS, was not associated with MI at follow-up, \( t(41) = -0.83, p = \text{n.s.} \), and \( t(39) = 1.44, p = \text{n.s.} \), respectively. Emotional guardedness measures were not significantly related to chest pain, \( t(41) = -0.63, p = \text{n.s.} \), difficulty breathing, \( t(41) = -0.36, p = \text{n.s.} \), or angina-related nausea, \( t(41) = -0.59, p = \text{n.s.} \), at follow-up.

**Discussion**

Psychosocial variables were measured in a sample of 51 patients enrolled in cardiopulmonary rehabilitation. Average ages of cardiac and pulmonary patients were similar, 66.70 and 66.59 years respectively. At the beginning of rehabilitation, cardiac and pulmonary patients did not differ on measures of depression, anger, social desirability, stress from friends, stress from children, or social support. Pulmonary patients did report more anxiety at the beginning of the program as indicated by the BAI but not the PRFS. Pulmonary patients also reported more stress from spouse than cardiac patients did.

As expected, patients who were deceased at follow-up were significantly older than patients who were alive at follow-up (van Jaarsveld, et al., 2006). However, the surviving older
patients did not report more subsequent MIs, chest pain, difficulty breathing, or angina-related nausea at follow-up. Older age was not related to more frequent hospitalizations, heart catheterizations, or other surgical procedures. This finding is in partial agreement with Tully, Baker, and Knight (2008) who found that older patients were at higher risk for both mortality and morbidity.

Men and women did not differ in the number of rehabilitation sessions they completed or amount of oxygen they used at follow-up. Nor did men and women differ in number of hospitalizations for heart or lung problems. Men were expected to have increased risk for mortality than women (van Jaarsveld, Ranchor, Kempen, Coyne, van Veldhuisen, Ormel, et al, 2006), but there was no significant difference between the sexes.

There were no significant differences in mortality or number of hospitalizations between cardiac and pulmonary patients. Cardiac patients did differ from pulmonary patients in the number of rehabilitation sessions completed, but this can be attributed to the practices of the rehabilitation program in that cardiac patients were typically prescribed more sessions than were pulmonary patients.

There was a significant relationship between number of rehabilitation sessions and mortality. Participants who completed more sessions were less likely to have died at follow-up. This is supported by research conducted by the American Association of Cardiovascular and Pulmonary Rehabilitation (2003). Number of hospitalizations was negatively correlated with number of rehabilitation sessions completed. This suggests that rehabilitation is associated with fewer hospitalizations and perhaps overall better health. This finding is extremely important in that rehabilitation may be a vital part of recovery for cardiac and pulmonary patients with acute conditions. This finding is important for healthcare professionals, insurance providers, patients,
and their families. Not all physicians or patients prescribe or strongly recommend rehabilitation (Ferrara, Corbi, Bosimini, Cobelli, Furgi, Giannuzzi, et al., 2006), but the present finding indicates that rehabilitation can make a big difference in a patient’s quality of life.

High levels of depressive symptoms were associated with decreased mortality. This is contrary to our hypothesis and to findings by Ahto, et al., (2006), Barth, Schumacher, and Herrmann-Lingen (2004), and Burg, Benedetto, and Soufer (2003), who all found an association between depression and mortality as well as depression and morbidity. This finding may be supported by the work of Carroll, Phillips, Hunt, and Der (2006) who found that higher levels of depression were associated with decreased cardiac reactivity in a sample of 1608 patients performing a mentally stressful task. This relationship is contrary what would be expected if depression were linked to cardiovascular problems. Depression also had an impact on who finished rehabilitation. Patients who were depressed at the onset of rehabilitation were less likely to complete the program. This agrees with the findings of Caulin-Glaser and colleagues (2007), who observed that depressed patients were less likely to complete rehabilitation. Decreasing depressive symptoms may make it more likely for patients to complete rehabilitation programs and maintain better health.

In the present study, depression as measured by the BDI (Beck, 1996) and PRFS Depression Subscale (Eichenauer & Feltz, 2006) was not significantly related to morbidity. Depression was not significantly related to MI and angina, although there was a trend between higher scores on the Depression Subscale of the PRFS and incidence of chest pain at follow-up. Although no significant relationship was found between depression and morbidity, the relationship between depression and mortality is reason enough to consider mental health a vital aspect of rehabilitation for cardiac and pulmonary patients.
In agreement with Tully, Baker, and Knight (2008), patients who reported high levels of anxiety at the beginning of the study were more likely to have passed away at follow-up. High anxiety was also significantly related to subsequent MI and angina at follow-up. These findings illustrate the impact of stress and anxiety on physical health. Such findings indicate that physicians and rehabilitation programs must address mental health in patients managing problems with cardiopulmonary health.

Unlike research by Boyle, et al. (2004), the present study failed to find a statistically significant relationship between anger at the beginning of the rehabilitation program and mortality, MI, chest pain, or trouble breathing at follow-up. However, the Anger Subscale of the PRFS was significantly related to angina-related nausea at follow-up. Although this does not strongly support the relationship between anger and cardiopulmonary health, the relationship between the PRFS and nausea may suggest something more. If anger is a part of anxiety or depression, it would be vital to address as well.

Low levels of social support, were expected to be associated with morbidity and mortality at follow-up (Berry, Lloyd-Jones, Garside, Wang, & Greenland, 2007; Lache, Meyer, & Herrmann-Lingen, 2007), but neither social resources nor social stressors were significantly associated with mortality, MI, or chest pain. To some extent, the findings of the present study support the work of Lett and colleagues (2007), who did not find a significant relationship between social support and mortality or MI. However, both stress attributed to a spouse and lack of support from a spouse were associated with angina-related nausea at follow-up. This suggests that a supportive spouse that does not add stress to the patient’s life may reduce the nausea aspect of angina and supports the findings of Moser and Dracup (2004), who discovered that a spouse can have a major impact of cardiovascular health. Patients who reported having high
levels of social support from their friends reported significantly less angina-related nausea at follow-up, suggesting that having friends may decrease angina in this capacity. This finding complements the work of Berry and colleagues (2007), who found that patients who had positive social resources were less likely to die from cardiovascular complications.

A high level of emotional guardedness at the beginning of rehabilitation, as measured by the Marlowe-Crowne (Crowne & Marlowe, 1960) and PRFS emotional guardedness scale (Eichenauer & Feltz, 2006), was expected to be associated with morbidity and mortality at follow-up (Denollet, Sys, & Brutsaert, 1995; Denollet, Sys, Stroobant, Rombouts, Gillebert, & Brutsaert, 1996; Denollet, Pederson, Vrints, & Conraads, 2005). However, the present study failed to find any significant relationships between emotional guardedness and any of the outcome variables. Rather than suggesting that emotional guardedness has no impact of cardiopulmonary health, perhaps the strong effects of depression and anxiety overpower the impact of emotional guardedness. Or perhaps emotional guardedness in the chronically ill is different than that of the general population.

Limitations of the Study

Due to the longitudinal nature of this study, some participants were lost to follow-up. The participants included in the sample for this project were only those who could be reached by telephone at follow-up or whose death records were found in Clark, Logan, or Champaign Counties. It is possible that the participants lost to follow-up were somehow qualitatively different than the participants reached via phone interview, and their information could have profoundly affected the data collected.

Another weakness of study lies in its self-report format. Although the scales used to assess psychosocial variables are well-known and reliable measures, their accuracy depends
largely on the participant’s understanding of the questionnaire and awareness of his or her own mental and emotional states. Self-report also posed a problem during the follow-up telephone interview because the questionnaire asked participants to recall many details about their health, including which procedures they had undergone since rehabilitation and when these procedures occurred. Although some participants kept a log of their hospitalizations and procedures, many were guessing as to what was done when and how long their hospital stays were. The fact that the sample was mostly elderly was likely to make recollection of specific procedures and dates even more difficult.

Although this study’s goal was to examine relationships between psychosocial measures at the beginning of cardiopulmonary rehabilitation and health outcomes about two years after rehabilitation, the findings cannot be interpreted as causal. The findings are instead correlational, suggesting a relationship exists between two variables. Besides the psychosocial variables measured, there could be other forces affecting health outcomes, such as another illness like diabetes, cancer, or multiple sclerosis, duration of cardiac or pulmonary illness, and whether or not the participant participated in routine follow-up care after rehabilitation. Such variables were not taken into account in this study.

Recommendations for Future Research

One way to improve accuracy and reduce attrition in this study would be to provide researchers with direct access to participants’ medical information. If researchers could examine participants’ medical files directly, specific dates, diagnoses, and types of procedures could be more accurately recorded. Data collection would not depend on the participants’ memories or availability to complete a telephone questionnaire. This would also help the researchers ascertain whether or not the patient was deceased at follow-up. Due to privacy regulations and
Psychosocial predictors

...time constraints, this was not possible for the present experiment, but getting permission to examine medical files would be helpful in future studies.

It may also be beneficial to take psychosocial measures periodically throughout the duration of the study. These measures were assessed at the beginning of rehabilitation, but it may be more helpful to assess such variables after rehabilitation was completed as well. This would provide more detailed information about the psychological outcomes of cardiopulmonary rehabilitation and the measurements may reflect the more recent attitudes of participants later in the study. It may also be helpful to examine psychosocial variables at follow-up. It is possible that some major lifestyle change occurred since the beginning of cardiopulmonary rehabilitation. For example, a participant may have lost a spouse or been diagnosed with a terminal illness since rehabilitation. Such events could have a profound impact on the participant’s psychological state, making it much different than the baseline psychosocial measures.

It may also have been helpful to ask participants more subjective questions about their health at follow-up. Number of hospitalizations and operations are valid concrete measures, but it may also be helpful to know how the participant feels he or she is doing day-to-day. It may also be interesting to ask participants how they felt they were affected by the rehabilitation program and if there have been any major changes in their life situation since the program began a few years ago. Such subjective feelings may help explain the patient’s health at follow-up because if a patient feels disabled or incompetent, he or she is likely to behave differently.

Conclusions

This study examined a group of 51 patients in cardiopulmonary rehabilitation. At the start of rehabilitation, pulmonary patients were significantly more anxious than cardiac patients as measured by scores on the BAI, but not the PRFS. Pulmonary patients also reported more
stress related to their spouses and children than did cardiac patients. At follow-up approximately two years later, six patients had died. The deceased patients had significantly lower BDI scores when they began rehabilitation, but no other psychosocial variables were significantly related to mortality. Anger, anxiety, and social support during rehabilitation were significantly associated with reports of cardiopulmonary morbidity at follow-up.

Because cardiovascular and pulmonary disease affects millions of people in the US and across the globe, it is important to gain a clearer understanding of all the factors that contribute to health outcomes. A better understanding of the relationship between psychosocial variables and health may allow healthcare professionals to consider each patient’s life situation and mental health when prescribing a treatment plan. The evidence that anxiety and anger may affect cardiovascular morbidity suggests that a person’s mental health must be thoroughly evaluated and treated as a part of cardiopulmonary rehabilitation and follow-up care.
References


Appendix A
Predictive Validity of the PRFS
Mercy Medical Center
Dr. Kent Eichenauer and Dr. Glenn Feltz

Telephone contact with former cardiac and pulmonary patients

This is the script for the introduction and informed consent. Please read it to the patient:

My name is Sarah and I am representing the Cardiopulmonary Rehab program at Mercy Medical Center and researchers of Delta Psychology Center. I am following up on some research that was started while you were in the Cardiopulmonary Rehab program at Mercy Medical Center. I would like to ask you a few questions about your health since you were in rehab. Would that be OK with you?

If yes—I will need to record our conversation. Is that OK with you? _________

If yes, turn on recorder—let me first explain for the recording that I will be asking you a few questions about any heart or lung problems you have had since the time that you participated in the cardiopulmonary rehabilitation program at Mercy Medical Center. The purpose of these questions is to see if this questionnaire can help staff or patients decide who is more likely to have more heart or lung problems. This can benefit other patients who might be able to know if they are more at risk of these kinds of problems in the future. You can stop answering these questions whenever you choose with no penalty. These questions ordinarily take less than three minutes. You can decide if that is too much time for you. The answers to your questions will be confidential and the only people who will know your answers are the few that are necessary to make sure that the research is conducted properly. This would include the research assistant who is entering the information into a computer, the lead researchers, Dr. Kent Eichenauer and Dr. Glenn Feltz, and me, Sarah Kennedy, a psychology intern from Wittenberg University. May I ask you the questions about any heart or lung problems that you have had recently for this research? Please state your name again for the recording.

If the patient assents, then proceed to page two and ask the questions and record their responses.
Appendix B
DATA FORM
Predictive Validity of the PRFS
Mercy Medical Center
Dr. Kent Eichenauer and Dr. Glenn Feltz

Information from Records:

Name: ____________________________  DOB: _____ M  F
Phone #: _________________________  ID# : __________________
Diagnosis at time of completing PRFS: ___________________________
Rehab Facility: ________________________________
Start date of Cardiopulmonary Rehab:  _______________
End date of Cardiopulmonary Rehab:  _______________  Number of Sessions: ______
Living  or  Deceased
Date last took PRFS ________________  ** note this date will be used in
the questions below

Questions for Interview:

Informed Consent was read to patient?  Yes  No  Patient agreed?  Yes  No
Contact Date: ________________________
Name/Signature of person making contact: __________________________________________

1) Since (date that patient most recently completed the PRFS), has a physician told you that you have had a heart attack?  ____________  If yes, when did the heart attack occur?
________________________________________________

2) Since (date that patient most recently completed the PRFS), have you been hospitalized for a heart or lung problem?  ____________  If yes, when?  ________________  For how many days?
________________________________________________
Why were you hospitalized?  _______________________________________________________

Have you experienced any angina related symptoms, like:
Shortness of breath:  Yes  No
Chest Pain:  Yes  No
Nausea:  Yes  No

3) If you were in rehab for your lungs, since (date that patient most recently completed the PRFS), has there been a change in your use of oxygen?  ______________
How many hours per day were you using oxygen on a typical day at the time that you were in rehab?  ________________
How many hours per day do you use oxygen now?  ________________
How many liters did you have your oxygen set at when you were in rehab?  ______________
How many liters do you have your oxygen set at now?  ________________
4) Since (date that patient most recently completed the PRFS), have you undergone a cardiac catheterization? _______________ If yes, when? _______________  

5) Since (date that patient most recently completed the PRFS), have you undergone a heart procedure involving a balloon angioplasty or a stent? ________ If yes, when? _______________ 

6) Since (date that patient most recently completed the PRFS), have you undergone open heart surgery involving a bypass of any of your heart’s arteries? ______ If yes, when? _______________ 

7) Since (date that patient most recently completed the PRFS), have you undergone open heart surgery to work on your heart’s valves? _______________ If yes, when? _______________ 

8) Have you had an implant device like a pacemaker or defibrillator? Yes  No  If yes, when? ___________ 

NOTES:
Table 1. *Mean scores of psychosocial variables for cardiac and pulmonary patients*

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<th>Variable</th>
<th>Scale</th>
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<th>Pulmonary</th>
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* significant difference at $p = 0.05$
** significant difference at $p = 0.005$
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* significant difference at $p = 0.01$
### Table 3. Effects of psychosocial variables on morbidity (p values)

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* statistical significance at p = 0.05

** statistical significance at p = 0.01
Psychosocial predictors 43