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Depression and Self-Reported Physical Health in Patients With Coronary Disease: Mediating and Moderating Factors

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Objectives: The purpose of this study was to define how the relation between depression and self-reported physical health in patients with coronary disease is modified by other patient-centered factors. **Methods:** We conducted a prospective cohort study of 111 patients (members of a health maintenance organization) with angiographically documented coronary disease, examining factors (physical symptoms, psychological states and traits, and spousal support) modifying the relation between depression and patient-reported physical health 5 years later using multiple hierarchical regression models. **Results:** Five regression models (all including demographic and disease severity covariates) were constructed to predict physical health from depression only (R^2 = 0.22); depression plus angina and fatigue (R^2 = 0.53); depression plus positive affect and novelty seeking and their interaction (R^2 = 0.48); depression plus spousal support (R^2 = 0.27); and depression, angina, fatigue, positive affect, and novelty seeking (overall model) (R^2 = 0.65). Depression remained significant in each model, but the proportion of variance it predicted was diminished in the presence of the other variables (bivariate r = 0.39, partial r = 0.37–0.13). **Conclusions:** The effect of depression on self-reported physical health is significantly mediated by physical symptoms (angina and fatigue), personality states and traits (positive affect and novelty seeking), and spousal support. Positive affect and novelty seeking had more marked effects on physical health in the presence of more depression. Thus, a broad range of factors beyond the severity of coronary disease itself affect the perceived physical health of patients with coronary heart disease. **Key words:** coronary heart disease, depression, personality, perceived health.

CAD = coronary artery disease; HMO = health maintenance organization; MAF = Multidimensional Assessment of Fatigue; MPI = Multidimensional Pain Inventory; PANAS = Positive and Negative Affect Scale; PCS = physical health component score from the SF-36; SAQ = Seattle Angina Questionnaire; SF-36 = Medical Outcomes Study Short Form-36; TPQ = Tridimensional Personality Questionnaire.

INTRODUCTION

Cross-sectional studies have demonstrated a significant relationship between depression and physical disability in community (1) and clinical populations (2). Longitudinal studies of primary care patients have shown that depression and physical disability tend to change together. Those who remain depressed tend to remain disabled, whereas those whose depression improves show a reduction in disability (3, 4). New prospective studies have demonstrated that depression increases the risk (approximately 1.5 times) of physical disability onset in primary care patients (5) and community-dwelling elders (6).

The association between depression and physical disability may be strongest for those with preexisting physical vulnerability, such as the elderly and those with chronic disease (7). In these individuals, there is likely a reciprocal relationship between disability and depression (8). In studies of a single chronic disease, in which it is possible to quantify objective disease severity (eg, systemic lupus erythematosus), depression and disability are associated with each other but not with disease severity (9, 10). Depression is associated with increased physical disability and somatic symptoms in neurology patients even though the patients attribute these to their neurological disorder (11).

We have previously shown that depression and anxiety predict self-reported physical disability in coronary disease patients for up to 5 years (12, 13). The process by which this occurs largely remains to be elucidated. The effect of depression on disability in this population is so powerful that any exploration of other psychosocial predictors of disability should include consideration of the depression effect. Reduction in self-efficacy seems to play a role but accounts for only a small portion of the depression effect on disability (14). Better understanding of the factors through which depression exerts its effect on physical health (mediating variables) and factors that modify the effect of depression on physical health (moderating variables) could clarify the nature of the depression effect and help inform clinical interventions. If angina *mediates* the effect of depression on physical health, for example, it means controlling for angina will diminish the strength of the relation between depression

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and physical health. This might occur clinically if depression increases the severity of angina. If positive affect *moderates* the effect of depression on physical health, for example, patients with low positive affect may show a greater effect of depression on physical health than those with higher positive affect. This might occur clinically if positive affect is protective for physical health in the presence of significant depression but plays little role in the absence of depression.

We examined three types of potential mediating and moderating factors: 1) physical symptoms, 2) psychological states and traits, and 3) spousal support. We hypothesized that physical symptoms would mediate the depression effect and that psychological and spousal variables would moderate the depression effect.

METHODS

Patient Sample

Patients were recruited from the Group Heath Cooperative of Puget Sound, a consumer-owned HMO in western Washington. Between December 1991 and February 1993, all Group Health Cooperative members aged 45 to 80 years undergoing elective cardiac catheterization for suspected CAD were screened for participation in the study. Inclusion criteria were as follows: 1) at least 50% occlusion of one major coronary vessel confirmed by angiography, 2) treadmill stress test within the past year, 3) CAD was the subject's most disabling disease, and 4) the subject was ambulatory at the time of catheterization. Two hundred six members (86% of eligibles) provided consent and completed an extensive baseline psychosocial interview. One hundred sixty-one subjects completed all assessments at baseline and 1 year later. One hundred twenty-seven subjects completed a 6-year assessment done by phone interview and a mailed questionnaire. A total of 111 patients had complete baseline, 1-year, and 6-year data for the present analyses (Figure 1). Of the 34 subjects lost to follow-up during the 5-year follow-up interval (between the 1- and 6-year time points), 21 were ineligible for the following reasons: death (10), dementia (2), critical illness (4), left Group Health Cooperative before completion of the 5-year follow-up period (3), or could not be contacted (2). Fourteen additional subjects declined to complete the 6-year interview or questionnaires. Two subjects had too many missing data to be included.

Procedures

Subjects who had completed the baseline and 1-year assessments were mailed postcards notifying them of the planned 6-year follow-up study. A research assistant then called all of these subjects, except those who requested not to be contacted, to obtain informed consent for the follow-up study. A reminder postcard was sent 2 weeks later if the questionnaires had not been received. A phone call was made 1 month later. Another packet was mailed or the questionnaire was administered over the phone if necessary. The research protocol and informed consent procedures were approved by the Human Subjects Review Committees of the University of Washington and the Group Health Cooperative of Puget Sound.

Measures

Primary outcome. The physical health component score (PCS) from the Medical Outcomes Study SF-36 administered 6 years after cohort inception was used. This score provides a broader summary of physical health than the physical functioning score of the SF-36 and has similar relative validity. The PCS positively weights scores from the physical function, physical-role, bodily pain, and general health perception scales. The PCS negatively weights the mental health and emotional-role scales to provide an orthogonal relationship between the PCS and the mental health component score of the SF-36 (15). Simon et al. (16) have criticized this artificial "cleansing" of mental health elements from the PCS. For our purposes, it provides a conservative estimate of the impact of psychosocial variables on perceived physical health.

Predictor variable. The Hamilton Rating Scale for Depression was used to assess severity of depressive symptoms. This was administered 12 months after cohort inception using a phone interview by a research assistant trained and supervised by Dr. Sullivan. This 24-item interviewer-administered scale is the psychiatric standard for the assessment of the severity of depression and can correct for reporting bias that can affect self-report scales, allowing for more accurate characterization of psychiatric symptoms (17). It has been validated for phone administration (18).

Mediating and moderating variables. All mediating and moderating variables were assessed concurrently with the main outcome variable at 6 years to maximize their relevance to the outcome. The exceptions were the TPQ score, which was assessed at 0 months because it is a trait variable, and spousal support, which was assessed at 12 months to provide prospective data (see Figure 2). The following variables were assessed: 1) *physical symptoms:* angina frequency (using the SAQ, a disease-specific quality-of-life measure for patients with coronary artery disease that has been validated against both clinical and other self-report measures; Ref. 19) and fatigue severity and frequency (using the MAF; Ref. 20); 2) *psychological states and traits:* current positive and negative affect (using PANAS) and personality traits (harm avoidance, novelty seeking, and reward dependence, using the TPQ); and 3) *subject report of spousal support:* overall support and solicitous, punishing, and distracting responses to subject's illness behavior (using the MPI) and two questions concerning change in quality or closeness of marital relationship in the presence of heart disease.

Covariates. The following covariates were included: 1) age; 2) gender; 3) cardiovascular events (myocardial infarction, bypass grafting, or angioplasty) during the follow-up period as ascertained through automated HMO utilization data; 4) cardiac disease severity (number of four main coronary vessels stenosed >70% as confirmed

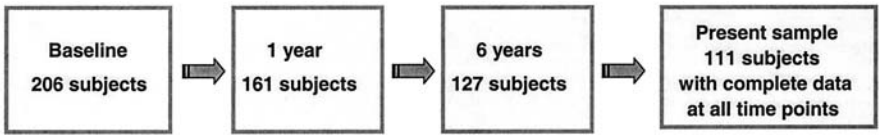

Fig. 1. Subject flow chart.

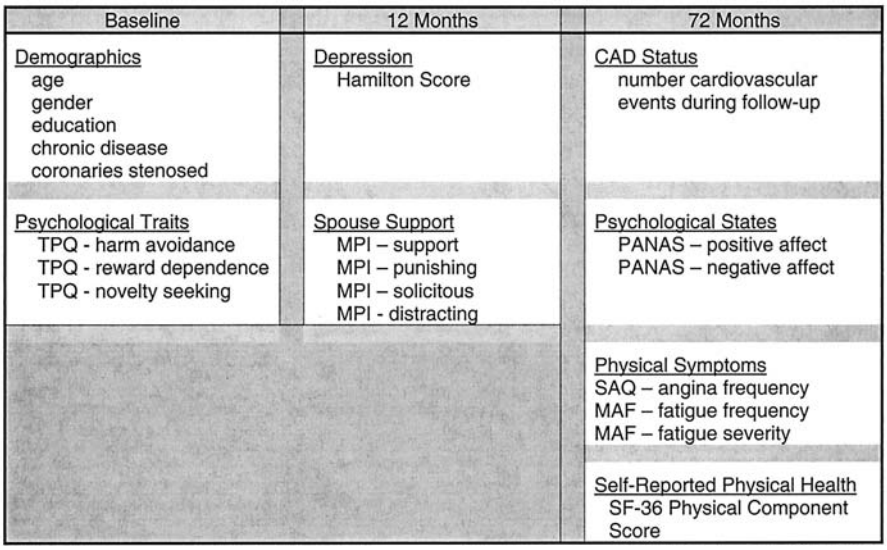

Fig. 2. Model variables.

by angiography at baseline; this was chosen from among various standard measures of objective disease severity because it showed the *strongest* relation to physical function in our previous study on this cohort; see Ref. 12); and 5) a pharmacy-derived chronic disease score covering the 12 months before the 1-year assessment (this was used to control for the effect of medical comorbidity on physical health; see Ref. 19). Conceptual grouping and relative timing of study variables is shown in Figure 2.

Statistical Analyses

The purpose of the analyses was to determine whether physical symptoms, psychological states and traits, and spousal support mediate or moderate the longitudinal relationship between depression and self-reported physical health. The dependent variable for all the analyses was the PCS from the SF-36 assessed at the 6-year follow-up. After examining the distributions of all study variables, we first tested multiple regression models within each construct group: symptom variables, psychological variables, and marital variables. In every model six covariates were included: age, gender, medical comorbidity (chronic disease score), coronary disease severity (number of vessels stenosed >70%), cardiovascular events during follow-up, and education level. For each construct the main effects were tested to examine mediating effects, and the interactions between depression and construct variable were tested to examine moderating effects. Because of the amount of collinearity within models, each interaction or moderating effect was tested individually. For each construct a final model was constructed using all significant interactions, the main effects necessary to support them, any other significant main effects, depression, and the covariates. This procedure resulted in a model for each of the personality, medical, and marital variables. The significant terms from these three models were combined to produce an overall summary model. Variables that became insignificant (with the exception of covariates) were omitted from the overall summary model. In the event of significant interactions, post hoc Pearson correlations were computed to interpret the findings.

RESULTS

Study Cohort

Characteristics of subjects in the current study are shown in Table 1. The typical patient was a man in his 60s with at least a high school education. Twenty-nine percent of the sample underwent a revascularization procedure during the first year after the index catheterization. An additional 30% underwent a revascularization procedure during the 5-year follow-up period. No statistically significant differences were found in demographic, coronary disease, or psychiatric variables between subjects completing follow-up and those lost to follow-up.

Table 2 shows the model with just baseline demographics (including severity of coronary artery disease and medical comorbidity), cardiovascular events during follow-up, and depression at 1 year. Baseline demographics accounted for 7% of the variance in the 6-year physical component score. The 1-year depression score added an additional 15% of explained variance so the total model explained 22% of the variance in self-reported physical health at 6 years.

Table 3 describes the physical symptoms model. All three candidate variables (fatigue severity, fatigue frequency, and angina frequency) were significant mediators of the effect of depression on physical health. Subjects with more frequent or severe fatigue and more frequent angina reported poorer physical health. The correlation between depression and physical health was reduced by two-thirds (from −0.39 to −0.13) after adding fatigue and angina to the model. None of these variables had a significant interaction with depression,

TABLE 1. Sample Characteristics

Variable	Mean ± SD (*N* = 111)
Baseline variables	
Age	62.0 ± 9.1
Gender (% male)	81
Education[a] (%)	68
Chronic disease score	6.0 ± 2.2
No. of coronary arteries stenosed >70%	1.5 ± 0.8
TPQ: harm avoidance	12.9 ± 5.5
TPQ: reward dependence	16.9 ± 4.8
TPQ: novelty seeking	12.3 ± 4.7
One-year variables	
Hamilton depression	5.7 ± 6.0
MPI: spouse support	4.2 ± 1.2
MPI: spouse punishing	1.7 ± 1.3
MPI: spouse solicitous	2.9 ± 1.4
MPI: spouse distracting	1.9 ± 1.3
Six-year variables	
No. of cardiovascular events	0.7 ± 0.5
PANAS: positive affect	24.8 ± 8.6
PANAS: negative affect	11.7 ± 3.2
SAQ: angina frequency	74.8 ± 17.9
MAF: fatigue frequency	3.5 ± 2.0
MAF: fatigue severity	3.3 ± 2.4
SF-36: PCS	44.9 ± 10.3

[a] More than a high school education.

TABLE 2. Depression-Only Model[a]

Predictors	Standardized β	Wald's *t*	Zero-Order *r*	Partial *r*
Baseline covariates[b]				
Chronic disease score	0.01	0.13	−0.04	0.01
Education	−0.18	−1.99*	−0.08	−0.19
No. of vessels stenosed >70%	−0.08	−0.81	−0.01	−0.08
Age	−0.11	−1.21	−0.06	−0.12
Gender	−0.12	−1.33	−0.18	−0.13
No. of cardiovascular events during follow-up	0.16	1.74	0.13	0.17
Depression[c]				
Hamilton (1 y)	−0.41	−4.45***	−0.39	−0.40

[a] Total model: $F(7,103) = 4.23$, $p = .000$, $R^2 = 0.22$.
[b] Covariate model: $F(6,104) = 1.38$, $p = .22$, $R^2 = 0.07$.
[c] Depression model: $F(1,103) = 19.82$, $p < .001$, R^2 change = 0.15.
* $p < .05$; *** $p < .001$.

indicating that they did not moderate the depression effect on physical health. The model was highly significant ($p < .001$) and accounted for 53% of the variance in the PCS.

Table 4 describes the psychological states/traits

TABLE 3. Physical Symptoms Model[a]

Predictors	Standardized β	Wald's *t*	Zero-Order *r*	Partial *r*
Baseline covariates[b]				
Chronic disease score	0.05	0.74	−0.04	0.07
Education	−0.08	−1.07	−0.08	−0.11
No. of vessels stenosed >70%	−0.12	−1.61	−0.01	−0.16
Age	−0.13	−1.82	−0.06	−0.18
Gender	−0.10	−1.40	−0.18	−0.14
No. of cardiovascular events during follow-up	0.07	1.01	0.13	0.10
Depression[c]				
Hamilton (1 y)	−0.11	−1.33	−0.39	−0.13
Six-year physical symptoms[d]				
Fatigue severity	−0.53	−5.58***	−0.67	−0.50
Angina frequency	0.21	2.69**	0.46	0.26

[a] Total model: $F(9,101) = 12.92$, $p = .000$, $R^2 = 0.53$.
[b] Covariate model: $F(6,104) = 1.38$, $p = .22$, $R^2 = 0.07$.
[c] Depression model: $F(1,103) = 19.82$, $p = .001$, R^2 change = 0.15.
[d] Physical symptoms model: $F(2,101) = 33.88$, $p < .001$, R^2 change = 0.31.
** $p < .01$; *** $p < .001$.

model. Six-year positive and negative affect were entered into the model with the 1-year Hamilton Depression score. Because of collinearity between the 6-year negative affect and 1-year Hamilton Depression score, the interaction term could not be sustained in the model. Positive affect had significant main and interaction effects, indicating that it both mediated and moderated the effects of depression on physical health. The correlation between depression and physical health was reduced by one-third (from −0.39 to −0.24) after adding positive affect, novelty seeking, and their interactions with depression to the model.

To examine the moderating effect of positive affect on the depression effect, two depression groups were formed. Subjects were stratified above and below a Hamilton score of 8. A score of 8 or below is accepted as depression remission in psychopharmacology and psychotherapy trials (21). For patients with low depression, there was no difference in physical health by amount of positive affect. In sharp contrast, patients with higher levels of depression reported much better physical health if they also reported higher levels of positive affect. This effect is demonstrated in Figure 3.

Neither harm avoidance nor reward dependence were significant predictors of the PCS. Novelty seeking had no significant main effect but did have a significant interaction effect with depression, indicating that