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A Longitudinal Causal Model of Cardiac Invalidism Following Myocardial Infarction

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▶ ***Background:*** Invalidism has been discussed in the cardiovascular literature for decades. Researchers have studied health perceptions, emotional distress, and dependency in patients after acute myocardial infarction in an attempt to understand the phenomenon. However, no theory of the manner in which these variables interact has been proposed.

▶ ***Objectives:*** Using previous research, a model of invalidism was specified in which individuals' perceptions that their health is poor lead to emotional distress and increased dependency. As health perceptions improve over time, emotional distress and dependency decrease.

▶ ***Method:*** Survey data were collected from 111 men and women 1 and 4 months after a first myocardial infarction and were tested using structural equation modeling.

▶ **Results:** The model was rejected using a confirmatory approach ($\chi^2(89) = 141.40$; $p = .00034$). The fit indices, however, suggested an adequate fit of the model to the data (CFI = .96; NNFI = .94).

▶ ***Conclusion:*** The conclusion is that the model is reasonable and serves as a starting point for a theory-based empirical exploration of the invalidism process.

▶ ***Key Words:*** cardiac invalid • emotions • health perceptions • dependency • causal model

Each year 600,000 individuals in the United States experience a myocardial infarction (MI) and survive (American Heart Association, 1996). During the past 3 decades, researchers have demonstrated that approximately 25% of individuals with MI have moderate to severe psychosocial difficulties related to recovery (Doehrman, 1977; Schleifer et al., 1989; Shanfield, 1990). The term *cardiac invalid* was coined in the mid-1960s to describe individuals who experience physical and psychological disability despite adequate physical recovery from an MI (Wynn, 1967). The term has been used to describe patients who exhibit helplessness and exaggerated frailty related to their heart disease; they seek frequent attention and reassurance from family, friends, and health care professionals long after the usual recovery period. Such individuals are characterized by the maintenance of sick role behaviors for an indeterminate amount of time despite normal or near normal cardiac function (Blackwell, 1992).

Three variables have been identified as characterizing cardiac invalidism: the individual's perception of his or her health as being poor (Ben-Sira & Eliezer, 1990; Garrity, 1973; Wiklund, Sanne, Vedin, & Wilhelmsson, 1984a), emotional distress (Wiklund, Sanne, Vedin, & Wilhelmsson, 1984b; Wynn, 1967), and feelings of interpersonal dependency (Brown & Munford, 1983–1984; Coyne & Smith, 1991a). In the past, researchers have tried to delineate the relationship between two or three variables using separate analyses. No previous multivariate analyses of all three variables have appeared in the published literature. In this study, the variables were examined simultaneously using structural equation modeling. Longitudinal data were used in an attempt to clarify the manner in which the variables contributing to invalidism influence each other and change over time. The ultimate goal was to provide preliminary evidence for a theory of cardiac invalidism. The specific purpose of this study was to test a causal model of cardiac invalidism by elucidating the relationships among these three variables in individuals who recently experienced a first MI.

Relevant Literature

The usual course of individuals suffering an MI is characterized, in the early recovery phase, by altered health per-

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ceptions and preoccupation with heart function, anxiety and depression, and altered family roles (Brown & Munford, 1983–1984; Dracup, 1985; Terry, 1992; Waltz, 1986). As the weeks and months pass, a process of normalization occurs in which approximately 75% of all patients show a satisfactory psychosocial recovery according to several criteria, such as return to work, resumption of sexual activity, and resolution of severe emotional distress (Wiklund et al., 1984b). Premorbid levels of social activity are resumed and family relationships return to normal (Schleifer et al., 1989; Shanfield, 1990).

Health perceptions are defined as the individual's subjective evaluation of physical and mental completeness, proper function, and well-being (Ware, Brook, Davies, & Lohr, 1981). Individual differences in personal values influence how a person will evaluate his or her health status (Ware, 1984). Health perceptions may or may not be related to objective disease status because they are subjective and influenced by expectations, values, and experiences.

Patients have been found to group their ideas of illness around themes referred to as illness perceptions (Leventhal, Meyer, & Nerenz, 1980). The five main themes of illness perception are identity, cause, timeline, consequences, and cure or control. Recent research by Petrie, Weinman, Sharpe, and Buckley (1996) demonstrated that return to work within 6 weeks after MI was significantly predicted by the perception that the timeline for recovery was short and consequences were relatively less grave. Later disability was associated with the perception that the illness was associated with serious consequences. Sexual dysfunction was associated with a strong illness identity.

Emotional distress is a negative alteration in mood. In acute MI patients, the primary emotion experienced almost uniformly at some point in recovery is depression (Forrester, Lipsey, Teitelbaum, DePaulo, & Andrzejewski, 1992; Freedland, Carney, Lustman, Rich, & Jaffe, 1992; Schleifer et al., 1989). Anger occurs in some patients (Smith, 1992). Anxiety (Faller, 1990) and denial (Lowery, 1991; Robinson, 1990) are also commonly reported in the cardiac literature, but these emotions peak early (Cassem & Hackett, 1971).

Dependency is a complex of thoughts, beliefs, feelings, and behaviors revolving around the need for emotional protection and social support after a stressful event (Goldin, Perry, Margolin, & Stotsky, 1972; Hirschfeld, Klerman, Chodoff, Korchin, & Barrett, 1976). A regression to childlike patterns of coping manifested by dependency is described after acute MI (Cook, 1979). Few investigators have measured dependency directly. Instead, they have measured sick role (Brown & Rawlinson, 1975) or return to work (Garrity, 1973) and then discussed these behaviors in terms of dependency.

Previous tests of bivariate relationships among these variables have provided some insight into the nature of cardiac invalidism. Perceptions of poor health have been shown to be associated with emotional distress in patients after MI (Garrity, 1973; Waltz, 1986). Poor health perceptions have been related to high levels of dependency (Petrie et al., 1996). It is evident that these variables are related; however, the nature of the multivariate relationships and the direction of causality remain unclear. It is conceivable that health perceptions or emotional distress could trigger the sequence of events in cardiac invalidism. For example, the perception of poor health by an individual who has suffered an MI may cause emotional distress, and alternatively, the emotional distress may lead to a sense of decreased health and well-being. In the model outlined here, a change in health perceptions was proposed as the event that begins the development of cardiac invalidism after an acute illness event. Once an individual perceives his or her health as poor, emotional distress leads to the need for support and nurturing, which is demonstrated in increases in interpersonal dependency.

Invalidism appears to occur in response to a change in health perceptions precipitated by an acute illness event such as an MI.

One might expect that the severity of the MI and the resulting decrease in cardiac function would predict cardiac invalidism. However, researchers have repeatedly demonstrated little or no relationship between various measures of illness severity and psychosocial recovery (Riegel, 1993; Schleifer et al., 1989). For example, in a study of 560 male survivors of MI, researchers found that 3 weeks and 6 months after the MI, the extent of infarction, as measured by an electrocardiographic score, and behavioral responses were not significantly related to one another (Ladwig, Kieser, Konig, Breithardt, & Borggrefe, 1991). These findings have been duplicated in studies with even longer periods of follow-up from the initial MI and with patients whose physiologic function was severely compromised by advanced heart failure (Dracup, Walden, Stevenson, & Brecht, 1992).

Theoretical Model

Although invalidism has been described in the literature for 3 decades, the dynamics of the response have never been clearly delineated. Ware (1984) proposed that general health perceptions, psychological distress/well-being, and social/role functioning be used as a conceptual framework in studying the impact of disease (both cardiac and noncardiac) on the individual. These three dimensions are similar to the cognitive, emotional, and social factors described by some authors as characterizing the sick role (Pilowsky, 1990; Susser, 1990). For example, in discussing sick role susceptibility, Blackwell (1992) describes health beliefs and hypochondriasis as cognitive influences, depression and anxiety as emotional influences, and learned helplessness and affiliative tendencies as behavioral features of the sick role. These authors have proposed conceptual frameworks of sick role susceptibility or invalidism without the addition of causal or theoretical links. That is, although the key variables have been identified, no theoretical prediction regarding the relationships among the variables has been proposed.

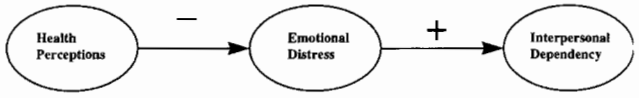

FIGURE 1. Theoretical model of cardiac invalidism. Perceptions of poor health were predicted to be associated with emotional distress. High levels of emotional distress were predicted to be associated with increased interpersonal dependency.

Toward that purpose, a theory of invalidism (Fig. 1) is proposed. Invalidism occurs in the context of an acute illness, beginning in response to a change in health perceptions. Invalidism is characterized by poor health perceptions, which are associated with emotional distress, and emotional distress is associated with increased interpersonal dependency. Emotional distress mediates the relationship between health perceptions and dependency. Dependency is a normal response that decreases in intensity and frequency with emotional maturity but fluctuates during times of stress, such as illness (Bowlby, 1982; Hirschfeld et al., 1976). Invalidism wanes over time in individuals whose health perceptions improve, but it remains problematic in those who maintain a perception of poor health. This theoretical model may help clarify the processes by which invalidism develops and persists.

To test this theory, three propositions were specified. First, a decrease in health perceptions results in emotional distress. Second, emotional distress leads to dependency. Third, there is a positive relationship between repeated measures of specific responses over time. For example, health perceptions tend to be stable over time. These three propositions served as hypotheses tested in a structural equation model.

Method

A longitudinal survey design was used to collect data on health perceptions, emotional distress, and interpersonal dependency in individuals experiencing an acute MI. Individuals experiencing a first MI were chosen because invalidism is known to occur in MI patients and because the change in health perceptions was predicted to be most acute in previously well individuals.

Sample: A nonprobability convenience sample was solicited from nine hospitals in southern California. Sample selection criteria included patients (a) experiencing a first MI documented by cardiac isoenzymes or electrocardiogram, (b) unaware of preexisting coronary heart disease, (c) without history of serious comorbidity, (d) without prior significant psychiatric illness, and (e) whose coronary artery disease was not treated surgically within the 4-month study period. Patients meeting the eligibility criteria were contacted by the primary investigator either in person during hospitalization or by mail with telephone follow-up after hospital discharge.

A total of 187 individuals were eligible to participate in the study. Of those, 120 subjects were enrolled and 111 completed the study. Of the 67 eligible individuals who did not participate, 35 (19%) refused, 6 (3%) were unable to be contacted, 13 (7%) were unable to participate until beyond the deadline date for entry, and 13 (7%) were eliminated because they no longer met sample selection criteria (e.g., they underwent cardiac surgery). Of the 120 who completed preliminary testing, 9 (7.5%) dropped out of the study, 2 died, 3 chose not to continue, and 4 were unavailable when the time for data collection occurred. Nonparticipants and enrolled subjects who dropped out did not differ from the 111 who completed the study in age, gender, location of MI, severity of illness as measured by the Coronary Prognostic Index (Norris, Brandt, Caughey, Lee, & Scott, 1969), size of the infarct, or MI treatment received.

Data from the 111 subjects who completed the study were collected a mean of 28 days after hospital discharge (range 20–37 days) and again an average of 121 days after discharge (range 109–136 days). The average age of subjects was 60.7 years (SD = 11.6); ages ranged from 31 to 91 years. Most were married (73%, n = 81), male (74%, n = 82), and Caucasian (85.6%, n = 95). Social position was symmetrically distributed throughout five social classes; the highest number of subjects (46.8%, n = 52) was in class III, typified by a high school graduate who owns a small business (Hollingshead, 1980).

Measures: The three latent constructs—health perception, emotional distress, and dependency—were measured using standardized instruments, with subscales used as indicators. Health perceptions were measured using the 31-item Health Perceptions Questionnaire (Davies & Ware, 1981). Three subscales—current health, health outlook, and resistance to illness—were used in this analysis. A typical item from the current health subscale is "I have been feeling bad lately." Response choices range from 1 (definitely false) to 5 (definitely true). Subscale scores are computed by summing the items in each subscale. If all items are answered, scores range from 9 to 45 for current health and 5 to 20 for health outlook and resistance to illness. Scores were reversed so that higher scores reflect better health perceptions. Construct validity was supported through factor analysis conducted by the instrument authors. Alpha coefficients for the subscales used in analysis ranged from .67 (resistance to illness) to .86 (current health) in this study.

Emotional responses were measured using the 65-item Profile of Mood States (McNair, Lorr, & Droppleman, 1981). Three subscales—tension/anxiety, depression/dejection, and anger/hostility—were used. *Nervous* is an example of an item from the tension/anxiety subscale. Response choices range from 0 (not at all) to 4 (extremely). Subscale scores are computed by summing the responses to each adjective defining the factor. Scores range from 0 to 36 for the tension/anxiety subscale, from 0 to 60 for depression/dejection, and 0 to 48 for anger/hostility. Higher scores reflect higher emotional distress. Alpha coefficients for the subscales used ranged from .89 to .94. Predictive and convergent validity were demonstrated previously in studies of brief psychotherapy, controlled outpatient drug trials, and studies of response to emotion-inducing conditions (McNair et al., 1981).

Interpersonal dependency was measured using the 48-item Interpersonal Dependency Inventory, a Likert-type

scale with three subscales: emotional reliance on another person, lack of social self-confidence, and assertion of autonomy (Hirschfeld et al., 1977). An item from the lack of social self-confidence subscale is "I would feel helpless if deserted by someone I love." Response choices were increased from the original 1–5 scale to 1 (not like me) to 7 (just like me) to maximize internal consistency. Subscale scores are computed by summing the items in each subscale. If no items are missing, scores range from 18 to 72 on the emotional reliance subscale, from 16 to 64 on the social self-confidence subscale, and from 14 to 56 on the assertion of autonomy subscale. Higher scores reflect higher interpersonal dependency. Subscale alpha coefficients were .77 (lack of social self-confidence), .83 (emotional reliance), and .78 (assertion of autonomy) in this study. Discriminant validity was demonstrated by the authors by comparing scores of healthy subjects with those of psychiatric patients ($p < .01$).

Procedure: Home visits were made to collect data approximately 1 month after hospital discharge. Data collection was timed to capture patients' perceptions as they began the recovery phase. Loved ones are often overly solicitous in the early weeks after a frightening illness (Coyne & Smith, 1991b), which may delay the onset of negative perceptions. The second data collection visit was scheduled for approximately 4 months after hospital discharge, based on previous studies supporting the observation that recovery has taken place by this time and that patients have returned to previous levels of activity and work (Dracup, 1985; Yates & Booton-Hiser, 1992). Data were collected in person rather than by mail to ensure that (a) the questionnaires were completed at the correct time, (b) missing information did not compromise statistical analysis, (c) minimal frustration and confusion were experienced by the subject, and (d) the subject, not a friend or family member, completed the questionnaires.

Data Analysis: Structural equation modeling was used to assess the fit of the model to the data using a two-panel (i.e., longitudinal model) latent variable path model with an autoregressive structure for the three latent variables (Bollen, 1989; Hayduk, 1987). The analytic program used was LISREL 8 (Joreskog & Sorbom, 1993a).

Statistical assumptions were tested to assess for violations of both the univariate and multivariate assumptions using PRELIS 2 (Joreskog & Sorbom, 1993b). Depression and anger were skewed positively, and significant univariate skewness and kurtosis was found for the combination of depression, anger, health outlook, and resistance to illness at 1 month and for depression, anger, anxiety, and resistance to illness at 4 months. Tests of multivariate normality for continuous variables were significant for skewness, kurtosis, and the multivariate combination of skewness and kurtosis. Because transformation did not make any substantive changes in the model fit, the untransformed data were used to maintain the scale metric (Tabachnick & Fidell, 1996). Maximum likelihood estimation was used in the analysis; alternative estimation procedures (e.g., weighted least squares) could not be used because of the insufficient sample size.

Results

Measurement Model: A two-step approach to structural equation modeling is advocated by most experts (Anderson & Gerbing, 1988; Bentler, 1989; Bollen, 1989; Joreskog & Sorbom, 1993a). In the first step, the measurement model was tested using confirmatory factor analysis with the covariance matrix, which can be calculated from the data in Table 1, as the unit of analysis. One indicator per latent variable was fixed at 1 to define the unit of measurement for each of the latent variables (Joreskog & Sorbom, 1993a). Early testing showed that the assertion of autonomy subscale of the interpersonal dependency construct could not be used in the analysis because the model would not converge. Lack of convergence was related to a poor correlation between assertion of autonomy and lack of social self-confidence ($r = -.10$) and emotional reliance ($r = -.006$) at time 1 and lack of social self-confidence ($r = .12$) and emotional reliance ($r = -.12$) at time 2. These low correlations suggest that the assertion of autonomy subscale measures a different phenomenon than interpersonal dependency. According to the instrument authors, items in the assertion of autonomy subscale reflect the tendency to deny dependency or attachment (Hirschfeld et al., 1977). For this reason, eliminating this indicator from the model did not substantively change the theoretical conception of the model.

Several variables were rescaled before the analysis because successful convergence of a model is partially dependent on a reasonable similarity of variances among the indicators (Bentler, 1989). Anxiety, depression, anger, and lack of social self-confidence were divided by 10 and emotional reliance was divided by 100. No transformation was made that disproportionately altered the interval between individual scores on any variable. When the same variable is used repeatedly, as in a longitudinal analysis, the corresponding errors often correlate over time (Joreskog & Sorbom, 1993a). Thus, the errors for each indicator pair were allowed to covary.

Analysis of the measurement model resulted in a significant chi square ($\chi^2(81) = 126.97$, $p = .00084$); however, the fit indices demonstrated an adequate fit of the model to the data. The goodness of fit index (GFI) was .89, slightly below the preferred .90 cutoff. However, the comparative fit index (CFI) was .96, the incremental fit index (IFI) was .96, and the non-normed fit index (NNFI) was .94; generally, .90 is considered to be the acceptable boundary for these indices. The root mean square residual (RMSR) was .062; convention indicates that RMSR be less than .05. The root mean square error of approximation of .072 was within the acceptable range (.05–.08) (Hair, Anderson, Tatham, & Black, 1995). All of the parameter estimates for the indicators loaded significantly on their respective latent constructs ($t > 2.00$).

All of the squared multiple correlations (SMC or R^2) were greater than .45, with the exception of resistance to illness at 1 (.22) and 4 months (.26). However, parameter estimates were significant as was theoretical importance, so these were maintained in the model. Each of the error terms that were free to covary was significant except current health perceptions ($t = 1.81$) and depression ($t = 1.76$). Reanalyses of the measurement model revealed no sub-

TABLE 1. Matrix of Means, Standard Deviations, and Correlations Among Indicators Measured 1 and 4 Months After Myocardial Infarction in 111 Men and Women

1[a]	2[a]	3[a]	4[a]	5[a]	6[b]	7[b]	8[b]	9[b]	10[b]	11[b]	12[b]	13[b]	14[a]	15[a]	16[a]
1.0															
.310**	1.0														
.391**	.801**	1.0													
.358**	.687**	.748**	1.0												
.581**	.284**	.373**	.247**	1.0											
.766*	.206*	.296**	.251**	.395**	1.0										
−.112	−.253**	−.295**	−.244*	−.079	−.096	1.0									
−.106	−.233*	−.329**	−.248**	−.231*	−.094	.698**	1.0								
−.189*	−.208*	−.264**	−.203*	−.290**	−.131	.457**	.439**	1.0							
.253**	.624**	.541**	.569**	.208*	.271**	−.476**	−.361**	−.327**	1.0						
.365**	.575**	.671**	.613**	.283**	.354**	−.333**	−.309**	−.252**	.776**	1.0					
.272**	.494**	.504**	.738**	.153	.298**	−.248**	−.222*	−.287**	.708**	.718**	1.0				
.493**	.261**	.319**	.216*	.792**	.456**	−.144	−.304**	−.318**	.206*	.270**	.096	1.0			
−.312**	−.346**	−.368**	−.270**	−.181	−.162	.601**	.509**	.394**	−.355**	−.260**	−.267**	−.224*	1.0		
−.299**	−.283**	−.416**	−.316**	−.361**	−.149	.436**	.667**	.370**	−.298**	−.313**	−.213*	−.323**	.563**	1.0	
−.138	−.109	−.138	−.070	−.232*	−.045	.327**	.418**	.661**	−.302**	−.166	−.153	−.270**	.319**	.479**	
M 70.11	11.02	9.42	6.99	49.21	70.78	3.48**	3.64	3.90	8.58**	7.15	6.23	48.48	3.20	3.72	3.91
SD 16.78	6.88	10.20	7.92	13.57	15.70	.74	.63	.55	6.34	8.82	7.41	12.69	.76	.68	.59

1 = emotional reliance; 2 = anxiety; 3 = depression; 4 = anger; 5 = lack of social self-confidence; 6 = emotional reliance; 7 = current; 8 = outlook; 9 = resistance; 10 = anxiety; 11 = depression; 12 = anger; 13 = lack of social self-confidence; 14 = current; 15 = outlook; 16 = resistance.

[a]Measured 1 month after myocardial infarction.

[b]Measured 4 months after myocardial infarction.

*$p < .05$; ** $p < .01$.

stantive differences for the fit indices when these two pairs of error terms were fixed at default and not allowed to covary. Thus, for the duration of the analyses, all pairs of error terms were free to covary. When the measurement model was compared over time, a better fit was obtained for month 1 (χ^2 = 21.04, p = .22; GFI = .96, CFI = .99, NNFI = .98) than for month 4 (χ^2 = 42.20, p = .00063; GFI = .92, CFI = .93, NNFI = .89).

Structural Model: The theoretical model was tested in the second step. At 1 month, perceptions of poor health were related to high emotional distress, and high levels of emotional distress were related to high levels of interpersonal dependency. At 4 months, health perceptions improved, on average (Table 1), and the relationships between health perceptions, emotional distress, and dependency were weak (Fig. 2).

The chi-square of the final model was significant and the model was rejected (χ^2(89) = 141.40, p = .00034). Examination of the fit indices (CFI = .96, NNFI = .94), however, suggested that the data fit the model adequately. Standardized residuals and the Q-plot were examined in a search for outliers to help explain the discrepancy (Joreskog & Sorbom, 1993a). By using a value of 2.58 as a basis for detecting potential outliers, particularly high standardized residuals were associated with the variables outlook and resistance at 1 month (3.05), resistance and lack of social self-confidence at 4 months (–2.73), outlook and lack of social self-confidence at 1 month (–2.70), and outlook at 1 month and current health perceptions at 4 months (–2.68). Furthermore, the standardized RMSR for the fitted model was .07, higher than the preferred .05. These residuals suggest that measurement error may have caused the model to be rejected in spite of the adequate overall fit.

The path from emotional distress to dependency was strong at 1 month but not significant at 4 months after MI (t = 1.40). Given that this path was proposed a priori, it was maintained. No modifications were made based on the modification indices.

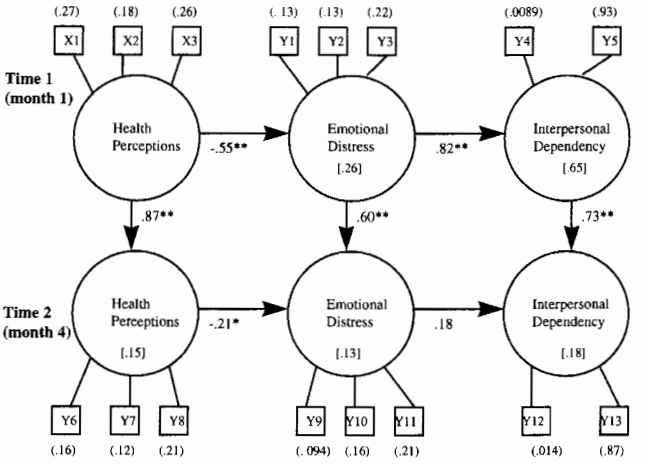

FIGURE 2. Structural model of cardiac invalidism shown with construct equations. The context for invalidism is an acute illness event. Latent variables are shown in circles, and empirical indicators are shown in boxes. Error variances for each of the indicators are in parentheses. Error variances associated with each of the latent variable equations are noted within brackets. Statistical significance of standardized path coefficients are marked with asterisks (*.01, **.001). All construct equations were significant except for the emotional distress to interpersonal dependency path at 4 months after MI. X1 = current, month 1; X2 = outlook, month 1; X3 = resist, month 1; Y1 = anxiety, month 1; Y2 = depression, month 1; Y3 = anger, month 1; Y4 = emotional reliance, month 1; Y5 = lack of social self-confidence, month 1; Y6 = current, month 4; Y7 = outlook, month 4; Y8 = resist, month 4; Y9 = anxiety, month 4; Y10 = depression, month 4; Y11 = anger, month 4; Y12 = emotional reliance, month 4; Y13 = lack of social self-confidence, month 4).

Discussion

The results of this study suggest that the model specified is reasonable and can serve as a starting point for a theory-based empirical exploration of the invalidism process. Invalidism appears to occur in response to a change in health perceptions precipitated by an acute illness event, such as an MI. Other investigators have postulated that emotional distress precedes a change in health perceptions (Brown & Munford, 1983–1984). For example, Rosen, Contrada, Gorkin, and Kostis (1997) argued that emotional changes initiated psychological adaptation based on data from 146 heart failure patients analyzed using structural equation modeling. However, the strength of the path from emotional distress to health perceptions was lower than that found in our study (–.28 vs. –.55), suggesting that the direction is reversed. Our findings support the work of Petrie and colleagues (1996) who found that health perceptions predicted return to work and functioning after an MI. Future investigators should test alternative models with a single data set to resolve this controversy.

Invalidism waned over time in those patients who experienced improved health perceptions. Once health perceptions improved 4 months after the MI, emotional distress also resolved and the relationships between the constructs were weak. This finding, coupled with mean improvements in current health perceptions (3.2–3.48; p < .01) suggests that after 4 months, most of the MI patients in the study felt well again. After the patients perceived themselves as having successfully negotiated this health crisis, emotional distress and dependency waned.

There is preliminary support for the three propositions. The first proposition was that a change in health perceptions causes an emotional response. At 1 month, the path from health perceptions to emotional distress was significant and negative, indicating that perceptions of poor health were associated with high emotional distress. This finding is consistent with those of previous investigators, including Bennett (1993), who found emotions to be the result of perceived threat in a sample of MI survivors.

The second proposition was that emotional distress leads to dependency. At 1 month, the path from emotional distress to dependency was significant, indicating that emotional distress accentuated feelings of dependency on others. Richman and Flaherty (1985) found emotional distress and interpersonal dependency to be significantly related in a population with high levels of stress. Theoretical work in this area also supports this relationship;

Hirschfeld and colleagues (1976) argued that dependency needs are high in depressed individuals.

The third proposition was that there are positive relationships between repeated measures of the same variable over time. The relationships between the 1-month and 4-month measures of each latent construct remained strong over time. That is, once dependency developed early in recovery after acute MI, it remained a factor 4 months later. This finding illustrates the importance of halting the sequence of events in the early recovery period. Interventions designed to help patients feel increasingly optimistic about their health in the early postdischarge period may lessen emotional distress and feelings of dependency later.

Two intervention trials have demonstrated the power of changing health perceptions. In the first study, exercise training designed to influence positively perceptions of physical capacity was effective in decreasing anxiety and depression among 210 post-MI men (Taylor, Houston-Miller, Ahn, Haskell, & DeBusk, 1986). In the second trial, treadmill testing conducted until symptoms indicated the need to stop (i.e., symptom-limited) and a formal recommendation to return to work within 2 weeks was provided to 99 post-MI men randomized to the intervention group (Dennis et al., 1988). Return to work was significantly shorter when compared with the 102 men in the usual care group (median 51 vs. 75 days). These results demonstrate that a simple intervention designed to influence health perceptions positively can result in reduced emotional distress and early return to work.

The major limitation of this study is that cause and effect relationships cannot be identified with confidence from this nonexperimental study which used a convenience sample and self-report measures. However, the use of longitudinal data adds confidence to the conclusions.

Interpretation of a model for which the χ^2 is significant but the fit of the data to the model is adequate according to the fit indices is challenging. Hu and Bentler (1995) argue that "a χ^2 test offers only a dichotomous decision strategy implied by a statistical decision rule and cannot be used to quantify the degree of fit along a continuum with some prespecified boundary" (p. 81). This argument is similar to the current controversy surrounding significance testing versus confidence intervals (Cohen, 1994; Greenwald, Gonzalez, Harris, & Guthrie, 1996). Even though the χ^2 test was significant in this case, the fit indices provide some preliminary evidence of the validity of the model.

Another limitation was that the model was tested in a sample uniformly experiencing one specific illness event. Future testing of the model should be done in individuals experiencing other, perhaps less severe, illness events. Finally, this analysis confirmed one specific model derived deductively from literature review and clinical experience. It is possible that other models could fit as well. Alternative models such as cross-lagged models should be tested in future research. A particularly interesting model would be a multisample model in which individuals with initially poor health perceptions are compared to those with initially good health perceptions.

In summary, the results of this study suggest that the process of cardiac invalidism begins with a change in health perceptions in the context of an acute MI. This change leads to emotional distress and increased interpersonal dependency. Cardiac invalidism decreases in most patients within 4 months. A significant subset of patients, however, continue to demonstrate emotional distress and dependency based on their subjective evaluation of changed health status. Nurses and other health care professionals may be able to alter the incidence of invalidism by helping cardiac patients to reinterpret or modify their perceptions of the changes in their health. ▼

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