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Predictors of Compliance with Diet and Exercise Six Months After Heart Transplantation

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PREDICTORS OF COMPLIANCE WITH DIET AND EXERCISE SIX MONTHS AFTER HEART TRANSPLANTATION

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THE FACULTY OF THE SCHOOL OF NURSING
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CHAPTER I

PATIENT COMPLIANCE WITH HEALTH CARE REGIMENS

Patients are often noncompliant with health care regimens, which can result in increased morbidity and mortality. During the 1970's, researchers found that compliance with short-term regimens decreased rapidly over time, and only 50% of patients were compliant with long-term regimens (Haynes, Taylor, & Sackett, 1979). The paucity of methodologically sound compliance studies reported in the literature prevented Haynes et al. (1979) from drawing conclusions about compliance with lifestyle changes beyond saying that compliance was low. In a review of current issues related to compliance, Kaplan and Simon (1990) noted that noncompliance rates varied between 15-93%. Furthermore, patients who required long-term therapy and/or had to comply with regimens that involved lifestyle changes had high noncompliance rates. Therefore, patient compliance with health care regimens is an important clinical problem which continues to occur and requires further investigation.

In a recent study of compliance in organ transplant recipients, Schweizer et al. (1990) found that 6% (3/50) of heart transplant patients, 2% (2/82) of kidney transplant patients, and 23% (3/13) of liver transplant patients were noncompliant with immunosuppressive medications. The consequences of noncompliance with immunosuppressive medications are graft rejection and possible death.

Heart transplant patients are provided with complex therapeutic regimens by health care providers. As a clinical nurse specialist in cardiac transplantation, I have observed that compliance with therapeutic regimens varies among patients, depending upon the specific regimen. Discussions with many heart transplant patients have revealed that noncompliance with diet and exercise prescriptions occurs frequently.

Reduced compliance rates with prescriptions for diet and exercise after heart transplantation may contribute to obesity (i.e., being equal to or greater than 110% of ideal body weight) and hyperlipidemia (i.e., having serum cholesterol and/or triglyceride levels greater than 200mg/dl). In a study by Grady and Herold (1988), patients (n=65) became obese, and serum cholesterol and triglyceride levels became elevated 6 months after heart transplantation. Further investigation of post heart transplant obesity and hyperlipidemia revealed that patients (n=54) continued to be greater than 110% of ideal body weight, and cholesterol and triglyceride levels also remained elevated (>200 mg/dl) through the third postoperative year (Grady, Costanzo-Nordin, Herold, Srinivasan, & Pifarre, 1991). Interestingly, cholesterol levels, although elevated, were significantly lower at 3 years (207 mg/dl) versus 1 year (250 mg/dl) after surgery (Grady et al., 1991). This evidence for post heart transplant obesity and hyperlipidemia has been supported by other researchers (Keogh et al., 1988; Renlund et al., 1989; Taylor et al., 1989). Furthermore, several lines of evidence suggest that obesity and hyperlipidemia may contribute to the development of allograft coronary arteriopathy in heart transplant patients. In this process atherogenic plaque is deposited in the coronary arteries at an accelerated pace by an as yet unidentified mechanism (Bilodeau, Fitchett, Guerraty, & Sniderman, 1989; Hosenpud, Shipley, & Wagner, 1992; Winters et al., 1990).

The causes of obesity and hyperlipidemia are multifactorial and not yet fully defined. Factors that may contribute to weight gain and hyperlipidemia in cardiac transplant patients include genetic factors, a diet high in saturated fats, lack of exercise, and the use of immunosuppressive medications, such as corticosteroids and cyclosporine (Grady et al., 1991; Keogh et al., 1988; Renlund et al., 1989; Taylor et al., 1989). Becker et al. (1988) identified some predictive factors for cholesterol levels and found cumulative prednisone exposure to be the strongest predictor. Psychosocial factors, such as compliance with diet and exercise, logically may also influence body weight and lipid levels. Therefore, the purpose of this dissertation is to examine patient compliance with diet and exercise prescriptions after heart transplantation, guided by the Health Belief Model. Given that obesity and hyperlipidemia start to occur 6 months after heart transplantation, that time period was selected for the study. The following research questions will be addressed:

1. To what extent do patients comply with their diet prescription 6 months after heart transplantation?
2. To what extent do patients comply with their exercise prescription 6 months after heart transplantation?
3. How much difficulty do patients have complying with their diet prescription 6 months after heart transplantation and why?
4. How much difficulty do patients have complying with their exercise prescription 6 months after heart transplantation and why?
5. What is the relationship between demographic, physiologic, and psychosocial variables and compliance with diet 6 months after heart transplantation?
6. What is the relationship between demographic, physiologic, and psychosocial variables and compliance with exercise 6 months after heart transplantation?
7. What are the demographic, physiologic, and psychosocial predictors of compliance with diet 6 months after heart transplantation?
8. What are the demographic, physiologic, and psychosocial predictors of compliance with exercise 6 months after heart transplantation?

CHAPTER II

REVIEW OF RELATED LITERATURE

Compliance as a Concept

Controversy and confusion exist about the meaning and use of the term compliance. Compliance has been used in a variety of ways and with different connotations by different authors, and a variety of other terms have also been used interchangeably with compliance. Webster's dictionary (1987) provides a definition of compliance as follows: "the act or process of complying to a desire, demand, or proposal or to coercion" or "a disposition to yield to others" (p. 269). Ice (1985) also has a broad definition of compliance: "a class of behaviors resulting from a specific set of cues and consequences" (p. 1832).

Marston (1970) uses the term compliance as a "normative expectation that patients will follow whatever their physicians recommend" (p. 312). Sackett and Haynes (1976) define compliance in the medical setting even more specifically as "the extent to which the patient's behavior (in terms of taking medication, following diets, or executing other life-style changes) coincides with the clinical prescription" (p. 1). Likewise, Ruffalo, Garabedian-Ruffalo, and Pawlson (1985) define compliance as "the degree to which a patient's behavior coincides with directions from a physician or other health professional" (p. 94).

Dracup and Meleis (1982) provide the following definition of compliance: "the extent to which an individual chooses behaviors that coincide with a clinical prescription" (p. 31). However, this definition differs from the others in the use of the word "chooses" in that it suggests greater patient decision-making and is somewhat more process oriented. Trostle (1988) prefers to define compliance in regard to the specific behavior being investigated, such as drug-taking behavior, clinic attendance, or following a diet. Thus, Sackett and Haynes, Ruffalo et al., Dracup and Meleis, and Trostle all define compliance in a behavioral sense, which involves the self-care activities that are initiated by the patient that concur with a clinical prescription.

Sackett and Haynes further add that the term compliance is appropriate in all situations, including those in which the patient yields to physician wishes and those in which consensus is mutually arrived at between health care worker and patient. Thus, according to Sackett and Haynes, the terms adherence and therapeutic alliance can be used interchangeably with compliance.

However, other more recent reports in the literature distinguish among these three terms. Dracup and Meleis (1982) suggest that adherence is different from compliance and carries a less authoritative tone, wherein the patient is a more willing participant in the therapeutic regimen. Madden (1990) defines therapeutic alliance as "an interpersonal relationship between a nurse and a client that is directed toward the development of client health behaviors by mutual goal setting" (p. 77). Therefore, she describes therapeutic alliance as being interactional (i.e., process oriented), and directed toward mutual goal setting, and views compliance and adherence as more outcome oriented.

It is important to define the term compliance when using it for research purposes. Without a conceptual definition of compliance, operationalization of the term to measure it is not possible. Therefore, for the purposes of this dissertation, the term compliance will be used in a behavioral sense, according to the definition of Sackett and Haynes (1976): compliance is "the extent to which the patient's behavior (in terms of taking medication, following diets, or executing other life-style changes) coincides with the clinical prescription" (p. 1).

Patient Compliance

A review of the literature related to what is known about compliance of patients with solid organ transplantation (especially heart) was conducted. Given the paucity of articles about compliance of solid organ transplant patients with diet and exercise, compliance with all aspects of the health care regimen was examined. Also, articles were sought which used the Health Belief Model to guide the research; however, no patient compliance articles in the transplant literature used this model. Therefore, articles about compliance of cardiovascular patients generally with diet and exercise which used the Health Belief Model were reviewed to examine this topic in a related population of patients: patients who may require heart transplantation in the future and who are also placed on diet and exercise regimens similar to heart transplant recipients.

Methods for Literature Review

A comprehensive on-line search of the Medline database, (English language only, including national and international citations) was conducted for the years 1980-1992. The search was limited to articles about adult patients (18-70 years) who required solid organ transplantation (specifically kidney, liver, or heart transplantation) or who had cardiovascular disease (specifically coronary artery disease with myocardial infarction, [MI] and/or angina). The cardiovascular patients may have required therapy, such as coronary artery bypass surgery (CABG) or percutaneous transluminal coronary angioplasty (PTCA).

The literature review has two sections: (1) review of the Health Belief Model and its use in chronic illness populations, including cardiovascular patients and (2) review of articles about solid organ transplant patient compliance.

The Health Belief Model is described because it has been used as the theoretical basis for compliance research. The compliance articles are analyzed to explore what is known about solid organ transplant patient compliance with diet, exercise, and other therapeutic prescriptions. Conceptual and methodologic problems with the existing literature for these two populations of patients are examined, and gaps in the literature are identified. Therefore, the review of the literature provides (1) a description of the Health Belief Model and its usefulness in research on cardiovascular patients and (2) an analysis of the existing body of knowledge, and evidence for the lack of research and theoretical underpinnings on diet and exercise in solid organ transplant patients.

The Health Belief Model

Theories and models are useful in their ability to provide guidance and direction for research and subsequently practice. A useful theory should provide a researcher with important variables that can be examined in relation to phenomena of interest. Thus far, no single theory or model has captured all potential variables related to patient compliance.

However, one of the models which is useful in the study of patient compliance is the Health Belief Model. Usefulness of the Health Belief Model lies in the ability to examine health beliefs and interrelationships with other variables, and thus perhaps alter the beliefs so that an appropriate health behavior becomes more likely.

The Health Belief Model was developed by Hochbaum, Kegeles, Leventhal, and Rosenstock during the 1950's. The model has its origins in a select aspect of the social psychological theory of Kurt Lewin, which relates to goal setting in the level of aspiration situation (Lewin, Dembo, Festinger, & Sears, 1944). Lewin et al. postulated that behavior depended primarily on two variables: the value placed on a given outcome by an individual and the estimate by the individual that an action will result in that outcome. Lewin defined level of aspiration as "the degree of difficulty of attainment of the goal toward which the person is striving" (Deutsch, 1968, p. 453-454). It has been suggested that people aspire to goals that are slightly higher than those which they have successfully attained in the past. In addition, goal attainment is also dependent on cultural and individual differences.

This approach to predicting behavior has been termed value-expectancy. Lewin uses the term valence, the value placed by an individual on a particular goal or outcome. Two assumptions of goal setting in Lewin's theory include: that the difficulty of attaining a goal is directly related to valence and the difficulty of attaining a goal is negatively related to subjective probability of success (Maiman & Becker, 1974). In other words, the more difficult something is, the more highly valued it is and the less likely one will attain it.

The Health Belief Model was formulated from Lewinian theory, originally to explain preventive health behavior. The model explains an individual's motivation to act in the area of health behavior, based on his/her expectancy of goal attainment. The central concern of the model is an individual's subjective perspective of the world. The following theoretical components are proposed within this model: (1) an individual's psychological readiness to take action as related to a particular health condition determined by the person's perceived susceptibility (vulnerability) and perceptions of the severity related to contracting that condition; (2) an individual's evaluation of the advocated health action in terms of its feasibility and efficaciousness (i.e., its potential benefits in reducing susceptibility and/or severity) as weighed against his perception of barriers or costs; and (3) a stimulus (internal, e.g., symptoms or external, e.g., interpersonal communications) that triggers the appropriate health behavior or cue to action (Maiman & Becker, 1974). This theoretical approach to health behavior is expectancy-based in that the action an individual will take is related to (1) a desire to reduce susceptibility and severity and (2) an estimation of benefits and costs (Maiman & Becker, 1974).

Perceived susceptibility and severity related to a given health problem are thought to vary widely among individuals. Susceptibility, or subjective assessment of risk, may be denied, admitted as being possible, or affirmed as highly likely by an individual. Perceived severity may be more broadly defined to include concerns related to a variety of issues such as: medical or clinical consequences, i.e., whether a disease could lead to death, diminished mental or physical capacity, or permanent disability; and impact on family life, work, and social relations. Perceived susceptibility and severity have a cognitive component in that they are dependent on knowledge acquisition.

Given that an individual accepts his susceptibility to a disease thought to be serious, he is prepared to take action. The action taken is dependent on perceived benefits and barriers (Maiman & Becker, 1974). The benefits relate to an individual's beliefs about the availability and effectiveness of various courses of action. If a particular course of action reduces susceptibility to and seriousness of an illness, it may be seen as beneficial. A person's beliefs are influenced by family and social groups.

Barriers are negative aspects of health action, wherein the action is seen as unpleasant, painful, inconvenient, expensive, etc. These barriers arouse conflict in an individual, wherein indecision, heightened anxiety, and inability to act may occur.

An individual is thus motivated to act, based upon perceived susceptibility and seriousness of a disease, and selects an action based on benefits minus barriers (Maiman & Becker, 1974). However, this process is believed to be set into motion only by some instigating event referred to as a cue to action. Cues might be internal or external, as previously described.

Finally, other variables, such as demographic variables (e.g., age, sex, level of education), sociopsychological variables (e.g., personality, social class, peer groups), and structural variables (e.g., knowledge about or prior contact with a disease) are seen to modify the course of action (Maiman & Becker, 1974). The Health Belief Model assumes that motivation is a necessary prerequisite for action.

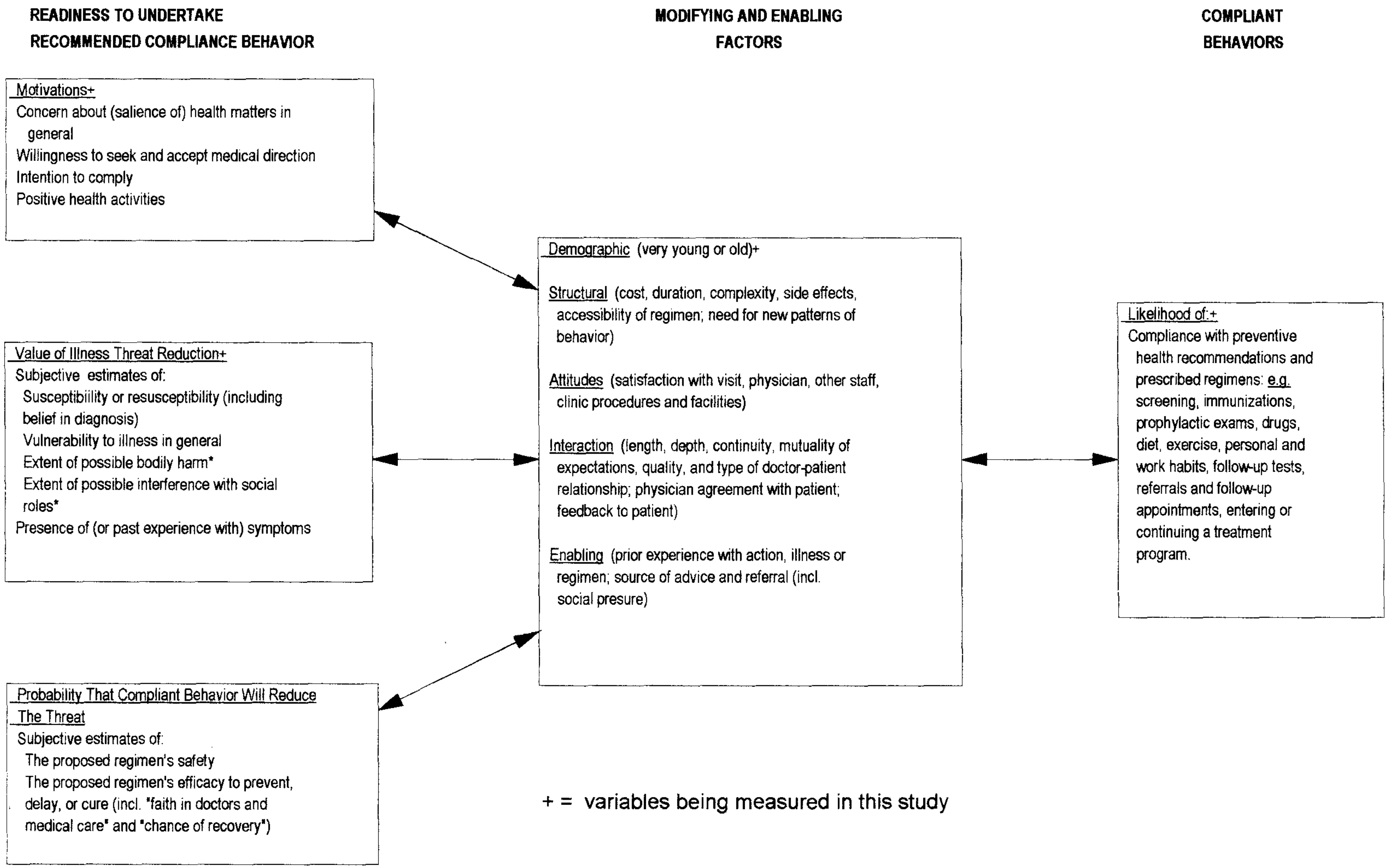
Development of a Second Generation Health Belief Model

A second generation Health Belief Model was developed as a result of research with the original Health Belief Model. In the second model as seen in figure 1, additional dimensions thought to be valuable in describing a more complete model were added (Becker & Maiman, 1975). Motivation, only assumed in the original model, was added to the second model as well as additional modifying factors.

Motivation is defined as "differential emotional arousal in individuals caused by some given class of stimuli (e.g., health matters)" (Becker & Maiman, 1975, p. 17). In their

Figure 1

HEALTH BELIEF MODEL



*At motivating, but not inhibiting, levels.

Becker M. & Maiman L. (1975). Sociobehavioral determinants of compliance with health and medical care recommendations. Medical Care, 13, 10-24. (Reprinted with permission).

conceptualization of this dimension, variables of concern about general health matters, willingness to seek and accept medical care, intent to comply, and having positive health activities were included. Given that the original Health Belief Model dealt only with negative aspects of health (i.e., susceptibility and severity), the authors, after reviewing the research literature, were supported in the belief that positive factors (e.g., health motivation) also influenced compliant behavior.

In addition, modifying factors previously described in the original model were expanded upon and classified as being demographic, structural, attitudinal, interactional, and enabling. Demographic variables included in the second model were age, gender, and marital status. Structural factors such as cost, duration, complexity, side effects, accessibility of the regimen, and need for new patterns of behavior were added to this newer model. The attitudinal components related to satisfaction with health care providers, visits, procedures, and facilities. Interaction factors referred to patient-provider communication. Positive or negative interactional factors which influenced compliance were length, depth, continuity, mutuality of expectation, quality and type of physician and other health care provider relationship, physician agreement with the patient, and feedback to the patient. Finally, the influence of others via socialization or social pressure can impact on compliance. Thus, enabling factors such as a prior experience with action, illness, or the regimen, and a source of advice or referral were found to be related to compliance (Becker & Maiman, 1975).

<u>Application of the Health Belief Model to Chronic Illness Populations</u>

The Health Belief Model was originally developed for use in a preventive health behavior population, wherein health behaviors occurred in the absence of symptoms (Kasl, 1974). Subsequently, the model has been successfully applied to illness behavior, which occurs in the presence of symptoms, and in sick role behavior, which involves prolonged contact with a health professional and/or health care setting, and partial or total withdrawal from usual social functioning (Kasl, 1974). Kasl states that chronic illness behavior includes some of all three of the above formulations wherein the role occurs typically at home with associated health care duties and continued social obligations. However, reinforcement from health professionals is intermittent, and the time span is indefinite.

In a review of Health Belief Model research during the period 1974-1984, Janz and Becker (1984) summarized results from preventive, sick role, and illness behavior populations. Empirical support was found for the usefulness of the Health Belief Model in these populations. The component of perceived barriers was the most powerful dimension in predicting compliance, followed by benefits, susceptibility, and severity (Janz & Becker, 1984). The authors noted that a wide variety of operational definitions of the Health Belief Model were used, and comparison across studies was, therefore, difficult. However, they also stated that "it is a testament to the robustness of the model that the dimensions remain predictive despite different measures" (Janz & Becker, 1984, p. 45).

Health Belief Model Research in Chronic Cardiac Illness Populations

Subsequently, the original and second generation Health Belief Model have been used as frameworks for research in chronic cardiac illness populations, including patients who are post MI and post CABG surgery. Some of the studies examined compliance in relation to aspects of cardiac rehabilitation, including diet and exercise.

Tirrell and Hart (1980) examined how well patients (n=30) who had undergone CABG 10-12 months prior to the study complied with their exercise program, and the relationship of knowledge and health beliefs to long-term compliance. The researchers used a semi-structured interview, modified from the Compliance Questionnaire by Sackett and Haynes (1976), to ask questions about perception of disease severity, susceptibility, barriers to exercise, efficacy, and health motivation. Patients were also interviewed about their knowledge of the exercise program. Sixty percent of patients reported compliance with their exercise program; however, only one patient followed all of the exercise training details. The correlation of exercise program knowledge and compliance was .36. Correlations of health beliefs with compliance showed that perception of barriers correlated the highest with compliance (r=-.54); therefore, the greater the number of perceived barriers, the lower the level of compliance. The demographic variables of gender, marital status, and socioeconomic level and the temporal variable of time since CABG did not influence compliance with exercise.

Holm, Fink, Christman, Reitz, and Ashley (1985) described health beliefs of post MI or CABG patients (n=41) who completed a structured phase II outpatient cardiac rehabilitation program. The Compliance Questionnaire by Sackett and Haynes (1976) was also used for this study. The researchers found that patients tended to be generally compliant with their exercise program, and patients who were self-motivated (as measured by the Self-Motivation Inventory) regarding general health were even more compliant with their exercise prescription. Furthermore, Holm et al. found patient perception of the severity of an illness and resusceptibility, efficacy of treatment, and cues to take action to be above average and indicative of the potential for compliance with exercise. Finally, they also examined selected clinical variables and descriptively reported that 90% of the patients found that the time of day they attended the exercise program was convenient, and that 78% of patients lived from 1 to 10 miles distance from the program. Seventy-eight percent of patients had insurance coverage for the exercise program. In addition, patients reported that they were highly satisfied with the exercise program and staff. It is likely that all of these factors influenced compliance.

Factors that influenced coronary artery disease patient (n=39) participation in a cardiac rehabilitation program (including diet and exercise) were examined by Hiatt, Hoenshell-Nelson, and Zimmerman (1990). Patients were followed from their decision to enter versus not to enter into an in-hospital, structured phase I cardiac rehabilitation program (involving monitored exercises with incremental increases in duration) through 10 days after discharge. An author-developed tool (the Patient Entrance into a Cardiac Rehabilitation Program, PECRP) was used which had eighteen questions (based on the Health Belief Model), rated on a 7-point Likert scale. No significant differences in demographic variables were found between the two groups of patients. However, married subjects and patients earning more than $20,000/year perceived more benefits and fewer barriers to participation in cardiac rehabilitation. Furthermore, those who participated in rehabilitation perceived more benefits and fewer barriers than those who did not participate. No significant differences were found between groups regarding perceived susceptibility and severity.

Lastly, Oldridge and Streiner (1990) examined the usefulness of the Health Belief Model in predicting compliance with cardiac rehabilitation. They also used a modified version of the Sackett and Haynes (1976) Compliance Questionnaire, which included thirty items on a 5-point Likert scale. Male coronary artery disease patients (n=120) were followed for 6 months after entry into the rehabilitation program. Fifty-eight of the patients were classified as compliers and sixty-two as dropouts. The Health Belief Model accounted for only 5% of variance between compliers and dropouts, but predicted group membership correctly 65% of the time. Specifically, severity of disease threat, but not treatment efficacy or cues to take action, significantly differentiated compliers and dropouts from the exercise program. Adding demographics and health behavior variables to the Health Belief Model variables increased the amount of explained variance to 21% and predicted group membership 74% of the time. Finally, demographics, health behaviors, and the Health Belief Model accounted for 57% of the variance between avoidable and unavoidable dropouts and predicted group membership 84% of the time. Examples of avoidable reasons for dropping out were: patient loss of motivation/interest, inconvenience, fatigue, or achieved program objectives. Examples of unavoidable reasons included medical reasons, moving away, or death.

Conceptual and Methodologic Problems in HBM Studies

Conceptual and methodologic problems were present in these four studies. Although these studies used the Health Belief Model to guide their research, conceptual problems included lack of definition of the term compliance and lack of hypothesis testing.

Methodologically, sampling was identified as a problem. None of the studies used random sampling (the best way to generalize research findings beyond the sample). Three of the studies (Hiatt et al., 1990; Holm et al., 1985; Tirrell & Hart, 1980) used small sample sizes of between 30 and 41 patients (which are less representative of the population being studied and have less power for statistical analysis given the number of variables studied). The other study (Oldridge & Streiner, 1990) used males exclusively, which also limits generalizability, given that heart disease is also the leading cause of death in women (American Heart Association, 1992).

Design problems were also found. Two of the studies (Holm et al., 1985; Tirrell & Hart, 1980) were cross-sectional, which only presents data at one point in time. However, compliance as a concept is dynamic and changes over time; therefore, cross-sectional data does not adequately assess compliance as a changing behavior. In addition, all four of the studies were at the survey level of design and did not test interventions to improve compliance.

Measurement of variables in studies of compliance has been the subject of much concern regarding reliability of the tools used. A variety of data collection methods are available for the measurement of compliance. These may include direct objective measurement (e.g., direct observation), or indirect objective measurement (e.g., pill counts, body weight, and laboratory tests of variables impacted by compliance such as serum lipid levels). Also, compliance may be measured subjectively by patient self-report. Regarding self-report, researchers have long noted that patients frequently over-report compliance and under-report noncompliance (Hilbert, 1985). However, Kaplan and Simon (1990) found that patient self-report was surprisingly accurate, particularly when patients gained experience with a regimen, based on their review of research literature related to compliance in medical care. Also, Shankar, Mihalko-Ward, Rodell, Bucher, and Maloney (1990) found that self-reports of adherence to diet and exercise in CABG patients were consistent with objective measures of compliance in at least 50% of subjects. Tirrell and Hart (1980), Holm et al. (1985), and Hiatt et al. (1990) used self-report as the only measurement for compliance with diet and exercise. Rather than relying on one measure of compliance, triangulation of measurement will provide greater reliability in measurement of that variable.

Another important concern with the tools used in compliance studies using the Health Belief Model is psychometric testing. Evaluation of reliability, the consistency in measurement of a tool, and validity, whether the tool actually measures the construct it is designed to assess, were not described for two of the studies (Oldridge & Streiner, 1990; Tirrell & Hart, 1980).

Lastly, an important methodologic area of concern is the statistical techniques used in analysis of the studies. Multiple univariate statistical tests can lead to spurious results, the probability of rejecting falsely when the null hypothesis is true, a Type I error (Stevens, 1986). Three of the studies (Hiatt et al., 1990; Holm et al., 1985; Tirrell & Hart, 1980) used exclusively univariate techniques and only one study (Oldridge & Streiner, 1990) used multivariate statistical procedures.

Gaps in the research of cardiovascular patient compliance with diet and exercise guided by the Health Belief Model were also found. Three of the articles examined only exercise (Holm et al., 1985; Oldridge & Streiner, 1990; Tirrell & Hart, 1980). The other article (Hiatt et al., 1990) examined diet and exercise together as one entity. Examination of diet and exercise together or with other prescriptions is based on an assumption that compliance does not vary by type of prescription, which is not supported by empirical evidence.

Lastly, variables that were not examined in relation to compliance in the four studies, but which are compatible with the Health Belief Model, were identified by this investigator. These variables include stress, coping, functional ability, symptoms, perceptions of difficulty with compliance, life satisfaction, social support, perception of the helpfulness of health care provider interventions, and number of medications. Given that these variables were not examined in these studies of compliance with diet and exercise based on the Health Belief Model, the literature was reviewed to determine if these variables have been studied in relation to compliance under atheoretical or other theoretical conditions in the population of cardiovascular patients.

This literature review showed that some of these variables (symptoms, stress, life satisfaction, and social support) were included in an examination of compliance with diet and exercise in cardiovascular patients. Coping, compliance difficulty, perception of health care provider interventions, and number of medications were not found as variables in the study of cardiovascular patient compliance.

Symptoms and functional disability were examined in a limited way by two researchers (Dixhoorn, Duivenvoorden, & Pool, 1990; Shephard, Corey, & Kavanagh, 1981). Shephard et al. reported on the exercise compliance of 610 male post MI patients and found that angina reduced compliance with exercise. Likewise, Dixhoorn et al., who also studied post MI patient compliance with exercise training (n=156), found that angina occurred more frequently in patients who were noncompliant with exercise training after myocardial infarction. In addition, Dixhoorn et al. found that patients who were noncompliant with exercise also had more functional disability (e.g., as indicated by the need to take longer daytime naps).

Stress was examined by one researcher (Lynch et al., 1992) in relation to dietary and exercise compliance. These researchers reported that stress was not associated with adherence to exercise treatment of hypercholesterolemia in healthy subjects (n=31).

Social support as a factor influencing compliance with diet or exercise was described by two researchers (Cohen et al., 1991; Lynch et al., 1992). Lynch et al. found no association between social support and compliance with exercise in the treatment of elevated serum cholesterol levels. Cohen et al. examined the effect of a household partner on adherence to a sodium restricted diet in 107 hypertensive patients. They also found that social support had no influence on patient compliance with the prescribed low sodium diet.

Lastly, Oldridge et al. (1991) reported on the effects of rehabilitation after acute MI (n=201) on quality of life, a concept related to life satisfaction. Disease-specific and health-related quality of life were examined using a Quality of Life Questionnaire designed by the researchers for the study. Patients were divided into two groups: those receiving an 8-week program of exercise and counseling (n=99) versus those receiving conventional care (n=102). All measures of health-related quality of life improved significantly in the 12-month follow-up period in both groups. However, significantly greater improvement, albeit small, was found at 8 weeks in the emotion dimension of the quality of life instrument, favoring the experimental group. This study did not specifically examine compliance with each treatment regimen. However, the authors stated that active rehabilitation after acute MI and quality of life are important to examine regarding compliance with rehabilitative interventions in order to optimize patient benefits and outcome.

Thus, although the variables examined in relation to patient compliance with diet and exercise did not show consistent relationships to compliance, they need to be examined further due to the limited number of studies, some of them with small sample sizes. Furthermore, those variables which have not been examined in association with dietary and exercise compliance (coping, difficulty, and health care provider interventions) require study in order to determine if a relationship exists since the Health Belief Model suggests the salience of such variables.

Transplant Patient Compliance

As previously indicated, studies of compliance in the transplant population are sparse and tend to be related to medications and clinic visits, not diet and exercise. Only one study (Mai, McKenzie, & Kostuk, 1990) reported findings related to physical activity. Furthermore, the majority of findings were on kidney transplant patients. Only two studies described findings in heart transplant patients (Mai et al., 1990; Rogers, 1987), and one of these studies described only spousal behaviors supportive of compliance, not actual patient compliance (Rogers, 1987). Data on heart transplant patients were sometimes provided anecdotally in other studies, but sample sizes were insufficient for more than simple and brief descriptions of findings. Since the majority of articles are not related to compliance with diet and exercise in heart transplant patients, the following review of the literature will be condensed and summarized. An overview of each of the transplant patient compliance studies is found in appendix 1.

Demographic, physiologic, psychosocial, clinical, and temporal variables were examined in the articles of transplant patient compliance. Demographic variables described in relation to patient compliance were age, gender, race, marital status, education, living arrangements, socioeconomic status, and return to work (Didlake, Dreyfus, Kerman, Van Buren, & Kahan, 1988; Mai et al., 1990; Rodriguez, Diaz, Colon, & Santiago-Delpin, 1991; Rovelli et al., 1989a,b). As was found with cardiovascular patients, most demographic variables had an inconsistent relationship to compliance. Interestingly, differences in kidney transplant patient compliance with postoperative medications and follow-up were initially found by race. Subsequent study by the same investigational team (Rovelli et al., 1989a,b) revealed that the differences were due to socioeconomic status, rather than race. This finding was supported by Rodriguez et al. (1991) who found more economic problems in noncompliant versus compliant kidney transplant patients.

Few physiologic variables were examined in relation to compliance. The finding of no significant difference in medical regimen compliance between recipients of living related versus cadaveric kidney transplants was supported by four research groups (Didlake et al., 1988; Dunn et al., 1990; Rovelli et al., 1989a; Rodriguez et al., 1991). Interestingly, Dunn et al. found significantly more noncompliance in recipients of first versus second time kidney transplants, while Didlake et al. did not find any differences by number of kidney transplants per patient. Also, Didlake et al. and Rodriguez et al. both reported that noncompliant renal transplant patients were significantly more noncompliant with dialysis pretransplant than compliant renal transplant patients, thus providing a likely predictor of postoperative compliance.

A limited number of psychosocial variables were also examined in studies of transplant patient compliance. The only psychosocial variable looked at by more than one research group was psychiatric diagnosis. Findings were inconsistent. Rodriguez et al. (1991) described no difference in psychiatric history between compliant versus noncompliant patients, while Mai et al. (1990) found patients with fair to poor versus good compliance to have psychiatric problems. In addition, although Siegal, Hanson, Viswanathan, Margolis, and Butt (1989) looked at health beliefs, their data were not supported by a theoretical framework. Therefore, further study of the interrelationships of compliance with psychosocial variables is indicated.

Clinical variables relating to the health care system were examined in a few studies of transplant patient compliance. Dunn et al. (1990) reported that there were no significant differences in immunologic protocols when noncompliant patients with graft loss were compared to the entire group. All patients were receiving either cyclosporine and prednisone, or converted to cyclosporine, prednisone, and azathioprine. Didlake et al. (1988) reported that noncompliant patients with graft loss had a significantly higher dose of prednisone and a greater incidence of tremor, but no difference in cyclosporine dose or total number of medications taken, when compared to a matched group of recipients with functional allografts.

The majority of patients after heart, kidney, or liver transplantation were compliant with their medical regimens (Didlake et al., 1988; Dunn et al., 1990; Rovelli et al., 1989a,b; Schweizer et al., 1990). Patients who were noncompliant with one area (e.g., clinic visits) of their medical regimen were found to be noncompliant with other areas as well (e.g., medications) (Schweizer et al., 1990). Most importantly and in contradistinction to cardiovascular patients, patients who were noncompliant with their medical regimen, especially immunosuppressive medications, were found to have significantly more graft rejection and death (Dunn et al., 1990; Schweizer et al., 1990).

Conceptual and Methodologic Problems in Studies of Transplant Patient Compliance

Conceptual and methodologic problems were also found in the studies of transplant patient compliance, as seen in table 1. As indicated previously, none of the studies used a theoretical foundation or model to guide the research. Also, definitions of compliance were not provided. Only two authors (Mai et al., 1990; Siegal et al., 1989) proposed hypotheses in their studies. The paucity of hypothesis testing is related to the lack of theoretical support for the studies.

Methodologic problems were similar to those described in the cardiovascular studies guided by the Health Belief Model. Problems were found with sampling; there was no random

Table 1

Conceptual and Methodologic Problems with Compliance Findings in Transplant Patients From the Literature

Problems	*References
Not building on previous research	2,6,9
No theoretical basis/model used	1,2,3,4,5,6,7,8,9
No hypothesis testing	1,2,3,4,5,6,7,8
Small sample size (<40)	3,4,5
Cross-sectional approach	4,5,6,7,8,9
Descriptive design only	5
Retrospective study	6,7,8
Used only subjective measures	3
No data on reliability of tools	1,4,5,9
No data on validity of tools	1,3,4,9
Use of only descriptive statistics	5
Focusing primarily on morbidity and mortality rates	2,6
Lack of presurgical comparison data	2,5,6,7,8,9

*References

1. Didlake et al., 1988
2. Dunn et al., 1990
3. Mai et al., 1990
4. Rodriguez et al., 1990
5. Rogers, 1987
6. Rovelli et al., 1989a
7. Rovelli et al., 1989b
8. Schweizer et al., 1990
9. Siegal et al., 1989

sampling. Three of the studies (Mai et al., 1990; Rodriguez et al., 1991; Rogers, 1987) had a small sample size of fewer than forty patients, and there was no a priori power estimation to determine appropriate sample size.

Design problems were present in the studies also. Six studies (Rodriguez et al., 1991; Rogers, 1987; Rovelli et al., 1989a; Rovelli et al., 1989b; Schweizer et al., 1990; Siegal et al., 1989) used a cross-sectional approach to gather data rather than longitudinal. All of the studies were at the survey or exploratory-descriptive level and did not test interventions designed to increase compliance with the therapeutic regimens, thereby indicating a very early stage in exploration of compliance with medical regimens in posttransplant patients, as seen in table 1. Three of the studies were retrospective (Rovelli et al., 1989a,b; Schweizer et al., 1990), which limits study findings although they also collected some prospective data. Two studies (Dunn et al., 1990; Rovelli et al., 1989a) focused primarily on the impact of compliance on morbidity and mortality rates, thereby using a rather limited approach to the study of compliance, and most studies lacked pretransplant, baseline comparison data, as seen in table 1.

Concerns about the measurement of compliance in transplant studies were also identified. Although all studies except one (Mai et al., 1990) used both objective and subjective measures of compliance, only Mai et al. provided details about the subjective tools used. Most of the tools, except in the study by Mai et al., appeared to be developed by the researchers. Psychometric data were provided for measurement tools in only two studies (Mai et al., 1990; Rogers, 1987).

Statistical techniques were limited in sophistication in the studies of transplant patient compliance with a therapeutic regimen. Rogers (1987) used only descriptive statistics, and the remainder of the studies used univariate statistical techniques as seen in table 1. Four researchers (Rovelli et al., 1989a,b; Schweizer et al., 1990; Siegal et al., 1989) gave p-values for comparisons between groups of patients but did not report the statistical techniques used.

Lastly, the most evident gap in the transplant population is the lack of research on patient compliance with diet and exercise. The study of compliance with diet and exercise is important in transplant patients because of its potential impact on morbidity and mortality, as previously discussed.

Future Study of Patient Compliance

Patient compliance is therefore an important concept to examine in health care because of its relationship to patient achievement of preventive or therapeutic health care goals and to subsequent potential for reduction of morbidity and mortality. Without compliance, the effectiveness of a clinical prescription in preventing or treating illness cannot be determined, and thus the prescription cannot be modified to enhance patient care.

Furthermore, the Health Belief Model has been successfully used as a framework to examine health beliefs and compliance with cardiovascular chronic illness populations. The application of the Health Belief Model to another chronic illness population, solid organ transplant patients (specifically heart transplant patients), has not been reported in the literature. However, given that the model has been successfully used in similar chronic illness populations, its use with transplant patients should be pursued.

This research, therefore, builds on previous research and adds to the body of knowledge about patient compliance with a therapeutic regimen. Specifically, new knowledge is generated about heart transplant patient compliance with diet and exercise. The research is guided by the Health Belief Model, and variables compatible with the model are examined in relation to patient compliance.

Methodological gaps identified in the literature are addressed in the present study. Although a convenience sample is used (because of the small number of heart transplant procedures per year), both male and female patients have been recruited into the study, and data has been collected from two geographically different sites to enhance generalizability. Also, the sample size is large. Given the lack of research about heart transplant patient compliance with diet and exercise, a survey level of design is appropriate before proceeding to an experimental level.

Measurement of variables includes the gathering of objective (physiologic) and subjective (psychosocial) data. Subjective data are gathered prospectively via researcher-developed and established self-report tools. Results of psychometric testing are reported. Statistical techniques are multivariate and thus reduce the risk of spurious results.

CHAPTER III

METHODS

The purpose of this dissertation is to examine patient compliance with diet and exercise 6 months after heart transplant. The following research questions are addressed:

(1) To what extent do patients comply with their diet prescription 6 months after heart transplantation?

(2) To what extent do patients comply with their exercise prescription 6 months after heart transplantation?

(3) How much difficulty do patients have complying with their diet prescription 6 months after heart transplantation and why?

(4) How much difficulty do patients have complying with their exercise prescription 6 months after heart transplantation and why?

(5) What is the relationship between demographic, physiologic, and psychosocial variables and compliance with diet 6 months after heart transplantation?

(6) What is the relationship between demographic, physiologic, and psychosocial variables and compliance with exercise 6 months after heart transplantation?

(7) What are the demographic, physiologic, and psychosocial predictors of compliance with diet 6 months after heart transplantation?

(8) What are the demographic, physiologic, and psychosocial predictors of compliance with exercise 6 months after heart transplantation?

Design

It is appropriate to study these research questions with a correlational design. According to Brink and Wood (1989) the following assumptions are implicit in the use of correlational designs:

> (1) The study variables have not been shown to covary in previous studies of similar populations. (2) A conceptual framework can be proposed to support the possibility of relationships among variables. (3) There is no tested theory upon which to predict the possible relationships among variables. (4) The variables exist in the population and are amenable to study. (5) The sample is representative of the population. (6) Each variable can be measured accurately with a numerical scale. (7) There is no manipulation of variables; they are studied as they exist naturally. (p. 107)

This design was selected because the purpose of the research is to describe relationships among variables. The two multivariate research questions ask whether and to what magnitude the independent variables (demographic, physiologic, and psychosocial) predict the dependent variables (compliance with diet and exercise). There is no control over the independent variables; they are measured as they exist in the sample without manipulation. Likert scales are used to measure the variables for the various instruments.

A major strength of a correlational design is the ability to use multivariate analyses to study the effect of multiple independent variables on one or more dependent variables. Given that the real world is complex and influenced by multiple factors simultaneously, multivariate analyses allow the study of "reality" as it exists. In addition, many of the independent variables under study in the behavioral sciences are often latent variables which are presumed to underlie and be measured by an observed behavior. These latent variables cannot be manipulated, but none-the-less, their influence is thought to occur on a dependent variable. Correlational designs, using multivariate approaches, attempt to identify the impact and magnitude of these variables. In addition, this design can be used to support the further development of theory.

The conceptual framework, the Health Belief Model, is appropriate for the research of compliance using this study design because it proposes relationships among variables and further explicates their relationship with compliance conceptually. As previously described, the Health Belief Model has been successfully used in other chronic cardiovascular illness populations as a framework for research on compliance.

Sites

Two sites were used for data collection: Loyola University Medical Center, Maywood, Illinois and University of Alabama, Birmingham, Alabama. These sites were used because the data being collected for this study of heart transplant patient compliance is from a larger, funded (including NIH, National Center for Nursing Research) study on Quality of Life Before and After Heart Transplantation (Jalowiec, Grady, & White-Williams, 1987). In addition to a midwest site, a southern medical center was selected as an additional site for the larger study in order to increase sample size and diversity.

Sample

The nonrandom sample was selected from the pool of heart transplant patients at the two medical centers who agreed to participate in the larger study of quality of life. Given that the number of patients who undergo heart transplantation each year is limited (approximately 2,500 per year worldwide), random selection was not possible, and it was necessary to enroll all potential heart transplant patients into the study who agreed to participate, were physically able, and met study criteria. There are approximately 30-40 heart transplant procedures performed at each of the two medical centers per year, an acceptable range of procedures indicating active transplant programs.

Eligibility criteria for participation in the quality of life study are: ages 18-70 years, can read and write English, and undergoing orthotopic heart transplantation. Patients who agree to participate must be enrolled in the study before undergoing heart transplantation, as close to the date of being placed on the United Network for Organ Sharing (UNOS) waiting list as possible.

The pool of dissertation study participants included all patients who were enrolled in the larger quality of life study and who survived at least 6 months post-transplant. Six months post-transplant was selected for the study of patient compliance with diet and exercise because, as stated previously, the observation of obesity and hyperlipidemia has not been seen to occur before 6 months after transplant. Thus, whether patients are compliant with their diet and exercise prescriptions or not sooner than 6 months after surgery does not have an impact on obesity and hyperlipidemia because these physiologic problems are not yet evidenced clinically.

The sample of 6 month post heart transplant patients (n=94) for this dissertation had a mean age of 55 years (SD = 8 years) and was primarily male (80%). The majority of the sample was married (85%) and fairly well educated (mean number of years of education = 13.1 ± 3.1 years). Only 14% of the patients were working at 6 months after heart transplantation.

Clinical characteristics of the sample revealed that they had normal heart function after surgery. Eighty-eight percent of the sample were New York Heart Association Class I, 10% were Class II, and only 2% were Class III, indicating that the majority of patients had no or only mild functional limitations after their heart transplant. Also, in the one-third of the sample (n=29) who had radionuclide ventriculography done at 6 months post heart transplant, left ventricular ejection fraction was normal (mean = 52.6% ± 10.0) (normal=45-65%).

Physiologic parameters thought to be highly related to compliance were also measured at 6 months post heart transplant. The variables of ideal body weight, actual weight, the difference between actual and ideal body weight, percent ideal body weight (actual weight divided by ideal body weight), and serum cholesterol and triglyceride levels were examined. For the sample, mean ideal body weight was 70.8±10.7kg, while actual weight was higher (77.1±12.6kg) as expected. The difference between actual and ideal body weight (6.3±11.5kg) was significant ($t=5.37$, $p<0.0001$). When percent ideal body weight was calculated, patients were found to be 110±17% of ideal body weight. Both the difference between actual and ideal body weight and the percent ideal body weight revealed that patients were overweight. Furthermore, percent ideal body weight differed by gender. A trend existed wherein the mean percent ideal body weight was higher for women (n=19) than men (n=75) (117% versus 108%, t=1.86, p=.08). Thus, men did not meet the criteria for obesity (≥110% of ideal body weight). Data for lipids (available from 62/94=66% patients during this time period) indicated that levels were clinically elevated (>200mg/dl). Mean serum cholesterol level was 249±57mg/dl, and mean serum triglyceride level was 222±134mg/dl.

A power analysis was conducted to determine the power of the study to detect significant relationships that actually exist with the sample size available for analysis. An acceptable level of power is 80% (Cohen, 1977). It is necessary to know sample size, significance level, and effect size to calculate power. Level of significance was set at .05. Sample size was 94. Effect size was calculated by doing multiple regression with heart transplant data using compliance with diet and exercise as dependent variables and the sixteen variables being examined within the framework of the Health Belief Model as independent variables. The sixteen independent variables that were used in the multiple regression were two types of stress (self-care and psychological), health perception, two measures of functional disability (physiologic and psychosocial), three types of symptoms (gastrointestinal, neurologic, and dermatologic), two demographic variables (age and gender), two structural variables (number of medications and difficulty regarding compliance with diet or exercise), satisfaction with health/functioning, perception of helpfulness of emotionally supportive interventions by health care providers, and two measures of enabling (satisfaction with social support and coping effectiveness). Using forced entry of the independent variables in separate regression analyses for diet and exercise compliance, the squared multiple correlation coefficients (R^2 or effect size) were determined. Both dietary and exercise compliance had a large (.26 or greater based on Cohen, 1977) R^2 of .50 and .63, respectively.

The sample size, number of independent variables, and effect size at a .05 significance level were then used to calculate power. For multiple regression analysis with dietary compliance as the dependent variable at n=94, sixteen independent variables, and an effect size of .50, power was calculated to be 100%. When a power analysis was conducted with an effect size of .63 from the multiple regression with exercise as the dependent variable, n=94, and sixteen independent variables, the calculated power was 100%. Thus, conduct of this study with a sample size of n=94 patients and sixteen independent variables per dependent variable, at a significance level of .05, has adequate statistical power to detect significant relationships that exist.

Study Variables

The dependent variables are compliance with diet and exercise. The sixteen independent variables which have been examined regarding compliance with diet and exercise include demographic, physiologic, and psychosocial variables. The demographic variables are age and gender. The physiologic variable is number of medications. Psychosocial variables are symptoms, functional disability, stress, coping, difficulty with compliance, satisfaction with social support, life satisfaction, and health care provider interventions.

Instruments

Selected components from many of the instruments used in the larger quality of life study were analyzed for the dissertation. These tools are listed in table 2. Instruments are described within the conceptual framework of the second generation Health Belief Model. Therefore, instruments are subsumed within the following areas: (1) readiness to undertake recommended compliance behavior (2) modifying and enabling factors and (3) compliant behaviors. Subcategories within each area were identified and instruments were placed into those categories.

Preliminary psychometric data has been gathered for all of the tools with sample sizes of 260 patients awaiting heart transplantation at study entry and 155 patients 3 months later, from the larger study on quality of life. Reliability, the degree of consistency or accuracy with which an instrument measures an attribute, and validity, the degree to which an instrument measures what it is supposed to be measuring, are

Table 2

Tools Used in the Study of Quality of Life in Cardiac Transplant Patients, A. Jalowiec, RN, PhD, FAAN and K. Grady, RN, MS

1. Heart Transplant Symptom Checklist: developed by Grady, Jalowiec, & Grusk, 1988

2. Heart Transplant Stressor Scale: developed by Jalowiec, Grady, & Grusk, 1988

3. Heart Transplant Intervention Scale: developed by Grady, Jalowiec, & Grusk, 1988

4. Jalowiec Coping Scale: developed by Jalowiec, 1977, revised 1987

5. Social Support Index: developed by Jalowiec, Grady, & Grusk, 1988

6. Assessment of Problems with Heart Transplant Regimen: developed by Grady, Grusk, & Jalowiec, 1988

7. Work History: developed by Jalowiec, Grady, & Grusk, 1988

8. Rating Question Form: developed by Jalowiec, Grady, & Grusk, 1988

9. Sickness Impact Profile: modified from Bergner et al., 1978

10. Life Satisfaction Index: modified from Quality of Life Index by Ferrans & Powers, 1984

11. Heart Transplant Chart Review Form: developed by Grady, Grusk, & Jalowiec, 1988

12. Study Termination Form: developed by Grady, Jalowiec, & Grusk, 1988

therefore reported for each of the instruments. Reliability was examined using internal consistency and test-retest reliability, while validity testing included the use of criterion-related, predictive, and construct validity. Content validity was supported for all tools based upon the following: the broad literature base and empirical base from which the items were drawn and the large number of items used to tap the conceptual domain of each variable.

Only selected subscales of the tools were used for this dissertation analysis because they provided the best conceptual fit with the Health Belief Model. Also, when effect size was calculated using multiple regression, effect size was greater when subscales were used versus total tools and therefore, greater power of the study to detect significant relationships was achieved.

Readiness to Undertake Recommended Compliance Behavior

Regarding readiness to undertake recommended compliance behavior, the three subcategories are: motivation, value of illness threat reduction, and probability that compliant behavior will reduce the threat.

Motivation

Motivation, which relates to concern about health matters which then influences willingness to pursue positive health activities, was measured by two instruments: the Heart Transplant Stressor Scale and the Rating Question Form.

The Heart Transplant Stressor Scale. The first instrument, the Heart Transplant Stressor Scale: 6-Month Postoperative Assessment (Jalowiec, Grady, & Grusk, 1988), is a 92-item Likert scaled tool designed to measure how stressful the items have been for patients. A 0 = not stressful at all, 1 = slightly stressful, 2 = fairly stressful, 3 = very stressful, and NA = not applicable. The instrument has six subscales which were determined by the investigators: physical, psychological, self-care, family, work/financial, and hospital. Patient ratings are summed, and mean scores are obtained for each item, subscale, and the entire instrument.

Internal consistency reliability for the Heart Transplant Stressor Scale was very good. Cronbach's alpha for the entire scale was .95, and alphas for the subscales were .82, .90, .75, .81, .81, and .91, mean = .83 (well above the .70 standard for a new tool). Forty inter-item correlations >.70 were found. However, forty correlations >.70 only represents 0.7% of the total number of inter-item correlations on this tool, still indicating low multicollinearity.

Test-retest reliability, an indication of the stability of a measure, was done by correlating patient responses on the Heart Transplant Stressor Scale at study entry and 3 months later during the preoperative period. Stability of the tool was determined for the total tool ($r=.73$, $p<0.0001$) and for each subscale with r's ranging from .51-.72, $p<0.0001$.

Validity was also determined for the Heart Transplant Stressor Scale. Criterion-related validity was exhibited by a correlation of $r=.51$, $p<0.0001$ between the total stress score for the Heart Transplant Stressor Scale and a one-item question on how much stress a patient feels he/she has been under, from the Rating Question Form. In addition, total stress correlated with psychosocial functional disability (a composite of social interaction, communication, alertness, and emotional disability from the Sickness Impact Profile, $r=.50$, $p<0.0001$).

The Heart Transplant Stressor Scale also demonstrated predictive validity when correlated with other tools. Total stress correlated with: total functional disability (from the Sickness Impact Profile), $r=.48$, $p<0.0001$; total life satisfaction (from the Life Satisfaction Index), $r=-.53$, $p<0.0001$; and the rating of quality of life (a question on the Rating Question Form), $r=-.41$, $p<0.0001$. Therefore, increased stress is related to greater functional disability, less life satisfaction, and lower quality of life.

Lastly, construct validity, concerned with what an instrument is measuring and whether the instrument is adequately measuring the concept under investigation, was examined using a contrasted groups approach. Preoperative patients were divided into two groups at study entry: those hospitalized versus those at home. Construct validity (analyzed by an independent sample t-test) was partially supported when a trend toward total stress was found to be greater in hospitalized patients versus those patients at home ($t=1.75$, $p=0.084$).

Only two subscales of the stressor tool were used to measure motivation: self-care and psychological. These subscales of the instrument measure the stress of caring for yourself (e.g., trying to keep on a special diet, trying to keep your weight under control, and keeping up an exercise program) and psychological/emotional stress (e.g., mental and emotional changes caused by steroids and making changes in your lifestyle). The Heart Transplant Stressor Scale is appropriate as a measure of motivation because stress can motivate someone to seek and accept medical direction. Furthermore, the self-care and psychological subscales are related to concern about health matters and self-care, specifically as related to intention to comply.

The Rating Question Form. The second instrument which was used to measure motivation is the Rating Question Form: 6 - 12 Month Follow-Up (Jalowiec, Grady, & Grusk, 1988). This tool has seven single item, 10-point rating questions on stress level, coping ability, health perception, quality of life, postoperative prognosis, and satisfaction with transplant. Patient ratings are summed for each question, and mean item scores are then determined.

The Rating Question Form was examined for test-retest reliability. Results related to health perception showed significant correlations between study entry and 3 months later ($r=.62$, $p<0.0001$).

Predictive validity of health perception on the Rating Question Form revealed significant correlations. The quality of life rating correlated significantly with health perception ($r=.66$, $p<0.001$), indicating that feeling good about quality of life is related to good perception about health.

Only one question was used from this form: How good do you feel your health is at the present time? Patients are asked to circle a number from 1 to 10, with 1 meaning that they perceive their health to be very poor and 10 meaning that they perceive their health to be very good. This question is an indication of motivation because it seeks information from the patient about concern with health matters in general.

Value of Illness Threat Reduction

The value of illness threat reduction (e.g., susceptibility, vulnerability to illness, extent of possible bodily harm and interference with social roles, and experience with symptoms) was measured with two tools: the modified Sickness Impact Profile (SIP) and the Heart Transplant Symptom Checklist.

The Sickness Impact Profile. The SIP, developed by Bergner, Bobbitt, Carter, and Gilson (1981), was modified for the larger quality of life study and reduced to 110 items related to functional disability (e.g., problems with activities of daily living). The patient is instructed to place a check mark (to indicate yes) next to the item which describes his current situation. If the item does not describe his current situation, it is left blank (to indicate no). Examples include: I sit most of the day, I cannot walk up or down hills, I eat much less now, I have to eat special types of food, I often worry about my health, I get impatient with myself, and I stay alone much of the time. Bergner et al. have divided these items into two major subscales (physiological and psychosocial). The subscales are further subdivided into twelve subcategories as follows: (1) physiological: items relate to self-care, home management, work, recreation, sleep/rest, eating, ambulation, and mobility, and (2) psychosocial: items relate to social interaction, emotional behavior, alertness, and communication. Each of these items has been weighted for analysis by Bergner et al. to reflect the degree of functional disability. Mean functional disability scores are determined for each item, subscale, subcategory, and totally.

The SIP has been used widely and has extensive psychometric support from the literature, including: (1) homogeneity reliability: shown for the whole tool and for each subscale; (2) 24-hour retest reliability: .90 for the whole scale and ranging from .62-.89 for the subscales (median=.74); (3) concurrent validity: the SIP correlated significantly with self-assessment measures of dysfunction; (4) construct validity: the SIP discriminated between high and low levels of dysfunction; and (5) predictive validity: the SIP correlated significantly with clinicians' assessments of functional status (Bergner et al., 1976, 1981; Kaplan, 1985; Pollard et al., 1976).

Psychometric support for the SIP from the present quality of life study is as follows. Internal consistency reliability, determined from data of preoperative patients at study entry into the larger quality of life study, revealed Cronbach alphas for the total scale of .91, with a range of .42-.95 (mean=.63) for the twelve subscales. Collapse of the subscales into physiological and psychosocial functional disability revealed alphas of .87 and .81, respectively. Multicollinearity was not a problem, in that only seven inter-item correlations >.70 (<1%) were found. Test-retest reliability was supported for this tool by the finding of significant ($p<0.0001$) correlations between preoperative study entry and 3 months later for the total score ($r=.79$), physiologic composite ($r=.76$), psychosocial composite ($r=.68$), and the twelve subscales (range of $r=.38-.82$).

Validity testing for the SIP included concurrent, predictive, and construct. Correlation of the health perception rating question from the Rating Question Form and the total SIP score was -.30, $p<0.0001$, providing evidence for concurrent validity in that as functional disability increases, health perception gets worse. Concurrent validity was also found between the psychosocial SIP and psychological symptoms, from the Heart Transplant Symptom Checklist ($r=.59$, $p<0.0001$) and between the emotional subscale on the SIP and psychological symptoms ($r=.58$, $p<0.0001$).

The SIP also correlated significantly with other tools to demonstrate predictive validity. Total functional disability correlated with total symptoms ($r=.53$, $p<0.0001$) from the Heart Transplant Symptom Checklist; total stress ($r=.48$, $p<0.0001$) from the Heart Transplant Stressor Scale; and total helpfulness of interventions ($r=.21$, $p<0.0001$) from the Heart Transplant Intervention Scale. This revealed that more functional disability is related to being more bothered by symptoms, greater stress, and increased helpfulness of health care provider interventions. Negative correlations were found between total functional disability and the following ratings from the Rating Question Form: coping ability ($r=-.21$, $p=0.001$), quality of life ($r=-.33$, $p<0.0001$), and health perception ($r=-.30$, $p<0.0001$), indicating that as functional disability increases, coping ability, quality of life, and health perception become worse.

Construct validity was examined via analysis of variance (ANOVA) for preoperative patients at study entry on the SIP. Using a contrasted groups approach, significant differences between groups were found wherein patients who were unemployed had more functional disability than patients who were employed ($F=2.27$, $p<0.0001$). In addition, patients who were hospitalized, those who were classified as status 1 (more urgent) on the transplant waiting list, and those who were NYHA Class IV had more functional disability than patients who were at home, status 2 on the transplant waiting list, and NYHA Class I-III ($F=2.89$, $p<0.0001$).

For this dissertation study, the subscale scores for physiological and psychosocial functional ability were used to operationalize the value of illness threat reduction. These subscale scores provide measures of the extent of possible bodily harm (reduced physiologic function) and interference with social roles (reduced psychosocial function) which may predict noncompliance.

<u>The Heart Transplant Symptom Checklist</u>. The Heart Transplant Symptom Checklist (Grady, Jalowiec, & Grusk, 1988) is the second tool which was used to operationalize the value of illness threat reduction. Patients rate how bothered they are by each of eighty-nine symptoms on a Likert scale of 0 to 3. Zero = not bothered at all, 1 = slightly bothered, 2 = moderately bothered, 3 = very bothered, and NA = not applicable, meaning a patient does not have the symptom. The instrument has six subscales: cardiopulmonary, gastrointestinal, genitourinary, neuromuscular, dermatologic, and psychological/emotional. Patient scores are summed, and means are determined for each item, subscale, and totally.

Reliability of the Heart Transplant Symptom Checklist was tested using internal consistency reliability and test-retest reliability. Cronbach alpha reliability for the total scale at study entry was .94, with subscale alphas of .82, .78, .46, .87, .68, and .91 (mean=.75). Alphas met the accepted standard of >.70 for homogeneity reliability on a new scale for four of the six subscales. The low alpha on the genitourinary subscale (.46) may have been due to the small number of items (7) on that subscale. The alpha on the genitourinary subscale did not increase appreciably when any one of the items was deleted. Examination of the inter-item correlation matrix revealed only five correlations >.70 (<1%) among items, indicating little problem with multicollinearity.

Test-retest reliability was examined for the total score and subscales on the Heart Transplant Symptom Checklist at study entry into the larger study on quality of life and 3 months later. Correlation of the total score at study entry and 3 months later was significant ($r=.77$, $p=0.0001$). All of the subscales were also significantly correlated with themselves at study entry and 3 months later with r's ranging from .54-.75, $p<0.0001$, indicating stability of the tool.

Criterion-related, predictive, and construct validity of the Heart Transplant Symptom Checklist were also examined at study entry. Total symptoms and cardiopulmonary symptoms were correlated with four objective measures of heart function, specifically left ventricular ejection fraction (LVEF) (derived from radionuclide ventriculography) (r=-.06, p=.44 and r=-.06, p=.41), New York Heart Association functional classification (r=.10, p=.20 and r=.04, p=.58), urgency status on the transplant waiting list (r=-.07, p=.33 and r=.04,p=.59), and whether a patient was in the hospital or at home (r=-.14, p=.07 and r=-.03, p=.73), respectively. No significant correlations were found between total symptoms or cardiopulmonary symptoms and the objective measures of heart function. These findings are not unexpected as objective measures do not always correlate with subjective perceptions of health. However, when the subscale of psychological / emotional on the Heart Transplant Symptom Checklist and the subcategory of emotional on the SIP were examined, significant correlations emerged: r=.60, p<0.0001, thereby supporting criterion validity of this subscale.

Predictive validity testing revealed more interesting findings. The total symptom score from the Heart Transplant Symptom Checklist correlated significantly with the following: functional disability (from the Sickness Impact Profile), r=.52, p<0.0001; total stress (from the Heart Transplant Stressor Scale), r=.53, p<0.0001; and total life satisfaction (from the Life Satisfaction Index), r=-.44, p<0.0001. These findings suggest that being more bothered by symptoms is related to greater functional disability, increased stress, and decreased life satisfaction.

Construct validity was examined by dividing patients into two groups, working versus not working. Total symptom and cardiopulmonary symptom scores were compared between the two groups using an independent t-test. Patients who were not working had more total symptoms ($t=3.30$, $p=0.002$) and more cardiopulmonary symptoms ($t=3.10$, $p=0.003$) than patients who were working. This finding between symptoms and working is anticipated and logical. Also, when comparisons were made between patients who were hospitalized or waiting at home, a trend was found wherein hospitalized patients had more total symptoms ($p=0.084$) than patients at home.

The Heart Transplant Symptom Checklist was used to measure the recent experience with symptoms, as part of the value of illness threat reduction. Rather than using the total scale score, the following subscales were employed: gastrointestinal, neuromuscular, and dermatologic. These subscales were selected because of their potential independent impact on compliance with diet and exercise. For example, neuromuscular weakness and dermatologic symptoms due to immunosuppressive medications may interfere with compliance in an exercise program. Gastrointestinal symptoms due to immunosuppressive medications may also affect a patient's compliance with a dietary protocol.

Probability that Compliant Behavior Will Reduce the Threat

The subcategory of readiness to undertake recommended compliance behavior (probability that compliant behavior will reduce the threat) was not operationalized in this study. No instruments are being used in the larger study of quality of life (within which this study was done) that adequately measure this concept, as related to subjective estimates of regimen safety and efficacy. Additionally, it is not necessary or always practical/feasible to measure all subcategories within the Health Belief Model in order to test its usefulness regarding compliance.

Modifying and Enabling Factors

The subcategories of the second generation Health Belief Model under modifying and enabling factors include: demographic, structural, attitudes, interaction, and enabling factors. Each of these subcategories was measured regarding the investigation of compliance with diet and exercise.

Demographic Variables

Although demographic variables have not been strongly associated with compliance in other studies, two variables were examined in this study: age and gender. These variables are taken from the Heart Transplant Chart Review Form (Grady, Jalowiec, & Grusk, 1988) which is a comprehensive chart review of demographics, illness history, medications, complications, laboratory and other physical tests, and donor data. Being younger or older may be associated with better compliance. Also, one cannot assume that compliance by one gender necessarily indicates the same level of compliance by the opposite gender. Therefore, these variables were examined as possible predictors of compliance with diet and exercise.

Structural Variables

Two variables were examined as structural factors related to compliant behaviors: number of medications being taken and difficulty with compliance. The number of medications a patient takes was derived from the Heart Transplant Chart Review Form (described under demographic). The number of medications was summed for each patient. As a structural factor, the number of medications is an indication of the complexity of the overall posttransplant regimen, which may have an impact on compliance with diet and exercise.

Assessment of Problems with Heart Transplant Regimen. The second structural variable which was examined is difficulty with compliance. This variable was measured in the instrument: Assessment of Problems with Heart Transplant Regimen (Grady, Grusk, & Jalowiec, 1988). The instrument has thirteen items measured in two parts: Part A measures how much difficulty a patient has following his/her post-transplant health care regimen on a 4-point scale. Patients are instructed to check one of the following answers: no difficulty, a little difficulty, moderate difficulty, or a lot of difficulty. Part B measures actual compliance with the same items as in Part A, also on a 4-point scale. Patients check whether they are compliant all of the time, most of the time, some of the time, or hardly ever. The items cover: immunosuppressants, other medications, diet, exercise, smoking cessation, taking vital signs, calling the MD/RN with problems, clinic check-ups, and getting tests and labs done. Scores are calculated by summing patient responses and determining the mean for each item and for the subscales of difficulty and compliance.

Reliability and validity were tested for this tool with a posttransplant patient sample (n=85). Cronbach alphas for the tool were .48 for difficulty and .50 for compliance, which do not meet the minimum standard for a new tool. Perhaps a larger sample size and greater variance would improve the internal consistency reliability. Lower alphas may be influenced by the fact that multiple aspects of compliance are measured by this tool and also that compliance has been found to vary depending on which aspect has to be complied with (e.g., medications, diet, or exercise). Multicollinearity was also examined and only five inter-item correlations were >.70, a rate of only 1.4%.

Test-retest reliability was supported for this tool with significant ($p<0.01$) correlations between 2 weeks and 3 months posttransplant: difficulty $r=.30$ and compliance $r=.48$.

Predictive validity testing revealed that more difficulty with compliance with the transplant regimen correlated with more effective coping (from the Jalowiec Coping Scale) ($r=.27$, $p=0.05$). Therefore, as coping effectiveness improved, patients experienced more difficulty with compliance.

As a measure of structural factors which impact on compliance with diet and exercise, only the two specific items from Part A of the instrument that relate to difficulty with dietary and exercise compliance were used. As a structural variable, difficulty is related to the complexity of the regimen and the need for new patterns of behavior, which may be difficult to achieve.

Attitudes

The Life Satisfaction Index. Attitudes were operationalized with the Life Satisfaction Index, modified from the Quality of Life Index (QLI) by Ferrans and Powers (1984). The Life Satisfaction Index has thirty items which measure satisfaction with different areas of life on a 6-point scale from 1 (very satisfied) to 6 (very dissatisfied). There are four subscales for this instrument: health/functioning, socioeconomic, psychological, and significant others. Scores are summed for each item, and mean scores are determined for each item, subscale, and the total tool.

The following psychometric support for the Quality of Life Index comes from the literature and is based on findings from several studies on cardiovascular, cancer, dialysis patients, and graduate students: (1) criterion validity: correlations ranged from .65-.80 (mean=.75) between the QLI and a one-item rating assessing life satisfaction; (2) retest reliability: .87 correlation with a 2-week retest and .81 with a 1-month retest; (3) homogeneity reliability: Cronbach alphas ranged from .86-.97 for the total scale (mean=.93); .83-.94 for health (mean=.89); .66-.88 for socioeconomic (mean=.81); .33-.81 for significant others (mean=.65); and .82-.94 for psychological (mean=.90); (4) construct validity with the contrasted groups approach: patients with less pain, less depression, better coping, and better health had higher QLI scores; (5) construct validity with factor analysis: the four-factor structure generally matched conceptualizations from the literature about quality of life dimensions (Ferrans, 1990; Ferrans & Powers, 1985, 1992).

Reliability and validity of the Life Satisfaction Index were also examined with our larger quality of life study data. Internal consistency reliability testing revealed a Cronbach alpha for the entire instrument of .92 and subscale alphas of .88, .75, .80, and .69 (mean=.78). Only six inter-item correlations were >.70 (1.4%), indicating no problem with multicollinearity.

Test-retest reliability was supported for the Life Satisfaction Index by significant ($p<0.0001$) correlations of results between study entry and 3 months later: total life satisfaction $r=.77$, health/functioning $r=.72$, socioeconomic $r=.68$, psychological $r=.71$, and significant others $r=.66$.

Validity of the Life Satisfaction Index was also examined. Criterion-related validity was demonstrated through a correlation of .59, $p<0.0001$ between total life satisfaction and the overall quality of life rating from the Rating Question Form, indicating that these concepts overlap but are not exactly the same. Predictive validity was also examined, and significant correlations were found between higher life satisfaction and: less symptom distress (from the Heart Transplant Symptom Checklist), $r=-.44$, $p<0.0001$; less functional disability (from the SIP), $r=-.46$, $p<0.0001$; and less stress (from the Heart Transplant Stressor Scale), $r=-.52$, $p<0.0001$. In addition, increased life satisfaction was associated with the following variables from the Rating Question Form: less stress, $r=-.34$, $p<0.0001$; more coping ability, $r=.29$, $p<0.0001$; a good perception of health, $r=.47$, $p<0.0001$; and a perception of a good post-transplant prognosis, $r=.32$, $p<0.0001$. Life satisfaction was negatively correlated with the use of fatalistic ($r=-.31$, $p<0.0001$), evasive ($r=-.24$, $p<0.0001$), and emotive ($r=-.46$, $p<0.0001$) coping, so that more life satisfaction was associated with less use of these counterproductive coping styles.

Only the health/functioning subscale was used as a measure of attitudes related to health, health care providers, actual care, and facilities. An example of an item on the instrument which is part of this subscale includes: the health care you are receiving.

Interaction

The Heart Transplant Intervention Scale. The instrument which was used to measure patient and health care provider interaction as a modifying variable related to compliance with diet and exercise was the Heart Transplant Intervention Scale (Grady, Jalowiec, & Grusk, 1988). This 63-item instrument rates how helpful various interventions of the transplant team are, on a 0-3 scale, wherein 0 = not helpful at all, 1 = slightly helpful, 2 = fairly helpful, 3 = very helpful, and NA = not applicable, which means that a patient did not have that intervention. There are six subscales: self-care teaching, information provision, hospital-related, family-related, work/financial, and emotional/supportive, based on a grouping of the types of interventions provided by health care workers. Scores are obtained by summing patient ratings and calculating the mean for each item, subscale, and the total tool.

Reliability of the Heart Transplant Intervention Scale revealed internal consistency reliability of .96 for the total scale and the following alphas for the subscales: .93, .86, .94, .69, .63, and .84 (mean=.82). Although one hundred inter-item correlations were >.70, it represents only 1.3% of the total number of inter-item correlations. An examination of the items with correlations >.70 revealed that they related primarily to the hospital and least to the emotional/supportive subscales. Test-retest reliability between study entry and 3 months later was significant ($p<0.0001$) for the Heart Transplant Intervention Scale as follows: total r=.52, self-care teaching r=.54, information provision r=.50, hospital r=.19, family r=.46, work/school/financial r=.56, and emotional/supportive r=.44.

Predictive and construct validity were tested for the Heart Transplant Intervention Scale. Significant correlations were found between higher total stress (from the Heart Transplant Stressor Scale) and more helpfulness of hospital-related interventions (r=.30, $P<0.0001$) and more helpfulness of emotional interventions (r=.15, $p<0.0001$). Also, more effective coping (from the Jalowiec Coping Scale) was correlated with greater helpfulness of interventions (r=.19, p=0.009). More symptom distress (from the Heart Transplant Symptom Checklist) was correlated with greater helpfulness of family interventions (r=.19, p=0.008).

Lastly, a relationship was noted between more functional disability (from the SIP) and greater helpfulness of the following interventions: total (r=.21, p=0.003), hospital (r=.34, $p<0.0001$), family (r=.20, p=0.004), and emotional (r=.23, p=0.001). Interestingly, the composite of physical disability (from the SIP) related more strongly to helpfulness of hospital interventions (r=.40, $p<0.0001$), while the composite of psychosocial disability (from the SIP) did not relate significantly to helpfulness of emotional/supportive interventions (r=.13, p=0.08) or family interventions (r=.14, p=0.06), although there was a trend for both.

Construct validity, using a contrasted groups approach, showed that patients who worked found health care provider interventions to be more helpful than patients who did not work (F=6.92, p=0.009).

The emotional/supportive subscale was the only portion of the Heart Transplant Intervention Subscale which was used in the dissertation to operationalize the interaction factor related to compliance with diet and exercise. Examples of items in this subscale which indicate its usefulness include: receiving emotional support from members of the transplant team, having a chance to ask questions, and receiving support from your primary nurse. Interaction, for the purposes of this study included relationships with other health care providers, such as nurses and social workers. This subscale, therefore, is appropriate to use because it includes items related to health care continuity, relationships, and expectations.

Enabling

Finally, enabling factors from the Health Belief Model were measured with the Social Support Index (Jalowiec, Grady, & Grusk, 1988) and the Jalowiec Coping Scale, JCS, (Jalowiec, 1987).

The Social Support Index. The Social Support Index measures the size and type of social support network and satisfaction with the support provided for fifteen illness-related tasks plus single item questions regarding the relationship with spouse/family and the extent of participation in social activities, church, and the transplant support group. Satisfaction was measured on a 4-point scale, wherein patients were asked to check if they were very satisfied, somewhat satisfied, somewhat dissatisfied, or very dissatisfied with the support they received for each task. Satisfaction with support has two subscales: satisfaction with tangible support and satisfaction with emotional support. A frequency distribution can be determined for each member of the support network for each of the fifteen items, and the level of satisfaction of social support can be determined by summing the responses and calculating the mean response for the sample for each item, the two subscales, and the fifteen questions overall.

The Social Support Index was also tested psychometrically. Internal consistency reliability for satisfaction with social support was as follows: Cronbach alpha for the total scale=.84 and for the subscales of satisfaction with tangible support=.78 and satisfaction with emotional support=.69. Test-retest reliability for the Social Support Index was demonstrated with significant ($p<0.0001$) correlations between study entry and three months later for total satisfaction r=.54, satisfaction with tangible support r=.54, and satisfaction with emotional support r=.47.

Preliminary assessment for concurrent validity was found through correlation of the number of support persons and use of supportant coping ($r=.33$, $p<0.0001$); e.g., an increased number of support persons was related to increased supportant coping.

Overall satisfaction with social support was used as a measure of an enabling factor. Satisfaction with support from a patient's support network can be assistive as a factor related to compliance with diet and exercise.

The Jalowiec Coping Scale. The second instrument which was used to measure enabling as a factor associated with compliance was the Jalowiec Coping Scale (Jalowiec, 1988). The JCS measures the use and effectiveness of sixty coping strategies on a 0-3 scale. Regarding use, 0 = never used, 1 = seldom used, 2 = sometimes used, and 3 = often used. For effectiveness of the coping method used, 0 = not helpful, 1 = slightly helpful, 2 = fairly helpful, and 3 = very helpful. The JCS has eight subscales: confrontive, evasive, optimistic, fatalistic, emotive, palliative, supportant, and self-reliant. Scoring is done by summing the responses for each item, for each subscale by effectiveness and use, and for effectiveness and use overall and obtaining a mean.

The Jalowiec Coping Scale is widely used in research both nationally and internationally and has ample psychometric support. Jalowiec (1991) summarized psychometrics from twelve studies. Homogeneity reliability results from the twelve studies are: Cronbach alphas ranged from .64-.97 for total use (mean=.86), and from .84-.96 for total effectiveness (mean=.90). Mean subscale alphas ranged from .48-.80 for use and from .47-.80 for effectiveness. Early retest reliability results from our larger quality of life study using 3, 6, 9, and 12 month preoperative and postoperative retest intervals were: all retest correlations for use subscales were highly significant for all scales for all time periods except for the 9 and 12 month postoperative intervals for emotive, palliative, and supportant scales. All retest correlations for effectiveness subscales were highly significant for all time periods except for the 12 month postoperative interval for the evasive and supportant scales.

Examples of earlier validity support from the larger quality of life study (n=175) based on highly significant correlations include: patients who used less desirable ways of coping (evasive, emotive, and fatalistic) had more stress, rated their coping ability more poorly, had more psychological symptoms, rated their health more poorly, were less satisfied with their life, and rated their overall quality of life lower.

An empirical construct validity study (versus statistical construct validity study with factor analysis) was done on the JCS to determine extent of agreement between the author's classification of the sixty items into eight subscales (based on common conceptual themes) and the classification done independently by a panel of twenty-five nurse researchers familiar with the stress and coping literature (based on definitions provided in each coping category) (Jalowiec, 1991). Results showed that the mean percent agreement between the author and the panel was highest for classifying the supportant items (94%), confrontive items (86%), and evasive items (85%). The lowest percents of agreement were found on the fatalistic items (67%), self-reliant items (66%), and emotive items (54%). Further validation of the subscale composition of the JCS awaits factor analysis, for which a sample of at least 600 subjects will be needed for this 60-item tool.

Additional psychometric support for the JCS from the larger quality of life study is as follows. Internal consistency reliability results for the sample of heart transplant candidates is: Cronbach's alpha for the total scale=.88, for total use=.94 with a subscale range of .46-.82, (mean=.67), and for total effectiveness=.93 with a subscale range of .44-.79 (mean=.63). Four of the eight use subscale alphas and six of the eight effectiveness subscale alphas are below .70. The correlation matrix was examined for multicollinearity and only ten inter-item correlations (<1%) were >.70, indicating that this is not a problem.

Test-retest reliability was also conducted on the JCS by correlating results at study entry and 3 months later. All correlations were significant at p<0.002, thereby supporting stability of the tool. Correlations found between time periods were: total coping r=.69, total use r=.72, total effectiveness r=.65, coping use subscales range of r's=.53-.69, and coping effectiveness subscales range of r's=.27-.65.

Concurrent and predictive validity testing were also completed for the JCS. The use of supportant coping correlated with the number of people in the social support network (r=.33, p<0.0001). The coping ability rating from the Rating Question Form correlated negatively with two of the subscales: use of emotive coping (r=-.33, p<0.0001) and use of fatalistic coping (r=-.21, p=0.001), indicating that patients who used more emotive and fatalistic coping were coping more poorly.

Predictive validity revealed the following: more stress (from the Heart Transplant Stressor Scale) correlated with greater use of evasive coping (r=.39, p<0.0001), fatalistic coping (r=.41, p<0.0001), emotive coping (r=.45, p<0.0001), and palliative coping (r=.21, p=0.001). Also, a patient's use of emotive coping correlated significantly with a higher stress rating (r=.35, p<0.0001) from the Rating Question Form. Use of fatalistic coping correlated with ratings (from the Rating Question Form) of quality of life (r=-.25, p<0.0001), stress (r=.23, p<0.0001), and perception of health (r=-.18, p=0.005), indicating that more use of fatalistic coping was related to poorer quality of life, more stress, and a perception of a poorer state of health.

More life satisfaction, from the Life Satisfaction Index, correlated significantly with less use of evasive coping ($r=-.28$, $p<0.0001$), fatalistic coping ($r=-.40$, $p<0.0001$), and emotive coping ($r=-.43$, $p<0.0001$). Effectiveness of coping also correlated with helpfulness of emotional interventions (from the Heart Transplant Intervention Scale), $r=.20$, $p=0.005$, so that effective coping was related to perceiving greater helpfulness of emotional interventions from health care providers.

Overall coping effectiveness on the JCS was used as the second measure of enabling as a factor which impacts on compliance with diet and exercise. Effectiveness of coping is a measure of prior experience with action, e.g., the posttransplant regimen. Effectiveness of a patient's previous coping is thus an enabling factor as related to the current illness and treatment regimen.

Thus, a variety of correlates of compliance with diet and exercise after heart transplantation were examined to identify their strength of association with actual compliance.

Compliant Behaviors

The compliant behaviors which were measured, guided by the second generation Health Belief Model, were compliance with diet and exercise, as parts of the post heart transplant regimen. The tool, Assessment of Problems with the Heart Transplant Regimen, Part B (Grady, Grusk, & Jalowiec, 1988), was used to measure actual compliance. Compliance was measured on a 4-point scale (all of the time, most of the time, some of the time, or hardly ever). Only the questions: How much of the time during the last 3 months did you follow your diet as prescribed? and How much of the time during the last 3 months did you follow a scheduled exercise program? were used to measure compliance with diet and exercise. The other parts of the instrument and psychometric data have previously been discussed.

Additionally, in order to triangulate subjective dietary and exercise compliance data with objective physiologic measures, the variables of ideal body weight, actual body weight, the difference between actual and ideal body weight, and percent ideal body weight were calculated for each patient at 6 months after heart transplantation. Also, 6 month posttransplant serum lipid levels (cholesterol and triglycerides) were used as objective measures of compliance with diet and exercise. Patients who are not compliant with diet and exercise may be overweight and have elevated serum lipid levels.

Thus, measurement of independent variables which may influence compliance was via self-report and chart review. Measurement of compliance was via self-report but was also triangulated with the objective physiologic measures of body weight and serum lipid levels from chart review. These relationships were examined within the framework of the second generation Health Belief Model.

Procedure

The booklet is a self-administered questionnaire, consisting of ten separate instruments, as listed in table 2. Placement of each instrument in the booklet was randomly varied for each phase of data collection in the larger study in order to decrease fatigue effect and sensitization response bias.

Patients were approached in the hospital or clinic by the co-principal investigator, a co-investigator, or a trained research assistant. They were invited to participate in the larger study of quality of life as soon as possible after they were placed on the waiting list for heart transplantation. The study was explained, and patients were asked to sign a consent form if they agreed to participate in the study.

Patients were given their first booklet of instruments to complete for the study at the time they consented to participate. They were told to complete the first booklet within the time frame of the immediate past (e.g., the last 2-3 weeks). Subsequent booklets were completed with recall for the previous 3 months. Patients were told that they could complete the booklet of instruments in one sitting or over a few days. Patients indicated whether they completed the booklet in the hospital or at home and the date of completion. The booklets were returned to the researchers via mail in a stamped, self-addressed envelope. The booklets were reviewed by trained research assistants for missing data. Patients were telephoned if there were questions about booklet completion. Patients who did not return their booklets within the designated time frame (2 weeks after it was mailed) were also telephoned and reminded that the booklet needed to be returned as soon as possible. The booklet of instruments which was used for the current study of patient compliance with diet and exercise was the booklet which was completed 6 months after heart transplantation.

Data for the Heart Transplant Chart Review Form and Study Termination Form were gathered from hospital and clinic charts, and occasionally from patient flow charts (located in the Heart Transplant Program office) when this information could not be found elsewhere. All data were coded and entered into a computer software program (Word Star) and analyzed using SPSS/PC+.

Study Limitations

Limitations of this study of patient compliance after heart transplantation include a lack of randomization of the study sample. Random sampling is ideal; it is the best way to generalize research findings beyond the sample. However, the realities of clinical research often prohibit its use. As previously explained, a convenience sample was used due to the limited population of patients at the two medical centers and the need for an adequate sample size. Sample size was limited in this study not only by the small population from which to draw subjects, but also by attrition through patient withdrawal, morbidity, or mortality.

Also, correlational designs are at the survey versus experimental level. Therefore, there is no control over the independent variables in this correlational design. Thus, no manipulation of variables is possible. However, one must acknowledge the need for lower level research of compliance in this population before proceeding with higher level research (e.g., prescription to enhance compliant behaviors).

Another limitation of this dissertation is that the data are cross-sectional versus longitudinal. Such data only provide information at one point in time. Given that compliance is a concept which is temporal and may change over time, the dissertation data are limited.

This study used a mailed questionnaire. The potential for lack of response or inadequate response was high. However, systematic follow-up regarding booklet completion and return was done in order to ensure an adequate rate and accuracy of responses. Therefore, the larger study of quality of life has a 95% booklet completion rate.

Lastly, an important concern is psychometric testing of tools. Data for evaluation of reliability and validity of the tools in this study were preliminary. Additional psychometric testing needs to be performed for these tools in order to strengthen some of the preliminary results found so far.

Ethical Considerations

Attempts were made to protect the rights of subjects who participated in this study. As mentioned previously, informed consent was obtained from patients before they entered this study. Patients who were approached about the study had the right to refuse participation without biasing their care. Patients who participated had the right to withdraw at any time, also without adversely affecting their care. Patients were informed that the data gathered through self-report and chart review were confidential (e.g., patients were identified only by a study number), but not anonymous. Anonymity was not provided in that it was necessary to monitor booklet completion rates and call patients for inadequately completed booklets, as already mentioned. In addition, the larger study of quality of life required identification of patients for long term follow-up.

Risks and benefits were explained to subjects at the time they were approached for consent. The only risk was fatigue from the length of time it takes to complete the booklets. Patients were informed that if they felt any of the questions were too personal, they did not have to answer them. It was suggested to patients that they complete the booklets over several days if fatigue was a problem for them. Also, one of the research assistants was available to read the questions in the booklet to hospitalized patients if necessary.

There were no direct benefits to patients, except knowing that they were participating in a study which would improve patient care in the future, based on study results. Secondarily, patients could derive benefits from filling out the booklets in that the instruments may be a catharsis for patients who want to express how they feel about their situation at that time, and who can, via the booklets, do so in writing. Also, booklet completion may stimulate questions (that patients may not have otherwise considered) to be asked of Heart Transplant Team members at hospital or clinic visits.

CHAPTER IV

RESULTS

Statistics

The following statistics were used for the study of heart transplant patient compliance with diet and exercise: (1) descriptive statistics (frequencies and measures of central tendency), (2) Pearson correlations, and (3) multiple regression. Level of significance was set at 0.05.

Frequencies were used to describe actual compliance with diet and exercise (e.g., all of the time, most of the time, some of the time, and hardly ever) and level of difficulty regarding compliance with diet and exercise (e.g., no difficulty, a little difficulty, moderate difficulty, and a lot of difficulty). Open-ended responses regarding why patients had difficulty complying with diet and exercise were also tabulated, coded according to predominant themes by level of difficulty, and frequencies were shown in rank order. In addition, mean ideal and actual body weight, the difference between actual and ideal body weight, percent of ideal body weight, and serum lipid levels (cholesterol and triglyceride) were calculated.

Correlations were performed between all of the independent variables (age, gender, number of medications, symptoms, functional disability, stress, coping, difficulty with compliance, satisfaction with social support, life satisfaction, and health care provider interventions) and each of the dependent variables, dietary and exercise compliance. In addition, in order to triangulate compliance with physiologic measures, the following variables were correlated with both dietary and exercise compliance: ideal and actual body weight, the difference between actual and ideal body weight, percent ideal body weight, and cholesterol and triglyceride levels.

Lastly, separate stepwise and forced entry multiple regressions were performed using dietary and exercise compliance as dependent variables and the independent variables identified above, which were based on the Health Belief Model. In addition, stepwise multiple regression was also performed on the physiologic measures of percent ideal body weight and serum lipid levels in order to triangulate results with dietary and exercise compliance regression. Stepwise regression was used in order to allow successive entry of independent variables having the greatest correlations with the dependent variable. Also, forced entry was performed (only for compliance with diet and exercise as dependent variables) to determine what additional variance could be accounted for when all of the independent variables examined within the Health Belief Model were forced into the regression equation. Residuals were examined for normality, linearity, and homogeneity of variance. Independent variables were examined for multicollinearity via tolerances and variance inflation factors (VIFs). Outliers were identified by Mahalanobis' Distance and their influence was determined via Cook's Distance.

There was very little missing data for this analysis. All demographic and patient response data on tools were complete. Some of the chart review data (left ventricular ejection fraction, serum cholesterol and triglycerides) were missing because these tests were not done for some patients at 6 months post transplant. Frequency and correlational data for these variables were reported with the sample sizes available. These incomplete data were not used in any of the regression analyses.

Description of Compliance and Difficulty with Compliance

Regarding actual compliance and level of difficulty in complying with diet and exercise, interesting results were obtained.

Actual Compliance

Patient responses about compliance with diet at 6 months after heart transplantation (which pertained to their compliance for the previous 3 months) revealed that 22 patients (23.4%) complied all of the time, 59 (62.8%) complied most of the time, and 13 (13.8%) complied some of the time (see Table 3). The mean level of compliance with diet was 1.9±.61, which corresponded to the response of "most of the time" (range=1 [most compliance] to 4 [least compliance]).

Table 3

Frequency of Compliance with Dietary and Exercise Prescriptions

Extent of Compliance	#/(%) Patient Compliance with Diet		#/(%) Patient Compliance with Exercise	
All of the time	22	(23.4%)	24	(25.5%)
Most of the time	59	(62.8%)	45	(47.9%)
Some of the time	13	(13.8%)	20	(21.3%)
Hardly ever	0	(0.0%)	5	(5.3%)

For response to the question about actual compliance with a scheduled exercise program at 6 months after transplantation, 24 patients (25.5%) complied all of the time, 45 (47.9%) complied most of the time, 20 (21.3%) complied some of the time, and 5 (5.3%) complied hardly ever (see table 3). Mean level of compliance with a scheduled exercise program was 2.1±.62, corresponding to the response of "most of the time" (range=1 [most compliance] to 4 [least compliance]). Therefore, patients complied somewhat less with exercise than with diet at 6 months postoperatively. Although the difference between dietary and exercise compliance was not statistically significant, a trend toward less actual exercise compliance existed (mean=1.9 vs 2.1, p=.075).

Difficulty with Compliance

When patients were asked 6 months postoperatively about how much difficulty they had following their diet in the previous 3 months, 45 patients (47.9%) had no difficulty, 25 (26.6%) had a little difficulty, 17 (18.1%) had moderate difficulty, and 6 (6.4%) had a lot of difficulty (see table 4). The mean level of difficulty with compliance following a diet was $1.8 \pm .97$, reflecting roughly having "a little difficulty" with following a diet (range=1 [least difficulty] to 4 [most difficulty]).

Table 4

Frequency by Level of Difficulty with Dietary and Exercise Compliance

Level of Difficulty with Compliance	#/(%) Patients Having Difficulty with Dietary Compliance	#/(%) Patients Having Difficulty with Exercise Compliance
No difficulty	45 (47.9%)	45 (47.8%)
A little difficulty	25 (26.6%)	21 (22.3%)
Moderate difficulty	17 (18.1%)	19 (20.2%)
A lot of difficulty	6 (6.4%)	9 (9.6%)

Regarding patient level of difficulty in the previous 3 months with following a scheduled exercise program, 45 patients (47.9%) had no difficulty, 21 (22.3%) had a little difficulty, 19 (20.2%) had moderate difficulty, and 9 (9.6%) had a lot of difficulty (see table 4). Mean level of difficulty was 1.9±1.0, reflecting having "a little difficulty" with following a scheduled exercise program (range=1 [least difficulty] to 4 [most difficulty]). There was no significant difference between difficulty with following a diet versus an exercise program (mean=1.8 vs. 1.9, p=.36) at 6 months after heart transplantation.

<u>Reasons for Difficulty with Dietary and Exercise Compliance</u>

Patients were asked to state why they had difficulty following their diet and exercise programs. The reasons for having difficulty with diet and exercise were collated thematically into three categories (physical, psychological, and environmental) and then rank ordered by frequency of response and level of difficulty. The two most frequent reasons for having a little difficulty following a diet were: (1) being away from home, eating out, or finding it hard to select foods according to the diet (which are all similar problems related to food selection) and (2) increased appetite/hungry (see appendix 2). Those patients who had moderate difficulty following their diet cited increased appetite and/or hunger as their primary reason. Their second reason for having moderate difficulty complying with a diet was missing foods eaten previously. Increased appetite/hunger was also the first reason for having a lot of difficulty following a diet. The rest of the reasons represented responses cited only once by patients: getting used to the diet, craving certain foods, tired of fish and chicken, and love to eat sweets.

Patients who had a little difficulty following an exercise program stated the following reasons most frequently in rank order: (1) having no time/being too busy, and (2) being lazy and the weather (tied for second place) (see appendix 3). The reasons given by patients who had a moderate level of difficulty complying included (1) being tired/having no energy, and (2) the weather. Lastly, all reasons from patients who had a lot of difficulty following an exercise program were cited only once follows: fatigue, weather, being lazy, compression fracture of the back, pneumonia, leg weakness, haven't felt good (secondary to radiation), good health decreasing, and hernia repair.

When the most frequently occurring reasons for having difficulty complying with a diet and exercise program were examined by category (physical, psychological, or environmental), the following results emerged. The primary reason for having a little difficulty following a diet was environmental (away from home, eating out, hard to find food to go with the diet). At the moderate and higher level of difficulty, the primary reason was physical (e.g., increased appetite/hunger).

Regarding reasons for having difficulty following an exercise program, when patients had a little difficulty, the most frequent reason given was psychological (e.g., no time, too busy). Patients with a moderate level of difficulty following an exercise program stated that being tired, having no energy (a physical problem) was their primary reason. When patients described having a lot of difficulty following an exercise program, the reasons cited were primarily physical (e.g., fatigue, back problems, and declining health), although no one response occurred more frequently than others.

When overall frequency of reasons cited was examined by level of difficulty with dietary and exercise compliance, psychological reasons predominated at the level of having a little difficulty for both dietary and exercise compliance (see table 5). Physical and environmental reasons were second at the level of a little difficulty with dietary compliance; while, physical reasons followed by environmental reasons were second and third at the level of a little difficulty with exercise compliance. Physical reasons occurred most frequently at a moderate level of difficulty with dietary and exercise compliance, followed by psychological and environmental. The reasons for having a lot of difficulty with dietary compliance were most frequently psychological, followed by physical. Patients with a lot of difficulty following an exercise program cited primarily physical reasons, with psychological and environmental reasons tied for second. Together, physical and psychological reasons for having difficulty with dietary and exercise compliance occurred the vast majority of times.

Table 5

Frequency by Category for Difficulty with Dietary and Exercise Compliance

Level of Difficulty with Compliance	Category		
	Physical (#/%)	Psychological (#/%)	Environ-mental (#/%)
Dietary			
A Little	6/24 (25%)	12/24 (50%)	6/24 (25%)
Moderate	9/16 (56%)	6/16 (38%)	1/16 (6%)
A lot	2/6 (33%)	4/6 (67%)	0/6 (0%)
Exercise			
A little	7/20 (35%)	10/20 (50%)	3/20 (15%)
Moderate	15/27 (56%)	7/27 (26%)	5/27 (19%)
A lot	7/9 (78%)	1/9 (11%)	1/9 (11%)

Correlations with Dietary and Exercise Compliance

Correlations between dietary/exercise compliance and demographic, psychosocial, and physiologic variables based on the Health Belief Model were next examined.

Readiness to Undertake Recommended Compliance Behavior

Under readiness to undertake recommended compliance behavior, the subcategories of motivation and value of illness threat reduction were measured. Significant correlations were found between motivation variables and compliance with diet and exercise. Dietary compliance correlated significantly with self-care stress from the Heart Transplant Stressor Scale ($r=.33$, $p=0.001$), but not with psychological stress or with health rating from the Rating Question Form (see table 6). Thus, as self-care stress increased, dietary compliance decreased (note: a higher score indicates worse compliance). Exercise compliance correlated with self-care stress ($r=.31$, $p=0.002$), psychological stress ($r=.21$, $p=.04$), and health rating ($r=-.34$, $p=0.001$). Therefore, less compliance was related to more self-care stress, more psychological stress, and poorer health perception.

The value of illness threat reduction was also examined in relation to dietary and exercise compliance by using two tools: the Sickness Impact Profile (subscales of physiologic and psychosocial disability) and the Heart Transplant Symptom Checklist (subscales of gastrointestinal, neuromuscular, and dermatologic symptoms). Dietary compliance did not correlate significantly with physiologic or psychosocial functional disability. Dietary compliance did correlate significantly with symptoms: gastrointestinal ($r=.36$, $p<0.0001$), neuromuscular ($r=.24$, $p=.02$), and almost with dermatologic

Table 6

Correlations of Health Belief Model Variables with Dietary and Exercise Compliance

Health Belief Model Variables	Dietary Compliance	Exercise Compliance
Self-care stress	r= .33, p=0.001	r= .31, p=0.002
Psychological stress	r= .09, p=NS	r= .21, p=.04
Health perception	r=-.02, p=NS	r=-.34, p=0.001
Physiologic functional disability	r= .03, p=NS	r= .06, p=NS
Psychosocial functional disability	r= .11, p=NS	r= .16, p=NS
Gastrointestinal symptoms	r= .36, p<0.0001	r= .31, p=0.003
Neuromuscular symptoms	r= .24, p=0.02	r= .33, p=0.001
Dermatologic symptoms	r= .20, p=0.055	r= .29, p=0.005
Age	r=-.15, p=NS	r=-.14, p=NS
Gender	r= .12, p=NS	r= .12, p=NS
# of medications	r=-.06, p=NS	r=-.01, p=NS
Difficulty with complying	r= .56, p<0.0001	r= .74, p<0.0001
Satisfaction with health/function	r=-.07, p=NS	r=-.30, p=0.003
Helpfulness of interventions	r= .06, p=NS	r=-.37, p<0.0001
Satisfaction with social support	r= .15, p=NS	r=-.15, p=NS
Coping effectiveness	r= .05, p=NS	r= .06, p=NS

(r=.20, p=.055). Exercise compliance also did not significantly correlate with physiologic or psychosocial functional disability. However, exercise compliance did correlate significantly with symptoms: gastrointestinal (r=.31, p=0.003), neuromuscular (r=.33, p=0.001), and dermatologic (r=.29, p=0.005). Thus, symptoms seem to strongly influence compliance. As patients became more bothered by gastrointestinal, neuromuscular, and dermatologic symptoms, both dietary and exercise compliance decreased.

Modifying and Enabling Factors

Modifying and enabling factors (demographic, structural, attitudes, interaction with health care providers, and enabling) from the Health Belief Model were also examined in relation to compliance with diet and exercise. The two demographic variables (age and gender) were not significantly correlated with dietary compliance or with exercise compliance.

The structural variables examined regarding actual dietary and exercise compliance were (1) the number of medications a patient takes at home (mean=9$\pm$3) and (2) difficulty with dietary and exercise compliance. Correlations were not significant between number of medications and dietary compliance or between number of medications and exercise compliance. Correlations were significant between dietary compliance and difficulty with dietary compliance (r=.56,

$p < 0.0001$) and between exercise compliance and difficulty with exercise compliance ($r = .74$, $p < 0.0001$). A higher score indicates greater difficulty with compliance and worse actual compliance. Thus, as difficulty with dietary and exercise compliance increases, actual compliance decreases, as would be expected.

Attitudes, health care provider interactions, and enabling factors were also correlated with dietary and exercise compliance. One subscale from the Life Satisfaction Index (health/functioning) was examined regarding dietary and exercise compliance as a measure of attitudes toward health and health care providers. The health/functioning subscale did not correlate significantly with dietary compliance but did correlate with exercise compliance ($r = -.30$, $p = 0.003$). The less patients were satisfied with their health/functioning, the less they complied with their exercise prescription.

Interaction was measured by the emotional/supportive subscale from the Heart Transplant Intervention Scale and was examined regarding dietary and exercise compliance. No significant correlation was found between helpfulness of emotional/supportive interventions and dietary compliance, but the correlation was significant with exercise compliance ($r = -.37$, $p < 0.0001$). Therefore, patients who perceived that emotional/supportive interventions of health care providers were less helpful had worse exercise compliance.

The Social Support Index and the Jalowiec Coping Scale provided measures of enabling factors as related to dietary and exercise compliance. Overall satisfaction with social support (from the Social Support Index) did not correlate significantly with dietary compliance or with exercise compliance. Likewise, overall coping effectiveness (from the Jalowiec Coping Scale) was not correlated significantly with dietary compliance or exercise compliance.

In order to triangulate dietary and exercise compliance with physiologic measures, the variables of actual body weight, the difference between actual and ideal weight, percent of ideal body weight, and cholesterol and triglyceride levels were examined regarding dietary and exercise compliance. These physiologic measures were selected because changes in compliance may be related to changes in weight and lipid levels. The only significant correlations between dietary compliance and physiologic measures were with the following variables: difference between actual and ideal body weight ($r=.23$, $p=.03$), and percent of ideal body weight ($r=.25$, $p=.02$). These correlations reveal that as dietary compliance becomes worse, actual body weight increases over ideal (i.e., the patient becomes overweight). No significant correlations were found between any of the physiologic variables and exercise compliance.

Multiple Regression on Dietary and Exercise Compliance

Stepwise multiple regression was performed using compliance with diet and exercise as dependent variables (separately) and all of the independent variables measured by the instruments previously described within the conceptual framework of the Health Belief Model. Only three variables were significant predictors of compliance with diet (see table 7). Difficulty with dietary compliance (a structural variable) entered the equation first (F=42.28, p<0.00001) and by itself accounted for 31% of the variance based on the R^2.

Table 7

Multiple Regression on Compliance with Diet

Variable	Unique R^2	Cumulative R^2	Std. Beta Weight	F, p
Difficulty with dietary complying	.3102	.3102	.51	F=42.28, p<0.00001
Gastro-intestinal symptoms	.0289	.3392	.27	F=23.87, p<0.00001
Health rating	.0370	.3762	.21	F=18.50, p<0.00001

The second variable which entered the equation was gastrointestinal symptoms (a variable reflecting the value of illness threat reduction) (F=23.87, p<0.00001). Together, gastrointestinal symptoms and difficulty with dietary compliance accounted for 34% of the variance. The third and last variable which entered the equation was health rating (a motivation variable) ($F=18.50$, $p<0.00001$). All three variables accounted for 38% of the variance in compliance with diet. When the beta weights were examined, difficulty with dietary compliance accounted for approximately twice as much variance as gastrointestinal symptoms and health rating.

When multiple regression was performed using compliance with exercise as the dependent variable, only two variables were significant predictors (see table 8). The first variable to enter the equation was difficulty with exercise compliance (a structural variable) ($F=111.16$, $p<0.00001$) which alone accounted for 54% of the variance. The only other variable to enter the equation was health rating (a motivation variable) ($F=59.57$, $p<0.00001$) and together with difficulty in exercise

Table 8

Multiple Regression on Compliance with Exercise

Variable	Unique R^2	Cumulative R^2	Std. Beta Weight	F, p
Difficulty with exercise complying	.5418	.5418	.69	$F=111.16$, $p<0.00001$
Health rating	.0197	.5616	-.15	$F=59.57$, $p<0.00001$

compliance accounted for 56% of the variance in compliance with exercise. When the beta weights of these two variables were examined, difficulty with exercise compliance accounted for more than four times as much variance as health rating.

Given that prediction of compliance with diet and exercise was performed within the conceptual framework of the Health Belief Model, multiple regression was also run using a forced entry method, wherein all of the independent variables were entered into the equations for compliance with diet and exercise. When all sixteen of the variables were entered into the equation for compliance with diet ($F=4.95$, $p<0.00001$), they accounted for 50% of the variance. When all sixteen of the variables were entered into the exercise compliance equation ($F=8.33$, $p<0.00001$), they accounted for 63% of the variance. Thus, the method of forced entry regression provided an additional 12% of explained variance for dietary compliance and 7% of explained variance for exercise compliance.

Assumptions of Multiple Regression for Diet and Exercise Compliance

Assumptions needed for multiple regression (normality, linearity, and homogeneity of variance) were examined for the dependent variables of dietary and exercise compliance. A histogram of standardized residuals was analyzed for normality for each stepwise equation. The histogram for dietary compliance appeared to loosely fit a normal curve, but on closer inspection appeared to be bimodal. The histogram for exercise compliance also appeared to loosely fit a normal curve, but had three peaks. The presence of nonnormality may lessen the robustness of a regression model, but the larger the sample size, the less the impact of nonnormality (Tabachnick & Fidell,1989).

Standardized partial regression scatterplots were examined for linearity and homogeneity of variance between the dependent variables and the variables which entered the stepwise equations. For the dependent variable, dietary compliance, the strongest linear association was with difficulty with dietary compliance. The other two independent variables, gastrointestinal symptoms and health rating, showed weak linear associations with dietary compliance.

The spread of points was similar along the line for dietary compliance and difficulty with dietary compliance, thereby indicating homogeneity of variance. Homogeneity of variance was also found in the partial plots for the other two variables with dietary compliance, although the linear relationships were weak.

Likewise, the linear association between exercise compliance and difficulty with exercise compliance was strong, but weak with the only other variable to enter the equation, health rating. The spread of points along the line for exercise compliance and difficulty with exercise compliance was similar, indicating homogeneity of variance. Although the relationship was weak between health rating and exercise compliance, homogeneity of variance was also present when the partial plot was examined for these two variables.

Examination for Multicollinearity

To examine the issue of multicollinearity, the correlation matrix for all of the independent variables was inspected. Also, tolerances and variance inflation factors (VIFs) for the independent variables which entered the equations of the final models for dietary and exercise compliance were examined. The presence of multicollinearity was defined as a correlation of .70 or greater (Tabachnick & Fidell, 1989). Only 3/120 (3%) correlations among the independent variables were >.70, indicating virtually no problem with multicollinearity (see appendix 3). The relationships between independent variables that were greater than .70 were: gastrointestinal symptoms with neurological symptoms (r=.76), self-care stress with psychological stress (r=.78), and neurological symptoms with psychological disability (r=.74). The strong correlations among these independent variables indicate their similarity and make it difficult to separate out the effects of individual variables on the dependent variable.

Tolerances and variance inflation factors were also examined as indicators of collinearity. Tolerance is the proportion of variability in an independent variable not explained by the other independent variables. Tolerances $\leq$.01 are too small, so the variable must be discarded (Schroeder, 1990). For dietary compliance, each of the independent variables which entered the equation had acceptable tolerances (difficulty with dietary compliance=.86, gastrointestinal symptoms=.74, and health rating=.80) indicating that each variable is not a linear combination of the other variables (see table 9).

The variance inflation factor indicates the degree to which the model is degraded by multicollinearity. It is the inverse of the tolerance. The minimum acceptable value of VIF in the absence of multicollinearity is 1.0 (Schroeder, 1990). In the final model of the equation for dietary compliance, the VIFs were acceptable (1.17-1.36) for the three independent variables which entered the equation.

Table 9

Tolerances and VIFs for Multiple Regression on Dietary Compliance

Variable	Tolerance	VIF
Difficulty with dietary compliance	.8587	1.165
Gastrointestinal symptoms	.7353	1.360
Health rating	.8031	1.245

Tolerances and VIFs were also examined for the final model of exercise compliance. The tolerances and VIFs of the two independent variables which entered the equation (difficulty with exercise compliance and health rating) were acceptable: tolerances=.92 and VIFs=1.09 (see table 10). Thus, there was not a problem with collinearity of the independent variables which entered into the regression equations for compliance with diet and exercise.

Table 10

Tolerances and VIFs for Multiple Regression on Exercise Compliance

Variable	Tolerance	VIF
Difficulty with exercise compliance	.9190	1.088
Health rating	.9190	1.088

Lastly, outliers were identified by Mahalanobis' Distance and then examined for their potential influence on the regression equations by using Cook's Distance, which is a measure of the joint influence of a case being an outlier on y and on the set of predictors. Therefore, all outliers are not necessarily influential; only outliers with Cook's Distance >1 influence the regression equation and need to be considered for possible deletion (Stevens, 1986). For the regression equation on dietary compliance, there were no influential data points since the Cook's Distance for each of the ten outlier cases was <1 (see table 11). Likewise for

Table 11

Cook's Distance for Dietary and Exercise Compliance Equations

Case Number	Cook's Distance	Significance
Dietary Compliance		
93	.2264	.9230
66	.0735	.9900
51	.0657	.9920
79	.0581	.9936
55	.0506	.9951
24	.0375	.9973
52	.0297	.9983
72	.0258	.9987
7	.0229	.9990
28	.0228	.9990
Exercise Compliance		
85	.1556	.9258
17	.1118	.9530
64	.1049	.9571
41	.0517	.9844
95	.0377	.9902
46	.0312	.9925
14	.0300	.9930
27	.0291	.9933
52	.0213	.9957
51	.0181	.9967

the regression equation on exercise compliance, there were no influential data points (Cook's Distance <1 for each of the 10 outlier cases).

Regression on Compliance with Physiologic Variables

In order to triangulate results between the subjective measures of compliance with diet and exercise and the objective physiologic variables, stepwise multiple regression was also performed using percent ideal body weight and serum lipid levels as the objective dependent variables. Three variables were significant predictors of percent ideal body weight. The first variable was gastrointestinal symptoms (a value of illness threat reduction variable) (F=9.85, p=0.002) which accounted for 9% of the variance (see table 12). The

Table 12

Multiple Regression on Percent Ideal Body Weight

Variable	Unique R^2	Cumulative R^2	Std. Beta Weight	F, p
Gastro-intestinal symptoms	.0949	.0949	.29	F=9.85, p=.0023
Gender	.0450	.1399	.21	F=7.56, p=.0009
Emotional interventions	.0360	.1759	.19	F=6.55, p=.0005

second variable which entered the equation was gender (a demographic variable) ($F=7.56$, $p=0.0009$) which together with gastrointestinal symptoms accounted for 14% of the variance. The last variable which entered the equation was helpfulness of emotionally supportive interventions (an interaction variable) ($F=6.55$, $p=0.0005$), and with the first two variables accounted for 18% of variance in percent ideal body weight. When the beta weights were examined, gastrointestinal symptoms accounted for somewhat more variance than gender and helpfulness of emotionally supportive interventions (see table 12).

The regression on the objective dependent variable, percent ideal body weight, accounted for less variance than the equations for the subjective dependent variables, compliance with diet and exercise. One of the independent variables in the regression equation for percent ideal body weight (gastrointestinal symptoms) was the same variable as in the regression on compliance with diet. The other two independent variables (gender and helpfulness of interventions) were from different subcategories of the Health Belief Model (demographic and interaction) than the subcategories which predicted compliance with diet and exercise.

When multiple regression was performed with cholesterol as the dependent variable, no independent variables were significant. When regression was performed with triglyceride as the dependent variable, only one variable, overall coping effectiveness ($F=6.71$, $p=0.01$) (an enabling variable) entered the equation and accounted for minimal variance (7%). It appears that using the serum lipid level as a measure to triangulate with compliance with diet and exercise is not useful.

Assumptions of Multiple Regression on Percent Ideal Body Weight

Assumptions (normality, linearity, and homogeneity of variance) were also examined in the equation with percent ideal body weight as the dependent variable. The histogram of standardized residuals revealed loose normality with some platykurtosis and slight negative skewness. Given the adequacy of sample size, the affect of nonnormality on the regression equation and conclusions is lessened.

Linearity (as determined from standardized partial regression plots of the independent variables versus the dependent variable) was fair for gastrointestinal symptoms and emotional interventions, and very good for gender as plotted against percent ideal body weight. Homogeneity of variance was present for gastrointestinal symptoms and emotional interventions. Homogeneity of variance was not as strong for gender.

Examination for Multicollinearity

Multicollinearity was examined via inspection of the correlation matrix and determination of tolerances and VIFs. There was no problem with multicollinearity. Only 3/120 (3%) relationships between independent variables were >.70 (gastrointestinal symptoms with neurologic symptoms [r=.76], self-care stress with psychological stress [r=.78], and neurological symptoms with psychological disability [r=.74]). Tolerances were acceptable (.99 for all three variables) and VIFs were also acceptable (1.00-1.01 for all three variables) (see table 13).

Table 13

Tolerances and VIFs for Multiple Regression on Percent Ideal Body Weight

Variable	Tolerance	VIF
Gastrointestinal symptoms	.9922	1.008
Gender	.9995	1.000
Emotional interventions	.9922	1.008

Lastly, outliers were examined via Mahalanobis' Distance and Cook's Distance. Ten outliers were identified by Mahalanobis' Distance; however no outliers had a Cook's Distance >1. Therefore, these outliers were not influential data points in the regression equation on percent ideal body weight (see table 14).

Table 14

Cook's Distance for Multiple Regression on Percent Ideal Body Weight

Case Number	Cook's Distance	Significance
78	.1422	.9660
63	.0955	.9837
32	.0610	.9930
22	.0597	.9933
14	.0594	.9934
12	.0498	.9953
20	.0425	.9965
81	.0337	.9978
38	.0301	.9982
52	.0297	.9983

Summary

The following is a concise summary of findings examining 6-month post-transplant patient compliance with diet and exercise:

1. More than three fourths of patients complied most or all of the time with their diet prescriptions, and almost three fourths of patients complied with their exercise prescriptions.

2. Almost three fourths of patients had little or no difficulty following their diet and exercise prescriptions.
3. The primary reason for having a little difficulty following a diet was being away from home, eating out, or finding it hard to select foods according to the diet, while the primary reason for having moderate or more difficulty following a diet was increased appetite/hunger.
4. The primary reason for having problems following an exercise program differed by level of difficulty as follows: (1) a little difficulty: having no time, being too busy, (2) moderate difficulty: being tired/having no energy, and (3) a lot of difficulty: primarily physical reasons given.
5. Decreased dietary compliance was related to: increased self-care stress, being more bothered by gastrointestinal and neuromuscular symptoms, and greater difficulty with dietary compliance.
6. Decreased exercise compliance was related to: increased self-care and psychological stress, poorer health perception, being more bothered by gastrointestinal, neuromuscular, and dermatologic symptoms, greater difficulty with exercise compliance, less satisfaction with

health/functioning, and less helpfulness of health care provider interventions.

7. The only significant correlation from dietary and exercise compliance with physiologic measures revealed that less dietary compliance was related to being more overweight.
8. Predictors of dietary compliance were: difficulty with dietary compliance, gastrointestinal symptoms, and health rating with 38% variance explained.
9. Predictors of exercise compliance were: difficulty with exercise compliance and health rating with 56% variance explained.
10. Predictors of percent ideal body weight (an objective indicator of compliance with diet and exercise) were: gastrointestinal symptoms, gender, and helpfulness of emotional interventions, which accounted for 18% of explained variance.

CHAPTER V

DISCUSSION

Description of Compliance and Difficulty with Compliance

The great majority of this sample of heart transplant patients at 6 months postoperatively complied at least most of the time with diet and exercise prescriptions. Only a little over 20% of patients complied with their diet all of the time while more than 60% of patients complied with their diet most of the time. Similarly, 25% of patients complied with their exercise program all of the time and almost 50% complied most of the time. These rates of compliance reveal fairly good adherence to the clinical prescriptions. Perhaps patients are fairly compliant for one or more of the following reasons: (1) they are only a few months postoperative, (2) the diet and exercise prescriptions are therapeutic versus preventive, (3) patients have been educated in the importance of postoperative compliance, and/or (4) patients know that lack of compliance can cause complications and even death.

However, 14% of patients were compliant with their diet some of the time, and patients were compliant with their exercise plan some of the time (21%) or hardly ever (5%). Although the differences between dietary and exercise rates of compliance were not statistically significant, it appears that patients may comply with the many aspects of their therapeutic regimen at different rates of frequency. Patients may comply with various aspects of their therapeutic regimen based on their assessment of risk and/or benefit. For example, noncompliance with immunosuppressive medications causes acute rejection and possible death; whereas, the impact of noncompliance with a diet or exercise prescription is much less certain. Knowing the risks and/or benefits of compliance with a particular aspect of the regimen may influence actual compliance.

Tirrell and Hart (1980) and Holm et al. (1985) also found that CABG and/or MI patients generally complied with their diet and/or exercise prescriptions. Although these studies from the literature used self-report as the only measure of compliance, Kaplan and Simon (1990) and Shankar et al. (1990) found that self-report was an accurate method to determine patient compliance based on a review of the literature and their own studies. Therefore, it is reasonable to assume that the compliance rates found in this study of heart transplant patients also reflect reality.

Examination of the frequency and reasons for having difficulty with dietary and exercise compliance revealed results that concur with clinical experience. Overall, patients had only a little difficulty following a diet and exercise prescription. Almost 50% of patients stated that they had no difficulty following a diet prescription, while a little more than 25% experienced a little difficulty with compliance. For exercise compliance, almost 50% had no difficulty following the program, while almost 25% had a little difficulty. The reasons for having little or no difficulty following diet and exercise prescriptions may have included adequate education, prior experience with the prescriptions (especially by ischemic cardiomyopathy patients), and feeling well at 6 months postoperatively.

Sennott-Miller and Miller (1987), in their study of compliance with risk-reducing behaviors requiring life-style management (including diet and exercise) (n=60), found that the likelihood of performing health-related activities decreased as perceived difficulty increased. This study therefore supports the results of the current study, wherein rates of actual compliance were high and rates of difficulty with compliance were low.

When reasons for having difficulty with compliance were collated and rank ordered, interesting results emerged. For diet, no matter what the level of difficulty, patients cited increased appetite/hunger as the primary or secondary reason for having difficulty following a diet. This physiologic reason for having difficulty following a diet may be due to a side effect of the immunosuppressive medication prednisone. Between 3 and 6 months post-transplant, patients usually take .2-.3 mg/kg/day of prednisone, and a side effect of this drug may contribute to increased appetite and/or hunger and hence difficulty with dietary compliance. Thus, the immunosuppressant medication, prednisone, which transplant patients take routinely may play a role in the difficulty patients have following their diets. Perhaps as the dose is reduced over time to a minimum of .1 mg/kg/day, dietary difficulties due to this drug may be cited less frequently.

Other reasons for having difficulty following a diet were environmental and psychological. The primary reason for having a little difficulty following a diet was environmental; for example, being away from home, eating out, or finding it hard to select foods according to the diet. When patients dine out at restaurants or with family or friends, food served may not be compatible with their dietary prescription. Therefore, they may experience difficulty following the diet. Notification to family and friends of dietary restrictions and more careful selection of restaurants may help to reduce the frequency of this reason.

Many other reasons for not following a diet were psychological; for example, missing foods eaten previously, undisciplined/no willpower, like/love to eat, getting used to the diet, and craving certain foods. These psychological reasons for having difficulty with dietary compliance may or may not be amenable to health care provider interventions. Increasing appeal of acceptable foods may be accomplished by teaching patients how to use a variety of spices which enhance and add new flavors. Interestingly, as the level of difficulty following the diet increased from a little to a lot, the psychological reasons for having difficulty became more intense (e.g., wanting versus craving other foods), thus indicating the strong influence of this category.

Reasons for having difficulty with exercise compliance were different than for dietary compliance. For patients having a little difficulty with exercise compliance, the first and second rank-ordered reasons were psychological and environmental: (1) having no time/being too busy and (2) being lazy and the weather. The first reason may be amenable to better scheduling of time or simply may have provided an excuse for not exercising. Informing patients that exercise may increase energy and reduce feelings of laziness may also contribute to decreased difficulty following the regimen.

Patients who experienced moderate difficulty following an exercise prescription revealed that being tired and having no energy was their primary reason for having difficulty. These physical reasons which increase difficulty with compliance may be related to medications (e.g., prednisone, which can cause steroid myopathy and thus weakness in the limbs), complications of heart transplantation (e.g., acute rejection or infection), or lack of physical rehabilitation.

A variety of physical problems (e.g., pain and compression fracture, weak legs, and fatigue) were cited by patients with a lot of difficulty with exercise compliance. Osteoporosis and vertebral fractures are adverse effects of prednisone therapy. The impact of these physical problems on difficulty with exercise compliance is serious, and their resolution may not be easily achievable. It is important to identify patients who experience signs and symptoms of back pain and other problems and recommend assessment by a physician for subsequent medical or surgical intervention.

Weather was a common environmental reason given for having difficulty with exercise compliance, cited by patients at all levels of difficulty. Patients may have perceived weather to be a problem when their exercise program involved being outside, and the weather was inclement. Patient education about exercising indoors primarily or secondarily may be helpful in resolving difficulty related to weather.

Overall, by category, psychological reasons predominated at the level of having a little difficulty with dietary and exercise compliance while physical reasons predominated at the moderate level of difficulty with dietary and exercise compliance. At the level of a lot of difficulty, psychological again predominated as a category of reasons for having problems with dietary compliance, and physical continued to occur as the most frequent category for having problems with exercise compliance.

Understanding the findings related to level of difficulty with compliance by category provides clinicians with knowledge to target interventions appropriately. It appears that patients who experienced only a little difficulty with dietary and exercise compliance (and who were also mostly compliant with the prescriptions) were attempting to adapt to the changes in lifestyle. Comments such as being undisciplined, having no time, getting used to doing it, and remembering to do it allude to the process of adaptation. Sometimes, acknowledging the difficulty, being supportive and encouraging, and providing additional educational materials are all that is required to assist patients.

At a moderate level of difficulty with dietary and exercise compliance, the most frequently occurring category of reasons were physical (e.g., hunger, being tired, and back problems). These problems appear to be somewhat more serious, requiring assessment and educational/medical intervention.

Lastly, psychological reasons for having a lot of difficulty with dietary compliance appeared to be more intense representations of the problems at lower levels of difficulty (craving versus wanting different foods). Interventions required for these problems may include more intense therapy, such as psychological counseling or group therapy (i.e., Overeaters Anonymous). The variety of serious physical problems which occurred at the level of having a lot of difficulty with exercise compliance, also require more intense interventions, including individually designed physical therapy programs and treatment of the condition reducing the ability to comply with exercise.

Given the findings of Sennott-Miller and Miller (1987) regarding the relationship between increased difficulty with compliance and decreased actual compliance, it is important to target interventions toward patients experiencing moderate or higher levels of difficulty with compliance. Furthermore, in order to assist patients having difficulty with dietary and/or exercise compliance, it is important to understand the reasons for having difficulty so that interventions can be more specifically targeted at patient needs.

Correlations with Dietary and Exercise Compliance

Correlations between study variables (demographic, psychosocial, and physiologic) and diet and exercise compliance, within the framework of the Health Belief Model, differed by prescription. These differences support the notion that diet and exercise compliance should not be examined together under the guise of rehabilitation, but rather should be examined as two independent prescriptions with varying implications for health care practice. Furthermore, although the correlations were low to moderate, the results are meaningful because of adequate statistical power (100%) to detect significant relationships.

Correlations with Dietary Compliance

Dietary compliance was significantly correlated with two subcategories of readiness to undertake recommended compliance behavior: motivation (measured by self-care stress) and value of illness threat reduction (measured by gastrointestinal and neuromuscular symptoms). Increased self-care stress and being more bothered by gastrointestinal and neuromuscular symptoms were associated with decreased dietary compliance. Patients who are more highly stressed by the burden of caring for themselves become less compliant with their diet. Perhaps, patients have less time and energy to deal with their diet if more self-care is required of them. Similarly, certain types of symptoms related to immunosuppressant medications may interfere with dietary compliance. For example, patients who experience nausea, strong cravings for certain foods, feeling hungry all of the time (gastrointestinal symptoms), or problems with taste, trouble remembering things, or feeling tired all of the time (sensory/neurological/muscular symptoms) may become less compliant with their diet.

One structural factor (measured by difficulty with dietary compliance), a subcategory of modifying and enabling factors, was also significantly correlated with dietary compliance. As difficulty with following the diet increased, actual compliance decreased. This factor may be a type of barrier to achieving compliance. Thus, difficulty with compliance may occur because following the diet is unpleasant, inconvenient, or expensive. Nursing interventions including suggestions about heart healthy cookbooks to provide tastier recipes and alternative shopping locations which may be more convenient or less expensive can be helpful to patients. In addition, difficulty may be related to self-efficacy (i.e., confidence). Strategies to enhance a patient's confidence in complying with a diet prescription may be helpful.

The significance of the variables in the subcategories: (1) motivation, (2) value of illness threat reduction, and (3) structural as related independently to diet has not been examined in the Health Belief Model literature, and therefore has no previous support. Furthermore, Hiatt et al. (1990) did not find that value of illness threat reduction (measured by severity of illness and resusceptibility) was different between coronary artery disease patients who chose to participate versus not participate in a cardiac rehabilitation program, including diet and exercise. Although not supported in the Health Belief Model literature, difficulty was found to be an important determinant of compliance with health care prescriptions (Sennott-Miller & Miller, 1987). The relationship of these variables to dietary compliance requires further exploration in this and other cardiovascular populations of patients.

When correlations were performed to triangulate dietary compliance with physiologic measures, important relationships were found with some variables. Significant relationships were found between dietary compliance and the following two variables: (1) difference between actual and ideal body weight and (2) percent of ideal body weight. These data revealed that decreased dietary compliance is related to increased body weight. It appears that as dietary compliance decreases, patients gain weight. This relationship is supported by the mean weight gain to 110% of ideal body weight exhibited by patients at 6 months after heart transplant. However, a trend toward differences in percent of ideal body weight was found between men and women, indicating that women were somewhat more overweight than men. Perhaps women, who tend to experience more acute rejection than men, required higher doses of prednisone and were therefore more overweight. However, the sample of women was small (n=19) which may have contributed to the trend.

Correlations with Exercise Compliance

Significant correlations were also found between exercise compliance and variables in the Health Belief Model. As with dietary compliance, the subcategories of motivation and value of illness threat reduction significantly correlated with exercise compliance. Motivation was significantly related to exercise compliance as measured by self-care and psychological stress and perceived health status. As psychological and self-care stress increased and perceived health status became poorer, exercise compliance decreased. Self-care stress (e.g., keeping up an exercise program and trying to keep your weight under control) and psychological stress (e.g., making changes in your lifestyle and trying to get your life back to normal) may interfere with exercise compliance. Stress may alter compliance because increased self-care responsibility and mental stress may drain energy, and therefore, patients may be too tired to exercise. Patients who rate their health as poor also may not comply with an exercise prescription because they may not feel they are well enough to exercise.

The value of illness threat reduction also correlated with exercise compliance as measured by gastrointestinal, neuromuscular, and dermatologic symptoms. As patients became more bothered by these symptoms, their exercise compliance decreased. These symptoms may have been somewhat disabling and interfered with their ability to exercise. For example, weakness in the legs and tremors or shaking of the hands or body (neuromuscular symptoms) may physically interfere with the ability to exercise. Patients can be taught that some symptoms, such as weakness are related to lack of rehabilitation and can be counteracted with exercise, while other symptoms, such as tremors, are related to immunosuppressive medication and are temporary, thereby decreasing over time. Dermatologic symptoms such as easy bruising, sensitive skin, or swelling in the legs and feet (due to immunosuppressive medications) may also cause patients to reduce exercising in an attempt to protect themselves from further injury. Education about skin care and safety while exercising may allow patients to continue to exercise without worry.

Lastly, three modifying and enabling factors (structural, attitudes, and health care provider interaction) were significantly related to exercise compliance. The structural variable was measured by difficulty with following the exercise regimen; attitude toward health care providers was measured by satisfaction with health/functioning; and interaction was measured by helpfulness of emotionally supportive interventions of the transplant team.

As difficulty with exercise compliance increased, actual compliance decreased. Again, perceived difficulty may be a barrier in compliance with an exercise prescription as well as with a diet prescription. Perhaps the nature of the barriers (i.e., cost and convenience) could be explored with patients and solutions sought. For example, design of a home exercise program versus attending a formal rehabilitation program may be less expensive and more convenient. Assessment of patient self-efficacy and development of strategies to increase confidence might also be appropriate.

As patient attitudes toward health and health care providers became worse, exercise compliance became worse. If patients were disappointed with their health and those who cared for them, they complied less readily with their exercise programs. Implications for improving patient attitudes include asking about concerns with health and health care providers in order to optimize perceptions of well-being and improve care delivery.

Lastly, as patients perceived emotional support from health care providers to be less helpful, exercise compliance decreased. By 6 months after transplant, patients have often established meaningful relationships with health care providers, and decreased helpfulness of emotional support may have affected exercise compliance. Exploration of these issues with patients may enhance sagging relationships and positively influence regimen compliance.

Some support for the significance of these variables in exercise compliance was found in the literature. Holm et al. (1985) found motivation and severity of an illness and resusceptibility (as measures of value of illness threat reduction) to be indicative of the potential for compliance with exercise in post MI and CABG patients. Oldridge and Streiner (1990) also reported that severity of disease threat significantly differentiated compliers and dropouts from a cardiac rehabilitation program.

There was a lack of significant correlation of any physiologic variables with exercise compliance. This may be due to a lesser impact of exercise compliance on the variables examined. Exploration of other physiologic variables may reveal stronger correlations.

Lack of Support for Relationships of Some Health Belief Model Variables to Diet and Exercise Compliance

It is important to note that some Health Belief Model subcategories (motivation, value of illness threat reduction, and certain modifying and enabling factors) were related to heart transplant patient compliance with diet and exercise. However, within these subcategories, not all of the variables were significantly related to compliance with both diet and exercise. Demographic, attitudinal, interaction, and enabling factors were not related to dietary compliance, while demographic and enabling factors were not related to exercise compliance.

The reasons for a lack of significant relationships between many of the Health Belief Model variables and compliance with diet and exercise is unknown and requires further exploration. It is important to note that there was sufficient statistical power to detect significant relationships if they existed. Perhaps the use of other measures of Health Belief Model variables would have provided significant relationships not found in this study. The subcategory of probability that compliant behavior will reduce the threat (which was not examined) may have been important in this sample of patients. Also, relationships that were not significant between Health Belief Model variables and compliance at 6 postoperative months may become significant at other time periods, such as 1-2 years after transplant. Given that the Health Belief Model was originally developed for the study of preventive health behavior, all of the variables may not be as useful to study chronic illness populations.

Two of the modifying and enabling factors (attitudes and helpfulness of health care provider interventions) were related to compliance with exercise, but not compliance with diet. Again, the impact of the independent variables on the relationship with diet and exercise varies with the prescription.

Conflicting results or lack of findings have been reported in Health Belief Model and other literature regarding the influence of the two factors (demographic and enabling) which were not related to compliance with diet and exercise in this study. Tirrell and Hart (1980) in their study of CABG patients found a lack of significant influence of demographic variables on exercise compliance. However, Hiatt et al. (1990) found that two demographic variables (marital and socioeconomic status) did influence perception of benefits and barriers to participation in cardiac rehabilitation. Also, Oldridge and Streiner (1990) accounted for more variance when predicting compliance with cardiac rehabilitation after adding demographic variables into their regression model.

The enabling component of the model, as measured by social support, did not influence dietary and exercise compliance. The same lack of significance was found in other studies of dietary compliance and its relationship to social support (Cohen et al., 1991; Lynch et al., 1992). These findings are contrary to expectations. Given that the sample is predominantly male, one might expect that social support would readily influence dietary and possibly exercise compliance. Perhaps, satisfaction with tangible or emotional support rather than satisfaction with total support or the amount of social support received (not measured in this study) would reveal significant findings. Another social support tool might also reveal important relationships.

Multiple Regression on Dietary and Exercise Compliance

Multiple regression, performed within the framework of the Health Belief Model, provided insight into variables which predict compliance with diet and exercise in patients who are six months post heart transplantation.

Prediction of Dietary Compliance

Three variables together accounted for 38% of the variance in predicting dietary compliance. The Health Belief Model variables (in order of entry into the equation) were: (1) a structural variable (difficulty with dietary compliance), (2) a variable reflecting the value of illness threat reduction (gastrointestinal symptoms), and (3) a motivation variable (perceived health status).

The predictive ability of these variables provides valuable information for clinicians. The strongest predictor of actual dietary compliance was having difficulty following the diet. This implies that patients who experience difficulty with compliance, for reasons previously described, will comply less with their dietary regimen.

Clinicians, therefore, need to ask patients not only about whether they are following their diet prescription, but whether they are having difficulty following the regimen. If a patient is having difficulty following a dietary regimen, a health care provider can explore the level of difficulty and reasons for difficulty with a patient, in order to identify effective interventions to reduce difficulty with compliance and perhaps, thereby, improve actual compliance. For example, if a patient experiences moderate difficulty following his diet due to being hungry all of the time, food selection can be discussed with the patient to appease hunger within dietary guidelines (e.g., by ingesting more fiber). Also, planning smaller meals at more frequent intervals may be helpful.

Since there is a high correlation between actual compliance and difficulty with compliance, and therefore a lot of overlap, it may be acceptable to study only one of the variables. Patients may find it easier to describe difficulty with compliance rather than actual compliance, so that difficulty may be the more useful measure.

Gastrointestinal symptoms were the second variable which predicted dietary compliance, but accounted for only one-half as much variance as difficulty in following the regimen.

Gastrointestinal symptoms (e.g., upset stomach and stomach pain) are side effects of immunosuppressant medications, such as prednisone and azathioprine.

It is important to determine if a patient is experiencing gastrointestinal symptoms so that appropriate interventions can be provided and dietary compliance thus improved. Clinical assessment of the symptoms will guide the plan of treatment. Interventions appropriate for gastrointestinal symptoms may include altering the timing of daily medications. For example, azathioprine is usually administered once each day in the morning. If a patient is experiencing an upset stomach, perhaps changing the administration of azathioprine to three times a day with meals may decrease this symptom. Also, other medications, including antacids or hydrochloric acid blocking agents, may decrease the symptoms. Exploration of the relationship between foods and gastrointestinal symptoms may lead to dietary modifications within the dietary prescription. Lastly, if a patient is experiencing clinically significant stomach pain, invasive medical testing (e.g., endoscopy) may be indicated to determine the cause of the pain and provide direction for therapy.

The last variable to account for variance in the prediction of dietary compliance was perceived health status. This variable was the last to enter the regression equation, and its impact on dietary compliance was less than half of the impact of difficulty with compliance. An improvement in health rating (e.g., a patient's perception of his health) implied worse dietary compliance.

Thus, patients who perceive that their health is good may not comply with their diet well because if they feel that they are better, then there is less reason to follow a diet; whereas patients who rate their health as poor may comply with their diet better because they are not feeling as well. Unfortunately, this is commonly observed in clinical practice; patients who feel good may not comply with a clinical prescription, rationalizing that because they feel fine, the prescription is no longer necessary. Interventions should be directed toward patient education. Patients should be taught that dietary compliance is important even when a patient feels fine because reduced compliance can be associated with feeling worse subsequently and possible increased morbidity and mortality (e.g., developing allograft arteriopathy).

Both of the subcategories for readiness to undertake recommended compliance behavior (motivation and value of illness threat reduction) and one of the modifying and enabling factor subcategories (structural) of the Health Belief Model that were measured explained some of the variance in dietary compliance. However, many variables measured within the subcategories of the Health Belief Model did not predict dietary compliance. These non-predictive variables were: psychological and self-care stress, physiologic and psychosocial functional disability, neuromuscular and dermatologic symptoms, age, gender, number of medications, satisfaction with health and functioning, helpfulness of emotionally supportive interventions, satisfaction with social support, and overall coping effectiveness. The lack of predictive ability of these variables suggests a weak relationship with dietary compliance.

Furthermore, it is important to note that only 38% of the variance in dietary compliance was explained. Therefore, other variables within the Health Belief Model that were not measured in this study (e.g., probability that compliant behavior will reduce the threat), other operational definitions of the Health Belief Model components, and other variables outside of the theoretical framework used in this study (e.g., self-efficacy) may also help predict dietary compliance. Thus, further investigation is warranted.

<u>Prediction of Exercise Compliance</u>

Only two Health Belief Model variables entered into the prediction of heart transplant patient compliance with exercise. The variables were a structural variable (difficulty with exercise compliance) and a motivation variable (perceived health status). Together these two variables accounted for 56% of the explained variance in exercise compliance.

The variable accounting for the most variance was difficulty with exercise compliance. Therefore, difficulty following an exercise program is highly related to actual compliance with an exercise prescription. Understanding the importance of difficulty with exercise compliance (which alone accounted for 54% of explained variance) provides a basis for assisting patients to comply.

Given that the greater the difficulty, the worse the compliance, health care providers need to determine a patient's level of difficulty and the reasons for difficulty in order to plan effective interventions with the patient. Physical problems that interfere with exercise compliance (e.g., fatigue and back problems described previously) at a moderate and higher level of difficulty must be assessed for potential therapeutic intervention. Fatigue may be a result of poor rehabilitation. Exercise at a lower level of intensity may be necessary before proceeding to a more stimulating exercise program. Likewise, back problems may also require alteration in an exercise plan, as well as evaluation for medical intervention. Psychological problems (e.g., being lazy or too busy) may be less amenable to intervention. Educating patients about consequences of poor exercise compliance, assisting patients to schedule time for exercise, and providing emotional support by acknowledging how difficult it is to exercise may be strategies to address the issue of difficulty with exercise compliance.

Perceived health status, the second variable to enter the equation for exercise compliance, accounted for only an additional 2% of variance beyond difficulty with compliance. As a patient's perception of his health became poorer, his exercise compliance worsened, which is opposite to its effect on diet. The relationship between perceived health status and exercise compliance may be opposite of the relationship between perceived health status and dietary compliance because exercise requires physical effort and energy, which may be lacking if a patient perceives his health status to be poor. However, perceived poor health status was related to improved dietary compliance, wherein patients may have decided that they should go back on the diet and stop "cheating" given that they do not feel as well anymore.

If a patient feels that his health is poor, such as when he has an infection, he may not comply with an exercise prescription. An infection, even if only a minor upper respiratory infection, may be a justifiable reason for having difficulty exercising. However, if a patient feels his health is poor because he is tired, the fatigue may partially be due to decreased muscle strength from lack of exercise. Therefore, the solution to this reason for a poor health rating may be to exercise. Thus, it is important to determine the reason for a patient's rating of his health as poor to identify (1) whether the impact on exercise compliance is justifiable and (2) whether medical, educational, supportive, and/or other interventions are appropriate.

These two variables from the motivation subcategory and structural subcategory predicted exercise compliance and accounted for 56% of the explained variance. Other variables from the two predictive subcategories and from other subcategories did not explain exercise compliance. These non-explanatory variables were: gastrointestinal, neurological, and dermatological symptoms, psychological and self-care stress, physiologic and psychosocial functional disability, age, gender, number of medications taken, satisfaction with health and functioning, perception of emotional interventions from health care providers, satisfaction with social support, and overall coping effectiveness. Their lack of predictive ability may be related to (1) their relative weakness as related to exercise compliance and (2) the strong relationship between difficulty and actual exercise compliance. Health Belief Model variables not measured (e.g., from the subcategory, probability that compliant behavior will reduce the threat), other operational definitions of Health Belief Model variables that were measured, and other variables outside of the Health Belief Model may account for additional explained variance in exercise compliance.

Physiologic Measures as Predictors of Dietary and Exercise Compliance

In order to triangulate dietary and exercise compliance with physiologic measures, multiple regression was performed using body weight and serum lipid levels as objective indicators of dependent variables. Only percent ideal body weight provided more than minimal (<10%) explained variance. Three variables entered the regression equation and together accounted for 18% of the explained variance for percent ideal body weight. The variables (in order of entry) were a value of illness threat reduction variable (gastrointestinal symptoms), a demographic variable (gender), and an interaction variable (helpfulness of emotional/supportive interventions). Together, these three variables explained less variance in percent ideal body weight than was explained for compliance with diet and exercise. Also, none of the variables was much more strongly related to compliance than any of the others.

Being more bothered by gastrointestinal symptoms predicted a higher percent ideal body weight (i.e., being overweight). Perhaps having gastrointestinal symptoms caused a change in dietary habits. Patients may have altered the frequency of eating (i.e., increased food intake) and/or foods selected (i.e., foods not allowed in the diet prescription) in order to reduce gastrointestinal symptoms. These alterations in diet may have contributed to becoming overweight. Causes for the gastrointestinal symptoms, treatment of symptoms, and ways to stay on the diet plan should therefore be explored with patients.

Gender also predicted being overweight. As was described under sample characteristics, there was a trend toward women being more overweight than men. This finding provides direction for targeting interventions to lose weight toward women who are at greater risk for weight gain than men. Also, the interventions for losing weight may differ between men and women. These potential differences must be further explored.

More helpfulness of emotional interventions was related to being overweight. Perhaps overweight patients needed more support from health care providers.

The variables which entered the equation on percent ideal body weight were different (yet clinically sound) than those which entered for dietary and exercise compliance (except for gastrointestinal symptoms which predicted dietary compliance). Therefore, there may be other physiologic measures which are better to triangulate with prediction of dietary and exercise compliance than body weight and serum lipid levels.

Future Study of Compliance and Implications

Future study of patient compliance will provide additional data on which to base the clinical care of heart transplant patients. Further study of dietary and exercise compliance after heart transplantation should be longitudinal, given that compliance changes over time. Also, other measures of Health Belief Model factors, and other theoretical frameworks with their associated variables (e.g., Social Learning Theory and self-efficacy) should be tested in the study of compliance, since the Health Belief Model variables tested accounted for only some explained variance. As researchers are better able to describe and predict dietary and exercise compliance, prescriptive studies need to be conducted in order to improve patient compliance, especially at moderate and higher levels of difficulty with compliance. In addition, further study of associated concepts, including obesity, hyperlipidemia, and allograft arteriopathy after heart transplantation, needs to be conducted in association with dietary and exercise compliance, in order to better understand the impact of compliance on these physiologic variables.

The implications of additional study on post heart transplant dietary and exercise compliance and associated variables are ultimately to enhance patient care. Obesity and hyperlipidemia may potentially increase morbidity and mortality after heart transplantation. The study of dietary and exercise compliance therefore may alter the development of post transplant complications and thus improve survival and quality of life.

SUMMARY

The majority of patients were compliant with their diet and exercise prescriptions most or all of the time. The majority of patients experienced little or no difficulty complying with their diet and exercise prescriptions. Being away from home, eating out, finding it hard to select foods to go with the diet, and increased appetite/hunger were the primary reasons for having difficulty complying with a dietary prescription at all levels of difficulty. Having no time, being too busy, and fatigue/lack of energy were the primary reasons for having difficulty complying with an exercise prescription at a little and moderate level of difficulty.

Relationships between demographic, physiologic, and psychosocial variables with dietary and exercise compliance were found. Decreased dietary compliance was related to increased self-care stress, being bothered by gastrointestinal and neuromuscular symptoms, and increased difficulty with dietary compliance. Decreased exercise compliance was related to increased psychological and self-care stress, poorer health perception, being more bothered by gastrointestinal, neuromuscular, and dermatologic symptoms, increased difficulty with exercise compliance, less satisfaction with health/functioning, and less helpfulness of health care provider interventions.

Health Belief Model variables that predicted compliance with diet and exercise were somewhat different. Difficulty with dietary compliance (a structural factor), gastrointestinal symptoms (a value of illness threat reduction factor) and perception of health (a motivation factor) predicted dietary compliance. Difficulty with exercise compliance (a structural factor) and perception of health (a motivation factor) predicted exercise compliance.

Two out of the three Health Belief Model variables which predicted percent ideal body weight (a physiologic measure of compliance with diet and exercise) were different than those variables that predicted compliance with diet and exercise. Gastrointestinal symptoms (a value of illness threat reduction factor), gender (a demographic factor), and helpfulness of emotional interventions (a health care provider interaction factor) predicted percent ideal body weight.

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Appendix 1

Literature Review of Research Findings on Compliance in Transplant Patients

Study	Description/Tools	Design/Sample	Findings
Rogers, 1987	Examined spousal behaviors influencing pt compliance with a medical regimen after heart transplant. Open-ended semi-structured interview on adherence to medication, infection control, diet, & exercise.	Descriptive design. 6 male/female heart transplant pts 6-18 months postop.	Information provision and tangible support identified as received most frequently by pts. Exercise, infection control, and medication administration identified as areas where most support by spouses given.
Rovelli et al., 1989a	Examined compliance rates of kidney, heart, and liver transplant pts with post-transplant medications and follow-up. Chart review and observation on keeping clinic appointments.	Comparative design. Retrospectively, 260 kidney transplant pts followed for 9 months - 11.5 years and prospectively, 196 kidney transplant pts, 38 heart transplant pts, and 9 liver transplant pts followed for 17 - 32 months.	18% of 260 pts were overall noncompliant (91% rejected their kidney or died). 15% of 196 pts were overall noncompliant (30% rejected their kidney or died). 2/38 (5%) heart transplant pts were noncompliant with medications.

Appendix 1-Continued

Study	Description/Tools	Design/Sample	Findings
Rovelli et al., 1989b	Examined compliance differences in posttransplant medications and follow-up by socioeconomic level, race, and ethnicity. Collected demographics, chart review, and observation on keeping clinic appointments.	Comparative design. 196 kidney transplant pts followed for up to 4 years.	Greater incidence of noncompliance was seen in blacks (30%) vs. non-Hispanic whites (12%). More blacks (54%) were in a lower socioeconomic group vs. non-Hispanic whites (14%).
Siegal et al., 1989	Examined influence of demographics/ health beliefs on compliance with a medical regimen after renal transplant. Questionnaires with follow-up telephone interview.	Comparative design. 111 renal transplant pts.	76% of pts reported self-responsibility for general health and 60% reported sharing responsibility for transplant function with a physician. No relationship was found between health beliefs and race, gender, education, occupation, income, and clinic appointment compliance.

Appendix 1-Continued

Study	Description/Tools	Design/Sample	Findings
Rodriguez et al., 1991	Examined if pt compliance with appointments, diet, medications, and calling in with problems is related to rejection and death. Chart review and observation by staff.	Comparative design. 12 compliant and 12 noncompliant kidney transplant pts, identified by health care givers.	Noncompliant pts lived farther from transplant centers, had more behavioral, family, and economic problems, and were more noncompliant with pretransplant dialysis than compliant pts.
Didlake et al., 1988	Examined noncompliant behavior after renal transplant, predisposing factors, and association with complications. Medical records, psychosocial evaluations, noncompliant behavior documented by transplant team, or self-report of noncompliance by pt.	Comparative design. 531 kidney transplant pts on cyclosporine and prednisone immunosuppression.	25/531 (5%) kidney transplant pts were noncompliant, causing rejection or graft loss. Pts with graft loss due to noncompliance were younger, black, on more prednisone, had more tremor, less outpatient clinic attendance, and lived > 150 miles from a transplant center.

Appendix 1-Continued

Study	Description/Sample	Design/Sample	Findings
Dunn et al., 1990	Examined long-term survival after renal transplant. Chart review on demographics rejection, immunosuppression, other complications, and death.	Comparative design. 343 kidney transplant pts with graft function of 2-6 years.	Of 58/343 pts, 16/58(28%) who had graft loss after first time kidney transplant were noncompliant with medications. Noncompliance occurred more in men than women and in pts who received first vs. second time transplants.
Schweizer et al., 1990	Examined noncompliance rates with medications and post-transplant follow-up in kidney, heart, and liver transplant pts. Chart review re follow-up.	Comparative design. 82 kidney transplant pts (followed for up to 12 months), and 13 liver and 50 heart transplant pts (followed for at least 6 months).	Of 82 kidney transplant pts, 2/82 (2%) were noncompliant with medication and 5/82 (6%) were noncompliant with clinic visits. Of 13 liver transplant pts, 3 were repeatedly noncompliant with medication (2 of those pts died). Of 50 heart transplant pts, 3 became noncompliant with medication (1 pt died).

Appendix 1-Continued

Study	Description/Tools	Design/Sample	Findings
Mai et al., 1990	Examined pre and postop psychosocial and quality of life adjustment and compliance in heart transplant pts. Present State Examination, a structured interview, a rating of medical regimen compliance (including diet and exercise), Work and Employment Scale WES).	Comparative design. 27 male and female pts assessed pre and post heart transplant.	Posttransplant, no pts with good compliance had a psychiatric diagnosis, whereas 80% of pts with fair or poor compliance had a psychiatric diagnosis ($p<0.001$). Compliant pts had a higher level of return to work than pts with fair or poor compliance.

Appendix 2

Reasons for Having Difficulty Following a Diet by Level of Difficulty

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/Response
Little	1	5	Environmental: away from home, eating out, hard to find food to go with diet
Little	2	4	Physical: increased appetite/hungry
Little	3.5	3	Psychological: undisciplined, no willpower, cheat
Little	3.5	3	Psychological: like/love to eat
Little	4.5	1	Psychological: want different foods, diet not appealing so eat other foods
Little	4.5	1	Psychological: no salt
Little	4.5	1	Psychological: miss fried foods, snacks
Little	4.5	1	Psychological: so many restrictions
Little	4.5	1	Physical: steroids / medication
Little	4.5	1	Environmental: not always handy (at home) to eat what I should

Appendix 2-Continued

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/Response
Little	4.5	1	Psychological: try to eat the right foods
Little	4.5	1	Psychological: not knowing what to eat but learning about new fat-free foods
Little	4.5	1	Physical: meds have affected my taste
Moderate	1	7	Physical: increased appetite, hungry
Moderate	2	2	Psychological: I miss the foods I enjoyed eating
Moderate	3.5	1	Psychological: enjoy eating
Moderate	3.5	1	Psychological: because of its limitations
Moderate	3.5	1	Psychological: greedy
Moderate	3.5	1	Environmental: they keep changing the diet on me
Moderate	3.5	1	Psychological: I see so many things I can eat
Moderate	3.5	1	Physical: I do not eat too much and I'm still putting on weight

Appendix 2-Continued

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/Response
Moderate	3.5	1	Physical: watching what I eat with potassium in it (my potassium has been high)
Lot	1	2	Physical: increased appetite, hungry
Lot	2.5	1	Psychological: getting used to the diet
Lot	2.5	1	Psychological: craving for certain foods
Lot	2.5	1	Psychological: tired of fish and chicken
Lot	2.5	1	Psychological: love to eat non-diabetic (sweets) foods

Appendix 3

Reasons for Having Difficulty Following an Exercise Program by Level of Difficulty

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/Response
Little	1	5	Psychological: no time, too busy
Little	2.5	2	Psychological: lazy
Little	2.5	2	Environmental: weather
Little	3.5	1	Physical: legs weak
Little	3.5	1	Physical: bad foot, bad leg
Little	3.5	1	Psychological: getting used to doing it, and working it into schedule
Little	3.5	1	Physical: weak and tire easily
Little	3.5	1	Physical: working makes me too tired
Little	3.5	1	Physical: had flu/cold
Little	3.5	1	Physical: feet sore, hard to walk
Little	3.5	1	Physical: back pain secondary to compression fracture
Little	3.5	1	Environmental: it's harvest time now, there is more normal activity this time of year

Appendix 3-Continued

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/Response
Little	3.5	1	Psychological: I'm just back to normal as far as activity
Little	3.5	1	Psychological: remembering
Moderate	1	8	Physical: tired, no energy
Moderate	2	3	Environmental: weather
Moderate	3	2	Pschological: Getting started, getting into a routine
Moderate	4.5	1	Physical: legs weak
Moderate	4.5	1	Physical: breathing problems
Moderate	4.5	1	Physical: back pain/back problems
Moderate	4.5	1	Physical: swelling in legs
Moderate	4.5	1	Physical: cramping in legs
Moderate	4.5	1	Psychological: forgetful
Moderate	4.5	1	Psychological: don't enjoy it at times
Moderate	4.5	1	Physical: because of my injuries
Moderate	4.5	1	Psychological: time

Appendix 3-Continued

Level of Difficulty	Rank Order of Reasons	# Times Cited	Category/ Response
Moderate	4.5	1	Physical: keep getting sick (sinuses)
Moderate	4.5	1	Environmental: not allowed to exercise (had 1-2 months of acute rejection)
Moderate	4.5	1	Environmental: our road doesn't have sidewalks
Moderate	4.5	1	Psychological: scared to be around people
Moderate	4.5	1	Psychological: don't have a scheduled program, work hard otherwise
Lot	1	1	Physical: fatigue
Lot	1	1	Environmental: weather
Lot	1	1	Psychological: lazy
Lot	1	1	Physical: compression fracture of back
Lot	1	1	Physical: pneumonia
Lot	1	1	Physical: leg weakness
Lot	1	1	Physical: have gotten x-rays, feel poorly
Lot	1	1	Physical: good health decreased
Lot	1	1	Physical: hernia repair

Appendix 4

Correlation Matrix for Dietary Compliance

	T12CMP7	GISX12	NEURSX12	DERMSX12	SCSTS12	PSKSTS12	HLTRTG12	PHYSIP12	PSSIP12	T12AGE	SEX	HLTHLS12	EMTINT12	TOTSAT12	JCSEFF12	T12DIF7	T12MEDHO
T12CMP7	1.000	0.363	0.236	0.199	0.332	0.090	-0.022	0.028	0.114	-0.153	0.126	-0.073	0.064	0.148	0.048	0.557	-0.061
GISX12	0.363	1.000	0.762	0.637	0.548	0.516	-0.437	0.442	0.563	0.097	0.014	-0.503	0.087	0.185	0.003	0.367	-0.111
NEURSX12	0.236	0.762	1.000	0.632	0.615	0.654	-0.522	0.593	0.741	0.045	-0.027	-0.674	-0.094	0.052	-0.034	0.263	-0.052
DERMSX12	0.199	0.637	0.632	1.000	0.475	0.405	-0.266	0.351	0.470	0.082	0.087	-0.454	0.014	0.018	0.033	0.219	-0.122
SCSTS12	0.332	0.548	0.615	0.475	1.000	0.779	-0.438	0.448	0.590	0.169	0.026	-0.579	-0.036	0.075	0.146	0.419	-0.003
PSKSTS12	0.090	0.516	0.654	0.405	0.779	1.000	-0.442	0.471	0.694	0.048	-0.006	-0.633	0.000	0.147	0.136	0.237	-0.077
HLTRTG12	-0.022	-0.437	-0.522	-0.266	-0.438	-0.442	1.000	-0.483	0.453	0.005	0.052	0.647	0.056	-0.156	0.009	-0.234	-0.043
PHYSIP12	0.028	0.442	0.593	0.351	0.448	0.471	-0.483	1.000	0.689	0.240	0.015	-0.600	0.109	0.177	0.039	0.131	-0.069
PSSIP12	0.114	0.563	0.741	0.470	0.590	0.694	-0.453	0.689	1.000	0.061	-0.138	-0.610	-0.038	0.114	0.013	0.241	-0.103
T12AGE	-0.153	0.097	0.045	0.082	0.169	0.048	0.005	0.244	0.061	1.000	-0.063	-0.070	-0.050	-0.072	-0.077	-0.100	0.081
SEX	0.126	0.011	-0.027	0.087	0.026	-0.006	0.052	0.015	-0.138	-0.063	1.000	0.048	0.028	-0.128	0.107	0.136	-0.019
HLTHLS12	-0.073	-0.503	-0.674	-0.454	-0.579	-0.633	0.647	-0.600	-0.610	-0.070	0.048	1.000	0.186	-0.133	0.084	-0.284	0.073
EMTINT12	0.064	0.087	-0.094	0.014	-0.036	0.000	0.056	0.109	-0.038	-0.050	0.028	0.186	1.000	0.347	0.233	0.033	0.035
TOTSAT12	0.148	0.185	0.050	0.018	0.075	0.147	-0.156	0.177	0.114	-0.072	-0.128	-0.133	0.347	1.000	0.180	0.034	-0.017
JCSEFF12	0.048	0.003	-0.034	0.033	0.146	0.136	0.009	0.039	0.013	-0.077	0.107	0.084	0.233	0.180	1.000	0.096	-0.047
T12DIF7	0.557	0.367	0.263	0.219	0.419	0.237	-0.234	0.131	0.241	-0.100	0.136	-0.284	0.033	0.034	0.096	1.000	-0.140
T12MEDHO	-0.061	-0.111	-0.052	-0.122	-0.003	-0.077	-0.043	-0.069	-0.103	0.081	-0.019	0.073	0.035	-0.017	-0.047	-0.140	1.000

Appendix 5

Correlation Matrix for Exercise Compliance

	T12CMP8	GISX12	NEURSX12	DERMSX12	SCSTS12	PSKSTS12	HLTRTG12	PHYSIP12	PSSIP12	T12AGE	SEX	HLTHLS12	EMTINT12	TOTSAT12	JCSEFF12	T12DIF8	T12MEDHO
T12CMP8	1.000	-0.045	-0.071	-0.014	-0.038	0.027	-0.344	-0.022	0.039	-0.059	0.123	-0.306	0.120	0.069	-0.061	0.736	-0.146
GISX12	-0.045	1.000	0.762	0.637	0.548	0.516	-0.437	0.442	0.563	0.097	0.014	-0.503	0.087	0.185	0.003	0.066	-0.111
NEURSX12	-0.071	0.762	1.000	0.632	0.615	0.654	-0.522	0.593	0.741	0.045	-0.027	-0.674	-0.094	0.052	-0.034	0.020	-0.052
DERMSX12	-0.014	0.637	0.632	1.000	0.475	0.405	-0.266	0.351	0.470	0.082	0.087	-0.454	0.014	0.018	0.033	-0.048	-0.122
SCSTS12	-0.038	0.548	0.615	0.475	1.000	0.779	-0.438	0.448	0.590	0.169	0.026	-0.579	-0.036	0.075	0.146	0.024	-0.003
PSKSTS12	0.027	0.516	0.654	0.405	0.779	1.000	-0.442	0.471	0.694	0.048	-0.006	-0.633	0.000	0.147	0.136	0.071	-0.077
HLTRTG12	-0.344	-0.437	-0.522	-0.266	-0.438	-0.442	1.000	-0.483	0.453	0.005	0.052	0.647	0.056	-0.156	0.009	-0.285	-0.043
PHYSIP12	-0.022	0.442	0.593	0.351	0.448	0.471	-0.483	1.000	0.689	0.240	0.015	-0.600	0.109	0.177	0.039	0.025	-0.069
PSSIP12	0.039	0.563	0.741	0.470	0.590	0.694	-0.453	0.689	1.000	0.061	-0.138	-0.610	-0.038	0.114	0.013	0.108	-0.103
T12AGE	-0.059	0.097	0.045	0.082	0.169	0.048	0.005	0.244	0.061	1.000	-0.063	-0.070	-0.050	-0.072	-0.077	-0.096	0.081
SEX	0.123	0.011	-0.027	0.087	0.026	-0.006	0.052	0.015	-0.138	-0.063	1.000	0.048	0.028	-0.128	0.107	0.016	-0.019
HLTHLS12	-0.306	-0.503	-0.674	-0.454	-0.579	-0.633	0.647	-0.600	-0.610	-0.070	0.048	1.000	0.186	-0.133	0.084	-0.338	0.073
EMTINT12	0.120	0.087	-0.094	0.014	-0.036	0.000	0.056	0.109	-0.038	-0.050	0.028	0.186	1.000	0.347	0.233	0.082	0.035
TOTSAT12	0.069	0.185	0.050	0.018	0.075	0.147	-0.156	0.177	0.114	-0.072	-0.128	-0.133	0.347	1.000	0.180	-0.048	-0.017
JCSEFF12	-0.061	0.003	-0.034	0.033	0.146	0.136	0.009	0.039	0.013	-0.077	0.107	0.084	0.233	0.180	1.000	-0.052	-0.047
T12DIF8	0.736	0.066	0.020	-0.048	0.024	0.071	-0.285	0.025	0.108	-0.096	0.016	-0.388	0.082	-0.048	-0.052	1.000	-0.100
T12MEDHO	-0.146	-0.111	-0.052	-0.122	-0.003	-0.077	-0.043	-0.069	-0.103	0.081	-0.019	0.073	0.035	-0.017	-0.047	-0.100	1.000

VITA

Kathleen L. Grady was born in Dearborn, Michigan. She received her BSN from Mercy College of Detroit, Detroit, Michigan in 1973. She worked as a nurse in Honolulu, Hawaii and Stanford, California from 1973-1982. She graduated from the University of California, San Franciso in 1980 with a Master of Science degree from the School of Nursing and accepted a position as an educational coordinator at Stanford University Medical Center, Stanford, California.

In 1982, she moved to Chicago, Illinois and developed and coordinated the nursing aspect of the Heart Transplant Program at Loyola University Medical Center. Mrs. Grady has published numerous articles about heart failure, heart assist devices, and heart transplantation while at Loyola. She has conducted several small research studies related to heart transplantation and has been co-principal investigator on a large, funded (including NIH) research project on quality of life before and after heart transplantation. She lectures on a local, regional, and national level. Mrs. Grady is active in the International Society for Heart and Lung Transplantation and the American Heart Association, Council on Cardiovascular Nursing.

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is, therefore, accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

______________________ ______________________________

Date Director's Signature