PREDICTORS OF ADHERENCE TO EXERCISE
AFTER HEART TRANSPLANTATION

By

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PREDICTORS OF ADHERENCE TO EXERCISE AFTER HEART TRANSPLANTATION

By

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Major Department: Nursing

This non-experimental predictive study identified predictors of adherence to exercise in heart transplant recipients. The theoretical framework for this study was based on the Theory of Planned Behavior. Seven research questions were tested to identify factors that predicted adherence to exercise after heart transplantation. The factors included pre-operative, physical, psychological, situational, disease-related, and social influences.

A convenience, non-random sample (N = 16) of subjects who were six months post-operative heart transplant surgery was obtained. Each subject completed three questionnaires that assessed their exercise routine, feelings about exercise, symptoms, and motivation. Also, data were obtained from each subject’s medical record. The results showed positive correlations among pre-operative exercise participation ($r = -0.509, p = 0.043$), exercise at home ($r = 0.498, p = 0.049$), exercising functional status ($r = 0.575, p = 0.019$), and exercise adherence. Regression analysis showed that
the pre-operative factors, number of days on the waiting list ($F = 6.77, p = 0.032$) and functional status ($F = 8.42, p = 0.019$), significantly predicted exercise adherence and accounted for 65% of the total variance. Two situational factors, accessibility ($F = 10.37, p = 0.007$) and climate ($F = 6.43, p = 0.026$), significantly predicted exercise adherence and together accounted for more than 46% of the total variance. Additional findings revealed the demographic variable, pre-operative exercise participation ($F = 4.90, p = 0.043$), significantly predicted exercise adherence and accounted for over 26% of the variance.

Implications for clinical practice included increasing the exercise capacity of the transplant patient in the pre-operative period; developing exercise protocols tailored to the abilities of the transplant patient both pre-operatively and post-operatively; increasing the individual’s access to exercise; and implementing home-oriented exercise programs.
CHAPTER 1
INTRODUCTION

Heart transplantation is a treatment option for selected patients with end-stage heart disease. It offers a chance at renewed life and improved quality of life and an ability to resume normal activities of daily living. According to the seventeenth annual data report from the Registry of the International Society for Heart and Lung Transplantation (2001), over 55,000 heart transplants have been performed since 1967. Dr. Christiaan Barnard performed the first successful human cardiac transplantation in Cape Town, South Africa. Approximately 2,700 heart transplants are done yearly. The current one-year survival rate is 85.5%, three-year survival rate is 76.9% and five-year survival rate is 69.6%. Most heart transplant recipients are male (74%) and white (78%). The majority of recipients are in the 50-64 age group (50.3%). At the end of June 2001, there were 4,231 people on the national heart waiting list (United Network for Organ Sharing--UNOS, July 4, 2001).

Success in heart transplantation is attributed to advances in antimicrobial agents, immunosuppressive drugs, improved surgical techniques, methods of detecting rejection and preservation (Forsythe, 1997). For the recipients, the quality of survival is not only defined by their cardiac function and overall general health but also by their psychological adaptation during the years after the transplantation.

End-stage heart disease encompasses a wide range of pathophysiologic processes. The hallmarks are often left ventricular dilatation and severe decreased systolic ejection.
Myocardial failure is the end result (Forsythe, 1997). Once intense therapies and other surgical options have been tried and tested, the patient is often referred for heart transplantation. The indications for transplantation include cardiomyopathy, coronary artery disease, congenital heart disease, valvular heart disease and retransplant or graft failure (UNOS, 2001). Patients referred for heart transplantation often have a life expectancy of less than one year. To be considered for transplantation, the following criteria must be met: New York Heart Association (NYHA) Class III or IV functional disability that is refractory to maximal medical therapy; inoperable coronary artery disease with intractable angina symptoms; and intractable malignant ventricular dysrhythmias unresponsive to therapy. Exclusion criteria for heart transplantation includes severe pulmonary hypertension with pulmonary vascular resistance greater than six Woods units; age greater than 65 years; insulin-dependent diabetes with end-organ damage; weight greater than 140% of ideal body weight; active malignant disease; irreversible chronic functional impairment of other organs; human immunodeficiency virus; amyloidosis; substance abuse; and unstable psychosocial status. The patient must exhibit medical compliance, adequate social support and an appropriate cognitive ability (Rourke, Droogan, & Ohler, 1999).

The procedure most frequently performed is orthotopic heart transplantation and involves the donor heart replacing the native heart. The standard or biatrial surgical technique introduced by Lower and Shumway involves two atrial anastomoses with connections to the aorta and pulmonary arteries (Dressler, 1999). This traditional technique, however, alters the size and geometric shape of the atria and has been shown to be responsible for posttransplant complications such as tachyarrhythmias, tricuspid and
mitral regurgitation, atrial dysfunction and thrombus formation (Aziz, Burgess, El-Gamel, Campbell, Rahman, Deiraniya, & Yonan, 1999). To preserve the atrial geometry, two alternative techniques have been developed. The bicaval technique allows complete excision of the recipient heart and the donor left atrium is anastomosed to a small portion of the recipient’s left atrial cuff. The anastomosis sites are changed to the inferior and superior vena cavae. This technique has been reported to result in improved cardiac output and left ventricular performance, decreased right atrial pressure, and a decrease in the incidence of tricuspid incompetence (Aziz et al., 1999). Furthermore, there is improved exercise capacity associated with this technique. Total orthotopic transplantation involves complete atrioventricular transplantation with separate caval and pulmonary vein anastomoses.

**Stages of Heart Transplantation**

Heart transplantation does not constitute a single event. It is a process that involves many stages that individuals must go through and continue throughout their life. The process started many years earlier during the initial cardiac event that led to end-stage heart failure. It proceeded through the initial work-up for transplantation to a waiting period for a donor heart when the individual is placed on the heart transplant waiting list. With the availability of a suitable donor, the patient must then endure the surgical procedure and recovery experience. Once discharged from the hospital, the patient then begins the journey of long-term adjustment to the transplantation. Kuhn, Davis, and Lippmann (1988) identified seven stages of adjustment for heart transplant recipients: transplant proposal, evaluation, awaiting a donor organ, perioperative period, in-hospital convalescence, discharge, and post-discharge adaptation.
In 1999, the median waiting time for heart transplantation was 217 days as reported by UNOS (2001). In that year, 712 persons died before a suitable donor became available. One reason for this is the increasing number of patients being placed on the waiting list and the continued shortage of donor hearts. The waiting period creates many stressors for the patient and his/her family. Patients face the threat of further physical deterioration, the fear of dying, and the unpredictability of the availability of a donor organ. “Uncertainty about whether a donor organ will arrive in time is the primary concern of patients who need transplantation” (Crone & Wise, 1999, p. 51). Tahan (1998) identified six factors that affect uncertainty and stress in illness in patients awaiting heart transplantation: perception of illness-related events; characteristics of the experienced events; ability to process information; availability of resources and psychosocial support; ability to recognize and classify the experienced events; and efforts to reduce uncertainty. Patients undergo a multitude of emotions, behaviors and stressors. Those who require hospitalization and experience declining health find themselves in a position of increased dependency and loss of control. Feelings of anger and distrust surface as they hear of other patients receiving a donor heart (Professional experience, 1991).

When a donor heart becomes available, a chance for renewed health and improved quality of life becomes a reality. Most patients can anticipate experiencing renewed strength, energy, and endurance after the surgical recovery period. Quality of life has been shown to improve in the areas of social interaction, exercise tolerance, sleep, self-esteem and overall well-being (Crone & Wise, 1999).
However, once the patient survives the surgical experience, the patient may face a new set of problems after transplantation. The threat of organ rejection, opportunistic infections, medication-induced side effects, financial strain, frequent medical check-ups and life-style changes are among some of the stressors that may be encountered after heart transplantation (Hwang, 1996). One of the life-style changes the patient must undergo involves physical activity. Research has shown exercise to be a useful and therapeutic intervention to maximize both exercise tolerance and psychosocial outcomes in heart transplant recipients (Badenhop, 1995; Kavanagh, 1999; Squires, 1990).

**Exercise in Heart Transplant Patients**

Physical activity produces major stress on the body and it has the potential to disrupt internal homeostasis if the body’s control systems become overwhelmed. The control systems that play a major part in maintaining homeostasis during physical activity are the cardiovascular, respiratory, neuroendocrine, and skeletal muscle systems. Each system must maintain a steady state by responding and interacting to supply adequate oxygen and nutrients to the exercising muscles.

Exercise that is planned, structured, and purposeful can have beneficial effects on the respiratory, cardiovascular, musculoskeletal, and endocrine systems of the body. Positive psychological effects can also be achieved through regular exercise. Some of the positive benefits of regular exercise include lower prevalence of cardiovascular risk factors and reduction in mortality, improved ventilatory efficiency, improved hemostatic parameters, increased muscle strength and flexibility, enhanced glucose tolerance and increased sensitivity to insulin, and improved well-being and stress reduction (Shephard & Balady, 1999).
The heart transplant patient also derives additional benefits from performing regular exercise. Rest and exercise hemodynamics normalize over time. Habitual physical exercise may produce a reduction in resting heart rate, systolic, and diastolic blood pressure and a decreased submaximal exercise heart rate, minute ventilation, and a decreased peak exercise diastolic blood pressure (Niset, Hermans, & Depelchin, 1991). There may also be an increase in peak exercise heart rate, systolic blood pressure, double product (heart rate multiplied by systolic blood pressure), heart rate range, ventilatory threshold, and maximal ventilation. Overall, this leads to an improved submaximal exercise endurance and physical work capacity accompanied by a reduction in exercise perceived exertion. Other benefits include increased lean body mass, improved symptoms of fatigue and dyspnea, and a reduction in problems associated with immunosuppressive therapy (Badenhop, 1995).

There are many factors that are capable of interfering with the ability to exercise effectively. Personal characteristics such as age and weight of the individual may affect the ability to perform exercise. The older individual is less likely to engage in activity than a younger individual. Obesity has numerous health implications associated with it and thus may interfere with the ability to exercise. Many disease processes that affect cardiac output, blood flow, and respiration also interfere with exercise performance. Medications classified as antihypertensives, beta-adrenergic blockers, steroids, and immunosuppressants produce adverse reactions such as dizziness, fatigue, tremor, muscle weakness, loss of muscle mass, fluid retention, and bradycardia, all of which can directly affect the ability to exercise. The ability to participate in physical activity can also be
influenced by psychosocial characteristics such as mood, motivation, social support and financial situation (Ades & Coello, 2000; Badenhop, 1995; Powers & Howley, 1996).

The transplanted heart has a normal functioning coronary artery system and the same anatomical structure as the natural heart. However, the transplanted heart is denervated, and hemodynamic responses are different than the normal innervated heart. Both afferent fibers (sensory nerves) and efferent fibers of both the sympathetic and parasympathetic nervous systems are severed. Some of the changes as a result of denervation include a higher than normal resting heart rate of 90–110 beats per minute, blunted hemodynamic response to exercise and other stressors, abnormal diastolic function, orthostatic hypotension, absence of angina, altered response to cardioactive medications, and lack of response to vagal maneuvers (Cotts & Oren, 1997; Rourke, Droogan, & Ohler, 1999).

During exercise, cardiac function is altered in the transplanted heart. At the beginning of exercise, the heart rate response rises slowly and is dependent on the level of circulating catecholamines in the blood. In addition, blood pressure and cardiac output response are also delayed. In the first few minutes of exercise, the exercising muscle provides an increase in stroke volume and is the primary contributor of increasing cardiac output (Clough, 1990). Peak exercise heart rate is lower and is achieved during the early recovery phase of exercise instead of during peak exercise intensity. Following exercise, heart rate elevation is prolonged and slowly returns to pre-exercise levels (Kobashigawa, 1999). Oxygen uptake is decreased during exercise, thus delivering less oxygen to the exercising muscles. This results in both a lower anaerobic threshold and decreased exercise tolerance. Peak oxygen uptake is typically 60–70% of predicted values of age-
matched individuals (Dec, 1998). Ventilation is significantly higher but does not increase delivery of oxygen into the blood.

**Exercise Adherence**

Although the benefits of exercise has been shown to prevent disease and contribute to health and well-being, only a small percentage of all individuals engage in exercise programs with regularity to achieve optimal benefits. Dishman (1988) reported that 50% of individuals who begin a self-monitored exercise program drop out in the first six months. Astoundingly, in the United States (US) alone, 40% of adults do not participate in regular physical activity, while only 15% of adults engage in physical activity thirty minutes or longer, five days or more a week (Office of Disease Prevention and Health Promotion, 2001). The remainder of adults exercising are active only sporadically and it is uncertain as to the achievement of health benefits (Dishman & Buckworth, 1996). Recent recommendations from the Center for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) state that “every US adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all days of the week” (Center for Disease Control and Prevention, 2001).

Encouraging individuals to initiate and adhere to exercise programs has been noted in the literature to be quite challenging. Engaging in physical activity is a time-consuming event that takes considerable effort from the individual. It is often negatively viewed because the consequences associated with it are viewed as negative. The performance of physical activity is often accompanied by sweating, discomfort, exhaustion, and the experience of delayed onset muscle soreness. Also, it may be several
weeks or months before the exercising individual is able to perceive any noticeable changes. Older individuals with chronic diseases may view physical activity as negative because they may believe that it may do more harm than it would benefit them (Chao, Foy, & Farmer, 2000).

Adherence to exercise, whether in a structured program or outside of a formal program, has been linked to many variables, both physiological and nonphysiological. The variables have been categorized as situational or environmental, physical, psychological, health-related, behavioral or social, and previous exercise-related habits (Gale, Eckhoff, Mogel, & Rodnick, 1984; Sullivan, 2001). The variables categorized as situational that have been previously studied include convenience, time, climate, group size, money, and facilities, among others. Some physical factors are age, gender, body weight, heart rate, systolic blood pressure, maximal oxygen consumption (VO2 max) and injuries. Psychological variables are described as self-motivation, attitude, personality and beliefs. Other health-related variables include smoking, co-morbidities or disease, and exercise training among others. Variables categorized as social are social support and reinforcement.

Identification of specific variables related to an individual’s exercise adherence plays a vital role in maximizing the beneficial effects associated with physical activity. This enables practitioners to develop strategies to effectively individualize exercise treatment and protocols. Individualizing exercise prescription and implementing planned interventions through the use of education and behavior modification can increase maintenance of physical activity approximately 50% to 60% (Dishman, 1991). It is essential for the heart transplant recipient to acquire and maintain regular exercise
patterns because of the daily and lifelong requirements of immunosuppressive medical therapy, the increased risk for the development of osteoporosis, hypertension, and graft atherosclerosis, and the pre-operative effects of deconditioning. In this population, it is, therefore, of greater importance to identify factors that interfere with the ability to adhere to exercise so that the clinical benefits of exercise are obtained. However, predictors of exercise adherence after heart transplantation have not been previously identified in the research literature. It is therefore the goal of this research to address this gap in the knowledge base for heart transplant recipients.

**Problem Statement**

It is well known that exercise produces many positive physiological and nonphysiological effects. In order to perform exercise effectively, there are many factors that must be considered. Some of these factors are an efficient cardiovascular and respiratory system to pump oxygenated blood to the exercising muscles, adequate diet to supply needed nutrients to the body, and positive attitude, motivation and support system. In heart transplantation surgery, the technique employed to anastomose the donor heart to the native vessels can affect atrial function, thus affecting cardiac performance. In addition, it is known that there are numerous characteristics and factors that may interfere with the ability to effectively adhere to exercise. Some of these factors have been previously identified. The ability to adhere to exercise after heart transplantation may be problematic due to a preexisting debilitating condition and multiple risk factors associated with triple drug immunosuppressive therapy post transplantation.

The mainstay of clinical research in heart transplantation has focused closely on assessing the individual and the response to exercise in terms of cardiopulmonary
outcomes. Although very important, determining the response of the newly implanted heart to the stress of exercise has given rise to more precise exercise prescriptions for this population. Specific to the heart transplant recipient, what has not been precisely identified in the research literature are those factors that predict an individual’s adherence to exercise after heart transplantation so that he/she may benefit from the positive outcomes of exercise. The problem statement for this study was the following: What factors are predictive of adherence to exercise after heart transplantation?

**Statement of the Purpose**

The major purpose of this research was to identify the pre-operative factors, physical factors, psychological factors, situational factors, disease-related factors and social influences that are predictive of adherence to exercise after heart transplantation. A secondary purpose was to identify the combination of pre-operative, physical, psychological, situational, disease-related factors and social influences that best predict adherence to exercise after heart transplantation.

**Research Questions**

The research questions for this study were as follows:

1. What are the pre-operative factors that are predictive of adherence to exercise after heart transplantation?

2. What are the physical factors that are predictive of adherence to exercise after heart transplantation?

3. What are the psychological factors that are predictive of adherence to exercise after heart transplantation?

4. What are the situational factors that are predictive of adherence to exercise after heart transplantation?

5. What are the disease-related factors that are predictive of adherence to exercise after heart transplantation?
6. Is social influence predictive of adherence to exercise after heart transplantation?

7. What combination of pre-operative, physical, psychological, situational, disease-related factors and social influences best predict adherence to exercise after heart transplantation?

Significance of the Study

The ability to identify factors that are predictive of exercise adherence after heart transplantation may lead to interventions that improve exercise ability by identifying those factors that can then be changed and/or modified. Increasing the capability to adhere to exercise will increase the chance of experiencing the positive benefits associated with regular exercise.

It is well documented that regular physical activity lowers the prevalence of cardiovascular risk factors. Some of the risk factor modifications that occur are prevention of the development of hypertension by lowering blood pressure and decreasing left ventricular hypertrophy, improved glucose metabolism in diabetes by increased sensitivity to insulin, decreased production of glucose by the liver and increased number of muscle cells utilizing more glucose than adipose cells. It is estimated that over 50 million Americans try to lose weight each year. Regular exercise contributes to weight loss by reducing body fat and improving body composition. Physical activity can significantly decrease total cholesterol, low-density lipoprotein (LDL) cholesterol, and increase high-density lipoprotein (HDL) cholesterol, thus reducing cardiovascular risk.

For the heart transplant recipient, regular exercise training has a beneficial effect. In the heart, there is a significant peak heart rate increase and heart rate responsiveness
seen during the performance of exercise. Another major positive effect of regular
exercise is strengthening of skeletal muscles, thus combating the problems associated
with immunosuppressive therapy such as muscular atrophy and osteoporosis.

Research investigating the quality of life of heart transplant recipients has shown
tremendous improvements in both subjective and objective indicators (Lough, Lindsey,
Shinn, & Stotts, 1985). Subjects experienced positive changes in health status, physical
endurance, sense of achievement, and future outlook. Regular exercise also produces
positive psychological benefits such as improved mood, self-concept and overall well-
being. Stress reduction can also be achieved through regular physical exercise and may
decrease depression and anxiety.

Nursing

Nurse clinicians are in a vital position to promote health and positive health
behaviors. Nursing interventions to promote physical activity can be instituted at any
level and at any location where nurses interact with clients. Knowledge of factors that
predict exercise adherence for the heart transplant recipient allows nurses to assist in
improving the health of these patients by positively impacting a lifestyle change through
education and assistance with an exercise program. Promoting a healthy lifestyle can
also be provided through education on prevention and risk factor modification in an effort
to decrease mortality from coronary heart disease. Assisting the heart transplant recipient
in health promotion activities such as physical activity is one of the leading health
indicators of Healthy People 2010 (Office of Disease Prevention and Health Promotion,
2001).
Health Care and Society

In the United States, there will be approximately 70 million individuals 65 years and older by the year 2030. Those 85 years and older will represent the fastest growing portion of the population. With the advancing age of the population, it is imperative to intervene and decrease the problems that are associated with the aging process, most notably, cardiovascular disease. With the advancement in technology for heart transplantation, that is, improved surgical techniques, methods of detecting rejection and preservation of the heart, and superior immunosuppressive drugs, there may possibly be an increase in the number of older individuals that become heart transplant candidates. Thus, the ability to identify factors that are predictive of exercise adherence after heart transplantation is crucial. The ability to perform exercise is an effective intervention to reduce and/or prevent functional declines that are associated with the aging process. Exercise can prevent the loss of muscle mass associated with aging, improve postural stability, increase flexibility and range of motion and improve bone health, thus reducing the development of osteoporosis and the risk of falling and related injuries.

Improved adherence to exercise may also reduce the risk of other diseases such as colon cancer. Risk reduction and promotion of a healthy lifestyle may decrease the need to seek additional medical therapy or surgical intervention. As a result, the number of hospital admissions may be reduced.

Summary

This chapter introduced the topic of heart transplantation with emphasis on the stages of heart transplantation, exercise in heart transplantation patients, and exercise adherence. A statement of the problem was discussed followed by the statement of the
purpose of this research study. Seven research questions were identified. The significance of the study with reference to nursing, health care, and society was also addressed. The theoretical framework and a review of the literature are discussed in Chapter 2.
CHAPTER 2
REVIEW OF LITERATURE

This chapter presents and discusses the theoretical framework for this study. A review of the pertinent literature related to the major study variables is also presented.

Theoretical Framework

The theory of planned behavior served as the framework for this study. The theory of planned behavior (Ajzen, 1991) is a modification of the theory of reasoned action (Ajzen, 1980). A primary goal of this theory is to be able to understand and predict social behaviors and their outcomes. It was developed based on the limitations that were discovered in the original model in that there are behaviors over which people do not have complete volitional control. Behaviors, as explained by Ajzen, are located at some point along a continuum that extends from total control to complete lack of control. Those behaviors under total control are said to exist when there are no constraints to adopting a new behavior. On the other hand, a complete lack of control is present if adoption of the behavior requires opportunities, skills or resources that are currently lacking. Most behaviors performed by an individual depend to some degree on nonmotivational factors such as the availability of opportunities and extraneous resources such as time, money, skills, and the cooperation of others. The most important determinant of one’s behavior according to this theory (Figure 2-1) is the individual’s intention to perform a behavior. It is assumed that behavioral intentions take into account the motivational factors that influence a given behavior. This gives insight into how
much effort individuals put into performing a behavior. Generally speaking, the stronger the intention to elicit a behavior, the higher the likelihood of the performance taking place.

**Figure 2-1. Theory of Planned Behavior (Ajzen, 1991).**

The main determinants of intention in the theory of planned behavior are a combination of three conceptually independent components. The first component is the attitude toward the behavior. This is the degree to which an individual has a favorable or unfavorable evaluation of the behavior. Subjective norm is the second predictor and it reflects the perceived social pressure or influence to perform or not to perform the behavior. The third component of intention is perceived behavioral control. This can directly influence behavior in situations where the behavior is not under total volitional control of the person. Perceived behavioral control refers to the perceived ease or difficulty of adopting the behavior. It involves internal factors such as past experience, ability and skill, in addition to anticipated obstacles or external factors such as social support, time and money. The more favorable the attitude toward the behavior and the
subjective norm, and the greater the perceived behavioral control, the stronger the individual’s intention will be to perform the behavior. Attitude, subjective norm, and perceived behavioral control will vary in importance across behaviors and situations in the prediction of behavioral intention.

It is the intent of the theory of planned behavior to explain human behavior and not just predict it. The theory also involves antecedents to attitudes, subjective norms, and perceived behavioral control. These antecedents are a structure of beliefs that lead to attitudes, subjective norm and perceived behavioral control that determine one’s actions and intentions. In basic terms, the theory suggests that behavior deals with salient information, or beliefs that are relevant to the behavior. Attitudes toward a behavior are influenced by behavioral beliefs, beliefs that underlie subjective norms are normative beliefs and control beliefs provide the basis for perceived behavioral control.

Behavioral Beliefs

Attitudes are usually sensibly developed from the beliefs one holds regarding the object of the attitude. Mainly beliefs are formed about an object by linking it with other attributes such as in association with other objects, characteristics, or events. Regarding the determinant attitude toward the behavior, each associated belief links the behavior to a particular outcome, or to an attribute in which there is some cost incurred when performing the behavior. Because the attributes that are to be linked with the behavior already have a positive or negative value associated with them, the individual involuntarily acquires an attitude toward the behavior. Individuals have a tendency to favor those behaviors believed to have desirable consequences and for those behaviors
that have undesirable consequences, there is the tendency to form unfavorable attitudes toward the behavior.

Normative Beliefs

Normative beliefs relate to the likelihood that important others such as a person’s spouse, close friend or a group approve or disapprove of performing a certain behavior. The strength of the normative belief is determined by individuals or groups and by the individual’s motivation to comply with the expectations of these significant others.

Control Beliefs

Control beliefs are concerned with the presence or absence of opportunities and resources available for performing the behavior. There are many factors involved in forming control beliefs. They may be based on an individual’s past experience of the behavior, influenced by second-hand information regarding the behavior, from the experiences of friends or acquaintances, or by those things that increase or reduce one’s perception of the difficulty of performing the behavior. The fewer the obstacles anticipated and the more opportunities and resources believed to be possessed by the individual, the greater their perceived control should be over the behavior.

The purpose of this research study was to identify factors that are predictive of adherence to exercise after heart transplantation. The performance of exercise was the main behavior or outcome variable according to the Theory of Planned of Behavior (Figure 2-2). To determine the individual’s intention to exercise, the attitude toward the behavior was measured by asking the question, “What are the psychological factors that are predictive of adherence to exercise after heart transplantation?” To determine the behavioral beliefs associated with this component, the factors that were measured were
attitude and motivation. The subjective norm component was addressed by asking the question, “Is social influence predictive of adherence to exercise after heart transplantation?” Measuring the factor, perceived social influence identified the normative beliefs of this component. The perceived behavioral control component was measured by asking the question, “What are the pre-operative, physical, situational, and disease-related factors that are predictive of adherence to exercise after heart transplantation?”
transplantation?" To measure the control beliefs of this component, the following factors were measured: pre-operative factors include number of days on the heart transplant waiting list, functional status six months preceding surgery, and NYHA classification; physical factors are age, weight, ejection fraction, comorbidities, resting heart rate and resting blood pressure; situation factors are support system, financial concerns, convenience, and climate; and disease-related factors are number of rejection episodes since surgery, number of days since last rejection, number of days of hospitalization after surgery, and symptoms.

Review of Literature

This literature review includes a discussion of the study variables according to the theoretical framework, the Theory of Planned Behavior. The first component of this theory, attitude toward the behavior, addresses the two variables attitude and motivation. The variable perceived social influence is discussed and represents the second component, subjective norm. The third theoretical component, perceived behavioral control, includes the study variables waiting list, NYHA classification, functional status, symptoms, age, weight, ejection fraction, comorbidities, resting heart rate and blood pressure, support system, financial concerns, convenience and climate, length of hospitalization, and rejection factors.

Attitude Toward the Behavior

Attitude toward the behavior includes the psychological factors that are predictive of adherence to exercise after heart transplantation. The two major factors studied are attitude and motivation.
Attitude

In general, a positive attitude usually results in a positive outcome. Attitudes shape the behavior of the individual especially in the performance of exercise. Shephard (1985) reviewed different factors that shaped the exercise behavior of subjects. In general, he reports that those who are physically active and take part in regular exercise have more positive attitudes.

Dishman (1994) reviewed exercise patterns in relation to age. Although he reports that few differences exist between younger and older subjects, those over 65 years of age have a positive attitude toward exercising, yet, they perceive to have little control over being active. In addition, older adults who are sedentary do not have any intention of beginning an exercise program.

King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell and Yeager (1992) reviewed the literature regarding determinants of physical activity and reported that the belief that exercise is of little value was related to early drop-out of exercise programs and exercising less frequently than those with opposite viewpoints and attitudes. Additionally, individuals who perceived themselves as being in poor health were reported to participate less in structured exercise programs.

A study to investigate the relationship between factors and compliance in an exercise program among 639 male subjects was conducted by Andrew, Oldridge, Parker, Cunningham, Rechnitzer, Jones, Buck, Kavanagh, Shephard, Sutton, and McDonald (1981). A 60-item questionnaire was developed by the investigators and was self-administered by the subjects. To measure the attitude of the individual, subjects responded to questions regarding the perceived value and belief in the benefits of
exercise. As expected, those subjects that dropped out early from the exercise program did not have a strong belief in the value of exercise.

Motivation

Self-motivation is reported consistently in the literature to correlate with adherence to physical activity. Noted for his pioneering work in motivation and adherence to therapeutic exercise, Dishman (1981) developed a valid and reliable self-report measure of self-motivation. This Self-Motivation Inventory has been used in many population studies and it has been reported that self-motivation positively correlated with physical activity (King et al., 1992). Dishman, Ickes, and Morgan (1980) found that motivation was attributed to being the best discriminator between those who enroll and adhere to an exercise program and those who enroll and drop out.

The Self-Motivation Inventory was completed by a group of healthy subjects prior to participating in a six-month exercise program (Gale, Eckhoff, Mogel, & Rodnick, 1984). Thirty-three men and 73 women participated. The subjects were grouped according to exercise adherence patterns after program completion and were categorized as early drop-outs, nonadherers, or adherers. Men who were categorized as early drop-outs, i.e., attending less than 10% of exercise sessions, were found to have the lowest self-motivation scores as compared to women of the same category and those with superior attendance rates.

Welsh, Labbe, and Delaney (1991) investigated personality variables and the application of cognitive strategies to adherence to exercise. Twenty-six sedentary women were assigned to two groups to begin a jogging program. One group was given exercise instructions and verbal reinforcement during their exercise, the second group received the
same intervention as group one and they were also taught cognitive strategies to use during their exercise. None of the subjects had attempted a previous running program. Sixty percent of the subjects were at least 20% over ideal body weight. The Self-Motivation Inventory was one of the questionnaires administered at the beginning of the program. During the program, four subjects dropped out from exercising. Six weeks after the completion of the exercise program, a follow-up was conducted and eight subjects had quit exercising; however, 64% were still exercising. Six months following completion of the program, only 17 subjects could be contacted and of those 64% were still exercising. The researchers found no significant overall correlation between scores on the Self-Motivation Inventory and exercise compliance. The average score for the SMI was 132.12 out of a total possible score range of 40 to 200. However, they did find that when comparing the subjects who exercised for a minimum of three times per week with a target heart rate with those subjects that did not, the subjects who complied with exercise had a significantly higher set of scores on the SMI than those subjects who did not comply.

Self-motivation and mood were evaluated at the beginning of a rowing training program in 84 college freshman women (Raglin, Morgan, & Luchsinger, 1990). Physical performance also was initially evaluated with 44 subjects completing a standardized rowing ergometer task. At the end of the training season, 22 women had adhered to the training, while 64 dropped out. It was found that scores on the Self-Motivation Inventory were significantly lower (p<.05) among the drop-outs compared to the adherers. Drop-outs also took significantly longer to complete the rowing ergometer task compared to adherers (p<.05). Data analysis also revealed that ergometer time and self-motivation
correlated (-.47, p < .01), indicating that a shorter time to complete or superior
performance on the rowing ergometer task was associated with higher self-motivation.

**Subjective Norm**

Subjective norm involves the perceived social influence that is predictive of
adherence to exercise after heart transplantation. Social influences are important in
regard to opportunities, behaviors and consequences. One’s motivation to exercise may
therefore be formed by those social influences. However, measuring social influences on
exercise behavior has received very little attention in the research literature.

Booth, Owen, Bauman, Clavisi, and Leslie (2000) identified social-cognitive
variables and perceived social and environmental influences on physical activity. Four
hundred 49 Australian adults age 60 or older were randomly selected to complete a
physical activity questionnaire. This questionnaire was submitted along with the
Population Survey Monitor that was distributed by the Australian Bureau of Statistics.
They assessed for social influence by examining the frequency that family and friends
reported that physical activity appeared good for another’s appearance, if they got upset
regarding the activity the subject wanted to participate in and if they criticized the subject
about the activity in which they wanted to participate. The social reinforcement variable
appearance ("others say activity is good for appearance") was the only variable that was
significantly related to physical activity (p = .01). In addition, those subjects in the
physically active group received a higher percentage of positive social reinforcement
regarding the appearance variable (43.8%) than those in the inactive group (31.7%).
Perceived Behavioral Control

Perceived behavioral control involves the pre-operative, physical, situational, and disease-related factors that are predictive of adherence to exercise after heart transplantation.

Pre-operative Factors

The pre-operative factors studied include number of days on the heart transplant waiting list, functional status, and NYHA Classification.

Waiting list

During the waiting period for heart transplant surgery, the performance of exercise is extremely important. Besides gaining the beneficial effects of exercise, it serves as a diversion from the prolonged undetermined waiting period. Muscle strengthening and aerobic exercise helps condition muscles in an effort to prevent deconditioning that can occur after transplantation.

Each year the number of patients on the heart transplant waiting list continues to increase and the availability of donor hearts decreases. As a result, the waiting time for a donor heart lengthens. At the end of June 2001, there were 4,231 patients awaiting a heart transplant. In the previous six months, over 300 patients died while on the waiting list and over 1,100 received a new heart (UNOS, 2001). The mean waiting time for a transplant candidate in 1999 was 217 days with an approximate mortality rate of 24%.

Severity of illness is associated with the classification of heart transplant candidates according to UNOS and impacts waiting time. Those classified as status I have a more medically unstable condition and are hospitalized usually in an intensive care unit. Individuals in this status may often require invasive hemodynamic monitoring,
mechanical ventilation, diagnostic procedures and the use of vasoactive medications among other interventions. As the waiting period progresses in these individuals, further decompensation ensues increasing the unlikelihood of receiving a heart transplant. Status 2 candidates often reside in their home awaiting organ donation. Although they continue to be functional, their tolerance to physical activity is compromised due to the nature of their disease state. As waiting time for a heart transplant increases, worsening of their disease with increasing signs and symptoms occurs as time progresses and often they are changed to status 1 while on the waiting list for organ transplantation (Tahan, 1998).

As the organ waiting period is prolonged, deconditioning secondary to chronic heart failure becomes more severe (Rader & Vaughn, 1994). Studies have shown that chronic heart failure is associated with abnormal muscle metabolism and skeletal muscle atrophy leading to reduced ability and capacity to exercise (Drexler, 1992).

Transplant waiting time was selected as a clinical variable to determine its predictability of submaximal exercise capacity before hospital discharge and on maximal exercise capacity at approximately four months post hospital discharge in a study by Salyer, Jewell, and Quigg (1999). Total transplant mean waiting time was 122 days ±140 days (SD). Waiting time among the subjects varied between 3 to 516 days. In this study, total transplant waiting time did not correlate with predischarge submaximal exercise capacity (r = .25; p = .24), nor did it correlate with postdischarge exercise capacity. Total transplant waiting time was not predictive of either outcome variable in the study. Because waiting time was found not to be predictive of exercise capacity, this variable needs to be studied further.
Functional status

End-stage heart disease (ESHD) can have profound deconditioning effects on the body. Also, surgery and prolonged hospitalization can result in severe deconditioning on the body. As in chronic heart failure, the pathophysiologic and compensatory events that are associated with the disease often leave the individual bedridden in poor functional status.

The effects of end-stage heart disease are characterized by forward failure of the left ventricle producing a diminished cardiac output and backward failure resulting in pulmonary and hepatic congestion (Futterman, 1988). Signs and symptoms that are characteristic of ESHD are ventricular dilatation and severely diminished systolic ejection leading to myocardial failure, decreased cerebral tissue perfusion producing an alteration in neurological status, and increased respiratory effort. Other signs indicative of right ventricle failure include peripheral edema, atrial and ventricular gallops, hepatomegaly, ascites, jugular vein distention, presence of murmurs and alterations in blood pressure.

Prolonged bedrest and immobility have profound deconditioning effects on the body that result in functional impairments such as impaired ambulation and activity intolerance. The deconditioning effects of prolonged immobility affects all body systems. For example, the cardiovascular responses from prolonged bedrest include decreased cardiac output that contributes to a decrease in aerobic capacity, postural hypotension, increased cardiac workload, and venous stasis. The changes that occur in the musculoskeletal system are muscle atrophy, loss of muscular strength and a decrease in muscle oxidative capacity that contribute to a decline in aerobic and functional
capacity. Additional musculoskeletal changes that occur are osteoporosis, osteoarthritis, and contractures. Other changes that occur are sensory deprivation, pressure ulcers, atelectasis, and hypoxemia (Rader & Vaughen, 1994).

Grady, Jalowiec, and White-Williams (1998) investigated indicators of severity of illness and quality of life six months after heart transplantation. The two indicators studied were NYHA classification and UNOS status. Typically, UNOS status 1 are those individuals hospitalized in the intensive care unit receiving inotropic support or receiving either cardiac or pulmonary mechanical support. UNOS status 2 are all other individuals listed for heart transplantation. In a nonrandom sample of 219 adult subjects, the researchers found that subjects who were UNOS status 1 or NYHA class IV before transplantation were less satisfied with existing state of health and physical functioning at six months posttransplantation. They reported that UNOS status 1 patients experienced significantly more disability in performing ambulation six months after surgery that those in UNOS status 2 category.

NYHA classification

The New York Heart Association (NYHA) classification system was developed as a simple method to measure functional capacity according to the severity of heart failure. As described elsewhere, patients are classified into one of four functional classes that depend on the degree of effort that is needed to elicit symptoms. The symptoms of heart failure worsen when progressing from NYHA class I to class IV due to a decrease in ejection fraction that occurs over time (Packer & Cohn, 1999). As a result, individuals often experience symptoms of angina, shortness of breath and fatigue that result in exercise intolerance.
Riedinger, Dracup and Brecht (2000) performed a secondary analysis on data that were previously collected in the Studies of Left Ventricular Dysfunction. Their aim was to identify predictors of quality of life in 691 women with heart failure with physical functioning as one of the main dimensions in quality of life. NYHA classification was found to be a strong predictor and the second most predictive factor of global quality of life, vigor, intermediate activities of daily living and social activity. They found that as NYHA classification increased there was a decrease in general life satisfaction, vigor, basic and intermediate activity in daily living scores, social activity, and general health. Higher NYHA classification was also associated with an increased perception that the individual’s state of health interfered with the performance of normal activities.

Salyer, Jewell, and Quigg (1999) investigated clinical parameters that would predict submaximal exercise capacity in heart transplant recipients. In their study, they developed their own severity of heart failure score. Transplant recipients were assigned a description code at the time of their surgery to denote this score. The description code was identified as follows: 1 = working or attending school full time, 2 = working or attending school part time, 3 = homebound or failing to thrive, 4 = hospitalized, 5 = hospitalized in intensive care, and 6 = on life support. Of the 24 heart transplant recipients studied, sixteen were hospitalized and eight had been at home awaiting surgery. The mean pretransplant severity of heart failure score was 3.6 (SD ±1.5). Statistical analysis did not show pretransplant severity of heart failure score to be predictive of exercise capacity after discharge from the hospital.
Physical Factors

The physical factors studied include age, weight, ejection fraction, comorbidities, resting heart rate, and resting blood pressure.

Age

Advancing age has been associated with an increasing risk of functional decline and a decrease in the total amount of time spent participating in physical activity. It has been found that physical activity decreases with age starting after late adolescence and the decline in activity continues until after the age of 50 (King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell & Yeager, 1992). Dishman (1994) reports that physical activity may be limited with increasing age due to the deteriorating health of the individual. Exercise maintenance patterns are described as being poor in all age groups especially the older individual according to Emery, Hauck, and Blumenthal (1992). Although almost all the subjects that participated in their study self-reported continuing in physical activity after one year following exercise training, age was not a predictor of exercise behavior or overall activity.

In a research study to identify factors that predict exercise adherence in healthy adults, Gale, Eckhoff, Mogel, and Rodnick (1984) recruited 106 subjects, 33 men and 73 woman to participate in a six-month exercise program. They found that men who were categorized as early drop outs, i.e., attended less than 10% of all exercise sessions, were slightly but not significantly younger than those categorized as nonadherers and adherers combined. However, early drop-out women were found to be significantly younger (27.5 vs. 32.3 years; p< .05).
A study by Ades, Maloney, Savage, and Carhart (1999) was conducted to measure the effect of a three-month exercise rehabilitation program on physical functioning. Physical functioning was determined by using the self-administered Medical Outcomes Short Form Questionnaire. Subject age ranged from 20 to 87 years. Males represented 74.9% (227) of the study sample and females 25.1% (76). The average age for males were 60.0 (SD ± 11.1) and 62.5 (SD ± 12.0) for females. They found that patient age was significantly related to physical function scores that were determined at baseline prior to the exercise program. Older patients who were greater or equal to 60 years of age in the study had lower baseline physical function ($r = -.22; p<.001$).

Salyer, Jewell, and Quigg (1999) investigated exercise capacity after heart transplantation. The mean recipient age of the subjects was 46.0 ±10.5 (SD). Age was not found to be a predictor of predischarge submaximal exercise capacity. However, when they evaluated postdischarge maximal exercise capacity four months after hospital discharge, recipient age was inversely correlated with measured peak exercise oxygen consumption ($VO_2$) ($r = -.43; p<.04$). This finding was expected because for every decade after the age of 25, $VO_2$ declines approximately 9%. Regression analysis identified recipient age and two other variables, postoperative length of stay and time since resolution of rejection, explained 73% of the variance in early posttransplant estimated peak exercise metabolic equivalents (METs). Age contributed 19.9% to the explained variance. In regression analysis of peak $VO_2$, only recipient age entered the model and explained 18.5% of the variance.
Weight

It is estimated that approximately 50 million Americans attempt to lose weight every year (McInnis, 2000). There are many health implications associated with obesity including hypertension, coronary artery disease, diabetes, hyperlipidemia and many musculoskeletal conditions. It has been cited that overweight or obese people participate less frequently in physical activity than normal weight individuals (King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, & Yeager, 1992). In terms of exercise adherence, Dishman (1981) reported that percent body fat was a significant discriminator among exercise program participants and length of time of adherence. He concluded that those individuals who were leaner, lighter and less fit were more apt to continue in the exercise program for a longer length of time.

Gale, Eckhoff, Mogel, and Rodnick (1984) investigated weight as a factor and its relationship to exercise adherence among healthy adult subjects. After six months of group participation in an exercise program, they identified that men and women who were classified as early drop-outs in their exercise program were less fat than those nonadhering and adhering men and women. Comparisons were made between adherers and nonadherers of the exercise program and the results showed that the adhering women had significantly less weight and percent fat (p<.05). However, no significant differences of weight or percent fat existed between adhering and nonadhering men.

Studying factors to predict exercise adherence in women, Klonoff, Annechild, and Landrine (1994) recruited twenty-three subjects to enroll in an aerobics program. The average weight of the subject at initial assessment was 143.77 pounds. They found a significant correlation between exercise adherence and weight (r = .52, p<.005). These
results suggested that heavier subjects were more likely to adhere to the exercise schedule and attend class. Five variables were also reported as being the best subset to predict adherence to exercise and accounted for 73% of the total variance. Among these five factors, weight was included and individually contributed 20.7% to the variance.

Ejection fraction

The ejection fraction is a representation of the fraction of diastolic volume that is ejected from the heart during systole. It is often used as a marker of the state of contractility of the heart or overall left ventricular performance. Cardiopulmonary fitness is essential for the performance of physical activity and exercise. A principal factor in the performance of exercise is the ability of the heart, lungs and circulation to deliver adequate oxygen to the working muscles. Activity intolerance develops when there is a lack of supply of energy sources. Disease states such as myocardial infarction and heart failure can decrease ejection fraction, and cause pain and fatigue, all of which can influence the balance of energy needed for the performance of activity.

Very little information exists in the research literature utilizing ejection fraction as a marker to predict exercise tolerance. In fact, Sullivan and Hawthorne (1995) reported in a published review of heart failure and exercise intolerance that left ventricular ejection fraction predicts exercise tolerance only to a limited extent.

Clarke, Frasure-Smith, Lesperance, and Bourassa (2000) conducted a secondary analysis on data from the Studies of Left Ventricular Dysfunction (SOLVD) Prevention and Treatment trials for the purpose of identifying predictors of functional status in patients with left ventricular dysfunction. The variables explored were psychological, social, and physiological. Two thousand nine hundred ninety-three subjects selected for
this study had documented left ventricular ejection fraction of less than or equal to 35%. Mean ejection fraction of the sample was 26.7% (SD ±6.4). A global conclusion was made concerning several variables and it was stated that individuals with low left ventricular ejection fraction, who had highly anxious or depressed moods or low vigor levels, lower socioeconomic status and were non-White had an increased probability of having serious limitations associated with ADL functions.

**Comorbidities**

Physical activity plays a primary and secondary prevention role in cardiovascular disease, reduces the risk of cancer, improves muscle and joint function and builds healthy bones in those with bone or joint problems, and has psychological benefits (American Heart Association, 2001). However, the presence of diseases or conditions, whether primary or secondary to treatment or medications, can hinder and impair the ability of the individual to perform exercise. Some prevalent cardiovascular comorbidities include angina, myocardial infarction, heart failure, cerebrovascular disease and peripheral vascular disease. Arthritic or spine-related comorbidities include knee or hip arthritis, osteoporosis, disc disease or spinal stenosis. Other comorbidities that are prevalent are diabetes mellitus, chronic obstructive pulmonary disease, Parkinson’s disease, and cancer (American Association of Cardiovascular & Pulmonary Rehabilitation, 1999; McDermott, Liu, O’Brien, Guralnik, Criqui, Martin, & Greenland, 2000).

In myocardial infarction, the cardiopulmonary and hemodynamic response to submaximal and maximal exercise is often altered and results in a subnormal aerobic capacity (Franklin, 1997). This response is due to a decrease in cardiac output. Scarring of the left ventricle can further cause a progressive decline in ejection fraction and stroke
A common cardiac symptom during exercise is angina and it is often a diagnostic indicator of coronary artery disease. Although angina is predictable during exercise in those diagnosed with stable angina, it can become unstable and progress to an acute myocardial infarction (Friedman, 1997). Heart failure has a number of abnormalities that affect the acute response to exercise and involve central, peripheral and ventilatory factors. A reduced cardiac output is the central feature that leads to a poor exercise response. Other features include poor lung ventilation and perfusion leading to shortness of breath, leg fatigue due to blood flow abnormalities and changes in skeletal muscle metabolism that leads to changes in muscle fiber types among others. Cerebrovascular disease such as stroke or head injury may interfere with the ability to exercise and is dependent upon the extent of the injury. Injury involvement may be demonstrated as spasticity or weakness of the extremities, balance impairment, aphasia and mental confusion (Palmer-McLean & Wilberger, 1997). The main effect of peripheral vascular disease is claudication due to inadequate blood flow to the legs.

Arthritic conditions have both articular and systemic involvement and can affect pulmonary and cardiac function in addition to causing vasculitis. Acute inflammation of the joints can cause pain, swelling and stiffness leading to restricted range of motion and deconditioning of the muscles (Minor & Kay, 1997). Osteoporosis frequently leads to bony fractures that can hinder the performance of exercise. Vertebral fractures are often common and can lead to kyphosis and result in frequent falls (Bloomfield, 1997).

Diabetes mellitus predisposes the individual for developing microvascular complications that include peripheral neuropathy, retinopathy, nephropathy and others. Also, endogenous insulin concentrations do not respond normally during exercise. This
results in an imbalance between peripheral glucose utilization and glucose production by the liver (Albright, 1997).

The effect of chronic pulmonary diseases on the exercise response is varied depending on the primary impairment involved with the disease. Many individuals may experience impaired expiration with obstructive disease and decreased inspiratory capacity with restrictive diseases. These result in increased respiratory rates, hyperinflation, diminished tidal volumes and worsening respiratory efficiency (Cooper, 1997).

In Parkinson’s disease, there is dysfunction of the autonomic nervous system that interferes with thermal regulation, heart rate, blood pressure and position changes during exercise. Also, exercise efficiency is decreased due to muscle rigidity, loss of upright posture and movement disorders that are often seen in Parkinson’s. As a result, heart rate and oxygen consumption may be higher during submaximal exercise (Protas, Stanley, & Jankovic, 1997).

Cancer and its effect on exercise is dependent on the manifestation of symptoms and the prescribed treatment to eradicate the cancer cells. Overall, individuals undergoing cancer therapy are easily fatigued. Surgical procedures can cause pain, loss of movement and flexibility and sensory and nerve damage. Many chemotherapeutic agents can cause cardiomyopathy, anemia and pulmonary fibrosis all affecting the ability to exercise (Selby, 1997).

A study to examine the effects of physical functioning and cardiac rehabilitation was conducted by Ades, Maloney, Savage, and Carhart (1999). Three hundred three subjects with known coronary heart disease were selected to participate in three months
of exercise training as part of a rehabilitation program. The ages ranged from 20 to 87 years and 74.9% of the subjects were male. Baseline data collection consisted of the Medical Outcomes Short-Form Questionnaire, Geriatric Depression Questionnaire, symptom-limited exercise treadmill test, strength measures, and assessment of the presence of comorbid conditions. Comorbid conditions, if present, were quantified by their severity. The comorbid score was identified as follows: 1 = comorbid condition present by not exercise limiting, 2 = present and resulted in an impact on the exercise response, and 3 = exercise limiting. The comorbid conditions assessed for were diabetes, cerebrovascular disease, peripheral vascular disease, chronic obstructive pulmonary disease and arthritis. Comorbidity was found to be a significant predictor of the subject's baseline physical function score (r = -.23, p = .001) along with maximal exercise capacity, peak aerobic capacity, leg and upper body strength, depression score and age. The presence of comorbidities predicted poor physical function in this group of subjects.

Caruso, Silliman, Demissie, Greenfield, and Wagner (2000) used a cross-sectional study design to study factors predictive of impaired physical function specifically in individuals with Type 2 Diabetes. One thousand two hundred thirty-eight individuals who were 55 years or older completed a mailed questionnaire that included the Short-Form 36, health behaviors, demographic and diabetic information, comorbidity questions, and assessment of depression. They found eight independent variables that predicted impaired physical function (R² = .40, p< .05). Of these eight variables, comorbidity as measured by the Total Illness Burden Index, had the strongest association with impaired physical function.
Resting heart rate and blood pressure

The physiologic variables, resting heart rate and resting blood pressure and their association with exercise program participation and adherence has received very little consideration in the research literature. A retrospective study by Dishman (1981) investigated biological variables and their association with exercise adherence and coronary heart disease. Profiles for male subjects were retrieved from an exercise program that was conducted over a five-year period. The parameters assessed that are pertinent to this study were resting heart rate, resting systolic and diastolic blood pressure, maximum exercise heart rate, and maximum exercise systolic and diastolic blood pressure. The results of the study did not show these variables to discriminate between the exercise program participants and exercise adherence (p > .44 to .90).

Resting heart rate and resting systolic blood pressure were two variables included in the investigation of exercise adherence for healthy adults as described earlier (Gale, Eckhoff, Mogel, & Rodnick, 1984). Of the 33 men and 73 women participating in the study, no correlation was found between these variables and adherence rates to an exercise program (r = .203, r = .028).

Situational Factors

The situational factors studied include support system, financial concerns, convenience, and climate.

Support system

The degree of social support provided to an individual impacts adherence to the performance of exercise. Positive reinforcement or social support has been cited consistently in the research literature to be related to an increase in adherence to exercise.
Andrew, Oldridge, Parker, and colleagues (1981) investigated personal, psychosocial, and program-related factors and their relationship to exercise compliance in post-coronary patients. Seven hundred twenty-eight subjects were randomly assigned to either a high intensity exercise program or low intensity program based on the risk factors of occupation, personality, hypertension, and angina. A 60-item self-administered questionnaire was distributed to the subjects and they received an 87.8% response rate. Of the total respondents, there were 266 drop-outs and 373 compliers to the exercise program. It was found that the drop-out rate of those subjects without spousal support (i.e., spouses were indifferent or negative toward the exercise program) was three times higher than of those subjects who had spousal support.

Gale, Eckhoff, Mogel, and Rodnick (1984) investigated factors relating to exercise adherence among healthy adults. Thirty-three healthy men and 73 women participated in a group exercise program for six months, three times per week. Batteries of tests were conducted prior to the initiation of the exercise program and attendance was recorded daily. Analyzing the results, they found that being single was more prevalent in those subjects classified as early drop-outs (p < .05).

Rogers (1987) studied spousal behaviors that influence the compliance of heart transplant patients. This descriptive study consisted of six postoperative heart transplant recipients, four men and two women. Subjects were interviewed by the investigator using an open-ended, semistructured questionnaire guide in order to elicit responses regarding their perceptions of their spousal support. This study did not measure spousal support or compliance. The information obtained from the study suggested that the supportive behaviors from spouses are primarily informational in nature. Concerning
exercise, spouses suggested taking walks with the patient, suggested alternate ways of exercising indoors, and provided daily rest periods. To help the subjects maintain their routine exercise program, all spouses were reported to have participated with the subjects in their daily walking or bicycling.

In a literature review by King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, and Yeager (1992) they reported that investigators Dubbert, Stetson, and Corrigan (1991) studied predictors of exercise maintenance in women and found that family participation and family support strongly predicted exercise maintenance among women; however, it was not found to be supportive in men. Other researchers have also reported spousal support and attitude as being a highly important and consistent influence on adherence to participation in exercise programs (Dishman, 1982; Heinzelmann & Bagley, 1970).

Financial concerns

Participation in structured exercise programs at local gyms or health clubs can be quite expensive and become a barrier to performing exercise. Inadequate or unavailable financial resources are a common reason for the lack of participation in exercise programs where fees are required. Costs involved in purchasing gear and equipment can also add to the expense. Available research on program factors, i.e., costs, and their relationship to exercise adherence are limited (King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, & Yeager, 1992).

Heart transplant recipients have already endured a tremendous medical cost beginning in the pretransplant stage. Frequent hospitalizations, the need for inotropic and mechanical support, pretransplant evaluation workup, the waiting time, the surgical
procedure, medications, and frequent posttransplant diagnostic evaluations all contribute to financial strain for the individual and their family (Muirhead, 1989). In addition, the added burden of loss of employment due to the many hospitalizations further increases financial strain.

Campbell and Etringer (1999) surveyed 300 heart transplant recipients who were 6 months to 12 years posttransplantation for the purpose of identifying quality of life indicators, presence of depression, and compliance related behavior. Of the 185 heart transplant recipients that responded, 27.8% reported that finances were a problem after transplantation. Finances were among the five most significant problems identified.

Convenience and climate

The physical environment can either help or hinder the performance of physical activity and its adherence. In a review of the application and promotion of exercise by Martin and Dubbert (1982), it was stated that investigational studies have found that the location of the exercise program was inconvenient and detracted significantly from adhering to participation. A review by Dishman (1994) regarding motivation and exercise among older adults states that older adults living at home are more likely to engage in exercise in the atmosphere of their own home than in a structured and supervised environment. However, Shephard (1985) comments that the convenience of exercising in a group results in an increase in exercise adherence rates because it provides an opportunity for socializing and it is preferred for the extroverted individual.

A review on “Physical activity, nutrition, and chronic disease” was published by Blair, Horton, Leon, Lee, Drinkwater, Dishman, Mackey, and Kienholz (1996). Reviewing those barriers that prevent the adoption of a healthy lifestyle, it was reported
that inaccessibility to exercise facilities is one of two main reasons for not initiating or continuing with an exercise program, the other reason is lack of time. It was important to note that the perception of barriers differed among populations, age groups, and exercisers and nonexercisers.

In other literature reviews, lack of time is consistently reported to be a significant barrier and reason for dropping out of exercise programs (Dishman, Sallis, & Orenstein, 1985; King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, & Yeager, 1992; Martin & Dubbert, 1982).

Personal, psychological, and program-related variables and their relationship to exercise compliance in post-coronary patients were studied by Andrew, Oldridge, Parker et al. (1981). Seventy-two hundred twenty-eight subjects were randomly assigned to either a high intensity exercise group or a low intensity exercise group based on four prognostic risk factors as previously discussed.Completion of a 60-item questionnaire by the subjects resulted in 266 drop-outs and 373 compliers to the exercise program. The category of center inconvenience was reported to be significantly related with the high drop-out rate of subjects. The three questions that were perceived as significant were as follows: difficult to attend on time, inconveniently located, and difficulty with parking at the facility.

Disease-related Factors

The disease-related factors studied include rejection factors, length of hospitalization, and symptoms.
Rejection factors

Allograft rejection after heart transplantation is a major complication and common cause of mortality despite improvements in immunosuppression. The highest incidence of acute rejection occurs within the first month after transplantation. It is attributed to a reaction of the immune system of the recipient to the human leukocyte antigens of the donor heart (Rourke, Droogan, & Ohler, 1999). Histologically, acute rejection is characterized by diffuse inflammatory infiltration of mononuclear cells, myocardial necrosis and hemorrhage and myocardial edema (Niset, Hermans, & Depelchin, 1991). Hemodynamic instability due to left ventricular diastolic dysfunction results with an accompanying loss of the Frank-Starling mechanism. Reduced cardiac compliance is responsible for the reduction in stroke volume and cardiac output that is evident during exercise. Rejection also results in a dramatic reduction in vasodilatation capacity of the coronary vessels, thereby exposing the myocardium to an increase in oxygen demand. For these reasons, heart transplant recipients often stop all physical activity during rejection periods.

Cupples (1997) provided a comprehensive review of heart transplantation and women. She reported that investigational studies have found, that among female recipients of heart transplantation, there was an increased occurrence of rejection. An increase in rejection episodes was more significant within the first 30 days, at 4 months, and at 12 months after transplantation. Forty-seven percent more females had experienced rejection than males. It was also noted that women had required more immunosuppression therapy and significantly higher doses of prednisone.
Again, Salyer, Jewell, and Quigg (1999) investigated time (days) since resolution of rejection as a clinical variable to determine its effect on exercise capacity in heart transplant recipients. The number of days since the resolution of the last rejection episode in the subjects was approximately 18. Most subjects experienced only one rejection episode within the first four months after transplantation. The number of days to resolve the rejection episode varied between one and 65 days among the subjects. The results showed that time since resolution of rejection was positively correlated with estimated METs at peak exercise at four months after hospital discharge ($r = .55$, $p = .006$). Time since resolution of rejection also was one of three clinical variables that explained 73% of the variance in predicting early peak exercise METs in the posttransplant period. Individually, it contributed 29.6% of the explained variance. This study found that the longer since the last rejection episode, the better their exercise capacity.

**Length of hospitalization**

Uneventful planned surgical procedures usually have a predetermined number of hospital days that an individual will spend recuperating prior to his/her discharge home. It is logical to predict that any occurrences that involve postoperative complications, noncompliance, pre-operative medical condition of the patient, history of addictions, or any functional disability would prolong the hospital length of stay in the postoperative period. Likewise, in the heart transplant recipient, an episode of allograft rejection may also prolong hospitalization. As the number of days of hospitalization increases, the patient is delayed from returning to self-care and full activities of daily living. Thus, recommendations to participate in a rehabilitation program are postponed.
Grady, Haller, Grusk, and Corliss (1990) analyzed the medical records of 65 heart
transplant recipients (12% female, 82% male) in a retrospective study to determine
factors that predict hospital length of stay. The range of hospital length of stay was 15 to
45 days with an average of 24.4 days reported. Three models were generated to predict
length of stay from the data analysis. The factors that represented the pre-operative
model that were significantly related to length of stay were diagnosis, severity of heart
failure, duration of heart disease symptoms and pulmonary vascular resistance. As a
group, these factors accounted for 36% of the variance in length of stay. The second
model included the addition of donor information such as ischemic time, donor sex and
age and size. This model did not account for an appreciable increase in the variance. In
the third model, postoperative factors were added and accounted for 71% of the variance
in hospital length of stay. The significant variables in the final model were duration of
pretransplant cardiac symptoms, pulmonary vascular resistance, pre-operative severity of
heart failure, incidence of postoperative rejection, and transplant program experience.

Psychosocial and medical predictors of hospital length of stay after heart
transplant surgery have been studied. Grady, Jalowiec and White-Williams (1999)
studied pre-operative psychosocial variables and their relationship with hospital length of
stay after heart transplantation in 307 subjects. The sample of subjects consisted of 79%
males and 21% females. The mean length of stay for their subjects was 19.1 days (SD
±13.1). Five variables had significant differences on length of stay. Those subjects with
a history of smoking, no history of drug abuse, no financial problems, an adequate
understanding of heart failure and treatment, and complied with pretransplant medical
regime had a longer length of stay. Other pre-operative variables that correlated with
longer length of stay included greater emotional disability and less satisfaction with significant others and with psychological areas of life. Symptoms related to dermatological or soft tissue, self-care and ambulation functional disability and a decrease in satisfaction related to health, and stress related to work, school or finances showed a significant relationship with longer hospitalization.

Studying predictors of exercise capacity after heart transplantation, Salyer and coworkers (1999) found that their subjects had a posttransplant hospital length of stay of 14 to 44 days. Although postoperative length of stay did not correlate with either predischarge submaximal or postdischarge maximal exercise capacity, it did significantly explain 73% of the variance, along with two other clinical variables, regarding estimated peak exercise METs in the early posttransplant period. By itself, posttransplant length of stay contributed 23.6% to the explained variance of postdischarge estimated peak exercise METs. They concluded that a longer length of hospitalization can result from complications occurring in the postoperative period. This can add to the deconditioning effects already seen in the pre-operative phase and may then have an unfavorable effect on peak exercise METs in early postdischarge.

Symptoms

The presence of physical symptoms has been associated with exercise adherence. A negative relationship has been reported to occur between the number of symptoms and exercise adherence; in other words, there is a tendency of individuals who experience many symptoms to exercise less. On the other hand, individuals who have many symptoms and are aware of the beneficial effects of exercise and the potential to alleviate symptoms may actually adhere to a greater extent to an exercise program.
As a result of the nature of the disabling disease or condition or due to the heart transplant surgery itself, afflicted individuals commonly experience a variety of physical symptoms. End-stage heart disease patients awaiting a heart transplant reported the following symptoms occurred often: fatigue, shortness of breath and problems with physical strength and stamina. Other symptoms that occurred with moderate frequency included fluid retention, pain, lack of sleep, poor concentration and sexual dysfunction (Muirhead, Meyerowitz, Leedham, Eastburn, Merrill, & Frist, 1992).

After heart transplant surgery, the individual often experiences a new host of physical symptoms due to the surgery itself, its potential complications or the effect of immunosuppression therapy. Lough, Lindsey, Shinn, and Stotts (1985) studied life satisfaction after heart transplantation and found that all 75 subjects experienced side-effects due to immunosuppression. Those symptoms that occurred often or always were bruises, fragile skin, changes in body and facial appearance, poor vision, lack of sleep, sexual dysfunction, poor concentration, depression, mood swings, overeating, and excessive hair growth.

A comprehensive assessment was performed on symptoms three months following heart transplantation in a study by Jalowiec, Grady, White-Williams, Fazekas, Laff, Davidson-Bell, Kracht, & Wilson (1997). As part of a 10-year prospective design study, 173 subjects completed a study booklet at three months after heart transplantation. Seventy-nine percent were male and 21% were female. The results showed a significant decrease in total symptom distress from before the heart transplant surgery to three months following the surgery ($t = 2.52, p = .013$). Of the 23 symptoms that decreased significantly, 11 were cardiopulmonary (i.e., shortness of breath on exertion, orthopnea,
palpitations, shortness of breath when sitting, coughing, chest pain, chest tightness, wheezing, brady/tachycardia and pounding heart). Five symptoms were neuromuscular: lethargy, fatigue, insomnia, weakness, and restlessness. Three were categorized as emotional symptoms: anxiety, fear, and depression. Nausea and anorexia were the two gastrointestinal symptoms that decreased. One genitourinary symptom that significantly decreased was difficulty in sexual performance. It was found also in the study that some symptoms persisted despite the heart transplant surgery. These symptoms were fatigue, weakness, insomnia, lethargy, depression, anxiety, sexual problems, exertional shortness of breath and tachycardia. Analysis of symptom distress showed that 10 symptoms (p = .000) significantly increased in severity. These 10 symptoms were puffy face, hirsutism, changes in facial and body features, acne, tremors, leg cramps, problems with taste, feeling hungry and overeating.

Klonoff, Annechild, and Landrine (1994) investigated the impact of a variety of psychological, physical and biological factors on exercise adherence. Twenty-three women were recruited to participate in a free aerobics exercise program offered on a university campus. The investigators found that a combination of five variables—height, weight, physical symptoms, trait anxiety, and intensity of day-to-day hassles—best predicted exercise adherence in their normal sample. These five reported variables accounted for 73% of the variance in the number of exercise sessions attended by the subjects and also correlated (r = .855) with the number of attended sessions. Physical symptoms alone contributed 18.7% of the variance. The results of this study suggest that individuals are likely to adhere to an exercise program if they are overweight, experience several mild symptoms and are mildly anxious.
In a retrospective research study conducted by Dishman (1981), data from files on 362 males were retrieved that consisted of physiologic and morphologic variables, and medical and exercise history. In reference to symptoms, Dishman reported a significant relationship between coronary disease and adherence. He found that individuals in three classification groups that experienced more physical symptoms associated with coronary disease were more apt to be long-term adherers to an exercise program and attended more days in the exercise program than did asymptomatic patients in two groups combined. He concluded that individuals who experience more symptoms showed greater adherence possibly in an attempt to alleviate or impede coronary artery disease and its associated symptoms.

**Summary**

In summary, this chapter included a review of the theoretical framework, The Theory of Planned Behavior. Seventeen independent variables were identified and discussed in relation to the theoretical framework. The literature review presented all study variables and relevant research studies. Chapter 3 describes the methodology for the study.
CHAPTER 3
METHODOLOGY

The purpose of this study was to identify psychological, disease-related, physical, situational and pre-operative factors and perceived social influences that are predictive of adherence to exercise after heart transplantation. A secondary purpose was to identify the combination of these factors that best predict adherence to exercise after heart transplantation. Described in this chapter are the research design, human subjects protection, sample, setting, major study variables, extraneous variables, measurement, data collection procedure, data analysis, and limitations.

Research Design

The research design chosen for this study was a nonexperimental predictive design that was appropriate for the purpose of identifying predictors of adherence to exercise in heart transplant recipients. According to Burns and Grove (1997), predictive research designs enable the investigator to predict the value of a dependent variable based on the values obtained from other independent variables. Prediction attempts to explore causal relationships between different variables. The predictive design in this study used retrospective information to determine the relationships among the major study variables. In other words, the proposed cause and effect has already occurred. Identifying predictors of exercise adherence after heart transplantation will allow the development of studies to evaluate specific treatment and exercise protocols for heart transplant recipients with the goal of improving exercise adherence in this population.
Human Subjects Protection

Prior to implementing the research project, approval to conduct the study was obtained from the University of Florida Human Subjects Committee, and the Human Investigations Committee at Emory University where the study was conducted. Informed consent (Appendix A) was obtained from each subject prior to enrolling them in the study.

Confidentiality was maintained by coding the data obtained from each patient’s questionnaires with an identification number. The collected data were kept in a locked file cabinet to further assure confidentiality. The data were collected for statistical purposes only. Findings of the study were reported as group data. No individual patient was identified.

Sample

The nonrandom convenience sample for this research study consisted of those adult patients who had heart transplantation surgery six months prior to their participation in this study. The subjects selected for this study were recruited from an accessible patient population at the Transplant Outpatient Services Clinic at Emory University Hospital. It was anticipated based on the number of heart transplant surgeries performed during the previous years, this hospital clinic would have an adequate population of heart transplant patients from which a sufficient sample size could be obtained.

Initially, a total of 40 subjects were deemed an adequate sample size to address the research questions. This sample size was based on a formulation of 80% power, a critical effect size of 0.50, a significance level of 0.05 for a two-tailed test, and realizing at least 10 variables that would significantly explain the adherence. Due to death of
subjects, noncompliant behavior, and a decrease in the total number of heart transplant surgeries performed, only 16 subjects were recruited to participate in this study.

**Inclusion and Exclusion Criteria**

Inclusion criteria for selection of subjects for this study included the following:

- Adult subjects 18 years or older of either sex, received and survived heart transplant surgery, ability to read and write English, free of organ rejection, absence of significant cognitive deficit, and six months post-operative heart transplant surgery. Exclusion criteria for selection of patients for this study included the following: presently in a state of organ rejection. Organ rejection was determined by endomyocardial biopsy as performed by the transplant surgeon and/or cardiologist. Endomyocardial biopsy is currently the gold standard for detection of heart rejection (Rourke, Droogan, & Ohler, 1999).

The inclusion and exclusion criteria were selected according to the following rationale. Subjects must be 18 years or older in order to provide legal consent for participation in the study and to preserve autonomy (Burns & Grove, 1997). Subjects may be either male or female. Elimination of subjects based on gender limits the potential for obtaining an adequate sample size at the proposed institution. Controversial reports have been cited in the literature regarding the differences in gender in terms of exercise adherence and are discussed further under the section on extraneous variables (Emery, Hauck, & Blumenthal, 1992; King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, & Yeager, 1992). The population to be investigated in this study was post-operative heart transplant recipients and the time frame for data collection was set at six months post transplant. Therefore, subjects must have
successfully undergone heart transplant surgery and must be surviving six months later. Six months was selected as the time period to study the subjects for the following reasons: sternal precautions after surgery are implemented for approximately six weeks and range-of-motion may be limited for 8–10 weeks (Keteyian & Brawner, 1997); the highest incidence of acute rejection after surgery is within the first three months (Seifert, 1994), and approximately 50% of individuals participating in exercise programs dropout within the first 3–6 months (Dishman, 1982). To complete the self-administered questionnaires designed for this study, subjects must be able to read and write in the English language, and be free of any cognitive deficits that would interfere with completing the questionnaires. Subjects must also be free of organ rejection at the time the study was conducted because this study measured their adherence to prescribed exercise. If a subject was in a state of recent active organ rejection with abnormal cardiac function, the physicians at the transplant clinic would routinely have all patients stop all physical activity and exercise. Acute rejection usually is associated with left ventricular diastolic dysfunction, loss of cardiac compliance, and reduced coronary vasodilatation capacity, predisposing the heart to an increase in oxygen demand, thus, interfering with the performance of exercise (Niset, Hermans, & Depelchin, 1991). Patients are allowed to resume exercise when clinically stable and absent from rejection. The rationale for the exclusion criteria of organ rejection is as previously stated.

**Setting**

This study was conducted at the Transplant Outpatient Services Clinic at Emory University Hospital located in Atlanta, Georgia. This hospital was located in a metropolitan city in the Southeastern United States with a population of approximately
3.5 million persons. Emory University Hospital is a 435-bed adult tertiary care facility and teaching hospital and has the largest transplantation center in Georgia. The transplant program began performing heart transplant surgery in 1988 and has performed a total of 370 surgeries. The average yearly number of heart transplants done at this center is 29. In the previous two years, 29 were performed in 1999 and 28 in 2000. The one-year survival rate after successful transplantation is 92%. The primary surgical technique used at Emory is biatrial. The average age of the transplant recipient is 46.7 years old. Yearly, approximately 78% are male and 22% are female.

The Transplant Outpatient Services Clinic at Emory University Hospital is located on the second floor and consists of seven examination rooms, two stretcher bays, and an area for five recliners. The clinic provides services of pre-transplant evaluation, post-transplant follow-up care, ambulatory care and laboratory services. The patient population consists primarily of an adult population who are transplant recipients of a variety of solid organs including liver, pancreas, lung, heart, renal, and small bowel.

**Definitions of Major Study Variables**

For purposes of this study, the major study variables were defined as follows:

**Exercise Adherence**

The major outcome variable is exercise adherence. Exercise adherence is conceptualized as continuation and progression of daily performance of physical activity after hospital discharge as prescribed. It is operationalized as the independent daily performance of walking and/or bicycling and prescribed exercises after discharge from the hospital.
Attitude Toward the Behavior Variables

Attitude is conceptualized as an expression of one’s feelings or thinking. It is operationalized as the expressed positive or negative evaluation of performing exercise as measured by question 1 on the Adherence to Exercises Questionnaire II.

Motivation is conceptualized as the intention or inherent drive of the person to act or perform a behavior. It is operationalized as the intention or inherent drive of the person to perform exercise as measured by the total score on the Self-Motivation Inventory Questionnaire.

Subjective Norm Variables

Perceived Social Influence is operationalized as the perceived degree of influence others have regarding participation in exercise on a regular basis as measured by question 2 and 3 on the Adherence to Exercise Questionnaire II.

Perceived Behavioral Control Variables

Number of days on heart transplant waiting list is operationalized as the total number of days between the initial listing on the UNOS heart transplant waiting list and receiving the donor organ. Data on the number of days on the heart transplant waiting list were obtained from the patient’s heart transplant clinic record and were recorded in answer to question 1 on the Adherence to Exercise Questionnaire III.

Functional status is conceptualized as the physical ability of the individual to function in everyday life. It is operationalized as the physical ability of the study participant six months preceding heart transplant surgery and described as bedridden, ambulating or exercising as measured by question 4 on the Adherence to Exercise Questionnaire II.
New York Heart Association (NYHA) Classification is conceptualized as a classification of heart disease based on the relationship between symptoms and the amount of effort required to provoke those symptoms. It is operationalized as a classification of heart disease: Class I is cardiac disease without resulting limitations of physical activity; Class II is slight limitation of physical activity, comfortable at rest but ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain; Class III is marked limitation in physical activity, comfortable at rest, but less than ordinary physical activity causes fatigue, palpitation, dyspnea, or anginal pain; and Class IV is the inability to carry out any physical activity without the discomfort or symptoms at rest. (Braunwald, 1992). Data on classification of heart disease were obtained from the patient’s heart transplant clinic record and were recorded in answer to question 2 on the Adherence to Exercise Questionnaire III.

Age is operationalized as the chronological age of the individual at the time of study entry and was measured in years. Chronological age was obtained from the patient’s heart transplant clinic record and was recorded in answer to question 3 on the Adherence to Exercise Questionnaire III.

Weight is operationalized as the weight of the individual at the time of study entry and was measured in pounds. Weight was obtained from the patient’s heart transplant clinic record and was recorded on item 4 on the Adherence to Exercise Questionnaire III.

Ejection fraction is conceptualized as the percentage of preload volume ejected from the left ventricle per heart beat. It is operationalized as the percentage of ventricular diastolic volume ejected from the left ventricle with each beat as measured during cardiac catheterization and expressed in percent. Data on ejection fraction were obtained from
the patient’s heart transplant clinic record and recorded as the answer to question 5 on the Adherence to Exercise Questionnaire III.

Comorbidity is conceptualized as the presence of other diseases or conditions. It is operationalized as the total number of other diseases or conditions currently present that may interfere with the ability to exercise. Data on comorbidity were obtained from the patient’s heart transplant clinic record and recorded in answer to question 6 on the Adherence to Exercise Questionnaire III.

Resting heart rate is operationalized as the heart rate of the individual taken at rest and measured in beats per minute. Resting heart rate was obtained from the patient’s heart transplant clinic record and recorded as the answer to question 7 on the Adherence to Exercise Questionnaire III.

Resting blood pressure is operationalized as the blood pressure of the individual taken at rest and measured in mmHg on the sphygmomanometer. Resting blood pressure was obtained from the patient’s heart transplant clinic record and recorded as the answer to question 8 on the Adherence to Exercise Questionnaire III.

Support system is conceptualized as the availability of others to provide positive reinforcement regarding exercise. It is operationalized as family, friends and other significant persons who directly give positive support to the study participant as measured by question 5 on the Adherence to Exercise Questionnaire II.

Financial concerns is operationalized as the availability of personal finances to pay for applicable exercise fees as measured by questions 6 and 7 on the Adherence to Exercise Questionnaire II.
Convenience is operationalized as the relative ease or accessibility that is experienced by the study participant in order to initiate exercise and measured in regard to location and time as measured by questions 8, 9, 10, 11, 12, and 13 on the Adherence to Exercise Questionnaire II.

Climate is operationalized as the climate or weather condition that exists in which the study participant exercises and is classified as either outdoors or indoors and measured as the degree in which it interferes with the performance of exercise as measured by questions 14 an 15 on the Adherence to Exercise Questionnaire II.

Number of rejection episodes requiring pharmacological therapy since surgery is operationalized as the total number of rejection episodes occurring since the surgical procedure experienced by the study participant that were treated with immunosuppressive medications. Data on the number of rejection episodes requiring pharmacological therapy since surgery were obtained from the patient’s heart transplant clinic record and recorded in answer to question 9 on the Adherence to Exercise Questionnaire III.

Number of rejection episodes not requiring pharmacological therapy since surgery is operationalized as the total number of rejection episodes occurring since the surgical procedure experienced by the study participant that were not treated with immunosuppressive medications. Data on the number of rejection episodes not requiring pharmacological therapy since surgery were obtained from the patient’s heart transplant clinic record and recorded in answer to question 9 on the Adherence to Exercise Questionnaire III.

Number of days since last rejection is operationalized as the total number of days between the last day of the last rejection episode and the time of entry into the study.
Data on the number of days since last rejection were obtained from the patient’s heart transplant clinic record and recorded in answer to question 10 on the Adherence to Exercise Questionnaire III.

**Number of days of hospitalization after surgery** is operationalized as the total number of days of hospitalization from the day of surgery until the first discharge out of the hospital. Data on the number of days of hospitalization after surgery were obtained from the patient’s heart transplant clinic record and recorded in answer to question 11 on the Adherence to Exercise Questionnaire III.

**Symptoms** is conceptualized as the perception of an abnormal physical, emotional, or cognitive change in the body or its function in relation to disease or treatment. It is operationalized as the perception of changes in the body related to heart disease, heart failure, heart transplantation, medication side effects and complications and that can be categorized as psychological, neuromuscular, cardiopulmonary, gastrointestinal, genitourinary or dermatological as measured by questions 16, 17, 18, 19, 20, 21, 22, 23, and 24 on the Adherence to Exercise Questionnaire II.

**Extraneous Variables**

There are a number of variables that were not included in this study that may have had the potential of impacting the study findings. These variables included gender, education, smoking, heart transplant surgical technique, and previous participation in exercise.

Gender may have had an impact on the study findings because a review of the literature identified that women attain lower vigorous physical activity levels especially at younger ages (Sallis, Hovell, & Hofstetter, 1992). However, with the addition of light
and moderate exercise, there is no difference between gender (King, Blair, Bild, Dishman, Dubbert, Marcus, Oldridge, Paffenbarger, Powell, & Yeager, 1992). Gender was not found to be a predictor of exercise adherence one year after participating in a randomized exercise program (Emery, Hauck, & Blumenthal, 1992).

Education has been reported to be positively correlated with participation in regular exercise in middle-aged adults (Rhodes, Martin, Taunton, Rhodes, Donnelly, & Elliot, 1999). A primary reason cited for this positive correlation is that higher education may increase the awareness of the associated health benefits of exercise and, also, enhance the subjective norms related to exercise among those with greater education. Mullineaux, Barnes, and Barnes (2001) also found that the individual who possessed greater education was more likely to engage in physical activity to promote health. As a result, education may have potentially impacted the findings of this study.

An inverse relationship has been shown to exist between smoking and the performance of habitual exercise (Criqui, Wallace, Heiss, Mishkel, Schonfeld, & Jones, 1980). In addition, individuals who smoke are less likely to join exercise programs (Massie & Shepard, 1971) and those that do participate in a structured program drop out early (Oldridge, Wicks, Hanley, Sutton, & Jones, 1978). On the other hand, a past and present history of smoking did not affect adherence and exercise patterns according to Gale, Eckhoff, Mogel, and Rodnick (1984). For these reasons, smoking may have had the potential to impact the findings of this study.

The heart transplant surgical technique refers to the technique that is used to anastomose the donor heart to the recipient’s coronary vessels and is identified as biatrial or bicaval. Because of the technical difficulties associated with the biatrial technique and
benefits of the bicaval technique, as previously described, the surgical technique used may have potentially impacted the findings of this study.

Previous participation in exercise may also have had an impact on the study findings. Concerns for this factor are of importance because research studies have shown that in supervised exercise programs, past participation in exercise was reported to be positively correlated with present participation (Dishman, Sallis, & Orenstein, 1985). Also reported in the literature is a strong relationship between sports played as a youth and participation in vigorous activities as an adult (Dishman, Sallis, & Orenstein, 1985). In contrast, attendance and adherence to an exercise program were not affected by previous exercise patterns of subjects (Gale, Eckhoff, Mogel, & Rodnick, 1984).

Measurement

The instruments that were used in this study included the following: the Adherence to Exercise Questionnaire I, the Adherence to Exercise Questionnaire II, the Self-Motivation Inventory, the Adherence to Exercise Questionnaire III, and the Demographic Data Sheet. The Adherence to Exercise Questionnaire I and II, and the Self-Motivation Inventory were self-administered paper and pencil scaled questionnaires. The Adherence to Exercise Questionnaire III and the Demographic Data Sheet were data collection sheets for the investigator. Self-administered questionnaires were chosen for this study for the following reasons: these instruments are the most widely used to measure exercise adherence and can be administered with ease and low cost, a range of ages can be used, all dimensions of exercise can be assessed that can generate the examination of physical activity patterns, the behavior being studied is not altered, and these measures are easily adapted to suit the needs of the population being study or
research question (Sallis & Saelens, 2000). It is reported in the literature that there is “no
gold standard” for the measurement of exercise adherence (Vitolins, Rand, Rapp, Ribisl,
& Sevick, 2000, p. 1885). Measuring adherence is extremely difficult because it is
defined loosely and very widely in the research literature (Martin & Dubbert, 1982;
Vitolins, Rand, Rapp, Ribisl, & Sevick, 2000).

Adherence to Exercise Questionnaire I

The Adherence to Exercise Questionnaire I (Appendix B) was designed to
measure exercise adherence, the major outcome variable, and was developed by the
investigator after a review of the literature. Numerous questionnaires exist that measure
physical activity subjectively and then use objective measures to assess for validation of
the questionnaire. Questions for the present study were derived from the following
instruments that assess physical activity and exercise: The Aerobics Center Longitudinal
Study Physical Activity Questionnaire (Kohl, Blair, Macera, & Kronenfeld, 1988);
Paffenbarger Physical Activity Questionnaire (Paffenbarger, Wing, & Hyde, 1978); and a
literature review by Wilson, Paffenbarger, Morris and Havlik (1986).

The following is a discussion on the reliability and validity measurements of each
of the two questionnaires. The Aerobics Center Longitudinal Study Physical Activity
Questionnaire is a self-administered questionnaire that assesses for leisure and household
activity based on three-month recall. There are 14 subsets to the first question that
pertain to the frequency, method, intensity, and duration of exercise. The methods of
exercise and physical activity assessed for are walking, stair climbing, jogging or
running, treadmill, bicycling, swimming laps, aerobic dance/calisthenics/floor exercise,
m moderate sports, vigorous racquet sports, other vigorous sports or exercise involving
running, other activities, weight training, household activities, and lawn work and gardening. The second question asks the respondent the number of times a week that is spent engaged in vigorous physical activity that is long enough to work up a sweat.

Scoring of the questionnaire is done by assigning metabolic equivalent (MET) values to the reported activities. One MET is the resting metabolic rate of an individual and it is approximately equal to the resting oxygen consumption ($3.5 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) (Powers & Howley, 1996). A total score is then derived by the addition of all MET values for each of the activities.

Scale validity was reported by Kohl, Blair, Paffenbarger, Macera, and Kronenfeld (1988). A maximal exercise treadmill stress test was used as the objective measure to determine the contributions of the indices of the physical activity questionnaire in predicting physical fitness. The variables in predicting physical fitness had a multiple correlation coefficient of .65. The significant predictors of physical fitness were age ($\beta = -.34$), an index of running, walking, and jogging participation ($\beta = .31$), and the response on the frequency of sweating ($\beta = .35$). Validity of the questionnaire was also reported by Oliveria, Kohl, Trichopoulos, and Blair (1996). In this study a significant correlation ($r = .41$) was also found between baseline physical activity level and the objective measure of an exercise treadmill test. Reports for scale reliability could not be found in the literature.

The Paffenbarger Physical Activity Questionnaire is an interviewer or self-administered questionnaire that assesses leisure-time activity with the recall of activity based on either the previous week or previous year. It was initially designed to identify activities associated with hypertensive cardiovascular disease in college alumni.
There are eight questions that pertain to the type, frequency, intensity, and duration of exercise. Walking and stair climbing are two types of exercise specifically addressed. Open-ended questions allow the respondent to report their specific type of exercise they engage in regularly in terms of duration per year. Activity for a 24-hour period is described based on five activity categories. Using kilocalories is the primary method used for scoring walking, stair climbing and intensity of activity in the questionnaire. Activity is also ranked by MET value to derive at kilocalories expended. Scale reliability and validity were reported by Ainsworth, Leon, Richardson, Jacobs, and Paffenbarger (1993). Self-reported data were validated with direct and indirect measures that included cardiorespiratory fitness, body fatness, motion detection, and physical activity records. Correlation coefficients ranged from .25 to .65 in men and 0.28 to 0.86 in women. Higher correlations were reported for total and heavy-intensity physical activities (r = .34 – .69, p<.05). Lighter-intensity physical activity and the Caltrac motion detector did not show a significant correlation (r < .35, p>.05). Test-retest reliability at one month showed a high degree of scale stability (r = 72, p<.01) than it did at eight and nine months (r = .34, r = .43, p<.01, respectively).

The questions modified from the above instruments and contained in the final version of the Adherence to Exercise Questionnaire I were developed specifically for this study in order to identify exercise patterns of heart transplant recipients. The questions were selected for simplicity and were based on the specific activities performed by the subject during hospitalization after heart transplant surgery and the proposed home program designed for each transplant recipient. The questionnaire consisted of eight questions designed to determine how well patients adhered to their home exercise
program after heart transplant surgery. The questions pertained to the frequency, duration, intensity, and specific type of exercise such as walking, bicycling, and stair climbing. One question allowed the subject to identify other exercises performed that were not listed on the questionnaire.

The first question asked if the subject exercises and was coded as yes or no. The second question asked how many days per week exercise was performed and allowed the subject to write in a number. The third question asked how many times exercise was performed per week and also allowed the subject to write in the corresponding number. The fourth question related to the number of minutes exercise was performed during each session. This question also allowed the subject to write in a number. Questions 5, 6, and 7 related to a specific type of exercise, walking, bicycling or stair climbing, respectively, and asked about the number of sessions performed per week and the average duration of each session recorded in minutes. Questions 5 and 6 also investigated the number of miles per session. Specifically to question 5, the pace of walking was coded on a five-point scale where 1 equaled less than two miles per hour (mph), 2 equaled two mph, 3 equaled three mph, 4 equaled four mph, and 5 equaled more than four mph. An additional question asked if the subject used a treadmill and was coded as yes or no. Question 6 also coded on a five-point scale the pace at which the subject rode the bicycle and was coded as follows: 1=general leisure (less than ten mph), 2=light effort (10 – 11.9 mph), 3=moderate effort (12 – 13.9 mph), 4=vigorous effort (14 – 15.9 mph), and 5=racing (more than 16 mph). The final question on the Adherence to Exercise Questionnaire I allowed the subject to identify any other type of exercise they were performing regularly by writing in the name of the exercise. It also asked about the
number of times per week this exercise was performed and the duration in minutes per
session performed.

The other types of exercises that were performed and reported by the subjects
included situps, weight-lifting, stationary rowing, and water aerobics. These types of
activities were categorized as conditioning exercises and were reported as this category in
the results section.

Content validity of this questionnaire was supported by the following sources of
information: from a review of the literature addressing the measurement of exercise
adherence and by the Heart Transplant Coordinator and Physical Therapist assigned to
the transplant program who implemented the prescription for the physical rehabilitation
of the subject. A Content Validity Index (CVI) was determined for the Adherence to
Exercise Questionnaire I. The purpose for determining a Content Validity Index was to
judge and quantify the content validity of an instrument and its items (Lynn, 1986). A
panel of five experts was identified at Emory University School of Nursing and Emory
University Hospital. Three of the experts had substantial knowledge in instrument
construction and measurement. Two members of the panel were experts in the area of
exercise and physical therapy. Each member of the panel rated all eight items of the
questionnaire using a 4-point ordinal scale where 1 equaled irrelevant item, 2 equaled
slightly relevant, 3 equaled very relevant, and 4 equaled extremely relevant. An
additional question asked the experts to rate the entire instrument using the same 4-point
scale. Finally, the experts were asked to describe how the questionnaire items could be
improved. The mean CVI for each item was as follows: question one, 3.8; question two,
3.8; question three, 3.8; question four, 3.8; question five, 3.8; question six, 3.8; question
seven 3.4; question eight, 3.8; and overall opinion of the questionnaire, 3.4. A CVI rating with a minimal score of 3 indicates item and/or questionnaire relevance as indicated by the above scores. For the AEQ I, it can be concluded that the content of the questionnaire and the questionnaire itself has been determined to be valid and measures the performance of exercise. Suggested comments for the improvement of the questionnaire by the experts were reflected in the subsequent revision of the questionnaire.

Because the Adherence to Exercise Questionnaire I was derived from two other sources and a literature review as previously discussed, prior to implementing the research study, a pilot study was conducted. The purposes of conducting the pilot study were to test the clarity and readability of the questions, to ensure ease of administration, and to verify the time for completion of the questionnaire. The pilot study was conducted on six heart transplant recipients who were beyond six months from the date of their heart transplant surgery. Five males and one female were conveniently selected on two separate days at the Heart Transplant Clinic. The ages of these subjects ranged from 36 – 62 years and the subjects ranged from 8 months to 13 years post-operative heart transplant surgery. The questionnaire was administered to the subjects under the same conditions as previously discussed. The results of the pilot study demonstrated that the questionnaire was adequate in allowing the subjects to report their exercise, the subjects easily understood the questions, and the questionnaire was able to be completed in the anticipated time frame.

Scale reliability was estimated using test-retest procedures to determine the stability of the questionnaire across time. Thirteen (81.25%) of the population of this
study were retested after their initial test date. The average number of days between the initial test and the retest was 67 days with a range of 35-110.

Adherence to Exercise Questionnaire II

The Adherence to Exercise Questionnaire II (Appendix C) was a second data collection instrument that was developed by the investigator for the purpose of measuring attitude toward exercising, perceived social influence, functional status, support system, financial concerns, convenience, climate, and symptoms. It was designed after a review of the literature was conducted. The format of the questionnaire required the subject to respond to both Likert and semantic differential scales, as well as forced-choice questions.

Attitude is one psychological factor that was measured and used a 7-point semantic differential scale that asked the subject to respond to the phrase “my doing exercise regularly is.” There were eight sets of adjectives that were used to measure attitude and they were as follows: punishing-rewarding, useful-useless, bad-good, harmful-beneficial, wise-foolish, sad-happy, pleasant-unpleasant, and exciting-boring.

Measuring attitude was adopted from research conducted by Gatch and Kendzierski (1990). They studied The Theory of Planned Behavior and its ability to predict exercise intentions in 100 female college students. Their measurement of attitude was constructed according to the theory developed by Ajzen and Fishbein. Although three of the attitude measurement items were not significantly related to the other five items, they did report internal consistency reliability with a Cronbach’s alpha coefficient of .79. Attitude is one of the psychological factors that measured the attitude toward the
behavior component of the theoretical framework and is measured by question 1 on the Adherence to Exercise Questionnaire II.

The measurement of perceived social influence was derived from The Theory of Planned Behavior (Ajzen, 1991) and was a direct measure of subjective norm and normative beliefs as discussed earlier. It was assessed by having the subject respond to the statement “most people who are important to me would approve-disapprove of my doing exercise regularly” using a 7-point semantic differential scale ranging from not at all to very much. A second question rated the subjects’ motivation to comply with the following question: “how much do you care whether other people approve or disapprove of your performing exercise regularly.” It also used a 7-point semantic differential scale where 1=not at all and 7=very much. The product of these two ratings measured subjective norm (Ajzen, 1991; Gatch & Kendzierski, 1990). Although subjective norm is consistently measured in the research literature as suggested by Ajzen (1991), the normative component has consistently been found to contribute insignificantly towards the variance of exercise intention than the attitudinal component (Rhodes, Martin, Taunton. Rhodes, Donnelly, & Elliot, 1999; Smith & Biddle, 1999). Courneya and McAuley (1995) report that inconsistencies in the measurement of subjective norm exist that may contribute to these insignificant findings. Perceived social influence is a measurement of the subjective norm component of the theoretical framework and was measured by questions 2 and 3 on the Adherence to Exercise Questionnaire II.

The pre-operative factor that was assessed is the functional status of the subject six months preceding their heart transplant surgery, and was described as bedridden, ambulating or exercising (Grady, Jalowiec, White-Williams, 1998; Riedinger, Dracup, &
Pre-operative factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by question 4 on the Adherence to Exercise Questionnaire II.

Support system, financial concerns, convenience or access to exercise facilities, and climate was measured and recorded as situational factors. One question was designed to measure support system and asked the subject to respond to the following: “do you get the kind of support from others that you need” and utilized a 5-point Likert scale where 1 equaled not at all, 2 equaled not much, 3 equaled moderately, 4 equaled a great deal, and 5 equaled completely. It was derived from the World Health Organization Quality of Life Instrument (2000). Two questions were designed to measure financial concerns. The first question assessed whether the subject paid a fee to exercise. The second question assessed whether the subject had enough money to participate in exercise and was designed using a 5-point Likert scale where 1 equaled never, 2 equaled seldom, 3 equaled quite often, 4 equaled very often, and 5 equaled always. Six questions were designed to measure convenience or access to exercise facilities and assessed where the subject exercised, if travel was involved in order to exercise, its accessibility, the availability of time, and the convenience of the setting. All questions were formed allowing the subject to respond to a 5-point Likert scale and was coded as follows: 1=never, 2=seldom, 3=quite often, 4=very often, and 5=always. Two questions were devised that constituted the measurement of climate. The first question assessed whether the subject exercised indoors or outdoors. The second question involved whether the climate or weather prevented the subject from exercising and was formed using a 5-point Likert scale identical to the convenience scale as above (Campbell & Etringer, 1999;
Situational factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by questions 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 on the Adherence to Exercise Questionnaire II.

Symptoms were measured and recorded as disease-related factors. Eight questions were designed to measure symptoms using a 5-point Likert scale where 1 = not at all, 2 = slightly, 3 = moderately, 4 = very, and 5 = extremely. Eight symptoms were chosen to be measured and were derived from previous research studies involving heart failure patients and heart transplant recipients. The eight symptoms included fatigue, shortness of breath, pain, dizziness, leg or feet swelling, tremors, insomnia and weakness. These symptoms were cited in the literature to be common and frequent among those patients who were diagnosed with heart disease and myocardial infarction, the recipient of a heart transplant, and prescribed immunosuppressive therapy. (Cowan, Graham, & Cochrane, 1992; Grady, Jalowiec, Grusk, White-Williams, & Robinson, 1992; Jalowiec, Grady, White-Williams, Fazekas, Laff, Davidson-Bell, Kracht, & Willson, 1997; Lough, Lindsey, Shinn, & Stotts, 1985; Muirhead, Meyerowitz, Leedham, Eastburn, Merrill, & Frist, 1992). Additionally, a final question allowed the respondent to list any other symptoms that were experienced that interfered with the ability to exercise and that were not previously mentioned. Disease-related factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by questions 16, 17, 18, 19, 20, 21, 22, 23, and 24 on the Adherence to Exercise Questionnaire II.
Self-Motivation Inventory Questionnaire

Motivation is the second psychological factor that was measured, a component in the attitude toward the behavior of the theoretical framework, and utilized the Self-Motivation Inventory (Appendix D) developed by Dishman and Ickes (1981). It was a 40-item paper and pencil scale that assessed self-motivation. The items on the questionnaire were scored using a five-point Likert scale that indicated the degree each item was characteristic or uncharacteristic of the respondent’s typical behavior. The response choices were as follows: 1 = very unlike me; 2 = somewhat unlike me; 3 = neither like me nor unlike me; 4 = somewhat like me; and 5 = very much like me. The total possible score ranged from 40 to 200 and consisted of 19 positive and 21 negative items. The mid-point score for the questionnaire was 120 with those scoring above the mid-point considered to be more self-motivated, and those scoring below 120 classified as less self-motivated.

Scale reliability was reported by Dishman and Ickes to have a high internal reliability with a Cronbach’s alpha coefficient of .91. Repeated measurements at one month to five months showed a high degree of scale stability (r’s ranged from .86 to .92). Construct validity was provided by the correlation of the SMI with the Thomas-Zander Ego-Strength Scale (r = .63, p < .05) and a more reserved correlation with the Marlowe-Crowne Social Desirability Scale (r = .36, p < .05). Discriminant validity was supported by the minimal overlap with other motivational measures of social desirability, health locus of control, and achievement tendency. Less than 10% of the variance in self-motivation was explained in each measure. Diverse settings (habitual exercise programs,
preventive medicine and acute exercise) in which adherence to therapeutic exercise was easily measured helped to demonstrate predictive validity of the SMI.

**Adherence to Exercise Questionnaire III**

The Adherence to Exercise Questionnaire III (Appendix E) was a data collection sheet developed for use by the investigator. The purpose of this instrument was to record data on the pre-operative, physical, and disease-related factors of this study.

The pre-operative factors that were assessed are as follows: the number of days on the heart transplantation waiting list and the NYHA classification identified as either class I, II, III, or IV (Grady, Jalowiec, White-Williams, 1998; Riedinger, Dracup & Brecht, 2000; Salyer, Jewell, & Quigg, 1999). Pre-operative factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by questions 1 and 2 on the Adherence to Exercise Questionnaire III.

Measuring physical factors involved obtaining information about the subject’s age, weight, ejection fraction, existence of comorbidities, resting heart rate, and resting blood pressure. For comorbidities, a total score was reported. These characteristics were selected through a review of the literature (Dishman, 1994; Sallis, Hovell, & Hofstetter, 1992; Salyer, Jewell, & Quigg, 1999). Physical factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by questions 3, 4, 5, 6, 7, and 8 on the Adherence to Exercise Questionnaire III.

Disease-related factors were measured and reported as the number of total rejection episodes since surgery, the number of rejection episodes requiring pharmacological therapy and not requiring pharmacological therapy since surgery, number of days since last rejection and the number of days of hospitalization after
surgery. These characteristics were selected through a review of the literature (Grady, Haller, Grusk, & Corliss, 1990; Salyer, Jewell, & Quigg, 1999). Disease-related factors were a measurement of the perceived behavioral control component of the theoretical framework and were measured by questions 9, 10, and 11 on the Adherence to Exercise Questionnaire III. Secondary information was obtained on the surgical technique employed and indicated as either biatrial or bicaval technique (Cупplies, 1997; Niset, Hermans, & Depelchin, 1991; Salyer, Jewell, & Quigg, 1999).

Demographic Data Sheet: Sample Characteristics

The Demographic Data Sheet: Sample Characteristics (Appendix F) was the tool used to collect descriptive data on each subject selected for the study. The instrument contained demographic information about the subject’s gender, ethnicity, marital status, and educational level. Information was also obtained on the smoking history of the subject, and their participation in exercise in the pre-operative period. These variables represented extraneous variables that may have impacted the study findings as described earlier. Information regarding the type of immunosuppressive medications currently prescribed to the subject was also collected.

Data Collection Procedure

At the initiation of the study, the names of all patients who had heart transplant surgery beginning with the preceding six months up to the present date were obtained from the Clinic registry. Then, as each new heart transplant surgery was performed, that patient’s name and demographic data was obtained from the Clinic and the investigator was notified by the Clinic the date and time of the patient’s scheduled six-month clinic visit. Each patient’s chart was reviewed to identify whether he or she met the selection
criteria and was verified by the Heart Transplant Surgeon and/or Heart Transplant Coordinator.

In this nonexperimental predictive study, the methods used for data collection were the administration of questionnaires to the subjects and retrieval of data from the patient’s medical record as documented by the physician. Six months after heart transplant surgery, patients were required to return to the transplant clinic for the following scheduled activities: cardiac biopsy under echo guidance, the withdrawal of blood for laboratory analysis, and office visit with the transplant surgeon and transplant Coordinator. Those patients who met the criteria for inclusion in the study were identified during the clinic visit. Explanation of the study was given to each subject and informed consent was obtained. All subjects completed the Adherence to Exercise Questionnaire I, the Adherence to Exercise Questionnaire II, and the Self-Motivation Inventory Questionnaire. A quiet, private area in the clinic for completion of the questionnaires was provided. Data for the Adherence to Exercise Questionnaire III was obtained from the patient’s medical record in the heart transplant clinic.

Data Analysis

All data analyses were performed using the Statistical Analysis System (SAS). Descriptive statistics were used to obtain the summary measures for the data. It included frequency distributions, percentage distributions, means, standard deviations, and ranges. Regression and correlation analysis were used to address the research questions.
Limitations

The limitations identified for this study were as follows:

The first limitation of this study was that clinical generalizability may be limited due to convenience sampling and the small sample size. However, theoretical generalizability should not be limited. The small number of individuals receiving heart transplants results in a small sample size and, therefore, may limit the strength of the results and predictability of the study findings.

A second limitation of this study was that the majority of the data collected were from self-reports. A requirement for self-reports is accurate recall of information by the respondents. Self-reports may not be an appropriate instrument to use with all individuals that may lead to either over or under reporting of information.

A third limitation was that an objective direct method to measure adherence to exercise was not used. Direct methods of measuring exercise adherence provide more accurate data by measuring physiological changes in physical capacity (Robison & Rogers, 1994; Vitolins, Rand, Rapp, Ribisl, & Sevick, 2000).

Summary

This chapter identified the methodology of this research study. The design and protection of human subjects was described. The convenience sample and selection criteria including size and power analysis were stated. All variables for the study and their measurement were explicitly described. Finally, the data collection procedure and analysis of data were identified. Chapter 4 describes the results of the study and includes subject characteristics, data related to research questions, and test-retest data.
CHAPTER 4
RESULTS

This chapter presents a description of the subject characteristics as well as the results of the study according to the seven research questions. A summary of the study results concludes the chapter.

Subject Characteristics

Data were collected on a total of 16 subjects to identify the pre-operative factors, physical factors, psychological factors, situational factors, disease-related factors and social influences that predicted adherence to exercise after heart transplantation. All subjects met all selection criteria which consisted of adult subjects 18 years or older of either sex, received and survived heart transplant surgery, ability to read and write English, free of organ rejection, absence of significant cognitive deficit, and six months post-operative heart transplant surgery.

Based on power analysis, the initial plan was to recruit a total of 40 subjects. The final number of subjects who participated in this study was 16. There were several reasons a larger sample size could not be obtained. There has been a decline in the number of heart transplant surgeries performed at Emory University Hospital as a result of the lack of donor organs available. There were a total of 18 subjects who met the study criteria. Two subjects who underwent heart transplant surgery did not participate in the study because they had died after the procedure.
Data obtained from the Demographic Data Sheet: Sample Characteristics (Appendix F) as shown in Table 4-1 revealed 11 (68.75%) male and five (31.25%) female subjects, and nine (56.25%) White and seven (43.75%) Non-White subjects participated in the study. Eleven (68.75%) of the subjects were married and five (31.25%) were nonmarried. One (6.25%) had an educational level of 9th grade or less, three (18.75%) had some high school, five (31.25%) had a high school diploma, and seven (43.75%) reported education at the college level. Twelve (75%) had a smoking history, while four (25%) had never smoked. Finally, 10 (62.5%) of the subjects participated in exercise in the pre-operative period and six (37.5%) did not participate in exercise.

Table 4-2 presents secondary demographic variables, surgical technique and immunosuppressive medications. The biatrial surgical technique was performed on 16 (100%) of the subjects who underwent heart transplant surgery. The surgeons at this study site did not utilize the bicaval technique. The immunosuppressive medications that were administered to the subjects post-operatively were Cyclosporine, Imuran, Prednisone, and CellCept. Fifteen (93.75%) of the subjects were administered cyclosporine, four (25%) received Imuran, 16 (100%) received Prednisone, 12 (75%) had CellCept, and one (6.25%) received Prograf.

Summary Data on Exercise

This section presents summary data on adherence to exercise including the frequency of exercise, type of exercise describing the average duration per session and the frequency and total time of exercise per week for each individual exercise, average exercise time, and the intensity of exercise.
<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11</td>
<td>68.75</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>31.25</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>56.25</td>
</tr>
<tr>
<td>Non-White</td>
<td>7</td>
<td>43.75</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>11</td>
<td>68.75</td>
</tr>
<tr>
<td>Nonmarried</td>
<td>5</td>
<td>31.25</td>
</tr>
<tr>
<td>Educational Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9th or Less</td>
<td>1</td>
<td>6.25</td>
</tr>
<tr>
<td>Some High School</td>
<td>3</td>
<td>18.75</td>
</tr>
<tr>
<td>High School Diploma</td>
<td>5</td>
<td>31.25</td>
</tr>
<tr>
<td>College</td>
<td>7</td>
<td>43.75</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>75.00</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>25.00</td>
</tr>
<tr>
<td>Pre-operative Exercise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>62.50</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>37.50</td>
</tr>
</tbody>
</table>
Table 4-2
Secondary Variables (N =16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Transplant Surgical Technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biatrial</td>
<td>16</td>
<td>100.00</td>
</tr>
<tr>
<td>Bicaval</td>
<td>00</td>
<td>0.00</td>
</tr>
<tr>
<td>Immunosuppressive Medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclosporine</td>
<td>15</td>
<td>93.75</td>
</tr>
<tr>
<td>Imuran</td>
<td>4</td>
<td>25.00</td>
</tr>
<tr>
<td>Prednisone</td>
<td>16</td>
<td>100.00</td>
</tr>
<tr>
<td>CellCept</td>
<td>12</td>
<td>75.00</td>
</tr>
<tr>
<td>Prograf</td>
<td>1</td>
<td>6.25</td>
</tr>
</tbody>
</table>

Table 4-3 describes the frequency of exercise. Fifteen (93.75%) of the subjects were actively involved in exercise six months after heart transplant surgery. One (6.25%) of the subjects did not exercise. The average number of days of exercise performed each week was 3.87 (±2.02) with a range of 0-7. The average adherence rate, or percent of average number of days exercised per week, was 55.35 (±28.98) with a range of 00 - 100. Fifteen (93.75%) of the subjects walked as part of their exercise program; however, only seven (43.75%) used a treadmill. Bicycling was performed by five (31.25%) of the subjects, stair climbing by two (12.50%), and conditioning exercise by five (31.25%).
Table 4-3
*Exercise Adherence (N = 16)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
<th>Mean (M)</th>
<th>SD (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>93.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>6.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of Days Exercised Per Week</td>
<td></td>
<td></td>
<td>3.87</td>
<td>±2.02</td>
<td>0-07</td>
</tr>
<tr>
<td>Adherence Rate (%)</td>
<td></td>
<td></td>
<td>55.35</td>
<td>±28.98</td>
<td>00-100</td>
</tr>
<tr>
<td>Walking</td>
<td>15</td>
<td>93.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Treadmill</td>
<td>7</td>
<td>43.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bicycling</td>
<td>5</td>
<td>31.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>2</td>
<td>12.50</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Conditioning Exercise</td>
<td>5</td>
<td>31.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The type and duration of exercise is described in Table 4-4. Walking was performed an average duration of 48.59 (±31.11) minutes per session, and a mean 4.09 (±2.10) sessions per week, for an average total time of 243.51 (±232.28) minutes per week. The second type of exercise, bicycling, was performed an average duration of 7.15 (±13.38) minutes per session, a mean 0.81 (±1.19) sessions per week, for an average total time of 18.03 (±36.02) minutes per week. Stair climbing was performed an average duration of 3.28 (±9.51) minutes per session, a mean of 0.43 (±1.19) sessions per week,
Table 4-4

Type of Exercise. Mean Duration Per Session, Frequency and Total Time of Exercise Per Week (N = 16)

<table>
<thead>
<tr>
<th>Type of Exercise</th>
<th>Mean Duration (SD)</th>
<th>Frequency (SD)</th>
<th>Total Time (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>48.59 ±31.11</td>
<td>4.09 ±2.10</td>
<td>243.51 ±232.28</td>
</tr>
<tr>
<td>Bicycling</td>
<td>7.15 ±13.38</td>
<td>0.81 ±1.31</td>
<td>18.03 ±36.02</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>3.28 ±9.51</td>
<td>0.43 ±1.19</td>
<td>11.48 ±33.31</td>
</tr>
<tr>
<td>Conditioning Exercise</td>
<td>14.06 ±26.97</td>
<td>1.25 ±2.11</td>
<td>68.75 ±168.56</td>
</tr>
</tbody>
</table>

for an average total time of 11.48 (±33.31) minutes per week. The last type of exercise, conditioning exercise, was performed an average duration of 14.06 (±26.97) minutes per session, a mean of 1.25 (±2.11) sessions per week, for an average total time of 68.75 (±168.56) minutes per week.

Table 4-5 describes the average exercise time for all types of exercises combined.

The average number of minutes per session performed by all subjects combined was 73.09 (±54.66) minutes. The average exercise time was 341.78 (±380.24) minutes per week by all subjects combined.

Table 4-5

Mean Exercise Time (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Minutes Per Session (SD)</th>
<th>Minutes Per Week (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise Time</td>
<td>73.09 (±54.66)</td>
<td>341.78 (±380.24)</td>
</tr>
</tbody>
</table>
The intensity of exercise performed is presented in Table 4-6. Walking was classified as follows: light, 2 miles per hour (mph) or less; and moderate, 3 or more mph. General leisure and light effort bicycling were classified as moderate intensity; and moderate effort, vigorous effort, and racing were classified as vigorous intensity. Stair climbing was classified as moderate intensity exercise only. The intensity of the conditioning exercise was classified as light, moderate, or heavy according to the performed exercise as reported by the subject.

Table 4-6
*Intensity of Exercise (N = 16)*

<table>
<thead>
<tr>
<th>Type of Exercise</th>
<th>Light N</th>
<th>Light %</th>
<th>Moderate N</th>
<th>Moderate %</th>
<th>Vigorous N</th>
<th>Vigorous %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>11</td>
<td>68.75</td>
<td>4</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bicycling</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>18.75</td>
<td>2</td>
<td>12.50</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>12.50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Conditioning Exercise</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>31.25</td>
<td>2</td>
<td>12.50</td>
</tr>
</tbody>
</table>

Of the 15 subjects who walked, eleven (68.75%) of the subjects walked at a light intensity pace, while four (25%) walked at a moderate intensity pace. Of the five who bicycled, three (18.75%) reported bicycling at a moderate intensity, and two (12.50%) exercised at a vigorous intensity. Of the two who stair climbed, both of the subjects (12.50%) performed that activity at moderate intensity. Of the two who performed additional conditioning exercises. All five (31.25%) performed moderate intensity exercise such as water aerobics, light stationary rowing, and weight lifting, and two of the five (12.50%) performed vigorous intensity conditioning exercise such as sit-ups (calisthenics).
Summary Data on Major Study Variables

The major study variables were preoperative factors, physical factors, psychological factors, situational factors, disease-related factors, and social influence. Summary data on these variables are presented first. Data on psychological factors, attitude and motivation, are shown in Table 4-7. The average score for Attitude was 48.25 (±6.26), with a range of 35–56. The lowest possible score for the Attitude variable is eight and the highest score possible is 56. The mean score for the Self-Motivation Inventory was 154 (±22.55) and ranged from 122–190.

Table 4-7
Psychological Factors (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>48.25</td>
<td>±6.26</td>
<td>35-56</td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>154.00</td>
<td>±22.55</td>
<td>122-190</td>
<td></td>
</tr>
</tbody>
</table>

Results on the variable perceived social influence are shown in Table 4-8. The average score describing the perceived degree of influence others had on the subjects regarding participation in exercise was 18.81 (±17.42), with a range of 1–49.

Table 4-8
Social Influence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Score</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Social</td>
<td>18.81</td>
<td>±17.42</td>
<td>1-49</td>
<td></td>
</tr>
<tr>
<td>Influence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data for two pre-operative variables, functional status and NYHA, are presented in Table 4-9. Describing functional status, one (6.25%) subject reported being bedridden pre-operatively, nine (56.25%) were ambulating, and six (37.50%) were exercising pre-operatively. Using New York Heart Association (NYHA) classification, no subjects were categorized as Class I, three (18.75%) were NYHA Class II, five (31.25%) were NYHA Class III, and three (18.75%) were NYHA Class IV.

Table 4-9
*Pre-operative Factors (N = 16)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedridden</td>
<td>1</td>
<td>6.25</td>
</tr>
<tr>
<td>Ambulating</td>
<td>9</td>
<td>56.25</td>
</tr>
<tr>
<td>Exercising</td>
<td>6</td>
<td>37.50</td>
</tr>
<tr>
<td><strong>New York Heart</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Association</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>0</td>
<td>00.00</td>
</tr>
<tr>
<td>Class II</td>
<td>3</td>
<td>18.75</td>
</tr>
<tr>
<td>Class III</td>
<td>5</td>
<td>31.25</td>
</tr>
<tr>
<td>Class IV</td>
<td>3</td>
<td>18.75</td>
</tr>
</tbody>
</table>

Data for pre-operative and physical factors are shown in Table 4-10. The average number of days waiting for heart transplant surgery was 381.75 (±531.10). A wide range was seen among subjects from 4–1,840 days. Subjects were 19 – 66 years old and had a mean age of 50.37 (±15.00) years. The mean weight of subjects was 186.93 (±40.91)
pounds with a range of 111–255 pounds. Ejection fraction six months post-operatively ranged from 30% to 65% with a mean of 61.33% (±7.89). The average number of comorbidities that were present after heart transplant surgery was 2.06 (±1.69) with a range of 0–5. The mean resting heart rate was 99.8 (±16.05) beats per minute with a range of 0–5; mean resting systolic blood pressure was 138.33 (±19.76) mmHg with a range of 110-180; and mean diastolic blood pressure was 85 (±10.58) mmHg with a range of 70–108.

Table 4-10
Pre-operative and Physical Factors (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Days on Waiting List</td>
<td>381.75</td>
<td>±531.10</td>
<td>4-1840</td>
</tr>
<tr>
<td>Age</td>
<td>50.37</td>
<td>±15.00</td>
<td>19-66</td>
</tr>
<tr>
<td>Weight</td>
<td>186.93</td>
<td>±40.91</td>
<td>111-255</td>
</tr>
<tr>
<td>Ejection Fraction (%)</td>
<td>61.33</td>
<td>±7.89</td>
<td>30-65</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>2.06</td>
<td>±1.69</td>
<td>00-05</td>
</tr>
<tr>
<td>Resting Heart Rate</td>
<td>99.80</td>
<td>±16.05</td>
<td>60-119</td>
</tr>
<tr>
<td>Resting Systolic Blood Pressure</td>
<td>138.33</td>
<td>±19.76</td>
<td>110-180</td>
</tr>
<tr>
<td>Resting Diastolic Blood Pressure</td>
<td>85.00</td>
<td>±10.58</td>
<td>70-108</td>
</tr>
</tbody>
</table>

Data results for situational factors are presented in Table 4-11. The reported mean for support system was 4.31 (±0.70) with a range of 3-5. The mean is derived from a 5-point Likert scale where 1 equaled not at all, 2 equaled not much, 3 equaled
moderately, 4 equaled a great deal, and 5 equaled completely. Three (18.25%) paid a fee for exercise while 13 (81.25%) did not pay a fee. The mean for those subjects reporting having enough money to participate in exercise was 2.73 (±1.57) with a range of 1-5.

Mean scores for the variable convenience were as follows: exercise at home was 3.56 (±1.45) with a range of 2-5; exercise in a health club/gym was 1.75 (±1.39) with a range of 1-5; travel to exercise was 2.00 (±1.26) with a range of 1-5; accessibility was 3.93 (±1.61) with a range of 1-5; enough time during the day to exercise was 4.18 (±1.04) with a range of 2-5; and setting convenient was 4.12 (±1.25) with a range of 1-5.

Pertaining to the climate, nine (56.25%) exercised indoors, while seven (43.75%) exercised outdoors. The mean score for those subjects indicating whether the climate prevented them from exercising was 1.50 (±0.51) with a range of 1-2. The means for financial, convenience, and climate variables were derived from a 5-point Likert scale where 1 equaled never, 2 equaled seldom, 3 equaled quite often, 4 equaled very often, and 5 equaled always.

Data for disease-related factors are shown in Table 4-12. The average total number of rejection episodes was 2.81 (±1.68) with a range of 0–5 in the six-month postoperative period. The average number of rejection episodes requiring pharmacological therapy was 0.43 (±0.72) with a range of 0–2; number of rejection episodes not requiring pharmacological therapy was 2.37 (±1.45) with a range of 0–5; and the number of days since the last rejection episode was 89.43 (±88.36) with a range of 0–366. The average number of days of hospitalization after heart transplant surgery was 18.18 (±27.82) with a range of 7–111.
Table 4-11
*Situational Factors* (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support System</td>
<td>-</td>
<td>-</td>
<td>4.31</td>
<td>±0.70</td>
<td>3-5</td>
</tr>
<tr>
<td>Financial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay Fee for Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>18.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>81.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Enough Money to Participate in Exercise</td>
<td>-</td>
<td>-</td>
<td>2.73</td>
<td>±1.57</td>
<td>1-5</td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise at Home</td>
<td>-</td>
<td>-</td>
<td>3.56</td>
<td>±1.45</td>
<td>2-5</td>
</tr>
<tr>
<td>Exercise in Health Club/Gym</td>
<td>-</td>
<td>-</td>
<td>1.75</td>
<td>±1.39</td>
<td>1-5</td>
</tr>
<tr>
<td>Travel to Exercise</td>
<td>-</td>
<td>-</td>
<td>2.00</td>
<td>±1.26</td>
<td>1-5</td>
</tr>
<tr>
<td>Accessibility</td>
<td>-</td>
<td>-</td>
<td>3.93</td>
<td>±1.61</td>
<td>1-5</td>
</tr>
<tr>
<td>Time</td>
<td>-</td>
<td>-</td>
<td>4.18</td>
<td>±1.04</td>
<td>2-5</td>
</tr>
<tr>
<td>Setting Convenient</td>
<td>-</td>
<td>-</td>
<td>4.12</td>
<td>±1.25</td>
<td>1-5</td>
</tr>
<tr>
<td>Climate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indoors</td>
<td>9</td>
<td>56.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Outdoors</td>
<td>7</td>
<td>43.75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Climate Prevents Exercise</td>
<td>-</td>
<td>-</td>
<td>1.50</td>
<td>±0.51</td>
<td>1-2</td>
</tr>
</tbody>
</table>

Range for values: 1-5, ±1.57, ±1.45, ±1.39, ±1.26, ±1.61, ±1.04, ±1.25.
Table 4-12
*Disease-Related Transplant Factors (N = 16)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Rejection Episodes</td>
<td>2.81</td>
<td>±1.68</td>
<td>0-5</td>
</tr>
<tr>
<td>Number of Rejection Episodes Requiring Pharmacological Therapy</td>
<td>0.43</td>
<td>±0.72</td>
<td>0-2</td>
</tr>
<tr>
<td>Number of Rejection Episodes Not Requiring Pharmacological Therapy</td>
<td>2.37</td>
<td>±1.45</td>
<td>0-5</td>
</tr>
<tr>
<td>Number of Days Since Last Rejection</td>
<td>89.43</td>
<td>±88.36</td>
<td>0-366</td>
</tr>
<tr>
<td>Length of Hospitalization</td>
<td>18.18</td>
<td>±27.82</td>
<td>7-111</td>
</tr>
</tbody>
</table>

Additional disease-related factors are shown in Table 4-13. Eleven (68.75%) subjects reported the occurrence of fatigue, a mean of 2.00 (±0.96) and range of 1-4; six (37.50%) developed shortness of breath, a mean of 1.62 (±1.08) and range of 1-5; seven (43.75%) experienced pain, a mean of 1.93 (±1.34) and range of 1-5; eight (50.00%) had dizziness, a mean of 1.56 (±0.62) and a range of 1-3; eight (50%) reported swelling, a mean of 1.75 (±0.93) and range of 1-4; eight (50%) had tremors, a mean of 1.87 (±1.20) and range of 1-5; eight (50%) reported insomnia, a mean of 1.68 (±0.87) and range of 1-4; and ten (62.25%) experienced weakness, a mean of 1.87 (±0.88) and range of 1-4, post-operatively. The means for symptoms were derived from a 5-point Likert scale where 1 equaled not at all, 2 equaled slightly, 3 equaled moderately, 4 equaled very, and 5 equaled extremely. Only four (25%) subjects reported the occurrence of other
symptoms not listed on the AEQ II. The average total number of symptoms reported by the subjects was 4.38 (±2.31) with a range of 0-9.

Table 4-13
Disease-Related Symptom Factors (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
<th>M(SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>11</td>
<td>68.75</td>
<td>2.00(±0.96)</td>
<td>1-4</td>
</tr>
<tr>
<td>Shortness of Breath</td>
<td>6</td>
<td>37.50</td>
<td>1.62(±1.08)</td>
<td>1-5</td>
</tr>
<tr>
<td>Pain</td>
<td>7</td>
<td>43.75</td>
<td>1.93(±1.34)</td>
<td>1-5</td>
</tr>
<tr>
<td>Dizziness</td>
<td>8</td>
<td>50.00</td>
<td>1.56(±0.62)</td>
<td>1-3</td>
</tr>
<tr>
<td>Swelling</td>
<td>8</td>
<td>50.00</td>
<td>1.75(±0.93)</td>
<td>1-4</td>
</tr>
<tr>
<td>Tremors</td>
<td>8</td>
<td>50.00</td>
<td>1.87(±1.20)</td>
<td>1-5</td>
</tr>
<tr>
<td>Insomnia</td>
<td>8</td>
<td>50.00</td>
<td>1.68(±0.87)</td>
<td>1-4</td>
</tr>
<tr>
<td>Weakness</td>
<td>10</td>
<td>62.25</td>
<td>1.87(±0.88)</td>
<td>1-4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total Number of Symptoms</td>
<td>-</td>
<td>-</td>
<td>4.38(±2.31)</td>
<td>0-9</td>
</tr>
</tbody>
</table>

Correlations Among Demographic Variables

This final section presents the correlational data among the demographic variables and exercise adherence and among the major study variables and exercise adherence. A correlation analysis was performed between demographic variables, gender, ethnicity, marital status, educational level, smoking, pre-operative exercise participation and exercise adherence (Table 4-14). Pre-operative exercise participation significantly
correlated (p ≤ 0.05) with exercise adherence (r = -0.509, p = 0.043). Five demographic variables did not correlate with exercise adherence: gender (r = 0.351, p = 0.181); ethnicity (r = -0.040, p = 0.882); marital status (r = 0.420, p = 0.104); educational level (r = -0.025, p = 0.924); and smoking (r = 0.367, p = 0.161).

Table 4-14
Correlations Between Demographics and Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.351</td>
<td>0.181</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>-0.040</td>
<td>0.882</td>
</tr>
<tr>
<td>Marital Status</td>
<td>0.420</td>
<td>0.104</td>
</tr>
<tr>
<td>Educational Level</td>
<td>-0.025</td>
<td>0.924</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.367</td>
<td>0.161</td>
</tr>
<tr>
<td>Pre-operative Exercise Participation</td>
<td>-0.509</td>
<td>0.043 *</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05

Correlations Among Major Study Variables

Table 4-15 presents the correlation analysis among the psychological factors, subjective norm, situational factors and exercise adherence. One situational factor, exercise at home, significantly correlated (p ≤ 0.05) with exercise adherence (r = 0.498, p = 0.049). Thirteen variables did not correlate with exercise adherence: attitude (r = 0.191, p = 0.477); motivation (r = 0.313, p = 0.237); perceived social influence (r = -0.013, p = 0.959); support system (r = 0.285, p = 0.283); fee (r = -0.091, p = 0.735);
Table 4-15
Correlations Between Psychological Factors, Social Influence, Situational Factors and Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychological Factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>0.191</td>
<td>0.478</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.313</td>
<td>0.238</td>
</tr>
<tr>
<td>Subjective Norm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Social Influence</td>
<td>-0.014</td>
<td>0.959</td>
</tr>
<tr>
<td>Situational Factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support System</td>
<td>0.286</td>
<td>0.283</td>
</tr>
<tr>
<td>Financial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fee</td>
<td>-0.092</td>
<td>0.736</td>
</tr>
<tr>
<td>Money</td>
<td>-0.024</td>
<td>0.932</td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise at Home</td>
<td>0.498</td>
<td>0.049*</td>
</tr>
<tr>
<td>Exercise in Health Club/Gym</td>
<td>-0.213</td>
<td>0.429</td>
</tr>
<tr>
<td>Travel</td>
<td>-0.117</td>
<td>0.666</td>
</tr>
<tr>
<td>Accessibility</td>
<td>0.446</td>
<td>0.083</td>
</tr>
<tr>
<td>Time</td>
<td>0.090</td>
<td>0.740</td>
</tr>
<tr>
<td>Setting Convenient</td>
<td>0.242</td>
<td>0.368</td>
</tr>
<tr>
<td>Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate</td>
<td>0.040</td>
<td>0.883</td>
</tr>
<tr>
<td>Weather</td>
<td>-0.223</td>
<td>0.407</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05
money ($r = -0.023, p = 0.932$); exercise in a health club/gym ($r = 0.212, p = 0.429$); travel ($r = -0.116, p = 0.666$); accessibility ($r = 0.446, p = 0.083$); time ($r = 0.090, p = 0.739$); setting convenient ($r = 0.241, p = 0.367$); climate ($r = 0.040, p = 0.882$); and weather ($r = -0.222, p = 0.407$).

A correlation analysis among pre-operative factors, physical factors, disease-related factors and exercise adherence is presented in Table 4-16. The pre-operative, physical, and disease-related factors did not significantly correlate with exercise adherence. The pre-operative factors were days on the waiting list ($r = 0.474, p = 0.063$); functional status (bedridden) ($r = -0.377, p = 0.149$); functional status (ambulating) ($r = -0.376, p = 0.150$); functional status (exercising) ($r = 0.575, p = 0.019$); and NYHA ($r = 0.183, p = 0.588$). The physical factors were age ($r = 0.237, p = 0.376$); weight ($r = -0.423, p = 0.101$); ejection fraction ($r = 0.003, p = 0.989$); comorbidities ($r = 0.041, p = 0.879$); resting heart rate ($r = 0.128, p = 0.647$); resting systolic blood pressure ($r = -0.027, p = 0.921$); and resting diastolic blood pressure ($r = 0.101, p = 0.718$). The disease-related factors were number of rejection episodes ($r = 0.100, p = 0.712$); number of days since rejection ($r = -0.038, p = 0.887$); and length of hospitalization ($r = -0.114, p = 0.674$). The symptoms were fatigue ($r = 0.034, p = 0.900$); shortness of breath ($r = -0.008, p = 0.977$); pain ($r = 0.144, p = 0.594$); dizziness ($r = -0.097, p = 0.718$); swelling ($r = -0.088, p = 0.745$); tremors ($r = -0.306, p = 0.247$); insomnia ($r = -0.155, p = 0.566$); weakness ($r = -0.157, p = 0.559$); and other symptoms ($r = 0.367, p = 0.161$).
Table 4-16
Correlations Between Pre-operative Factors, Physical Factors, Disease-Related Factors and Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>P *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-operative Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days on the Waiting List</td>
<td>0.474</td>
<td>0.063</td>
</tr>
<tr>
<td>Functional Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedridden</td>
<td>-0.377</td>
<td>0.149</td>
</tr>
<tr>
<td>Ambulating</td>
<td>-0.376</td>
<td>0.150</td>
</tr>
<tr>
<td>Exercising</td>
<td>0.575</td>
<td>0.019 *</td>
</tr>
<tr>
<td>NYHA</td>
<td>0.183</td>
<td>0.588</td>
</tr>
<tr>
<td><strong>Physical Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.237</td>
<td>0.376</td>
</tr>
<tr>
<td>Weight</td>
<td>-0.423</td>
<td>0.101</td>
</tr>
<tr>
<td>Ejection Fraction</td>
<td>0.003</td>
<td>0.989</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>0.041</td>
<td>0.879</td>
</tr>
<tr>
<td>Resting Heart Rate</td>
<td>0.128</td>
<td>0.647</td>
</tr>
<tr>
<td>Resting Blood Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic Blood Pressure</td>
<td>-0.027</td>
<td>0.921</td>
</tr>
<tr>
<td>Diastolic Blood Pressure</td>
<td>0.101</td>
<td>0.718</td>
</tr>
<tr>
<td><strong>Disease-Related Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Rejection Episodes</td>
<td>0.100</td>
<td>0.712</td>
</tr>
<tr>
<td>Number of Days Since Rejection</td>
<td>-0.038</td>
<td>0.887</td>
</tr>
<tr>
<td>Length of Hospitalization</td>
<td>-0.114</td>
<td>0.674</td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>0.034</td>
<td>0.900</td>
</tr>
<tr>
<td>Shortness of Breath</td>
<td>-0.007</td>
<td>0.977</td>
</tr>
<tr>
<td>Pain</td>
<td>0.144</td>
<td>0.594</td>
</tr>
<tr>
<td>Dizziness</td>
<td>-0.097</td>
<td>0.718</td>
</tr>
<tr>
<td>Swelling</td>
<td>-0.088</td>
<td>0.745</td>
</tr>
<tr>
<td>Tremors</td>
<td>-0.306</td>
<td>0.247</td>
</tr>
<tr>
<td>Insomnia</td>
<td>-0.155</td>
<td>0.566</td>
</tr>
<tr>
<td>Weakness</td>
<td>-0.157</td>
<td>0.559</td>
</tr>
<tr>
<td>Other Symptoms</td>
<td>0.367</td>
<td>0.161</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05
Research Questions

This section presents the regression analysis data among the major study variables and exercise adherence. Data on the extraneous variables also are presented.

Research Question One

The first research question stated the following: What are the pre-operative factors that are predictive of adherence to exercise after heart transplantation? Stepwise regression analysis was performed to examine the effect of three pre-operative factors, number of days on waiting list, functional status, and NYHA, on exercise adherence. These data are presented in Table 4-17. Initially, more than 66% of the variance in exercise adherence was explained by these three independent variables ($R^2 = 0.6609$). The variable that did not show a significant effect was NYHA ($F = 0.23, p = 0.649$). The functional status category, bedridden, was omitted from the regression analysis because only one subject comprised this category and there was insufficient variance to be calculated in the model. The two variables, number of days on the waiting list and functional status (ambulating and exercising), accounted for 65% of the total variance in exercise adherence ($R^2 = 0.650$) and significantly predicted exercise adherence ($F = 6.77, p = 0.031; F = 8.42, p = 0.019$).

Research Question Two

The second research question stated the following: What are the physical factors that are predictive of adherence to exercise after heart transplantation? Stepwise regression analysis was performed to examine the effect of six physical factors, age, weight, ejection fraction, comorbidities, resting heart rate, and resting blood pressure, on exercise adherence. These data are presented in Table 4-18. The results indicated that
### Table 4-17
**Pre-operative Predictors of Exercise Adherence (N = 16)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>F value</th>
<th>P value *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-operative Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Days on Waiting List</td>
<td>0.296</td>
<td>6.77</td>
<td>0.032 *</td>
</tr>
<tr>
<td>Functional Status</td>
<td>0.368</td>
<td>8.42</td>
<td>0.019 *</td>
</tr>
<tr>
<td>NYHA</td>
<td>0.011</td>
<td>0.23</td>
<td>0.649</td>
</tr>
</tbody>
</table>

* *P significant $\leq 0.05$

### Table 4-18
**Physical Predictors of Exercise Adherence (N = 16)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>F value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.000</td>
<td>0.00</td>
<td>0.985</td>
</tr>
<tr>
<td>Weight</td>
<td>0.115</td>
<td>1.31</td>
<td>0.285</td>
</tr>
<tr>
<td>EF</td>
<td>0.019</td>
<td>0.19</td>
<td>0.681</td>
</tr>
<tr>
<td>Comorbidities</td>
<td>0.055</td>
<td>0.60</td>
<td>0.463</td>
</tr>
<tr>
<td>Resting Heart Rate</td>
<td>0.181</td>
<td>2.00</td>
<td>0.190</td>
</tr>
<tr>
<td>Resting Blood Pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic Blood Pressure</td>
<td>0.011</td>
<td>0.18</td>
<td>0.698</td>
</tr>
<tr>
<td>Diastolic Blood Pressure</td>
<td>0.009</td>
<td>0.01</td>
<td>0.935</td>
</tr>
</tbody>
</table>

* *P significant $\leq 0.05$*
these variables did not have a significant effect on exercise adherence: age (F = 0.00, p = 0.985), weight (F = 1.31, p = 0.285), ejection fraction (F = 0.19, p = 0.681), comorbidities (F = 0.60, p = 0.463), resting heart rate (F = 2.00, p = 0.190), and resting systolic blood pressure (F = 0.18, p = 0.698), (resting diastolic blood pressure (F = 0.01, p = 0.935).

Research Question Three

The third research question stated the following: What are the psychological factors that are predictive of adherence to exercise after heart transplantation? Regression analysis was performed to examine the effect of two psychological factors, attitude and motivation, on exercise adherence. The model did not show that the independent variables had a significant effect on exercise adherence (F = 0.76, p = 0.4890). The partial t tests indicated that attitude (t = 0.30, p = 0.770) and motivation (t = 0.99, p = 0.340) did not have significant effects on exercise adherence. Both psychological variables only contributed approximately 10% of the total variance in exercise adherence ($R^2 = 0.1042$). These data are presented in Table 4-19.

Table 4-19

*Psychological Predictors of Exercise Adherence (N = 16)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Psychological Factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>0.30</td>
<td>0.770</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.99</td>
<td>0.340</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05
Research Question Four

The fourth research question stated the following: What are the situational factors that are predictive of adherence to exercise after heart transplantation? Stepwise regression analysis was performed to examine the effect of 11 situational factors, support system, fee, money, exercise at home, exercise at a health club/gym, travel, accessibility, time, setting convenient, climate, and weather, on exercise adherence. Initially, more than 74% of the total variance in exercise adherence was explained by the 11 independent variables ($R^2 = 0.7418$). Eight variables did not have a significant effect on exercise adherence and were removed from the model in the following order of elimination: time ($F = 0.00$, $p = 0.994$); setting convenient ($F = 0.07$, $p = 0.801$); fee ($F = 0.63$, $p = 0.464$); exercise at home ($F = 0.28$, $p = 0.615$); money ($F = 0.76$, $p = 0.412$); exercise in a health club/gym ($F = 0.84$, $p = 0.386$); weather ($F = 1.24$, $p = 0.294$); support system ($F = 0.86$, $p = 0.375$), and travel ($F = 1.59$, $p = 0.233$). Two variables, accessibility and climate, remained in the model and accounted for more than 46% of the total variance in exercise adherence ($R^2 = 0.4638$) and significantly predicted exercise adherence ($F = 10.37$, $p = 0.007$; $F = 6.43$, $p = 0.026$). These data are presented in Table 4-20.

Research Question Five

The fifth research question stated the following: What are the disease-related factors that are predictive of adherence to exercise after heart transplantation? Stepwise regression analysis was performed to examine the effect of four disease-related factors, number of rejection episodes, number of days since last rejection, length of hospitalization, and symptoms, on exercise adherence. Number of rejection episodes was further described as rejection episodes treated and not treated. These variables did
Table 4-20
Situational Predictors of Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>R²</th>
<th>F value</th>
<th>P value *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Situational Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support System</td>
<td>0.037</td>
<td>0.86</td>
<td>0.375</td>
</tr>
<tr>
<td>Financial Fee</td>
<td>0.032</td>
<td>0.63</td>
<td>0.464</td>
</tr>
<tr>
<td>Financial Money</td>
<td>0.033</td>
<td>0.76</td>
<td>0.412</td>
</tr>
<tr>
<td>Convenience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exercise at Home</td>
<td>0.013</td>
<td>0.28</td>
<td>0.615</td>
</tr>
<tr>
<td>Exercise in Health Club/Gym</td>
<td>0.036</td>
<td>0.84</td>
<td>0.386</td>
</tr>
<tr>
<td>Travel</td>
<td>0.067</td>
<td>1.59</td>
<td>0.233</td>
</tr>
<tr>
<td>Accessibility</td>
<td>0.122</td>
<td>10.37</td>
<td>0.007 *</td>
</tr>
<tr>
<td>Time</td>
<td>0.000</td>
<td>0.00</td>
<td>0.994</td>
</tr>
<tr>
<td>Setting Convenient</td>
<td>0.004</td>
<td>0.07</td>
<td>0.801</td>
</tr>
<tr>
<td><strong>Climate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate</td>
<td>0.341</td>
<td>6.43</td>
<td>0.026 *</td>
</tr>
<tr>
<td>Weather</td>
<td>0.052</td>
<td>1.24</td>
<td>0.294</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05

not significantly predict exercise adherence: number of rejection episodes (F = 0.23, p = 0.640); rejection episodes treated (F = 3.94, p = 0.067); number of days since rejection (F = 0.14, p = 0.714); length of hospitalization (F = 0.53; p = 0.478), and symptoms (F = 0.46, p = 0.509). Rejection episodes that were treated was left in the
model and accounted for more than 21% of the total variance in exercise adherence; however, it was not significantly predictive ($F = 3.94, p = 0.0671$). These data are presented in Table 4-21.

Table 4-21
*Disease-Related Predictors of Exercise Adherence (N = 16)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>$F$ value</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disease-Related Factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Rejection Episodes</td>
<td>0.002</td>
<td>0.04</td>
<td>0.848</td>
</tr>
<tr>
<td>Treated</td>
<td>0.219</td>
<td>3.94</td>
<td>0.067</td>
</tr>
<tr>
<td>Not Treated</td>
<td>0.002</td>
<td>0.04</td>
<td>0.848</td>
</tr>
<tr>
<td>Number of Days Since Last Rejection</td>
<td>0.018</td>
<td>0.30</td>
<td>0.595</td>
</tr>
<tr>
<td>Length of Hospitalization</td>
<td>0.015</td>
<td>0.24</td>
<td>0.631</td>
</tr>
<tr>
<td>Symptoms</td>
<td>0.013</td>
<td>0.46</td>
<td>0.509</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05

**Research Question Six**

The sixth research question stated the following: Is social influence predictive of adherence to exercise after heart transplantation? Regression analysis was performed to examine the effect of social influence on exercise adherence. The model did not show that the variable had a significant effect on exercise adherence ($F = 0.00, p = 0.9592$). The partial $t$ test indicated that social influence ($t = -0.05, p = 0.959$) did not have a significant effect. These data are presented in Table 4-22.
Table 4-22
Perceived Social Influence Predicting Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>R^2</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Social Influence</td>
<td>0.000</td>
<td>-0.05</td>
<td>0.959</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05

Research Question Seven

The seventh research question stated the following: What combination of pre-operative, physical, psychological, situational, disease-related factors and social influences best predict adherence to exercise after heart transplantation? A regression analysis was unable to be performed because the number of independent variables was larger than the number of observations with complete data. However, there were significant correlations found and several variables significantly predicted exercise adherence as previously discussed. The correlations found to be significant among the major study variables were functional status—exercising, and exercise at home. The variables that significantly predicted exercise adherence were number of days on the waiting list, functional status, accessibility, and climate.

Demographic Variables

Stepwise regression analysis was performed to examine the effect of six demographic variables, gender, ethnicity, marital status, education, smoking, and pre-operative exercise, on exercise adherence. The results indicated that pre-operative exercise participation had a significant effect on exercise adherence (F = 4.90, p = 0.043) and accounted for approximately 26% of the total variance in exercise adherence.
(R² = 0.2594). The following variables did not show a significant effect on exercise adherence: gender (F = 0.01, p = 0.926), smoking (F = 0.50, p = 0.495), education (F = 0.87, p = 0.371), ethnicity (F = 2.35, p = 0.150), and marital status (F = 1.87, p = 0.194). The variable pre-operative exercise participation was significant at the 0.05 level. These data are presented in Table 4-23.

Table 4-23
Demographic Predictors of Exercise Adherence (N = 16)

<table>
<thead>
<tr>
<th>Variable</th>
<th>R²</th>
<th>F value</th>
<th>P value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.000</td>
<td>0.01</td>
<td>0.926</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>0.106</td>
<td>2.35</td>
<td>0.150</td>
</tr>
<tr>
<td>Marital Status</td>
<td>0.093</td>
<td>1.87</td>
<td>0.194</td>
</tr>
<tr>
<td>Education</td>
<td>0.039</td>
<td>0.87</td>
<td>0.371</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.024</td>
<td>0.50</td>
<td>0.495</td>
</tr>
<tr>
<td>Pre-operative Exercise</td>
<td>-2.066</td>
<td>4.90</td>
<td>0.043 *</td>
</tr>
</tbody>
</table>

* P significant ≤ 0.05

Test-Retest Data on Exercise Adherence

This section presents retest summary data on selected scale items designed to measure adherence to exercise. These items were from the Adherence to Exercise Questionnaire I. Retest data was obtained on 13 subjects an average of 67 days after the original data was obtained. This test-retest data included the frequency of exercise, type of exercise describing the average duration per session and the frequency and total time of exercise per week for each individual exercise, and average exercise time.
Table 4-24 presents initial data on the frequency of exercise, as described earlier, and the retest data. On retesting of the subjects, 11 (84.60%) were actively involved in exercise compared to 15 (93.75%). Two (15.40%) subjects did not exercise compared to one (6.25%). Retest data on the average number of days of exercise that was performed each week was 4.23 (±2.64) compared to 3.86 (±2.03). Ten (76.92%) of the subjects continued to walk as part of their exercise program, compared to 15 (93.75%), while only five (38.46%) used a treadmill compared to seven (43.75%). Bicycling was performed by three (23.07%) of the subjects compared to five (31.25%), stair climbing by three (23.07%) compared to two (12.50%), and conditioning exercise by two (15.38%) compared to five (31.25%).

Table 4-24
Test-Retest Data on Adherence to Exercise Questionnaire I (N = 13)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test N (%)</th>
<th>M (SD)</th>
<th>Retest N (%)</th>
<th>M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15 (93.75)</td>
<td>-</td>
<td>11 (84.60)</td>
<td>-</td>
</tr>
<tr>
<td>No</td>
<td>1 (6.25)</td>
<td>-</td>
<td>2 (15.40)</td>
<td>-</td>
</tr>
<tr>
<td>Number of Days Exercised Per Week</td>
<td></td>
<td>3.86 (±2.03)</td>
<td></td>
<td>4.23 (±2.64)</td>
</tr>
<tr>
<td>Walking</td>
<td>15 (93.75)</td>
<td>-</td>
<td>10 (76.92)</td>
<td>-</td>
</tr>
<tr>
<td>Treadmill</td>
<td>7 (43.75)</td>
<td>-</td>
<td>5 (38.46)</td>
<td>-</td>
</tr>
<tr>
<td>Bicycling</td>
<td>5 (31.25)</td>
<td>-</td>
<td>3 (23.07)</td>
<td>-</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>2 (12.50)</td>
<td>-</td>
<td>3 (23.07)</td>
<td>-</td>
</tr>
<tr>
<td>Conditioning Exercise</td>
<td>5 (31.25)</td>
<td>-</td>
<td>2 (15.38)</td>
<td>-</td>
</tr>
</tbody>
</table>
The test-retest data on the type and duration of exercise is presented in Table 4-25. The initial test data was described earlier. On retest, the average duration of walking was 23.11 (±25.57) minutes per session compared to 48.59 (±31.11), 3.73 (±2.55) sessions per week compared to 4.09 (±2.10), for an average total time of 107.57 (±132.84) minutes per week compared to 243.51 (±232.28).

Table 4-25
Test-Retest Data on Type of Exercise. Mean Duration Per Session, Frequency and Total Time of Exercise Per Week (N = 13)

<table>
<thead>
<tr>
<th>Type of Exercise</th>
<th>Test Duration SD</th>
<th>Frequency SD</th>
<th>Total Time SD</th>
<th>Retest Duration SD</th>
<th>Frequency SD</th>
<th>Total Time SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>48.59 ±31.11</td>
<td>4.09 ±2.10</td>
<td>243.51 ±232.28</td>
<td>23.11 ±25.57</td>
<td>3.73 ±2.55</td>
<td>107.57 ±132.84</td>
</tr>
<tr>
<td>Bicycling</td>
<td>7.15 ±13.38</td>
<td>0.81 ±1.31</td>
<td>18.03 ±36.02</td>
<td>3.85 ±8.93</td>
<td>1.19 ±2.41</td>
<td>17.11 ±36.59</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>3.28 ±9.51</td>
<td>0.43 ±1.19</td>
<td>11.48 ±33.31</td>
<td>0.92 ±2.75</td>
<td>1.77 ±4.78</td>
<td>2.46 ±5.28</td>
</tr>
<tr>
<td>Conditioning</td>
<td>14.06 ±26.97</td>
<td>1.25 ±2.11</td>
<td>68.75 ±168.56</td>
<td>3.58 ±10.49</td>
<td>0.38 ±0.96</td>
<td>10.03 ±31.18</td>
</tr>
<tr>
<td>Exercise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At retest, bicycling was performed an average duration of 3.85 (±8.93) minutes per session compared to 7.15 (±13.38), for 1.19 (±2.41) sessions per week compared to 0.81 (±1.31), for an average total time of 17.11 (±36.59) minutes per week compared to 18.03 (±36.02). Stair climbing was performed an average duration of 0.92 (±2.75) minutes per session compared to 3.28 (±9.51), 1.77 (±4.78) sessions per week compared to 0.43 (±1.19), and for an average total time of 2.46 (±5.28) minutes per week compared to 11.48 (±33.31). Conditioning exercise continued to be performed an average duration
of 3.58 (±10.49) minutes per session compared to 14.06 (±26.97), for 0.38 (±0.96) sessions per week compared to 1.25 (±2.11), for an average total time of 10.03 (±31.18) minutes per week compared to 68.75 (±168.56).

The average exercise time for all types of exercises combined is described in Table 4-26 and includes both initial test and retest data. Again, initial test data was described earlier. On retest, the average number of minutes per session performed by all subjects combined was 31.46 (±26.25) minutes compared to 73.09 (±54.66). The average exercise time was 137.19 (±128.46) minutes per week by all subjects combined compared to 341.78 (±380.24).

Table 4-26
Test-Retest Data on Mean Exercise Time (N = 13)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test</th>
<th>Retest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minutes Per</td>
<td>Minutes Per</td>
</tr>
<tr>
<td></td>
<td>Session (SD)</td>
<td>Week (SD)</td>
</tr>
<tr>
<td>Exercise Time</td>
<td>73.09 (±54.66)</td>
<td>341.78 (±380.24)</td>
</tr>
<tr>
<td></td>
<td>31.46 (±26.25)</td>
<td>137.19 (±128.46)</td>
</tr>
</tbody>
</table>

Table 4-27 presents the correlational analysis between the test and retest data on the Adherence to Exercise Questionnaire I. These results measure the stability of this questionnaire over time. Nineteen test and retest variables were tested on the AEQ I. The results of the correlation analysis for those variables were as follows: number of days per week (r = 0.356, p = 0.233), number of times per week (r = 0.438, p = 0.134), minutes per session (r = 0.214, p = 0.483), treadmill (r = 0.537, p = 0.059), walking duration (r = 0.045, p = 0.884), walking sessions (r = 0.105, p = 0.732), walking miles (r = -0.397, p = 0.256), walking pace (r = 0.059, p = 0.849), bicycling (r = 0.426,
p = 0.147), bicycling duration (r = 0.891, p = 0.000), bicycling sessions (r = 0.483, p = 0.095), bicycling miles (r = 0.896, p = 0.000), bicycling pace (r = 0.799, p = 0.001), stair climbing (r = 0.272, p = 0.368), stair climbing duration (r = -0.039, p = 0.900), stair climbing sessions (r = 0.625, p = 0.022) conditioning exercise (r = 0.639, p = 0.019), conditioning exercise duration (r = 0.161, p = 0.600), and conditioning exercise sessions (r = 0.354, p = 0.235). The average correlation score for the entire questionnaire was r = 0.41 on all nineteen variables.

Summary

This chapter discussed and displayed the findings of the data analysis. The data were presented according to the subject characteristics and included sample characteristics and secondary demographic variables. Summary data on the major study variables and exercise were presented. Seven research questions were presented. Test-retest data on exercise adherence were also presented. Chapter 5 includes a discussion of the results, limitations, conclusions, and implications.
### Table 4-27
Correlations Between Test and Retest Data on Adherence to Exercise Questionnaire 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>P *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Per Week</td>
<td>0.356</td>
<td>0.233</td>
</tr>
<tr>
<td>Times</td>
<td>0.438</td>
<td>0.134</td>
</tr>
<tr>
<td>Minutes</td>
<td>0.214</td>
<td>0.483</td>
</tr>
<tr>
<td>Tread</td>
<td>0.537</td>
<td>0.059</td>
</tr>
<tr>
<td>Walking Duration</td>
<td>0.045</td>
<td>0.884</td>
</tr>
<tr>
<td>Walking Sessions</td>
<td>0.105</td>
<td>0.732</td>
</tr>
<tr>
<td>Walking Miles</td>
<td>-0.397</td>
<td>0.256</td>
</tr>
<tr>
<td>Walking Pace</td>
<td>0.059</td>
<td>0.849</td>
</tr>
<tr>
<td>Bicycling</td>
<td>0.426</td>
<td>0.147</td>
</tr>
<tr>
<td>Bicycling Duration</td>
<td>0.891</td>
<td>0.000 *</td>
</tr>
<tr>
<td>Bicycling Sessions</td>
<td>0.483</td>
<td>0.095</td>
</tr>
<tr>
<td>Bicycling Miles</td>
<td>0.896</td>
<td>0.000 *</td>
</tr>
<tr>
<td>Bicycling Pace</td>
<td>0.799</td>
<td>0.001 *</td>
</tr>
<tr>
<td>Stair Climbing</td>
<td>0.272</td>
<td>0.368</td>
</tr>
<tr>
<td>Stair Climbing Duration</td>
<td>-0.039</td>
<td>0.900</td>
</tr>
<tr>
<td>Stair Climbing Sessions</td>
<td>0.625</td>
<td>0.022 *</td>
</tr>
<tr>
<td>Conditioning Exercise</td>
<td>0.639</td>
<td>0.019</td>
</tr>
<tr>
<td>Conditioning Exercise Duration</td>
<td>0.161</td>
<td>0.600</td>
</tr>
<tr>
<td>Conditioning Exercise Sessions</td>
<td>0.354</td>
<td>0.235</td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION OF RESULTS

A discussion of the study findings is presented in this final chapter. The findings are discussed in relation to the literature. Also included in this chapter are limitations, conclusions, and implications for further research.

Discussion

A discussion of the study results is presented in this section. Summaries are presented on subject characteristics, major study variables, exercise adherence, research questions, and test-retest data.

Subject Characteristics

Over two-thirds of the study group was male, married, and predominantly white. The majority of the subjects were college-level educated, and had a previous smoking history. More than half of the subjects participated in exercise prior to their heart transplant surgery. All subjects underwent the biatrial heart transplantation technique. Most of the subjects were administered triple-drug immunosuppression therapy consisting of Cyclosporine, Prednisone, and CellCept.

No significant correlations were found between the demographic variables and exercise adherence. Although pre-operative exercise participation showed a p value of <0.05, the question was not specific in determining the subjects exercise participation pre-operatively. In the regression analysis, the demographic variables had no significant effects on exercise adherence.
Summary on Exercise Adherence

Examining the frequency of exercise, all but one patient continued to exercise six months after heart transplant surgery. Subjects continued to exercise an average of 3 – 4 days a week resulting in a 55% adherence rate. All subjects who exercised participated in walking as part of their exercise program, and approximately half of the subjects used a treadmill. One-third of those who exercised also participated in bicycling and conditioning exercises. Stair climbing was the exercise least performed.

Examining the duration of exercise, walking was performed longer and more frequently during the week resulting in a total time of about three and one-half hours per week. Stair climbing was the least performed exercise when considering duration of time and sessions per week performed. Overall, this group of subjects exercised at least one hour at every exercise session that added up to almost four hours of exercise each week.

Examining the intensity of exercise, the majority of subjects walked at a pace of two miles per hour or less. Of the small number of subjects that bicycled, more than half did so at a moderate intensity pace as opposed to a vigorous pace. Conditioning exercises when performed selectively by a subject were more often a moderate intensity exercise than vigorous.

The top leading health indicator established for this Nation’s health by Healthy People 2010 is physical activity (Office of Disease Prevention and Health Promotion, 2001). Also, a panel of experts established by the Centers for Disease Control and Prevention and the American College of Sports Medicine, developed a public health message targeting physical activity. Together, their recommendations state that adults should engage in at least 30 minutes of regular, preferably daily, moderate physical
activity. Comparing these recommendations with the exercise performed by this sample of subjects, the adherers to exercise do not meet these recommendations in frequency or intensity. These subjects exercised less than four days per week and mostly at light intensity. However, their duration of physical activity per session was well over twice the recommendations.

Summary of Major Study Variables

Subjects’ attitude scores regarding exercise were well above the measured average score indicating a positive attitude toward exercising regularly. As indicated by the scores on the Self-Motivation Inventory, these subjects were highly motivated. Also, perceived social influence had above average scores indicating overall positive reinforcement or approval of exercise from others.

Pre-operatively, the majority of subjects were categorized in the ambulating group and were classified as Class III NYHA. On the average, subjects waited one year to receive a donor heart, once selected as a heart transplant candidate.

Physical characteristics of the sample showed subjects averaged 50 years of age, weighed approximately 186 pounds, had high normal resting heart rates, with slightly high blood pressure, and a normal ejection fraction. Subjects had an average of two comorbidities after heart transplant surgery.

Subjects reported receiving support from others that ranged from a great deal to completely. The majority did not pay a fee to exercise, but at the same time, reported quite often that they did not have enough money to pay to participate in exercise. In reporting the convenience aspect of exercise, subjects very often exercised at home, found exercise to be accessible, had enough time to schedule exercise during the day, and
found the setting in which they exercised to be convenient. Seldom did they report they exercised in a health club or gym or had to travel to exercise. Slightly more subjects reported exercising indoors than outdoors and indicated that the climate or weather “never to seldom” prevented them from exercising.

On the average, subjects experienced two to three rejection episodes between the dates of their heart transplant surgery until they participated in this study, which was approximately a 6-month period. However, most of the rejection episodes were not treated with pharmacological agents and the average number of days since their last rejection episode was approximately three months prior to their participation in this study. After successfully receiving the heart transplant, the subjects remained hospitalized for an average of approximately two and one-half weeks. However, most subjects only spent 8–9 days in the hospital. One subject, due to post-operative complications, spent almost four months hospitalized. Subjects experienced an average of over four symptoms six months after heart transplantation surgery. The most common symptoms were fatigue and weakness. Half of the subjects also experienced dizziness, swelling, tremors, and insomnia.

Research Question One

The pre-operative variables that were investigated in this study were as follows: number of days on the waiting list, functional status, and NYHA classification. These variables were important to study because they all are related to the ability of the subject to function and perform activities of daily living including exercise.

Number of days on the waiting list and the functional status variable that included ambulating and exercising were significant predictors of exercise adherence and together
accounted for 65% of the variance (Figure 5-1). NYHA classification was not related to exercise adherence.

The variable number of days on the waiting list accounted for over 29% of the variance on exercise adherence. Research on exercise in heart transplant patients that has studied the number of days on the waiting list is very limited. Studying many clinical variables to predict exercise capacity following hospital discharge after heart transplantation, Salyer and coworkers (1999) found no correlation between total transplant waiting time in days and predischarge exercise capacity or estimated peak exercise METs and peak VO$_2$ within four months after heart transplant surgery. Their average waiting time was 122 days ($\pm$140), whereas, the average waiting time for subjects in this study was 381 ($\pm$531) days. As the waiting time for a heart transplant increases, it is known that deconditioning can occur leading to reduced exercise capacity, as discussed previously. One could presume that this deconditioning would affect the ability of the individual to adhere to exercise in the post-operative period, especially if the effects were severe. It is difficult to compare the findings of this study with those of
Salyer and colleagues. One reason for this is that the cited research investigated the capacity to exercise, whereas, this study investigated adherence to exercise. Even though the sample size was small in both studies, the methodologies and variables studied were different.

The components ambulating and exercising, describing pre-operative functional status significantly predicted exercise adherence, and accounted for over 36% of the variance on exercise adherence. Findings to support this were limited in the literature. A review of existing studies on adherence and randomized controlled trials by Martin and coworkers (2000), demonstrated that those individuals who best adhered to exercise were more fit at the start of exercise programs and also who lived a physically active life. These findings were similar to those in this study in which subjects who were at least ambulating were most likely to adhere to exercise. Grady and colleagues (1998) reported that those subjects who were more severely ill and had more functional disability pre-operatively had less satisfaction with their health and experienced more disability in ambulating and functioning six months post transplant surgery. These findings indirectly support the findings in this study. Comparisons with the present study are difficult because of the small sample size that only found one subject to be bedridden in the six months prior to heart transplant surgery.

NYHA classification did not significantly predict exercise adherence. These results are consistent with those reported by Salyer and coworkers (1999). In their study, they utilized a pretransplant severity of heart failure score as described previously. This score was not predictive of exercise capacity in the heart transplant recipient at discharge or at four months post-transplant. However, interestingly, Riedinger and colleagues
(2000) reported that NYHA classification predicted quality of life in heart failure patients. Also, they found that as NYHA class advanced, i.e., heart failure worsened, it was associated with diminished social activity, and activities of daily living. Grady and coworkers (1998) reported similar findings with NYHA classification. Subjects six months after heart transplantation who were class IV NYHA before surgery, reported less satisfaction with functioning and health compared to patients in NYHA III classification. These studies investigated reports of satisfaction with functioning and quality of life and not the capacity to exercise or adherence to exercise as in the present study. Therefore, it is difficult to make comparisons.

Research Question Two

The physical factors that were investigated in this study were age, weight, ejection fraction, comorbidities, resting heart rate, and resting blood pressure. These variables were important to study because they all are related to the whether an individual can exercise and the tolerance to exercise.

The variables, age, weight, ejection fraction, comorbidities, resting heart rate, and resting blood pressure, did not significantly predict exercise adherence. These findings are not consistent with the reported literature. Gale and colleagues (1984) found that women adhering to an exercise program had significantly lower body weight with less body fat than nonadherers. When determining the performance of exercise, Welsh and coworkers (1991) documented a negative correlation between weight and a 12-minute distance run, in that, heavier subjects ran shorter distances. Salyer and coworkers (1999) also reported similar findings that showed those subjects who were over their ideal body weight had poorer exercise capacity; however, these findings were not significant.
Interestingly, Klonoff and colleagues (1994) found a significant correlation between weight and adherence suggesting that heavier subjects were more likely to be present at exercise classes. Although weight was not a significant predictor on exercise adherence in a study by Emery and colleagues (1992), a common reported reason for continuing exercise a year later following an exercise program was that it allowed them to maintain good shape and health. It is difficult to make comparisons between the present study and those studies cited because of the smaller sample size in the present study and the age of the subjects. Also, Welsh and colleagues only studied sedentary women.

Although age was not shown to predict exercise adherence in this study, it was found to be negatively correlated with attendance at an exercise program as reported by Welsh and coworkers (1991). In another study, age was found to be a strong indicator of subjects likely to be active and participate in physical activity. As age increased, the odds of becoming sedentary greatly increased (Mullineaux et al., 2001). Other investigators also report that physical activity and function decreases with age (Caruso et al., 2000; Rhodes et al., 1999). Possible reasons that the present study did not find age to be predictive of exercise adherence may include the small sample size and the age range. The age range for this study was 19–66 years. The cited studies included subjects over 75 years of age. Older subjects beyond the traditional retirement age experience a decline in physical activity due to increasing health problems and other barriers to maintaining exercise (Booth et al., 2000; Emery et al., 1992). In addition, the sample size of the cited studies were in excess of 1,200 participants.

Studies are unavailable that determined the effect of ejection fraction on exercise adherence. However, Grady and colleagues (1990) found that pre-operative severity of
heart failure, based on the need for inotropic agents and/or mechanical support when transplantation was performed, as determined by the subject’s cardiac index and left ventricular ejection fraction, had predicted hospital length of stay postoperatively. Those experiencing more severe heart failure had a longer length of stay in the hospital.

The average number of comorbidities present after heart transplant surgery did not significantly predict exercise adherence. Research to investigate the relationship between comorbidities and exercise adherence has not been published. However, Ades and colleagues (1999) studied subjects who were known to have coronary artery disease and a high number of other comorbidities. They found that a strong association between the number of comorbidities and poorer physical function prior to starting a rehabilitation program. In addition, Caruso and coworkers (2000) reported that comorbidity (scores) were strongly associated with lower physically functioning. This implies that other coexisting diseases and conditions may interfere with an individual’s functional ability.

A possible reason that this study did not support the cited research studies is that this study analyzed heart transplant recipients while the other studies did not, therefore, having heart transplant surgery could have lessened associated problems of end-stage heart disease on otherwise healthy adults.

Both resting heart rate and blood pressure were not significant predictors of exercise adherence. These findings were consistent with previous studies by Dishman (1981) and Emery and colleagues (1992). Gale and colleagues (1984) also found no correlation between resting heart rate, resting blood pressure and adherence to an exercise program. Explanations for these findings were not given. However, to show how blood pressure can be affected by the performance of exercise, Cox, Puddey, Burke, Beilin,
Morton, and Bettridge (1996) found that systolic blood pressure significantly decreased with moderate intensity exercise but not vigorous intensity exercise. This effect was only seen at six months during the study program and was not evident at 12 months at the end of the program. They also concluded that for those subjects who continued to perform regular exercise, participation was a predictor of change in their systolic blood pressure.

Research Question Three

The psychological factors that were studied were attitude and motivation. Both of these factors have been given major attention in the research literature on exercise adherence. Because they constitute one of the main components of the theoretical framework, they were deemed important to include in the present study.

In the present study, attitude and motivation were not significant predictors of exercise adherence. These results of the study are very surprising and contrary to those findings cited in previous studies. First, the effect that exercise has on attitude and behavior has been sufficiently documented in the literature. As early as 1970, Heinzelmann and Bagley reported that the effect of an exercise program showed positive changes in the attitude of the subjects. The study group that participated in a supervised exercise program for 18 months reported a significantly more positive attitude about their health, their work performance, and also, a greater capability to control stress and tension. Biddle, Goudas, and Page (1994) provided supportive evidence that attitude was the best predictor of the intention to exercise in males and also in women along with other variables. In addition, Andrew and colleagues (1981) also supported attitude as a reason for dropout from an exercise program. They reported that subjects who did not have a strong belief that exercise was valuable to their health, had a higher dropout rate.
from exercise. Dishman (1994) has numerous citations regarding attitude and exercise. Generally, a positive attitude about exercise is seen in individuals over the age of 65. However, when compared to younger individuals, their perception regarding the amount of control they have over being active is less. In reviews by Rhodes and colleagues (1999) and Shepard (1985), both report that a greater positive attitude is generally seen in those who exercise regularly and significantly explains the intent to exercise. One possible reason that the present study did not produce results comparable to the literature is that the measurement of attitude was different when compared to other studies. Those studies cited used one question to determine the subjects’ attitude. In the present study, subjects were asked to respond to eight sets of adjectives used to measure attitude that produced summed scores.

There is a vast amount of literature supporting motivation and its positive effect on exercise. Although the subjects in this study were highly motivated as indicated by their scores on the Self-Motivation Inventory (SMI), this variable did not predict exercise adherence. Most well noted for their work on motivation, Dishman and Ickes (1980) developed a questionnaire to assess self-motivation. This factor has been shown to predict attrition rates of those involved in exercise programs. The lack of motivation experienced by individuals and its relationship with dropping out of exercise programs is frequently cited in the literature (Martin & Dubbert, 1982). Gale and coworkers (1984) reported significantly lower SMI scores for those men who were early dropouts of an exercise program. Similarly, Radke’s (1989) findings also showed that motivation and compliance to a home-based exercise program were significantly related, but, only at six weeks and not at six months. Motivation scores, although, did not change between the
two time periods. Results of this study were not significant at six months because of the smaller sample size at six months compared to that at six weeks. Raglin and colleagues (1990) concluded that higher SMI scores were significantly associated with adherers to a rowing program and associated with greater rowing ergometer performance. Also contributing to these positive findings, Mullineaux and colleagues (2001) found that individuals who possessed high motivation perceptions, also had an increase in the likelihood of participating in physical activity. In contrast, Welsh and colleagues (1991) indicated that overall correlations were not significant between SMI scores and attendance to an exercise program, but, for those subjects who did comply, SMI scores were significantly higher than those who did not comply. In the above studies that had smaller sample sizes as in this present study, it can be found that insignificant results were reported between motivation and exercise adherence. An observation from the current study was that many subjects encountered difficulty in understanding the questions of the SMI. Therefore, this could have impacted the subjects’ scores on the SMI and the study’s results.

Research Question Four

The situational variables that were investigated in this study were support system, financial concerns, convenience, and climate. There were two subcomponents of financial concerns: fee and money; six subcomponents of convenience: exercise at home, exercise in a health club/gym, travel, accessibility, time, and setting convenient; and two subcomponents of climate: climate and weather. It was important to study these factors because they can all directly help or hinder whether or not an individual will exercise.
Accessibility and climate significantly predicted exercise adherence and both accounted for 46% of the total variance (Figure 5-2). The situational variables that did not have an effect on exercise adherence were support system, fee, money, exercise in a gym, travel, time, convenience, and weather. Exercise at home was found to be positively correlated with exercise adherence.

![Figure 5-2. Situational Factors Model.](image)

Accessibility, a subcomponent of the variable convenience, accounted for over 12% of the variance in exercise adherence. These findings are consistent with the research literature. In reviews presented by several researchers, inaccessibility of the location in which to exercise has been cited as a primary reason for either not beginning or not continuing in an exercise program (Blair et al., 1995; Dishman, 1994; King et al., 1992; Robison & Rogers, 1994). Convenience was a main category that was significantly related to the high dropout rate of post-coronary patients in an exercise program (Andrew et al., 1981). The convenience aspects involved time, convenience of the exercise center, and parking at the center. Other convenience components that did not predict exercise adherence in this study but do show strong associations in the literature.
are exercise at home, exercise at a health club/gym, travel to exercise, time, and setting convenient (Blair et al., 1995; King et al., 1992; Sallis et al., 1992).

The climate in which the subject exercises, indoors or outdoors, significantly predicted exercise adherence and accounted for 34% of the variance in exercise adherence. There are no published studies that have directly studied this variable. Dishman (1994) states that as individuals age, access to exercise programs becomes more limited and, as a result, these individuals will often exercise at home. Studies are not available that specifically relate to the weather condition in which the subject exercises. Therefore, these findings have not been previously reported and this variable may be important to investigate further in future studies.

Support system did not significantly predict exercise adherence. This finding was contrary to those cited in the literature. Booth and coworkers (2000) found that the frequency with which the subject’s partner was physically active and also how often friends or family participated in exercise was significantly associated with the subject being active. Heinzelmann and Bagley (1970) stated that approximately 90% of their subjects specified a preference to exercise with another person or with a group. In another study, family and friend support significantly predicted the adoption of vigorous physical activity in sedentary women (Sallis et al., 1992). In their examination of factors related to exercise adherence, Gale and colleagues (1984) reported that the dropouts of the program had a greater number of subjects that were single. The present study did not support these previous research findings. A possible reason is the small sample size of this study. Those studies cited had a larger sample ranging from 106 to 1719 subjects.
Financial concerns, fee and money, did not have a significant effect on exercise adherence. Studies that have investigated financial concerns are very limited in the literature. However, this finding is contrary to that reported by Andrew and colleagues (1981). They reported that higher dropout rates from an exercise program were seen among those subjects whose income failed to reach their expectations. Rhodes and colleagues (1999) reported in a review of the literature that “higher rates of exercise behaviour have been correlated with increased socioeconomic standing” (p. 399). They also state that research has shown positive correlations between income and middle-age subjects that exercise regularly. The results of this study showed that although the majority of the subjects did not pay a fee to exercise, most of the subjects reported that they did not have enough money to participate in exercise. Yet, all but one subject continued to exercise six months after heart transplant surgery.

Research Question Five

The disease-related variables that were investigated in this study were number of rejection episodes, number of days since rejection, length of hospitalization, and symptoms. The symptoms that were studied were fatigue, shortness of breath, pain, dizziness, swelling, tremors, insomnia, and weakness. A category of ‘other’ symptoms was also included. These variables were studied because they all directly affect the physical ability of the individual.

The variables, number of rejection episodes, number of days since rejection, length of hospitalization, and symptoms did not significantly predict exercise adherence. Findings related to rejection are severely limited in the research literature. Therefore, the results of this study cannot be adequately compared. Salyer and colleagues (1999) found
that the number of days since the resolution of rejection was positively correlated with estimated METs four months after hospital discharge from heart transplant surgery. Also, it significantly explained over 29% of the variance of estimated peak exercise METs after discharge. This present study did not support these findings.

Length of hospitalization did not significantly predict exercise adherence. Research to support the findings on length of hospitalization is very limited. Salyer and colleagues (1999) reported that length of hospitalization posttransplant did not significantly correlate with exercise capacity; however, along with two other variables, it did explain 73% of the variance in peak exercise METs four months after transplant surgery. Alone, it explained over 23% of the variance. Both this study and Salyer's had a small sample size that may have been a reason for the insignificant results.

Symptoms did not significantly predict exercise adherence. This finding is contrary to the cited literature. Klonoff and colleagues (1994) found that the reported total number of physical symptoms by the subject was positively correlated with the number of exercise sessions attended and significantly predicted adherence accounting for over 18% of the total variance in exercise adherence. Those subjects who experienced more physical complaints attended a greater number of exercise sessions. On the other hand, Andrew and colleagues (1981) discovered that subjects who experienced a substantial amount of fatigue during an exercise session had a higher dropout rate. The measurement of symptoms was different in these studies as compared to the present study. Differences in measurement of this variable may have accounted for the difference in predicting exercise adherence.
Symptoms, whether from end-stage heart disease in the pre-operative period or from the administration of immunosuppression medications in the post-operative period, can be distressing to the heart transplant patient and can interfere with physical functioning. To acknowledge the significance of the presence of symptoms, Jalowiec and colleagues (1997) found a significant increase among 10 symptoms from before heart transplant surgery to three months posttransplant. These symptoms were tremors, puffy face, facial changes, hirsutism, overeating, body changes, leg cramps, taste problems, acne, and hunger. In addition, they also reported a large number of transplant patients continued to experience many preoperative symptoms three months after surgery. These symptoms were fatigue, weakness, insomnia, anxiety, sexual problems, lethargy, depression, exertional shortness of breath, and tachycardia. These findings indicated that heart transplant recipients experience numerous symptoms, and these symptoms can interfere with the ability to exercise. Subjects in the present study also reported many of these symptoms.

Research Question Six

The variable that was investigated was perceived social influence. Perceived social influence did not significantly predict exercise adherence. Although research on perceived social influence is limited, this finding is contrary to the cited research literature. Booth and coworkers (2000) investigated social reinforcement by friends and families and found that one of the tested components was significantly associated with physical activity. The component determined if “friends and families said that physical activity seemed to be good for their appearance” (p. 17). Thus, they found that if family and friends offered this positive reinforcement, then the subjects were more likely to
engage in physical activity. It was shown by Andrew and colleagues (1981) that in subjects whose spouses were indifferent or were negative toward the exercise program, the dropout rate of the subject was three times greater as compared to those who supported their spouses. Heinzelmann and Bagley (1970) reported that 80% of the male subjects in their study had good or excellent exercise adherence patterns as a result of their wives’ positive attitudes towards the exercise program. Perceived social influence was measured differently from those research studies cited above; thus, this may be a major reason the findings of this study were different.

Research Question Seven

The best combination of independent variables for predicting exercise adherence could not be performed by regression analysis as previously discussed. As an overview, with this particular sample of subjects, the variables that did significantly predict exercise adherence were two pre-operative factors, number of days on the waiting list and functional status, and two situational factors, accessibility and climate (Figure 5-3). The results of this study are difficult to compare with previous research studies due to the lack of research regarding some of the independent variables and to the differences in sample size, subject population, characteristics, and methodology.

Regression Analysis

Regression analysis was used in order to predict the value of exercise adherence based on the values obtained from the major independent variables. For this to be possible, certain assumptions must be met regarding regression analysis. The relationship between these assumptions and this study were as follows. The variables were measured at the interval level of measurement. All the major independent variables
were measured and treated at least at the interval level except for climate, which was nominal scale data. It can be assumed for this study that the major variables were independent of each other and were measured without error. An assumption of regression analysis is that the relationship between exercise adherence and the independent variables are linearly related and the scores are homoscedastic or equally scattered about the regression line. Scatter plot diagrams were not available on the study results; however, the standard error of estimates for the six regression analyses on the research questions were less than 2.22, indicating that the estimated regression lines showed a very small scatter of points about the regression lines (Burns & Grove, 1997).

Figure 5-3. Predictors of Exercise Adherence.

Test–Retest Data

As previously discussed, a majority of the subjects were retested to determine the stability of the Adherence to Exercise Questionnaire I over time. Administration of the questionnaire was conducted and 13 subjects were retested an average of 67 days after initial testing. Repeated measurements showed a moderate degree of scale stability (r = 0.41). Correlations for the individual variables tested ranged from -0.039 to 0.896.
Determining test-retest reliability may not be an appropriate test for the Adherence to Exercise Questionnaire I because the exercise behavior of the subjects had changed, in some cases dramatically, from the initial test date to the retesting date. Using a test-retest technique on exercise adherence has an underlying assumption that this factor, exercise adherence, has not changed and remains the same at the two testing periods. This assumption was clearly violated.

When examining how the exercise behavior of the subjects had changed from the initial test to the retest period, the following information was extracted from the study results. On retesting of the subjects, one subject dropped out from exercising, five subjects stopped walking, two stopped using the treadmill, two stopped bicycling, and three stopped performing conditioning exercises. In addition, walking decreased by over 25 minutes per session, the number of walking sessions decreased, and over 136 minutes less total time was spent walking per week. For the other exercises, bicycling decreased by over three minutes per session, stair climbing decreased by over two minutes per session, and conditioning exercise decreased by over 10.5 minutes per session along with a decrease in the number of sessions per week. Over nine minutes less total time was spent stair climbing, and over 58 minutes less total time was spent performing conditioning exercises per week. Also, the average number of minutes for all types of exercises combined decreased by 42 minutes per session, and the average number of minutes of exercise time per week decreased by 204 minutes on retest. Because of these changes in the exercise behavior of the subjects at retest, determining the stability of the Adherence to Exercise Questionnaire I based on the test-retest technique was deemed not feasible.
Limitations

Two limitations of this study are the small sample size and use of a convenience sample. Prior to the initiation of this research study, power analysis determined that a sample of 40 subjects was sufficient to address the research questions. At the conclusion of this study, a convenience sample of 16 patients was tested, and as a result, may not have been sufficient to answer the research questions. The small size was a result of an unanticipated decline in the number of heart transplant surgeries performed at the institution as previously discussed. Another factor that adversely affected the size of the sample was the death of two subjects prior to their scheduled testing date.

The generalizability of this study may be limited due to the clinical homogeneity of the sample. Subjects were selected from only one university medical center and participated in an in-hospital exercise program for a minimum of seven days that was specific to the institution. Therefore, these factors may limit the generalizability to other institutions that differ in exercise protocols for the transplant recipient. However, theoretical generalizability is not limited.

Another limitation of this study was the use of self-report measures of exercise and the intent to exercise. The data regarding adherence to exercise may have been confounded due to bias in the use of self-reports of exercise. There is no gold standard for measuring exercise adherence or physical activity that has both adequate reliability and validity. The self-report measures used in this study were beneficial in that they contained specific physical activities commonly performed by heart transplant patients. Space was also provided for the subjects to add other types of exercise, and it allowed for
quantification of exercise by delineating the frequency, duration, and intensity of exercise.

The subjects' level of education may have influenced their ability to complete the questionnaire on self-motivation. Difficulty was encountered by two subjects on their ability to comprehend the questions and the associated rating scale that pertained to the Self-Motivation Inventory Questionnaire.

The noncompliant behavior of the subjects to keep their clinic appointment may have been a factor that confounded the data to predict exercise adherence at 6 months. Fourteen subjects completed testing at 6 months. There were two subjects who completed testing beyond 6 months, one at 9 months and one at 12 months. These two subjects did not attend their scheduled 6-month clinic appointment. One subject rescheduled 2 months later, and the second subject rescheduled 6 months later. A decision was made to retain these subjects because of the unanticipated decrease in the number of heart transplant surgeries performed at the institution. Six months after heart transplant surgery was the time period selected for collecting the data. The major rationale for selecting this time period was that research demonstrates that approximately 50% of individuals will drop out of an exercise program within 6 months. Therefore, those subjects who were beyond the sixth month may have demonstrated poorer adherence to exercise and may have adversely affected the study results.

A final limitation of this study was the use of the Self-Motivation Inventory Questionnaire. As previously reported, a high degree of validity and reliability has been established for this instrument by Dishman and Ickes (1980). However, the settings used for instrument development and testing were naturalistic and the sample of subjects
consisted of healthy college-aged men and women and middle-aged adults in the absence of disease-related conditions. The use of this questionnaire with the older adult may not be appropriate because the indicators of motivation and measurement of the concept may be different between age groups (Resnick, 1995). In addition, the motivation of healthy subjects may be different compared to those subjects with disease processes and physical limitations. Because the sample of this study included older subjects with heart disease who had physical limitations, the use of this questionnaire in measuring motivation may limit the predictability of that factor for exercise adherence in the subjects in this study.

Conclusions

The following are the conclusions of this study. There are an abundance of variables that can potentially affect ones’ ability to exercise and adhere to a program of exercise. Many factors have been cited in this study of heart transplant patients that relate to the pre-operative period, physical and psychological makeup of the individual, situational and disease-related conditions, and perceived social influences. The factors that had a positive correlation with exercise adherence were functional status and exercising at home. The factors that significantly predicted adherence to exercise six months after heart transplant surgery were number of days on the waiting list, functional status, accessibility, and climate. Reasons for finding these factors significant in the present study could be attributed to the following: the average duration of the number of days on the waiting list was considerably longer; all but one subject was at least ambulating in the six-month period preceding their heart transplant surgery; and more subjects elected to exercise at home and indoors, therefore, finding exercise more accessible. Discovering that the variables, number of days on the waiting list, functional
status, and climate (exercising indoors/outdoors) significantly predict exercise adherence, enhances and positively contributes to the research literature that was otherwise limited. The findings on the accessibility of exercise in the present study provides additional support to a significant amount of research in the literature. Interestingly, the majority of the research studies cited in the present study did not involve heart transplant recipients, instead, examined subjects that were primarily healthy adults or in the pre-transplant, heart failure stage. As previously stated, identifying predictors of exercise adherence after heart transplantation has not been researched. Therefore, the results of the present study contribute to the gap of knowledge that exists between the prediction of exercise adherence and heart transplantation.

For the heart transplant patient, determining factors that are associated with the ability to adhere to exercise is vitally important for the purposes of maximizing the positive effects associated with exercise. Exercise has many benefits for the heart transplant patient. Some of these benefits include lower prevalence of cardiac risk factors; normalization of rest and exercise hemodynamics, decreased submaximal heart rate, blood pressure, minute ventilation, and perceived exertion; improved symptoms of fatigue, dyspnea, psychosocial function, lean body mass; and a reduction in side effects associated with immunosuppressive medications.

Adherence to exercise is a result of the interaction that occurs between many different variables, such as those investigated in the present study. These important factors should be assessed and taken into consideration as exercised is prescribed for the heart transplant recipient. Attitude and motivation should be kept as high as possible. Ideal body weight should be maintained. Compliance with medications should be
encouraged to enhance cardiac function pre-operatively and to maintain optimal immunosuppression post-operatively. Participation of family and friends should be encouraged. Financial support should be maximized. The convenience of exercise should be improved. Individuals and their families should be educated on the benefits of exercise that also focuses on the benefits of weight-reduction, symptom relief, and anxiety reduction.

Survival rates for the heart transplant recipient have dramatically improved since the late 1960's primarily as a result of improved immunosuppressive medications, surgical techniques and methods of detecting rejection and preservation. Therefore, more emphasis should now be placed on enhancing the quality of the life of the recipient by promoting a healthy lifestyle and engaging in a beneficial exercise program.

**Implications**

The following section presents a discussion of the implications of this study. Implications for clinical practice as well as future research are presented.

**Clinical Practice**

For the heart transplant patient, initiating interventions to improve exercise adherence in the pre-operative period would be beneficial to the patient post-operatively. Increasing the capacity to exercise by prescribing daily exercise and designing exercise protocols can help maximize the functional status of the transplant candidate. Exercise is known to affect every major system in the body both physical and psychological. Pre-operative exercise may counteract the deconditioning effects on the body due to prolonged bedrest and immobility.
The significant predictors of adherence to exercise after heart transplantation found in this study were the number of days on the waiting list, functional status, accessibility, and climate. Clinicians may not have direct control over the number of days a heart transplant patient spends waiting for an organ; however, they can make an impact by educating the public on organ donation and seeking ways to increase the supply of organs. The factors functional status, accessibility, and climate can be applied in the clinical setting and can be easily implemented. Improving and maintaining ambulation and exercise in the pre-operative period when feasible can be implemented by clinicians. After surgery and in preparation of the patient for discharge home, the clinician can express the importance of exercise with emphasis on adopting an exercise program either indoors or outdoors at home.

Exercise protocols, however, need to be designed specifically for each individual patient, with goals clearly defined and predetermined. The American College of Sports Medicine along with the Centers for Disease Control and Prevention recommend defining exercise in terms of frequency, duration, and intensity. The pre-operative period is also an excellent time to educate the patient on the overall effects of exercise and how exercise affects the denervated heart.

In the post-operative period, interventions to improve adherence to exercise is best initiated during hospitalization after heart transplant surgery has been performed. Exercise protocols that are specific to each phase of the recovery period should be developed. Exercise should be tailored to the physical abilities of the patient during the hospitalization phase. Once discharged from the hospital and up to the time period when the sternum completely heals, exercise should reflect the capabilities of the individual.
Finally, protocols should reflect any further progression of exercise and exercise maintenance specific to the individual.

Other interventions to improve exercise adherence should be targeted to increasing the individual’s accessibility to exercise. If specialized equipment for rehabilitation is not warranted, home-oriented exercise programs should be implemented. In addition, exercise for both indoors and outdoors could be incorporated into the prescribed program. Adequate exercise is well known to control or maintain desirable weight. For the transplant recipient, exercise may help counteract the effects of steroids known to produce post-operative weight gain.

Future Research

The following recommendations are suggested for future research:

1. Replicate the study using a larger sample.

2. Conduct a study that investigates and compares pre-operative exercise participation with post-operative exercise participation specifying frequency, duration, and intensity of exercise.

3. Develop and test exercise protocols for the heart transplant patient both in the pre-operative and post-operative period.

4. Conduct studies that incorporate physiologic measures of exercise to determine exercise adherence.

Summary

This final chapter presented a discussion of the findings of this study. Presented in the discussion were the subject characteristics, summary of major study variables, summary on exercise adherence, research questions, and test-retest data. Also presented were the limitations, conclusions, and implications of the study for clinical practice and future research.
APPENDIX A
INFORMED CONSENT
Informed Consent to Participate in Research

The University of Florida
Health Science Center
Gainesville, Florida 32610

You are being asked to participate in a research study. This form provides you with information about the study. The Principal Investigator (the person in charge of this research) or his/her representative will also describe this study to you and answer all of your questions. Read the information below and ask questions about anything you don’t understand before deciding whether or not to take part. Your participation is entirely voluntary and you can refuse to participate without penalty or loss of benefits to which you are otherwise entitled.

Name of the Subject

Title of Research Study
Predictors of Adherence to Exercise After Heart Transplantation

Principal Investigator and Telephone Number
Katherine R. Plitnick, RN PhD CCRN (404) 712-2394

Sponsor of the Study
The College of Nursing at the University of Florida.

What is the purpose of this study?
The purpose of this study will be to look at how different things may influence whether or not a person will exercise after having a heart transplant.

What will be done if you take part in this research study?

If you are willing to take part in this study, and after you sign the consent form, you will be asked to answer some questions and to fill out three questionnaires. There are eight questions in the first questionnaire that ask about your exercise routine. The second questionnaire has 24 questions that ask about your feelings about exercise. The third questionnaire has 40 questions that deal with motivation. It will take approximately 30 minutes to finish the questionnaires and to answer the questions about yourself. The researcher will also collect information about your medical and surgical history related to your heart transplant surgery from your medical record at the clinic.

What are the possible discomforts and risks?

There are no known discomforts or risks to you for taking part in this study.

What are the possible benefits to you or to others?

There are no known direct benefits to you by participating in this study. The potential long-term benefit to you and others is a better understanding of the different reasons why people will or will not exercise after having a heart transplant.

If you choose to take part in this study, will it cost you anything?

No, it will not cost you anything to participate in this study.

Will you receive compensation for your participation in this study?

No, you will not receive any monetary compensation for your participation in this study.

What if you are injured because of the study?

If you experience an injury that is directly caused by this study, only professional consultative care that you receive at the University of Florida Health Science Center will be provided without charge. However, hospital expenses will have to be paid by you or your insurance provider. No other compensation is offered.
If you do not want to take part in this study, what other options or treatments are available to you?

Participation in this study is entirely voluntary. You are free to refuse to be in the study, and your refusal will not influence current or future health care you receive at this institution.

How can you withdraw from this research study?

If you wish to stop your participation in this research study for any reason, you should contact: Katherine R. Plitnick at (404) 712-2394. You are free to withdraw your consent and stop participation in this research study at any time without penalty or loss of benefits to which you are otherwise entitled. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

In addition, if you have any questions regarding your rights as a research subject, you may phone the Institutional Review Board (IRB) office at (352) 846-1494.

How will your privacy and the confidentiality of your research records be protected?

Authorized persons from the University of Florida, the hospital and clinic involved in this research, and the Institutional Review Board have the legal right to review your research records and will protect the confidentiality of those records to the extent permitted by law. Otherwise, your research records will not be released without your consent unless required by law or a court order.

If the results of this research are published or presented at scientific meetings, your identity will not be disclosed.

Will the researchers benefit from your participation in this study (beyond publishing or presenting the results)?

There is no direct benefit to the researcher from your participation in this study besides advancing knowledge in the field and publishing or presenting the findings of the study.
Signatures

As a representative of this study, I have explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

_________________________________________________________  ________________________________
Signature of person obtaining consent                        Date

You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this Form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. You voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights.

_________________________________________________________  ________________________________
Signature of Subject                                         Date

_________________________________________________________  ________________________________
Signature of Witness (if available)                           Date
APPENDIX B
ADHERENCE TO EXERCISE QUESTIONNAIRE I
Adherence to Exercise
Questionnaire I

The following are general questions about participation in your “planned exercise program” during a typical week since your heart transplant surgery. Please answer each question to the best of your ability.

1. Do you exercise?
   Yes _____
   No _____

2. How many days per week do you exercise? _________

3. How many times do you exercise each week? _________

4. How many minutes do you exercise per session? _______

The following are questions about specific types of exercise that you might participate in during a typical week since your heart transplant surgery. Please answer each question to the best of your ability.

5. Does part of your program involve walking?
   NO YES If Yes, How many sessions per week? _________
   How many miles per session? __________
   Average duration per session? _______ (minutes)

What is your usual pace of walking?
1 ______ less than 2 mph
2 ______ 2 mph
3 ______ 3 mph
4 ______ 4 mph
5 ______ more than 4 mph

Do you use a treadmill?
Yes _____
No _____

6. Do you usually exercise on a bicycle?
   NO YES If Yes, How many sessions per week? _________
   How many miles per session? __________
   Average duration per session? _______ (minutes)
What is your usual pace of bicycling?
1 ___ general leisure, less than 10 mph
2 ___ light effort, 10 – 11.9 mph
3 ___ moderate effort, 12 – 13.9 mph
4 ___ vigorous effort, 14 – 15.9 mph
5 ___ racing, more than 16 mph

7. Do you usually climb stairs or use a stair machine?
   NO  YES  If Yes, How many sessions per week? __________
   Average duration per session? __________ (minutes)

8. Do you perform any other type of exercise regularly each week?
   Type of Exercise ________________________________
   How many sessions per week? _______________________
   Number of minutes per session ______________________

   Type of Exercise ________________________________
   How many sessions per week? _______________________
   Number of minutes per session ______________________

   Type of Exercise ________________________________
   How many sessions per week? _______________________
   Number of minutes per session ______________________
APPENDIX C
ADHERENCE TO EXERCISE QUESTIONNAIRE II
Adherence to Exercise
Questionnaire II

1. Place a check mark in the space that is closest to your response to the following phrase “my doing exercise regularly is”

- punishing
- useful
- bad
- harmful
- wise
- sad
- pleasant
- exciting

- rewarding
- useless
- good
- beneficial
- foolish
- happy
- unpleasant
- boring

2. Place a check mark in the space that is closest to your response to the following statement “most people who are important to me would approve-disapprove of my doing exercise regularly”

- not at all
- very much

3. Place a check mark in the space that is closest to your response to the following statement “how much do you care whether other people approve or disapprove of your performing exercise regularly”

- not at all
- very much

4. During the six months preceding surgery, what category would best describe your functional status?

- Bedridden
- Ambulating
- Exercising

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5. **Do you get the kind of support from others that you need?**

1-not at all
2-not much
3-moderately
4-a great deal
5-completely

6. **Do you pay a fee to exercise?**

Yes ____
No ____

7. **Do you have enough money to pay to participate in exercise?**

1-never
2-seldom
3-quite often
4-very often
5-always

8. **Do you exercise at home?**

1-never
2-seldom
3-quite often
4-very often
5-always

9. **Do you exercise in a health club or gym?**

1-never
2-seldom
3-quite often
4-very often
5-always

10. **Do you travel to exercise?**

1-never
2-seldom
3-quite often
4-very often
5-always
11. Is it easily accessible?
   1-never
   2-seldom
   3-quite often
   4-very often
   5-always

12. Is there enough time during the day to schedule time to exercise?
   1-never
   2-seldom
   3-quite often
   4-very often
   5-always

13. Is the setting in which you exercise convenient?
   1-never
   2-seldom
   3-quite often
   4-very often
   5-always

14. Do you exercise?
   indoors _________
   outdoors _________

15. Does the climate or weather prevent you from exercising?
   1-never
   2-seldom
   3-quite often
   4-very often
   5-always

16. How much are you bothered by fatigue?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely
17. How much are you bothered by shortness of breath?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

18. How much are you bothered by pain?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

19. How much are you bothered by dizziness?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

20. How much are you bothered by leg or feet swelling?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

21. How much are you bothered by tremors?
   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely
22. **How much are you bothered by insomnia?**

   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

23. **How much are you bothered by weakness?**

   1-not at all
   2-slightly
   3-moderately
   4-very
   5-extremely

24. **Are there any other symptoms that you experience that may interfere with your ability to exercise?**
APPENDIX D
SELF-MOTIVATION INVENTORY
Self-Motivation Inventory Questionnaire
Developed by R.K. Dishman and W.J. Ickes

Directions: Read each of the following statements and then blacken the appropriate number to the right of the statement to indicate how it best describes you. Please be sure to answer every item and try to be as honest and accurate as possible in your responses. There are no right or wrong answers. Your answers will be kept in the strictest confidence.

The alternatives are

1. I’m not very good at committing myself to do things.  
2. Whenever I get bored with projects I start, I drop them to do something else.  
3. I can persevere at stressful tasks, even when they are physically tiring or painful.  
4. If something requires too much effort, I’m likely to just forget it.  
5. I’m really concerned about developing and maintaining self-discipline.  
6. I’m good at keeping promises, especially the ones I make to myself.  
7. I don’t work any harder than I have to.  
8. I seldom work to my full capacity.  
9. I’m just not the goal-setting type.  
10. When I take on a difficult job, I make a point of sticking with it.  
11. I’m willing to work for things I want if it’s not a big hassle for me.  
12. I have a lot of self-motivation.  
13. I’m good at making decisions and standing by them.  
14. I generally take the path of least resistance.
<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>15.</td>
<td>I get discouraged easily.</td>
</tr>
<tr>
<td>16.</td>
<td>If I tell somebody I’ll do something, they can depend on it being done.</td>
</tr>
<tr>
<td>17.</td>
<td>I don’t like to overextend myself.</td>
</tr>
<tr>
<td>18.</td>
<td>I’m basically lazy.</td>
</tr>
<tr>
<td>19.</td>
<td>I have a very hard-driving, aggressive personality.</td>
</tr>
<tr>
<td>20.</td>
<td>I work harder than most of my friends.</td>
</tr>
<tr>
<td>21.</td>
<td>I persist in spite of pain or discomfort.</td>
</tr>
<tr>
<td>22.</td>
<td>I like to set goals and work toward them.</td>
</tr>
<tr>
<td>23.</td>
<td>Sometimes I push myself harder than I should.</td>
</tr>
<tr>
<td>24.</td>
<td>I tend to be overly apathetic.</td>
</tr>
<tr>
<td>25.</td>
<td>I seldom, if ever, let myself down.</td>
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<tr>
<td>26.</td>
<td>I’m not very reliable.</td>
</tr>
<tr>
<td>27.</td>
<td>I like to take on jobs that challenge me.</td>
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<td>28.</td>
<td>I change my mind about things easily.</td>
</tr>
<tr>
<td>29.</td>
<td>I have a lot of willpower.</td>
</tr>
<tr>
<td>30.</td>
<td>I’m not likely to put myself out if I don’t have to.</td>
</tr>
<tr>
<td>31.</td>
<td>Things just don’t matter much to me.</td>
</tr>
<tr>
<td>32.</td>
<td>I avoid stressful situations.</td>
</tr>
<tr>
<td>33.</td>
<td>I often work to the point of exhaustion.</td>
</tr>
<tr>
<td>34.</td>
<td>I don’t impose much structure on my activities.</td>
</tr>
<tr>
<td>35.</td>
<td>I never force myself to do things I don’t feel like doing.</td>
</tr>
<tr>
<td>36.</td>
<td>It takes a lot to get me going.</td>
</tr>
<tr>
<td>37.</td>
<td>When I reach a goal, I set a higher one.</td>
</tr>
<tr>
<td>38.</td>
<td>I can persist in spite of failure.</td>
</tr>
<tr>
<td>39.</td>
<td>I have a strong desire to achieve.</td>
</tr>
<tr>
<td>40.</td>
<td>I don’t have much self-discipline.</td>
</tr>
</tbody>
</table>

Used with permission Rod K. Dishman, PhD.
APPENDIX E
ADHERENCE TO EXERCISE QUESTIONNAIRE III
Adherence to Exercise Questionnaire III

1. Number of days on HTP waiting list

2. NYHA classification: I _____ II _____ III _____ IV _____

3. Age (years)

4. Weight (pounds)

5. Ejection Fraction (percent)

6. Co-Morbidities

   ____________________________  ____________________________  ____________________________

   ____________________________  ____________________________  ____________________________

   Total Number: _____

7. Resting heart rate (beats per minute)

8. Resting blood pressure (mmHg)

9. Number of total rejection episodes since surgery

   Rejection episodes requiring treatment

   Rejection episodes not requiring treatment

10. Number of days since last rejection

11. Number of days of hospitalization after surgery

12. Heart transplant surgical technique: Biatrial _____ Bicaval _____
APPENDIX F
DEMOGRAPHIC DATA SHEET:
SAMPLE CHARACTERISTICS
Demographic Data Sheet
Sample Characteristics

Gender

Male ________
Female ________

Ethnicity

White ________
Non-White ________

Marital Status

Married ________
Single, widowed, or divorced ________

Educational Level

9th or less ________
Some high school ________
High school diploma ________
College ________

Smoking History

Yes ________
No ________

Pre-operative Exercise Participation

Yes ________
No ________

Current Immunosuppressive Medications

________________________
________________________
________________________
________________________
APPENDIX G
UNIVERSITY OF FLORIDA
HUMAN SUBJECTS COMMITTEE APPROVAL
MEMORANDUM

DATE: December 24, 2001

TO: Katherine R. Plitnick, RN, PhD
Box 100187

FROM: R. Peter Iafrate, Pharm.D.
Chair, IRB-01

SUBJ: IRB Protocol #569-2001

TITLE: PREDICTORS OF ADHERENCE TO EXERCISE AFTER HEART TRANSPLANTATION

You have received IRB approval to conduct the above listed research project. Approval of this project was granted on 12/14/2001. Enclosed is the dated, IRB-approved Informed Consent Form that must be used for enrolling subjects into this project from 12/14/2001 - 11/26/2002.

You are responsible for applying for renewal of this project prior to the expiration date. Re-approval of this project must be granted before the expiration date or the project will be automatically suspended. If suspended, new subject accrual must stop. Research interventions must also stop unless there is a concern for the safety or well being of the subjects. You must respond to the continuing review questions within 90 days or your project will be officially terminated.

The IRB has approved exactly what was submitted. Any change in the research, no matter how minor, may not be initiated without IRB review and approval, except where necessary to eliminate hazards to human subjects. If a change is required due to a potential hazard, that change must be promptly reported to the IRB.

Any severe and unanticipated side effects or problems, and all deviations from federal, state, university or IRB regulations must be reported, in writing, within 5 working days.

Upon completion of the study, you are required to submit a summary of the project to the IRB office.

Research records must be retained for three years after completion of the research; if the study involves medical treatment, it is recommended that the records be retained for eight years.

If VAMC patients will be included in this project, or if the project is to be conducted in part on VA premises or performed by a VA employee during VA-compensated time, review by the VA Subcommittee for Research is required.

You are responsible for notifying all parties about the approval of this project, including your co-Investigators and Department Chair. If you have any questions, please feel free to contact the IRB-01 office at (352) 846-1494.

Cc: IRB File
Pharmacy
VA Research Center
Clinical Research Center
APPENDIX H
EMORY UNIVERSITY
HUMAN INVESTIGATIONS COMMITTEE APPROVAL
NOTIFICATION OF PROTOCOL APPROVAL (University of Florida IRB# 569-2001)

RE: NOTIFICATION OF PROTOCOL APPROVAL (University of Florida IRB# 569-2001)
P: Katherine Plitnick
IRB: 064-2002
TITLE: Predictors of Adherence to Exercise after Heart Transplantation
DATE: January 07, 2002

Review Type: Exempt (Review was deferred to the University of Florida)
This approval is valid from 1/7/2002 until 1/6/2003

Your research proposal referenced above and the associated informed consent process was reviewed and APPROVED by the Institutional Review Board.
Your approval period is noted above. Thereafter, continued approval is contingent upon the submission of a renewal form (found on our website) that must be reviewed and approved by the Institutional Review Board prior to the anniversary or expiration date of this study. Any serious reactions resulting from this study should be reported immediately to the Committee, to the Departmental Chairperson, and to any sponsoring agency or company. Approval is granted based upon your agreement to abide by the policies and procedures of Emory University with regard to use of human subjects in research and to keep appropriate records.
Projects, which are being submitted to agencies or other sponsors for external funding, must also be approved through the Office of Sponsored Programs prior to initiation of the study.
Please note that this protocol has been assigned the above referenced IRB protocol number. All inquiries and correspondence concerning this protocol must include: 1) The above referenced IRB number, 2) Name of the Principal Investigator, and 3) Full Title of Study. Please reference this number when making inquiries regarding this protocol and when submitting grant application materials.
If you have any questions or concerns, please contact the IRB office at 404-727-5646 or at email address irb@emory.edu. Our website is at http://www.med.emory.edu/IRB.

Sincerely,

James W. Keller, MD
Chairman, Institutional Review Board
REFERENCES


BIOGRAPHICAL SKETCH

Born in Hartford, Connecticut, in 1960 and raised in Miami, Florida, Katherine Rose Plitnick graduated from Oklahoma State University, Stillwater, Oklahoma, in 1982 and completed a Bachelor of Science degree in Nutrition and Dietetics. In pursuit of a nursing career, she graduated with a Bachelor of Science in Nursing degree in 1985 from Central State University, Edmond, Oklahoma. In 1993, she graduated from Northwestern State University with a Master of Science in Nursing degree, specializing in cardiovascular critical care as a Clinical Nurse Specialist. The chairman of her thesis, titled "The Impact of an Active Warming Therapy on Postoperative Hypothermia: A Retrospective Analysis," was Dr. Suzanne Prevost. In 1993, she was inducted into Sigma ThetaTau International Honor Society of Nursing.

From 1993 to 1998, Ms. Plitnick was employed as an Assistant Professor at Northwestern State University in Shreveport, Louisiana, teaching critical care nursing. She also continued her clinical practice in the area of adult critical care and postanesthesia nursing.

Deciding to pursue a Ph.D. degree in nursing, she relocated to Gainesville, Florida, in 1999 to attend the University of Florida. Her Ph.D. was awarded in December 2002.
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Jean E. Davis, Chair
Associate Professor of Nursing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James Jessup
Associate Professor of Nursing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Hossein Yarandi
Associate Professor of Nursing

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Randy W. Braith
Associate Professor of Exercise and Sports Sciences

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Samuel F. Sears, Jr.
Associate Professor of Clinical and Health Psychology
This dissertation was submitted to the Graduate Faculty of the College of Nursing and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 2002

[Signature]
Dean, College of Nursing

[Signature]
Dean, Graduate School