Predictors of Participant Retention in Cardiac Rehabilitation Programs

A dissertation presented to
the faculty of
the College of Arts and Sciences of Ohio University

In partial fulfillment
of the requirements for the degree
Doctor of Philosophy

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August 2008
This dissertation titled

Predictors of Participant Retention in Cardiac Rehabilitation Programs

by

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Background: Effective programs in cardiac rehabilitation exist to manage the manifestations and consequences of cardiovascular illness. Unfortunately, these programs are underutilized, with only 11-60% of eligible participants completing programs (Leon et al., 2005; Sanderson et al., 2004; Suaya et al., 2007). To date, most cardiac rehabilitation research has focused on urban, male program completers with little attention given to factors affecting overall outcomes such as retention or geographic variability (Taylor et al., 2004).

Purpose: The purposes of this study were to evaluate changes in body mass index (BMI), physical activity (METS), and quality of life (SF-36) by retention status and gender in cardiac rehabilitation participants from pre to post program participation. Additionally, the study aimed to identify predictors of retention in cardiac rehabilitation programs.

Methods: The study consisted of a retrospective medical chart review on archival data that were deidentified. Data were collected from two sites, one urban and one rural on cardiac rehabilitation participants attending between the years of 2004 and 2007. Sampling matched gender and geographic location each year.

Results: The current study examined 230 participants (115 male; 115 female) following a 12-week cardiac rehabilitation program. The sample was predominantly Caucasian
(90.4%), married (69%), earned $30,000 or less annually (41%), had an average age of 62 years (SD=11.6) and attended an average of 25 (SD=12.3) sessions. The total sample experienced significant improvements in body mass index, physical activity, and quality of life from pre to post program participation. There were no significant differences by retention in BMI or METS and by gender in BMI or SF-36. Compared to noncompleters, completers had greater change in SF-36 scores. Rural program location was predictive of retention. Compared to females, males had greater change in METS.

Conclusions: The current sample showed improvements in BMI, METS, and SF-36 with important outcome differences on SF-36 between completers and noncompleters and on METS between males and females. Findings suggest that geographic location was an important factor in participant retention status. The results of this study provide valuable information on group differences, along with important information for designing strategies to increase retention and improve outcomes in existing cardiac rehabilitation programs.

Approved: _____________________________________________________________

Mary K. de Groot

Assistant Professor of Psychology
I would like to dedicate this project to my friends and family. I am grateful for their love and encouragement. They have been an endless source of support throughout the entire graduate school process. To Arthur Sable, Richard and Diane Meyers, and Michelle Meyers, I wish to express heartfelt thanks for being such an unwavering source of unconditional love and support throughout my life and through all of my endeavors. Thank you for pushing me to exceed my boundaries and encouraging me to spread my wings…without you in my life none of this would matter.
ACKNOWLEDGMENTS

I would like to take this opportunity to thank my dissertation advisor, Dr. Mary de Groot, for her guidance and support, which were instrumental in the completion of this project. I would also like to extend my appreciation to Tom Murray and Dr. Kerry Stewart for allowing the use of their program data and for being so helpful during this process. I would like to thank the members of my committee, Drs. Chris France, Steve Patterson, Kathi Heffner, and Sharon Denham for their invaluable comments and suggestions. I am grateful to Amanda Blackford for her advice regarding statistical analysis. Furthermore, I wish to extend my appreciation to Drs. Keith Slifer, Adrianna Amari, Leanna Herman, Melissa DeMore, and Ms. Robin Frutchey for both their feedback on this project and their support throughout this process.
TABLE OF CONTENTS

Page

ABSTRACT ........................................................................................................................ 4
DEDICATION .................................................................................................................... 6
ACKNOWLEDGMENTS .................................................................................................. 7
LIST OF TABLES ............................................................................................................ 10
INTRODUCTION ............................................................................................................ 11
  Effectiveness in a General Population ................................................................. 12
  Patient Outcomes ..................................................................................................... 12
  Sociodemographic Risk Factors .......................................................................... 14
  Cardiac Rehabilitation Retention ........................................................................ 15
  Rural Cardiac Health ............................................................................................... 16
    Prevalence and Disparities .................................................................................. 16
    Access Barriers .................................................................................................... 17
  Limitations of Current Cardiac Rehabilitation Literature .................................. 19
  Purpose of the Current Study ................................................................................ 19
METHODS ....................................................................................................................... 23
Study Procedure ........................................................................................................ 24
Assessment Instruments ............................................................................................ 25
  Sociodemographic Information .......................................................................... 25
  Access Variables .................................................................................................... 26
  Comorbidity and Disease Specific Variables .................................................... 26
RESULTS ......................................................................................................................... 30

Overall Sample Characteristics.................................................................................. 30

Total Sample Outcomes............................................................................................. 33

Retention Status (Completer versus Noncompleter) ................................................. 33

Sample Characteristics ............................................................................................ 33

Retention Sample Outcomes ..................................................................................... 37

Variables Accounting for Retention Status .............................................................. 41

Gender Outcomes ...................................................................................................... 41

Within Gender Groups ............................................................................................. 41

Between Gender Groups .......................................................................................... 44

DISCUSSION ................................................................................................................... 45

Study Contributions .................................................................................................. 49

Limitations .................................................................................................................. 49

Future Directions ...................................................................................................... 51

REFERENCES ................................................................................................................. 54

APPENDIX A: CHART REVIEW FORM ................................................................. 68

APPENDIX B: ADDITIONAL INFORMATION ....................................................... 70
LIST OF TABLES

Table 1: Studies investigating outcomes of cardiac rehabilitation .................. 20
Table 2: Participant characteristics for overall sample and 230 completers and noncompleters .............................................................................................................. 31
Table 3: Total sample outcomes for 230 participants ........................................... 34
Table 4: Correlations between outcomes and sociodemographic variables .......... 35
Table 5: Correlations between outcomes and access variables............................... 36
Table 6: Within Subjects Outcomes for 230 completers versus noncompleters ...... 38
Table 7: Between subjects outcomes for 230 completers and noncompleters....... 40
Table 8: Logistic regression analyses to assess predictors of retention status......... 42
Table 9: Within subjects outcomes for 230 males and females .............................. 43
Table 10: Between subjects outcomes for 230 males versus females..................... 46
INTRODUCTION

More than one out of five persons in the United States has cardiovascular disease (CVD), and one out of two and a half deaths result from this disease (Thom et al., 2006). In the United States, more than 500,000 women die of CVD each year (American College of Sports Medicine [ACSM], 2005). While CVD is the leading cause of death for males and females, females experience greater medical challenges due to gender differences in disease presentation, assessment strategies, and evaluation findings (ACSM, 2005). Secondary prevention efforts such as programs in cardiac rehabilitation are critical to manage the manifestations and consequences of cardiovascular illness, specifically coronary artery disease (CAD; Leon et al., 2005).

Cardiac rehabilitation programs are typically 12-week structured exercise and education programs, designed to guide heart patients toward lifestyle modification and to increase functional exercise capacity following the diagnosis of heart disease or a cardiac event (e.g., myocardial infarction). These programs are aimed at a wide patient population and contain specific core components. These components aim to optimize cardiovascular risk reduction, reduce disability, and promote healthy behaviors along with an active lifestyle for those suffering from cardiovascular disease (Leon et al., 2005). While cardiac rehabilitation programs are recognized as effective and integral in the care of patients with cardiovascular disease, they are unfortunately underused (Leon et al., 2005; Suaya et al., 2007). Reasons for poor program utilization and its effects on physical and mental health outcomes are not well understood. The high prevalence of
CAD and the long term pervasive health threat that this disease presents underscore the importance of efforts to improve patient outcomes.

**Effectiveness in a General Population**

To monitor and potentially standardize indices of longer term benefits of cardiac rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) recommends outcome measurement and reporting in three domains: clinical, behavioral, and health (Sanderson et al., 2004). Clinical domains include measures of medical or psychosocial status used to determine treatment priorities (i.e., depression or body mass index; BMI). Behavioral domains are measures of the patient’s ability to make significant lifestyle changes (i.e., smoking status or physical activity). Health domains are global outcome measures related to overall functioning (i.e., morbidity, mortality, or health related quality of life; HRQL). Randomized controlled trials, meta-analyses, and systematic reviews of randomized trials have demonstrated a statistically significant reduction in mortality of 28-31% over an average two-year follow-up period in individuals engaged in cardiac rehabilitation (Jolliffe et al., 2001; Leon et al., 2005; O’Connor et al., 1989; Oldridge, Guyatt, Fischer & Rimm, 1988; Taylor et al., 2004; Taylor, Unal, Critchley & Capewell, 2006).

**Patient Outcomes**

Benefits from cardiac rehabilitation have also been demonstrated in relation to specific outcomes such as increased physical activity and quality of life, along with decreases in body fat. Sedentary lifestyle has been identified as a cardiovascular disease risk factor. Regular physical activity has been associated with 20-30% reduction in all
causes of mortality in cardiovascular disease patients (Peipoli, Davis, Francis & Coates, 2004; Smart & Marwick, 2004; Taylor et al., 2004). Cardiac rehabilitation involvement has been linked to increased physical activity (Arena et al., 2007). Studies of individuals aged 65 years and older have reported increases in functional capacity for physical activity following 12 weeks of exercise training. In these studies functional capacity for physical activity was measured by peak metabolic equivalent levels (METS) which equal units of resting oxygen uptake per kilo of body weight per minute (Ades et al., 1993; Lavie, Milani, & Littman, 1993).

Additionally, obesity is an independent risk factor for death from CAD and is linked to numerous medical conditions such as type 2 diabetes mellitus and hypertension (Lois, Young & Kumar, 2008; Pi-Sunyer, 2000). While more than 75% of cardiac rehabilitation candidates qualify as overweight (i.e., BMI > 25 kg/m²), cardiac rehabilitation program involvement has yielded decreases in obesity among participants. Following 12 weeks of cardiac rehabilitation, young patients (aged < 55) demonstrated significant improvements in BMI (-1.7%; p < 0.01) (Lavie & Milani, 2006). Improvements in this population were significantly greater than in older patients (aged ≥ 70; -1.7% vs. -0.4%; p = 0.03). When comparing obese patients (n = 116) to non-obese patients (n = 198) following 12 weeks of cardiac rehabilitation, Lavie and Milani (1996) also found that the total sample demonstrated significant improvements in BMI (-1.5%; p < .0001), with the obese sample exhibiting significantly greater improvements in BMI (-3% vs. 0%; p = 0.0001) compared to the non-obese sample.
Lower quality of life is associated with other cardiovascular disease risk factors such as obesity. However, the relationship is bidirectional and cardiovascular disease can also impact quality of life. The AACVPR recommends patient-reported HRQL measures in determining effectiveness of cardiac rehabilitation programs (Sanderson et al., 2004). Using both generic and specific measures of QOL, existing literature demonstrates that cardiac rehabilitation positively affects quality of life across CAD diagnoses, age groups, and gender (Belardinelli, Georgiou, Cianci & Purcaro, 1999; Belardinelli et al., 2001; Gardner et al., 2003; Lavie & Milani, 1995; Lavie & Milani, 1997; Ueshima et al., 2004; Van Tol et al., 2006).

Sociodemographic Risk Factors

Though cardiac rehabilitation involvement may improve outcomes, its effectiveness may be limited by certain sociodemographic variables (such as gender, age, and socioeconomic status) that have been found to be risk factors for CAD. For example, female patients are typically older, and have an increased number and severity of comorbid medical conditions, lower exercise capacity, and less social support than males upon cardiac rehabilitation program entry (O’Farrel, Murray, Huston, LeGrand & Adamo, 2000; Todaro, Shen, Niaura, Tilkemeier & Roberts, 2004). Elderly participants and women are also referred less frequently to cardiac rehabilitation programs despite similar or worse presenting conditions than males and younger individuals. Some studies indicate female gender and older age are factors associated with lack of program retention (Cooper, Jackson, Weinman & Horne, 2002; Suaya et al., 2007; Todaro et al., 2004). However once involved, females and elderly individuals achieve comparable
gains to males and younger participants in cardiac rehabilitation with regard to risk factor modification, exercise benefits, increased quality of life, and improved psychological functioning (O’Farrel et al., 2000; Todaro, et al., 2004). Limited studies of age and sex differences in cardiac rehabilitation outcomes make generalizability of results difficult. Similar to increased age and female gender, lower socioeconomic status is a reported risk factor for cardiovascular disease incidence and mortality and is linked to lower cardiac rehabilitation retention (American Heart Association [AHA], 2006; Evenson, Rosamond & Luepker, 1998; Lane, Carroll, Ring, Gareth-Beevers & Lip, 2001; Ramm, Robinson & Sharpe, 2001; Suaya et al., 2007).

Cardiac Rehabilitation Retention

Despite the established benefits of cardiac rehabilitation programs, under-use of these services has been documented for the past decade (Thomas, 2007). Estimates of patient adherence to program completion range from 11-60% (Barber, Stommel, Kroll, Holmes-Rovner & McIntosh, 2001; Suaya et al., 2007; Sundararajan, Bunker, Begg, Marshall & McBurney; 2004; Wenger, 2008). Studies have cited male participation rates ranging from 25-31%, with women having lower participation rates ranging from 11-20% (Ades et al., 1993; Barber et al., 2001). High drop-out rates have been attributed to clinical, psychological, behavioral, and demographic factors. Risk factors associated with poor attendance include higher BMI, lower physical activity levels, depression, and smoking (Glazer, Emery, Frid & Banyasz, 2002; Grace et al., 2002). Additionally, women, older individuals, and patients without insurance coverage have lower completion rates (Grace et al, 2002; Jackson, Leclerc, Erskine & Linden, 2005).
Furthermore, logistical barriers such as inconvenient session schedules and long distances to facilities have been associated with higher drop-out rates in cardiac rehabilitation patient samples (Jackson et al., 2005; Sundararajan et al., 2004). Number of risk factors associated with increased co-morbidity, poorer initial presentation, as well as demographic and logistical barriers all appear to affect retention. In general, it appears that low rates of program use lead to decreased patient outcomes (Sundararajan et al., 2004; Thomas, 2007).

Increasing evidence suggests geographic variation in retention as well as geographic variation in the prevalence of health disparities (Barnett & Halverson, 2001; Burkhardt, 2000; Gamm, Castillo & Pittman, 2003). Health disparities are defined as population differences in the presence of disease, health outcome, or access to healthcare (Health Resources and Services Administration, 2003). These factors may limit the generalization of urban outcome information to rural settings (American Academy of Family Physicians, 2007; Suaya et al., 2007).

Rural Cardiac Health

Prevalence and Disparities

According to the 2000 U.S. Census, 19.4% of the population (55.4 million people) live in rural areas (Hobbs & Stoops, 2002). The Census Bureau defines a “rural” area as having less than 50,000 people in one city and a total metropolitan statistical area of less than 100,000 individuals (Office of Management and Budget, 2000). Rural rates of heart disease are currently 1.34 times higher than urban rates. Furthermore, higher rates of CAD mortality and slower reductions of CAD mortality exist in rural compared
to metropolitan areas (Barnett, Halverson, Elmes & Braham, 2000; Barnett & Halverson, 2001; James, Li & Ward, 2007). Factors hypothesized to play a role in the decreased prevalence of CAD morbidity and mortality noted in urban areas include medical and technological advances, as well as lifestyle changes (i.e. improved diet and reduction in cigarette smoking) that individuals in rural areas may embrace less readily (Pearson & Lewis, 1998). Moreover, a significantly higher proportion of rural individuals are sedentary and obese compared to their urban counterparts (Eberhardt et al., 2001; Kumar et al., 2001; National Center for Health Statistics [NCHS], 2001). Finally, the rural population is typically older, poorer, less likely to be insured, and has a greater likelihood of chronic disease (AHA, 2005).

Along with higher rates of heart disease and risk factors, rural areas typically have less availability of overall medical care resources than urban areas. Rural areas comprise half of the health professional shortage areas in the U.S. (HRSA, 2003; Rosenblatt & Hart, 1999). Although approximately 20% of the U.S. population resides in rural areas, less than 10% of the nation’s physicians practice in these areas. Rural areas also have a noted paucity of specialized providers, which may be due to a lack of educational resources for providers and lower reimbursement rates (Rosenblatt & Hart, 1999).

*Access Barriers*

Many of these geographic discrepancies are compounded by, or are perhaps due to, specific barriers that typically exist in rural areas that impinge on the cardiovascular health of residents in these areas. A shortage of rural physicians directly correlates to a shortage of rural cardiac rehabilitation facilities, as rehabilitation facilities depend on
physician referral and typically require oversight by a licensed physician. Many persons living with CAD in rural areas must navigate through multiple facilities that are geographically dispersed when there is either limited or absent public transportation available to access necessary services (Jackson, Leclerc, Erskine & Linden, 2005). Rural individuals may also need to travel long distances to receive care from an appropriate cardiac specialist (Burkhardt, 2000; Casey, Call & Klinger, 2001; Rosenblatt & Hart, 1999; Rosenthal & Fox, 2000). Additionally, rural individuals are less likely than urban individuals to have health insurance for cardiac services due to higher rates of unemployment, part-time employment, employment by small private firms, seasonal employment, and many other employment related factors (Bolin & Gamm, 2003). For those not covered by Medicare or Medicaid, lack of affordable healthcare can be a major barrier (Taylor, Hughes & Garrison, 2002). A recent study of 97 participants from six rural Australian hospitals explored barriers to cardiac rehabilitation attendance (DeAngelis, Bunker & Schoo, 2008). Distance to travel to the cardiac rehabilitation facility was the only statistically significant demographic factor predicting attendance ($p=.02$) in attendees ($M=15.4$ km, SD $20.6$) compared to decliners ($M=40.4$ km, SD $37.5$). Non-attendees reported distance to travel, access to transport, and fuel costs as the main barriers to retention. In total, few studies have examined cardiac rehabilitation outcomes in rural populations, though these studies demonstrate participant gains following involvement (Aoun & Rosenberg, 2004; Aude, Hill, & Anderson, 2006; Verrill, et al., 2003; Yates, Braklow-Whitton & Agrawal, 2003).
Limitations of Current Cardiac Rehabilitation Literature

Urban and rural cardiac rehabilitation programs have been found to be effective (See Table 1). However, the majority of cardiac rehabilitation research demonstrates methodological shortcomings or limitations. Much of the retention literature is limited by small sample size, particularly among female participants. Many of these studies focus on exercise-based rather than comprehensive rehabilitation programs and lack comparison samples (Verrill et al., 2003). Much of the cardiac rehabilitation retention literature relies on urban samples, allowing no rural comparison. Rural outcome studies have not accounted for sociodemographic variables and access barriers that may be playing a role in patient and program outcomes. These limitations may restrict generalizability of the literature to rural cardiac rehabilitation outcomes. Moreover there is an overall paucity of literature on cardiac rehabilitation retention. While there are numerous factors that contribute to retention, geography is an important variable on which to focus, given the limitations of the current literature.

Purpose of the Current Study

Using outcome data collected at two geographically disparate cardiac rehabilitation facilities, the current study had two primary aims. The aims of the current study were to: 1) examine outcomes associated with retention and examine predictors of retention, and 2) examine cardiac rehabilitation outcomes by gender pre to post then compare males to females on outcomes.

Compared to program non-completers, program completers were hypothesized to demonstrate greater increases in quality of life and physical activity, and a larger decrease
Table 1

*Studies investigating outcomes of cardiac rehabilitation*

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Geographic Location</th>
<th>Type of Measure</th>
<th>Results</th>
<th>Effect Sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavie &amp; Milani (1996)</td>
<td>314 participants</td>
<td>New Orleans &amp; Massachusetts</td>
<td>BMI</td>
<td>-1.5% improvement *</td>
<td>d=.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>METS</td>
<td>31% improvement *</td>
<td>d=.68</td>
</tr>
<tr>
<td>Yates, Braklow-</td>
<td>222 participants</td>
<td>rural Nebraska</td>
<td>SF-36</td>
<td>Improved on 7 scales*</td>
<td>N/A</td>
</tr>
<tr>
<td>Whitton &amp; Agrawal (2003)</td>
<td>(at 9 mos. 47 males; 47 females)</td>
<td></td>
<td>BMI</td>
<td>Improvement*</td>
<td>N/A</td>
</tr>
<tr>
<td>Verill et al. (2003)</td>
<td>630 participants</td>
<td>urban/rural North Carolina</td>
<td>QOLI</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>(472 males; 206 females)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Number of Studies</td>
<td>Participants</td>
<td>Location(s)</td>
<td>Outcome Measure</td>
<td>Improvement (%)</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------</td>
<td>--------------</td>
<td>--------------------------------------</td>
<td>----------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Smart &amp; Marwick (2004)</td>
<td>81 Studies</td>
<td>1197</td>
<td>Peak oxygen consumption</td>
<td>Improvement (average)</td>
<td>17%</td>
</tr>
<tr>
<td>Peipoli et al. (2004)</td>
<td>9 Datasets</td>
<td>801</td>
<td>Canada, Netherlands, Switzerland, Italy, Germany, Finland, Sweden</td>
<td>Improvement*</td>
<td>d=.74</td>
</tr>
<tr>
<td>Lavie &amp; Milani (2006)</td>
<td>635 participants</td>
<td>New Orleans</td>
<td>BMI</td>
<td>-1.7% improvement*</td>
<td>d=.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Depression (Kellner Ques.)</td>
<td>-58.5% improvement*</td>
<td>d=.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SF-36</td>
<td>15.8% improvement *</td>
<td>d=.81</td>
</tr>
<tr>
<td>van Tol et al. (2006)</td>
<td>35 RCTs</td>
<td>N/A</td>
<td>MLWHFQ (QOL)</td>
<td>-28.1% improvement *</td>
<td>d=.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1542 males; 210 females)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Location</td>
<td>Measure</td>
<td>Improvement</td>
<td>Effect Size</td>
</tr>
<tr>
<td>-------------------------------</td>
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<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Aoun &amp; Rosenberg (2004)</td>
<td>362 participants</td>
<td>rural Australia</td>
<td>SF-36</td>
<td>Improved on 8 scales*</td>
<td>N/A</td>
</tr>
<tr>
<td>Aude, Hill &amp; Anderson (2006)</td>
<td>121 participants</td>
<td>rural Illinois</td>
<td>SF-36</td>
<td>Improved on 8 scales*</td>
<td>d=.80</td>
</tr>
</tbody>
</table>

Note: MLWHFQ=Minnesota Living with Heart Failure Questionnaire; *=significant.
in BMI. It was hypothesized that retention would be predicted by age, gender, socioeconomic status, insurance provider, distance to cardiac rehabilitation, and number of comorbid diagnoses. It was predicted that females would demonstrate similar increases in quality of life and physical activity, and a comparable decrease in BMI compared to males.

METHODS

Data were collected from two sites, one urban and one rural. The urban sample was composed of 115 participants from Johns Hopkins Bayview Cardiac Rehabilitation program operated by Johns Hopkins Medical Institution in Baltimore, Maryland. The rural sample consisted of 115 patients from HeartWorks Cardiac Rehabilitation Program, sponsored by O’Bleness Memorial Hospital in Athens, Ohio. Both were hospital-based facilities with a 12-week program offered 3 times per week by a multidisciplinary staff. Both programs complied with AACVPR guidelines and operated in a consistent manner from a physical, nutritional, and medical standpoint. The urban program was located in a large metropolitan area with a population of 651,154 (U.S. Census Bureau, 2003a) and was associated with a large medical institution. The rural program was located in a geographic area with a population of 21,342 (U.S. Census Bureau, 2003b) and operated in a small rural hospital, while a cardiac specialist was located up to 100 miles from many participants.

Patients from both programs were referred to their respective facility following a major cardiac event (i.e., myocardial infarction, angioplasty). In both settings, referred patients received an initial clinical examination including a clinical interview and
administration of self-report measures (e.g., the Medical Outcome Study Short Form). Patients also received formal exercise testing with measurement of peak workload prior to entering their respective cardiac rehabilitation program. The structure of both programs was tailored for individual needs. The centerpiece of each of the involved programs was the graduated exercise course, lasting 12 weeks with self-selection of further involvement for exercise maintenance. The programs focused on individually programmed aerobic exercise on a treadmill or Nu-Step three times per week while the patient was monitored with a heart-rate monitor. Supervised circuit resistance training sessions were also performed once or twice weekly. The circuit resistance training and aerobic exercise were increased progressively at a rate determined by heart rate response to the previous session. Other program components at each of the involved sites included: education, stress management, and risk factor monitoring. At the end of Johns Hopkins Bayview Cardiac Rehabilitation or HeartWorks Cardiac Rehabilitation program involvement, the initial tests were repeated and at this time the individual was considered to have graduated from the program.

Study Procedure

The current study consisted of an IRB-approved retrospective medical chart review on original archival data that were deidentified. Charts for patients attending between the years of 2004 and 2007 from HeartWorks Cardiac Rehabilitation Program and Johns Hopkins Bayview Cardiac Rehabilitation Facility were identified by the program directors and reviewed for assessment data. These years were chosen in an
effort to control for time, cohort effects, innovation, and changes in medical standards of
care.

Eligible participants from both programs satisfied the following inclusion criteria: (1) 18 years of age or older; (2) diagnosis of a cardiac event (e.g., myocardial infarction); (3) past involvement in the Johns Hopkins Bayview or HeartWorks Cardiac Rehabilitation Program between 2004 and 2007. Sampling matched gender and geographic location, each year. Despite the fact that more males than females attended these programs, matched sampling of females was performed in an effort to address previous under-inclusion of females in the existing literature. Matched sampling by geographic location was performed in an effort to add to the previous paucity of literature on rural cardiac rehabilitation programs.

Assessment Instruments

Data from the following sources were collected at two different time points: Pre (first day of regular exercise training) and Post (last day of regular exercise training).

Sociodemographic Information

Sociodemographic characteristics that were assessed included participants’ age, sex, and number of sessions attended. Participants for retention status were coded as a completer if they finished 36 sessions and a non-completer if they discontinued prior to 36 sessions. Thirty-six sessions are considered reasonable and necessary for cardiac patients (ACSM, 2005). This operational definition has been used to indicate program completion in cardiac rehabilitation literature (Lavie & Milani, 1995; Lavie & Milani, 1997; Lavie & Milani, 2006). Census 2000 data on mean family income for zip code
were collected from the medical chart as a proxy for income because income data were
not directly available from the patients’ medical record (US Census Bureau, 2007).
Income data were then assigned to categories (i.e., $0-$30,000).

Access Variables

Information obtained about access to cardiac services included the home
address of the participant, and address of the cardiac rehabilitation facility. From these
addresses, distance was calculated between sites utilizing an on-line mileage calculator
(i.e., Mapquest, 2007) which calculates distance between a beginning and ending address.
The name of the insurance provider was also collected from the chart. Insurance
providers were coded as Medicare, Medicaid, Private Insurance, or No Insurance.

Comorbidity and Disease Specific Variables

Comorbidity and disease specific information obtained included type and number
of comorbid diagnoses and participant history of cardiac conditions.

Body Mass Index

Body mass index (BMI; Keys et al., 1972; Quelet, 1871) is calculated using the
Body Mass Index Formula (weight in kilograms is divided by height in meters squared;
kg/m²) and is then compared to current weight status categories (Keys, Fidanza,
Karvonen, Kimaura & Taylor, 1972; Quelet, 1871). Higher scores are indicative of
greater body fat. The BMI has been deemed an appropriate measurement of total body
fat for purposes of cardiac rehabilitation outcome measurement by the AACVPR
(Sanderson et al., 2004). Further information on this study variable is provided in
Appendix B.
The Medical Outcome Study Short Form

The medical outcome study short form (SF-36; Ware, Snow, Kosinski & Gandek, 1993) is a multi-scale self-administered 36-item questionnaire that assesses an individual’s appraisal of health-related concepts quality of life. The SF-36 is comprised of 8 subscales: role limitations due to physical health problems, role limitations due to emotional problems, vitality, physical functioning, mental health, general health, social functioning, and bodily pain. Participants respond to each item using a five-point Likert scale (1=”None of the time” to 5=”Most of the time”) or report Yes or No responses. Higher scores indicate more favorable quality of life. The SF-36 has been deemed an appropriate evaluation tool for cardiac rehabilitation programs (Hawkes, Nowak & Speare, 2003). Reliability studies have shown an internal consistency exceeding a Cronbach’s alpha level of 0.70 for each of the subscales (Ware et al., 1993). Median reliability coefficients for each of the eight scales has been shown to be equal to or greater than 0.80 except for social functioning, which had a median reliability across studies of 0.76 (Ware et al., 1993). Test-retest reliability has been found to range from 0.43 to 0.90 in studies on various population samples (Ware, Kosinski & Gandek, 1993). The eight subscales in the SF-36 have been found to be those most frequently measured in health surveys, which represents high content validity (Ware et al., 1993). Additionally, this measure has been found to be high in concurrent, criterion, and predictive validity (Ware et al., 1993). The current study used a scoring algorithm for collapsing scores from the eight subscales into two summary scores: physical component summary (PCS) and mental component summary (MCS; Taft, Karlsson & Sullivan,
The summary scores were calculated from principal component analyses of subscale scores from a general US population sample (Taft, Karlsson & Sullivan, 2001). There was high relative validity for the mental (0.94 to 1.45) and physical (0.20 to .94) summary scales (Ware et al., 1995). Test-retest reliability and internal consistency have been found to be high in the summary scales (Ware et al., 1993). Estimates for the mental and physical summary scores typically exceed a Cronbach’s alpha level of 0.90 (Ware et al., 1993).

Metabolic Equivalents

Metabolic equivalents (METS; U.S. Department of Health and Human Services et al., 1999) provide a method of characterizing physical activities at different levels of exertion based on a standard of care set by the American College of Sports Medicine (ACSM, 2005). METS are used to estimate the amount of oxygen used by the body during physical activity (ACSM, 2005). Higher scores indicate more favorable functional capacity. Many insurance companies base the number of approved cardiac rehabilitation sessions on METS and doctors may prescribe exercise by MET values for cardiac rehabilitation (Ades et al., 2006). This measure is a valid and reliable measure of physical activity in cardiac rehabilitation programs (ACSM, 2005). See Appendix B for more information on this variable.

Statistical Analyses

The outcome variables of interest in this study included the SF-36, BMI, and METS. The eight SF-36 subscales were summarized into two component scores (PCS and MCS; Ware, Kosinski & Keller, 1994). The current study used the intent to treat
approach (Sheiner & Rubin, 1995). Baseline data on quality of life were entered as follow-up data for program non-completers. Scores on BMI and METs obtained from the last session attended were entered as follow-up data for program non-completers.

Outcome variables were measured before and after cardiac rehabilitation. Potential predictors of retention status included: age, gender, insurance provider, income, distance to a rehabilitation facility, program location (i.e., rural versus urban), and number of comorbid conditions. Variables were evaluated for their conformity to the general linear model by calculating skewness, kurtosis, and homoskedascity. Two outlier values were found in the variables distance to cardiac rehabilitation facility. These values were replaced by the mean value for the facility, as these individuals were not residing in their usual or permanent place of residence during time in the program. Income and distance to cardiac rehabilitation facility were assigned to discrete categories.

Predictor variables were summarized using means and standard deviations or frequencies for the overall sample, and by completion status and gender. One sample t-tests with means adjusted for gender, income, and number of sessions were used to test for adjusted mean differences in pre-and post-rehabilitation outcome measures. One-way between group analyses of covariance (ANCOVA) holding for gender, income, and number of sessions, chi-square tests and Fisher’s exact test were used to test for differences in the distributions of predictor variables by completion status and gender. Differences in the number of comorbid conditions by completion status were tested using Poisson regression. Multivariate logistic regression models were used to identify predictors of completion status.
RESULTS

Overall Sample Characteristics

The sample consisted of 230 participants (107 completers, 123 noncompleters; 115 urban, 115 rural). Within these participants, the sample contained 115 males and 115 females. The sample was predominately Caucasian (90.4%), married (69%), retired (48.3%), had no smoking history (51.3%), had either Private Insurance or Medicare coverage (45.2% and 44.8% respectively), had an income of $30,000 or less (41% ), traveled 10 miles or less to their cardiac rehabilitation facility (64%). Additional characteristics of the general sample included a mean age of 61.6 years (SD = 11.6), attendance at an average of 25.4 (SD = 12.3) sessions, an average of 4.0 (SD = 2.3) comorbid conditions, and an average of 8.2 (SD = 3.7) prescribed medications. The sample also demonstrated an initial mean BMI of 31.7 (SD = 6.8), initial mean METS of 2.6 (SD = 0.9), and showed an initial mean SF-36 physical component summary score of 43.8 (SD = 9.1) and initial mean SF-36 mental component summary score of 52.9 (SD = 10.1). See Table 2 for a summary of overall sample characteristics.

To examine differences by geographic location, independent samples t-test and chi-square tests were conducted. Tests revealed that a greater proportion of urban participants had a higher income ($\chi^2 = 110.42, p < 0.0001$), attended fewer cardiac rehabilitation sessions (mean difference = -12.10, $t(228) = 8.57, p < 0.0001$), had greater number of comorbid conditions (mean difference = 1.13, $t(228) = 3.90, p < 0.0001$), and traveled shorter distances to their cardiac rehabilitation facility ($\chi^2 = 12.09, p < 0.0001$) compared to the rural sample.
Table 2

*Participant characteristics for overall sample and 230 completers and noncompleters (numbers & %; means ± SD)*

<table>
<thead>
<tr>
<th>Location</th>
<th>Total n=230</th>
<th>Completer n=107</th>
<th>Noncompleter n=123</th>
<th>p-Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>115 (50%)</td>
<td>24 (22.4%)</td>
<td>91 (74.0%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Rural</td>
<td>115 (50%)</td>
<td>83 (77.6%)</td>
<td>32 (26.0%)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Male</td>
<td>115 (50.0%)</td>
<td>56 (52.3%)</td>
<td>59 (48.0%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>115 (50.0%)</td>
<td>51 (47.7%)</td>
<td>64 (52.0%)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>62 (11.6)</td>
<td>63 (11.6)</td>
<td>61 (11.6)</td>
<td>NS</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Single</td>
<td>24 (10.4%)</td>
<td>13 (12.1%)</td>
<td>11 (8.9%)</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>22 (9.6%)</td>
<td>8 (7.5%)</td>
<td>14 (11.4%)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>159 (69.1%)</td>
<td>75 (70.1%)</td>
<td>84 (68.3%)</td>
<td></td>
</tr>
<tr>
<td>Divorced</td>
<td>25 (10.9%)</td>
<td>11 (10.3%)</td>
<td>14 (11.4%)</td>
<td></td>
</tr>
<tr>
<td>Smoking Status</td>
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<td></td>
<td>NS</td>
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<tr>
<td>Yes</td>
<td>49 (21.3%)</td>
<td>21 (19.6%)</td>
<td>28 (22.8%)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>181 (78.7%)</td>
<td>86 (80.4%)</td>
<td>95 (77.2%)</td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Full-time</td>
<td>81 (32.5%)</td>
<td>37 (34.6%)</td>
<td>44 (35.8%)</td>
<td></td>
</tr>
<tr>
<td>Part-time</td>
<td>10 (4.3%)</td>
<td>2 (1.9%)</td>
<td>8 (6.5%)</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Completers</td>
<td>Noncompleters</td>
<td>Noncompleters</td>
<td>p&lt;0.0001*</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------</td>
<td>---------------</td>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Unemployed</td>
<td>22 (9.6%)</td>
<td>11 (10.3%)</td>
<td>11 (8.9%)</td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>111 (48.3%)</td>
<td>55 (57.4%)</td>
<td>56 (45.5%)</td>
<td></td>
</tr>
<tr>
<td>Disability</td>
<td>6 (2.6%)</td>
<td>2 (1.9%)</td>
<td>4 (3.3%)</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>p&lt;0.0001*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-30,000</td>
<td>95 (41.3%)</td>
<td>61 (57.0%)</td>
<td>34 (27.6%)</td>
<td></td>
</tr>
<tr>
<td>30,000-40,000</td>
<td>91 (39.6%)</td>
<td>31 (27.0%)</td>
<td>60 (48.8%)</td>
<td></td>
</tr>
<tr>
<td>40,000-50,000</td>
<td>25 (10.9%)</td>
<td>10 (9.3%)</td>
<td>15 (12.2%)</td>
<td></td>
</tr>
<tr>
<td>50,000-above</td>
<td>19 (8.3%)</td>
<td>5 (4.7%)</td>
<td>14 (11.4%)</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
<td>103 (44.8%)</td>
<td>53 (49.5%)</td>
<td>50 (40.7%)</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>12 (5.2%)</td>
<td>7 (6.5%)</td>
<td>5 (4.1%)</td>
<td></td>
</tr>
<tr>
<td>Private Insurance</td>
<td>104 (45.2%)</td>
<td>44 (41.1%)</td>
<td>60 (48.8%)</td>
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</tr>
<tr>
<td>Other</td>
<td>11 (4.8%)</td>
<td>3 (2.8%)</td>
<td>8 (6.5%)</td>
<td></td>
</tr>
<tr>
<td>Number of Sessions</td>
<td>25 (12.3)</td>
<td>36.0 (4.3)</td>
<td>16.7 (10.3)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Number of Comorbid Cond.</td>
<td>4 (2.3)</td>
<td>3.7 (2.2)</td>
<td>4.3 (2.2)</td>
<td>p&lt;0.0001‡</td>
</tr>
<tr>
<td>Number of Medications</td>
<td>8 (3.7)</td>
<td>8.4 (3.3)</td>
<td>8.2 (3.2)</td>
<td>NS</td>
</tr>
<tr>
<td>Distance to CR Facility (miles)</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>149 (64.3%)</td>
<td>62 (57.9%)</td>
<td>87 (70.7%)</td>
<td></td>
</tr>
<tr>
<td>10-20</td>
<td>65 (28.3%)</td>
<td>33 (30.8%)</td>
<td>32 (26.0%)</td>
<td></td>
</tr>
<tr>
<td>20-above</td>
<td>17 (7.4%)</td>
<td>12 (11.2%)</td>
<td>5 (4.1%)</td>
<td></td>
</tr>
</tbody>
</table>

† p values for t-tests for continuous variables and chi-square tests for categorical variables that compare completers to noncompleters.
‡ p value from Poisson regression for difference in number of comorbidities.
* Fisher’s Exact Test for categorical variables with low frequency in cell.
Total Sample Outcomes

The current study first examined the benefits of cardiac rehabilitation involvement in the total sample (collapsed across retention status and geographic location) on clinical, behavioral, and health outcomes. One sample t-tests using means adjusted for gender, income, and number of sessions were conducted to evaluate the impact of cardiac rehabilitation involvement on participants’ body mass index, level of physical activity, and quality of life from pre to post program participation. There was a statistically significant decrease in participants’ body mass from the beginning of the program until program completion (mean difference = -0.17, t(229) = -2.65, \(p = 0.009\)) and participants showed statistically significant increases in level of physical activity (mean difference = 0.98, t(229) = 12.23, \(p < 0.0001\)). Participants also had statistically significant increases in quality of life on component summary scores (mean difference physical component summary = 3.69, t(229) = 8.67, \(p < 0.0001\); mean difference mental component summary = 2.64, t(229) = 6.85, \(p < 0.0001\)) and on each of the eight individual subscales following program completion. See Table 3 for total sample outcomes and Tables 4 and 5 for sample correlations.

Retention Status (Completer versus Noncompleter)

Sample Characteristics

Independent samples t-test and chi-square tests conducted to compare group differences (completers and noncompleters) revealed that the completers were more likely to be from a rural location, \(\chi^2 = 60.83, p < 0.0001\), have a lower income, \(\chi^2 = 21.17, p < 0.0001\), have fewer comorbid health conditions (mean difference = -0.6,
Table 3

*Total sample outcomes for 230 participants (means + SD)*

<table>
<thead>
<tr>
<th>Outcome Variables</th>
<th>Pre</th>
<th>Post</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index</td>
<td>31.7 (6.8)</td>
<td>31.5 (6.5)</td>
<td><em>p</em>=0.009</td>
</tr>
<tr>
<td>METS</td>
<td>2.6 (0.9 )</td>
<td>3.6 (1.6 )</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Physical Component</td>
<td>43.8 (9.1)</td>
<td>47.5 (9.9)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Mental Component</td>
<td>52.9 (10.1)</td>
<td>55.5 (9.4)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Physical Function Subscale</td>
<td>55.8 (23.7)</td>
<td>60.4 (24.5)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Role Physical Subscale</td>
<td>43.6 (32.1)</td>
<td>56.5 (32.7)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Bodily Pain Subscale</td>
<td>44.6 (33.7)</td>
<td>58.7 (33.1)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 General Health Subscale</td>
<td>57.0 (23.0)</td>
<td>63.0 (24.0)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Vitality Subscale</td>
<td>46.0 (22.6)</td>
<td>53.4 (22.0)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Social Function Subscale</td>
<td>65.3 (25.6)</td>
<td>73.9 (25.8)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Role Emotional Subscale</td>
<td>61.2 (38.2)</td>
<td>72.3 (34.2)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Mental Health Subscale</td>
<td>69.8 (20.3)</td>
<td>73.8 (20.0)</td>
<td><em>p</em>&lt;0.0001</td>
</tr>
</tbody>
</table>
Table 4

*Correlations between outcomes and sociodemographic variables*

<table>
<thead>
<tr>
<th></th>
<th>MCS</th>
<th>PCS</th>
<th>METS</th>
<th>BMI</th>
<th>Race</th>
<th>Age</th>
<th>Gender</th>
<th>Sessions</th>
<th>Comorbid</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS</td>
<td>-----</td>
<td>0.05</td>
<td>-0.01</td>
<td>-0.09</td>
<td>-0.08</td>
<td>0.06</td>
<td>0.01</td>
<td>0.17**</td>
<td>0.01</td>
<td>-0.15*</td>
</tr>
<tr>
<td>PCS</td>
<td>-----</td>
<td>-----</td>
<td>0.12</td>
<td>0.01</td>
<td>-0.04</td>
<td>0.05</td>
<td>0.05</td>
<td>0.25**</td>
<td>-0.09</td>
<td>-0.12</td>
</tr>
<tr>
<td>METS</td>
<td>-----</td>
<td>-0.05</td>
<td>0.01</td>
<td>-0.09</td>
<td>0.31**</td>
<td>0.06</td>
<td>-0.07</td>
<td>0.42**</td>
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<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-----</td>
<td>0.05</td>
<td>0.03</td>
<td>-0.08</td>
<td>-0.11</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td>-----</td>
<td>-0.03</td>
<td>0.05</td>
<td>-0.15*</td>
<td>0.06</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-----</td>
<td>0.06</td>
<td>0.13*</td>
<td>0.10</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-----</td>
<td>-0.06</td>
<td>0.22</td>
<td>-0.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sessions</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.19</td>
<td>-0.24**</td>
</tr>
<tr>
<td>Comorbid Conditions</td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
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<td>0.12</td>
</tr>
<tr>
<td>Income</td>
<td>-----</td>
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<td></td>
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</tr>
</tbody>
</table>

* = p < .05
** = p < .10
Table 5  

*Correlations between outcomes and access variables*

<table>
<thead>
<tr>
<th>Program</th>
<th>MCS</th>
<th>PCS</th>
<th>METS</th>
<th>BMI</th>
<th>Insurance</th>
<th>CR</th>
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</thead>
<tbody>
<tr>
<td>MCS</td>
<td>-----</td>
<td>0.05</td>
<td>-0.01</td>
<td>-0.09</td>
<td>-0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>PCS</td>
<td>-----</td>
<td>0.12</td>
<td>0.01</td>
<td>0.04</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>METS</td>
<td>-----</td>
<td>-0.05</td>
<td>0.18**</td>
<td>0.13*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-----</td>
<td>-0.03</td>
<td></td>
<td>-0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Dist. To CR Program</td>
<td>-----</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* = $p < .05$  
** = $p < .10$

t(228) = -2.22, $p < 0.0001$ and attend a greater number of sessions, (mean difference = 18.67, t(228) = 17.50, $p < 0.0001$) compared to noncompleters. See Table 2 for a summary of participant characteristics for completers and noncompleters.
Retention Sample Outcomes

**Within Retention Groups**

The benefits of cardiac rehabilitation involvement within retention samples on clinical, behavioral, and health outcomes were examined. One sample t-tests using means adjusted for gender, income, and number of sessions revealed that completers experienced significant improvements in level of physical activity (mean difference = 1.00, \( t(106) = 8.69, p < 0.0001 \)) and quality of life on the component summary scores (mean difference physical component summary = 6.28, \( t(106) = 10.56, p < 0.0001 \); mean difference mental component summary = 4.51, \( t(106) = 8.89, p < 0.0001 \)) and on each of the eight subscales. Additionally, they experienced a significant change in body mass (mean difference = -0.32, \( t(106) = -2.66, p = 0.009 \)). In comparison, noncompleters evidenced significant improvement in level of physical activity (mean difference = 0.97, \( t(122) = 8.61, p < 0.0001 \)) but did not change in body mass (mean difference = -0.04, \( t(122) = -0.72, p = 0.47 \); see Table 6). Quality of life analyses were not run on noncompleters because scores were the same at pre and post.

**Between Retention Groups**

ANCOVAs controlling for gender, income, and number of sessions were conducted to compare the change in body mass, physical activity, and quality of life...
<table>
<thead>
<tr>
<th></th>
<th>Comp Pre</th>
<th>Comp Post</th>
<th>Comp p-Value</th>
<th>NonComp Pre</th>
<th>NonComp Post</th>
<th>NonComp p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index</td>
<td>31.3 (7.3)</td>
<td>31.0 (6.8)</td>
<td>(p=0.009)</td>
<td>32.0 (6.3)</td>
<td>31.9 (6.3)</td>
<td>NS</td>
</tr>
<tr>
<td>METS</td>
<td>2.6 (0.7)</td>
<td>3.6 (1.5)</td>
<td>(&lt;0.0001)</td>
<td>2.6 (1.1)</td>
<td>3.6 (1.6)</td>
<td>(&lt;0.0001)</td>
</tr>
<tr>
<td>SF-36 Physical Component</td>
<td>42.8 (8.6)</td>
<td>49.2 (9.6)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Mental Component</td>
<td>3.8 (10.1)</td>
<td>58.4 (7.8)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Physical Function Subscale</td>
<td>55.9 (22.5)</td>
<td>63.0 (22.5)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Role Physical Subscale</td>
<td>46.2 (29.3)</td>
<td>65.2 (28.2)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Bodily Pain Subscale</td>
<td>34.4 (36.0)</td>
<td>60.8 (36.4)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 General Health Subscale</td>
<td>60.1 (22.7)</td>
<td>71.7 (24.2)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Vitality Subscale</td>
<td>43.5 (22.3)</td>
<td>57.5 (21.0)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Social Function Subscale</td>
<td>66.0 (24.6)</td>
<td>83.1 (21.1)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Role Emotional Subscale</td>
<td>62.8 (40.3)</td>
<td>81.0 (29.6)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36 Mental Health Subscale</td>
<td>72.2 (18.2)</td>
<td>78.8 (15.6)</td>
<td>(&lt;0.0001)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
between program completers and noncompleters. There were no significant differences revealed in scores for completers and noncompleters in body mass F(1, 225) = 0.41, \( p = 0.52 \). In addition income (\( p = 0.98 \)), gender (\( p = 0.19 \)) and number of sessions (\( p = 0.92 \)) were not significant predictors of body mass. There was also no significant difference in physical activity, F(1, 225) = 0.02, \( p = 0.88 \). There was a strong relationship between income and gender with METS (\( p < 0.0001 \); \( p < 0.0001 \) respectively). Analyses of covariances controlling for gender, income, and number of sessions demonstrated significantly different quality of life scores for completers and noncompleters (physical component summary: F(1, 225) = 6.44, \( p = 0.01 \); mental component summary: F(1, 225) = 6.68, \( p = 0.01 \)), and on six of the eight subscales (role physical, bodily pain, general health, vitality, social, role emotional, and mental health). Income, gender, and number of sessions were not significant predictors of quality of life on either of the component summary scales or on any of the eight subscales. The current sample demonstrated that all participants improved on physical activity even if they did not continue the program to completion although completers reported a significantly greater improvement in quality of life compared to noncompleters (see Table 7).

Multiple regression analyses were also calculated to assess the contribution of number of sessions attended to change in primary outcome variables in the presence of age, gender, income, and number of comorbid conditions. Number of sessions (standardized beta weight = -0.13, \( p = 0.06 \)), was not a significant predictor of BMI: F(5, 229) = 1.08, \( p = 0.37 \). However, it was a significant predictor of change in SF-36 PCS scores, F(5, 229) = 3.48, \( p = 0.01 \) (standardized beta weight = 0.23, \( p = 0.001 \)) and SF-36
Table 7

*Between subjects outcomes for 230 completers versus noncompleters (adjusted means ± standard deviations)*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Completers</th>
<th>Non-Completers</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index Difference</td>
<td>-0.26 (0.2)</td>
<td>-0.09 (0.2)</td>
<td>NS</td>
</tr>
<tr>
<td>METS Difference</td>
<td>0.96 (.14)</td>
<td>1.00 (.13)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Physical Component Diff.</td>
<td>5.91 (1.0)</td>
<td>1.76 (0.9)</td>
<td>p=0.01</td>
</tr>
<tr>
<td>SF-36 Mental Component Diff.</td>
<td>4.67 (0.9)</td>
<td>0.88 (0.8)</td>
<td>p=0.01</td>
</tr>
<tr>
<td>SF-36 Physical Function Subscale</td>
<td>6.29 (1.9)</td>
<td>2.99 (1.8)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Role Physical Subscale</td>
<td>18.33 (3.2)</td>
<td>8.12 (2.9)</td>
<td>p=0.05</td>
</tr>
<tr>
<td>SF-36 Bodily Pain Subscale</td>
<td>25.61 (3.8)</td>
<td>4.09 (3.4)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 General Health Subscale</td>
<td>10.39 (2.2)</td>
<td>2.26 (2.0)</td>
<td>p=0.02</td>
</tr>
<tr>
<td>SF-36 Vitality Subscale</td>
<td>13.25 (2.1)</td>
<td>2.32 (1.9)</td>
<td>p=0.01</td>
</tr>
<tr>
<td>SF-36 Social Function Subscale</td>
<td>18.17 (2.4)</td>
<td>0.12 (2.1)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Role Emotional Subscale</td>
<td>15.77 (3.5)</td>
<td>7.04 (3.2)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Mental Health Subscale</td>
<td>6.60 (1.5)</td>
<td>1.70 (1.4)</td>
<td>p=0.04</td>
</tr>
</tbody>
</table>
MCS scores $F(5, 229) = 2.19, p = 0.05$ (standardized beta weight = 0.14, $p = 0.04$).

Number of sessions (standardized beta weight = 0.16, $p = 0.01$) was a significant predictor of change in physical activity, $F(5, 229) = 17.60, p < 0.0001$, along with gender (standardized beta weight = -0.25, $p < 0.0001$) and income (standardized beta weight = 0.44, $p < 0.0001$).

**Variables Accounting for Retention Status**

To determine which variables were predictive of retention status, a series of logistic regression models was run. By entering the univariate results (as shown in Table 2) into the regression, the variables income, number of comorbidities, and location (urban versus rural) were significant predictors of retention status. When controlling for income and number of comorbidities, program location was predictive of retention status. Those in a rural location were about two times more likely to complete the program than those in an urban location (odds ratio = 1.9 [1.6, 17.4], $p<0.0001$; see Table 8 for summary).

**Gender Outcomes**

**Within Gender Groups**

The current study next examined the benefits of cardiac rehabilitation involvement for males and females on clinical, behavioral, and health outcomes. As shown in Table 9, one sample t-tests using means adjusted for gender, income, and number of sessions revealed that males experienced significant improvements in level of physical activity (mean difference = 1.39, $t(114) = 10.46, p < 0.0001$) and quality of life
Table 8  
*Logistic regression analyses to assess predictors of retention status*

<table>
<thead>
<tr>
<th>Location</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Ref.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Rural</td>
<td>1.9</td>
<td>1.6, 17.4</td>
<td><em>p&lt;0.0001</em></td>
</tr>
</tbody>
</table>

Income (dollars)

<table>
<thead>
<tr>
<th>Income (dollars)</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 30,000</td>
<td>Ref.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>30,000 – 40,000</td>
<td>2.40</td>
<td>0.02, 2.9</td>
<td><em>p=0.23</em></td>
</tr>
<tr>
<td>40,000 – 50,000</td>
<td>1.51</td>
<td>0.20, 6.2</td>
<td><em>p=0.49</em></td>
</tr>
<tr>
<td>50,000 – above</td>
<td>0.99</td>
<td>0.10, 6.2</td>
<td><em>p=0.99</em></td>
</tr>
</tbody>
</table>

Number of Comorbid Conditions | 1.02 | 0.89, 1.4 | *p=0.78* |
Table 9

*Within subjects outcomes for 230 males and females (means + SD)*

<table>
<thead>
<tr>
<th></th>
<th>Males Pre</th>
<th>Males Post</th>
<th>Males p-Value</th>
<th>Females Pre</th>
<th>Females Post</th>
<th>Females p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index</td>
<td>29.9 (5.6)</td>
<td>29.8 (5.3)</td>
<td>NS</td>
<td>33.5 (7.4)</td>
<td>33.2 (7.2)</td>
<td>p=0.03</td>
</tr>
<tr>
<td>METS</td>
<td>2.8 (1.0)</td>
<td>4.1 (1.8)</td>
<td>p&lt;0.0001</td>
<td>2.5 (0.9)</td>
<td>3.1 (1.0)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Physical Component</td>
<td>45.4 (9.0)</td>
<td>48.7 (10.0)</td>
<td>p&lt;0.0001</td>
<td>42.3 (9.0)</td>
<td>46.4 (9.8)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Mental Component</td>
<td>53.5 (10.0)</td>
<td>56.1 (9.2)</td>
<td>p&lt;0.0001</td>
<td>52.2 (10.0)</td>
<td>54.9 (9.5)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Physical Function Subscale</td>
<td>61.0 (22.5)</td>
<td>65.1 (24.8)</td>
<td>p&lt;0.0001</td>
<td>50.7 (23.8)</td>
<td>55.6 (23.3)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Role Physical Subscale</td>
<td>46.8 (32.8)</td>
<td>60.6 (33.2)</td>
<td>p&lt;0.0001</td>
<td>40.4 (31.1)</td>
<td>52.4 (31.9)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Bodily Pain Subscale</td>
<td>47.2 (34.2)</td>
<td>59.3 (34.3)</td>
<td>p&lt;0.0001</td>
<td>42.0 (33.1)</td>
<td>58.0 (32.1)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 General Health Subscale</td>
<td>59.5 (22.4)</td>
<td>65.7 (23.2)</td>
<td>p&lt;0.0001</td>
<td>54.5 (23.3)</td>
<td>60.4 (24.5)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Vitality Subscale</td>
<td>49.0 (22.8)</td>
<td>55.8 (21.2)</td>
<td>p&lt;0.0001</td>
<td>43.0 (22.2)</td>
<td>51.0 (22.6)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Social Function Subscale</td>
<td>66.5 (25.4)</td>
<td>75.6 (25.0)</td>
<td>p&lt;0.0001</td>
<td>64.2 (26.0)</td>
<td>72.1 (26.5)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Role Emotional Subscale</td>
<td>66.0 (37.0)</td>
<td>75.4 (33.3)</td>
<td>p&lt;0.0001</td>
<td>56.3 (39.0)</td>
<td>69.1 (34.9)</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 Mental Health Subscale</td>
<td>70.6 (21.4)</td>
<td>75.4 (21.0)</td>
<td>p&lt;0.0001</td>
<td>69.1 (19.3)</td>
<td>72.2 (19.0)</td>
<td>p&lt;0.0001</td>
</tr>
</tbody>
</table>
on the component summary scores (mean difference physical component summary = 3.28, t(114) = 5.42, \( p < 0.0001 \); mean difference mental component summary = 2.60, t(114) = 4.64, \( p < 0.0001 \)) and on each of the eight subscales, however they did not experience a significant change in body mass (mean difference = -0.70, t(114) = -1.00, \( p = 0.34 \)). In contrast, females significantly improved in body mass (mean difference = -0.28, t(114) = -2.56, \( p = 0.01 \)), level of physical activity (mean difference = 0.57, t(114) = 7.92, \( p < 0.0001 \)) and quality of life on the component summary scores (mean difference Physical Component Summary = 4.09, t(114) = 6.85, \( p < 0.0001 \); mean difference mental component summary = 2.69, t(114) = 5.04, \( p < 0.0001 \)) and on each of the eight subscales.

**Between Gender Groups**

Analyses of covariances controlling for income, and number of sessions were conducted to compare the change in body mass, physical activity, and quality of life between males and females. There were no significant differences found in body mass, F(1, 226) = 1.81, \( p = 0.18 \), with no statistically significant relationship between income and number of sessions on body mass, as indicated by \( p \) values of 0.93 and 0.97 respectively. There was also no significant difference found on quality of life component summary scores (physical component summary: F(1, 226) = 0.93, \( p = 0.34 \); mental component summary: F(1, 226) = 0.02, \( p = 0.89 \)), or on the eight subscales. However, there was a statistically strong relationship between number of sessions and quality of life on both the component summary scales (\( p < 0.0001 \); \( p = 0.02 \) respectively) and on each of the eight subscales. In contrast, ANCOVAs controlling for income, and number of
sessions demonstrated a statistically significant difference in scores for males and females on physical activity, $F(1, 226) = 22.42, p < 0.0001$. There was a significant relationship between income and number of sessions with METS ($p < 0.0001; p = 0.02$, respectively). Analyses of the current sample indicated that males made significantly greater improvements in level of physical activity compared to females. This finding was expected given standardized gender norms in which males exceed females in physical activity capacity (ACSM, 2005). However, analyses also demonstrated that females made comparable gains to males on body mass index and quality of life (see Table 10).

**DISCUSSION**

The specific aims of the current study were to evaluate changes in body mass index (BMI), physical activity (METS), and quality of life (SF-36) by retention status and gender in cardiac rehabilitation participants from pre to post program completion. The study also aimed to identify predictors of retention in cardiac rehabilitation programs. Findings from the current sample were consistent with the cardiac rehabilitation outcome literature in that this group of participants in cardiac rehabilitation showed improvements in body mass index, level of physical activity, and quality of life (Leon et al., 2005; Thomas, 2007). While the improvements across outcomes were in agreement with the previous literature, participants in the current total sample had smaller decreases in body mass pre to post compared to previous studies (-0.63% improvement compared to an average -1.6% improvement; Lavie & Milani, 1996; Lavie & Milani, 2006). Participants had greater increases in levels of physical activity pre to post compared to
Table 10

Between subjects outcomes for 230 males versus females (adjusted means ± standard deviations)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Males</th>
<th>Females</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Mass Index Difference</td>
<td>-0.06 (0.1)</td>
<td>-0.29 (0.2)</td>
<td>NS</td>
</tr>
<tr>
<td>METS Difference</td>
<td>1.34 (0.3)</td>
<td>0.63 (0.1)</td>
<td>(p&lt;0.0001)</td>
</tr>
<tr>
<td>SF-36 Physical Component Diff.</td>
<td>3.17 (0.9)</td>
<td>4.20 (0.8)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Mental Component Diff.</td>
<td>2.58 (0.8)</td>
<td>2.71 (0.7)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Physical Function Subscale</td>
<td>3.90 (2.0)</td>
<td>5.15 (1.8)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Role Physical Subscale</td>
<td>13.16 (2.7)</td>
<td>12.58 (2.4)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Bodily Pain Subscale</td>
<td>12.00 (3.1)</td>
<td>16.21 (2.9)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 General Health Subscale</td>
<td>6.05 (1.6)</td>
<td>6.04 (1.9)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Vitality Subscale</td>
<td>6.54 (1.8)</td>
<td>8.36 (1.6)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Social Function Subscale</td>
<td>8.76 (1.9)</td>
<td>8.28 (1.8)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Role Emotional Subscale</td>
<td>9.21 (2.6)</td>
<td>13.00 (2.6)</td>
<td>NS</td>
</tr>
<tr>
<td>SF-36 Mental Health Subscale</td>
<td>4.70 (1.3)</td>
<td>3.25 (1.1)</td>
<td>NS</td>
</tr>
</tbody>
</table>
previous studies (38.5% improvement versus 31% improvement; Lavie & Milani, 1996), but less improvement in quality of life scores (PCS = 8.5% improvement and MCS = 5.0% improvement in the current sample compared to 15.8% improvement overall in Lavie & Milani, 1996).

However, between group comparisons illustrated some important outcome differences. Completers and non-completers both improved their levels of physical activity. Contrary to the original hypothesis, both completers and noncompleters benefited from program involvement, although quality of life indices had greater improvements upon program completion. Greater number of sessions was found to be an independent predictor of retention status in the current sample. Rural participants were five times more likely to complete a cardiac rehabilitation program than urban participants. These findings could indicate that while there is limited transportation in rural areas and individuals may need to travel longer distances to services (Burkhardt, 2000; Jackson, Leclerc, Erskine & Linden, 2005), those in rural areas with access to transportation may be more willing to utilize transportation and may be more motivated to attend.

Analyses of gender differences indicated that women had comparable outcomes to men with the exception of physical activity, in which men made greater improvements. As previously noted, this gender difference in physical activity was to be expected given standardized gender norms (ACSM, 2005). Males in the current sample increased from 40% to 55% (15% difference) of the predicted exercise capacity for their mean age pre to post, while females increased from 40% to 50% (10% difference) (Gulati et al., 2005).
These findings are comparable to the relative increase in physical activity capacity in male and female cardiac rehabilitation participants pre to post (18% and 12% respectively; Ades et al., 2006). However, in comparison to physical activity gender norms in a healthy sample, the current participants remain in the high risk category at program completion by an average of three METS (ACSM, 2005). The gender difference findings partially support the current limited literature, which indicates that once females are involved in cardiac rehabilitation they achieve gains comparable to males (Brezninka & Kittel, 1996; Todaro et al., 2004).

It is notable that quality of life changes across time in the current sample were similar to previous cardiac rehabilitation findings (Morrin, Black & Reid, 2000). The current sample had lower rates of PCS changes compared to a previous cardiac rehabilitation sample in the total sample and across retention and gender. However, MCS changes compared to the same sample were greater within the total sample and across all groups pre to post; indicating that the current sample may have began the program with increased mental health compared to other cardiac rehabilitation samples. Compared to U.S. norms, PCS scores were lower in the current cardiac rehabilitation population sample but approached norms at post (Ware, Kosinski & Keller, 1994). In contrast, the current sample had begun the program with MCS scores approaching U.S. norms (Ware, Kosinski & Keller, 1994). The current sample increased in quality of life at rates similar to individuals who had experienced a cardiac event but did not attend cardiac rehabilitation (Lindsay, Hanlon, Smith & Belcher, 2003). However, the current sample had begun with higher ratings of quality of life, which may have been due to hope related
to potential future gains from program involvement. Additionally, individuals motivated
to attend cardiac rehabilitation may be participants who endorse higher quality of life.

Study Contributions

The current study expands upon the literature by examining programs using
consistent outcome measures. The majority of studies in the cardiac rehabilitation
outcome literature have not made comparisons utilizing the exact same measures, thereby
limiting the accuracy of program comparison. This study also assists in identifying and
understanding underlying causes of disparities in program outcomes. Additionally, the
study adds to documentation of outcomes related to individuals who are at risk for
additional cardiac events.

Limitations

Given the exploratory nature of this study, only one program was selected from
each geographic location. The choice of these programs was based on convenience and it
limited the generalizability of results. In particular, the chosen rural program may not
have been representative of the average rural cardiac rehabilitation facility. The rural
program operated in a university setting under the guidance of a director with a
progressive mindset that emphasized the importance of the mind-body connection. The
rural facility had a health psychology service that offered group relaxation,
psychoeducation sessions and individual interventions as required. Further examination
of separate programs with and without health psychology staff may clarify the
importance of this role.
The current study also did not account for the overall milieu and atmosphere of the program. It might be useful to examine staff availability, staff expertise, and group dynamics as factors potentially contributing to retention. Access to increased levels of expertise may affect program attendance. Factors similar to those on group dynamics affecting membership and attendance in exercise programs reported in the literature may also play a role in cardiac rehabilitation (Christensen et al., 2006). A positive, cohesive group dynamic could be instrumental in making participants feel supported and thus increase likelihood of attendance, as well as enhance a patient’s experience of attendance by making it more socially reinforcing (Morrin, Black & Reid, 2000). In contrast, a negative group dynamic or a noncohesive group could negatively affect a participant’s experience and deter attendance. Future studies could utilize patient self-report on their group experience to assess this possible variable.

The study is potentially limited by the lack of sensitivity of one outcome variable, body mass index. While this outcome may simply not have changed much in the current sample, it also may not have been sensitive enough to demonstrate change in the current sample. While this is an outcome measure supported by the AACVPR and accepted throughout the cardiac rehabilitation literature (Sanderson et al., 2004; Wenger, 2008), a more sensitive measure such as waist circumference may have been more appropriate for use within the timeframe of a 12-week intervention program.

Additionally, the study was not experimental in that participants were not randomly assigned to groups. There was no control group. The current study did not account for pre-program exercise history and access to exercise facilities outside of the
cardiac rehabilitation program. Urban participants may have a history of organized exercise and greater access to facilities, which may make them less likely to attend organized sessions and more likely to be independent in their recovery. Level of patient motivation was also not assessed. Some individuals may be more motivated to change, and after only a few sessions they may learn the principles and feel secure in implementing these independently.

Despite these limitations, results of the current study extend the literature by identifying common barriers to the achievement of optimal cardiac rehabilitation outcomes. The continued challenge for cardiac rehabilitation programs will be to provide services that are appropriate for patients so that they can take full advantage of this effective therapy, thereby optimizing independence, health, and quality of life (Sanderson, Phillips, Gerald, DiLillo & Bittner, 2003).

Future Directions

The overall benefit of cardiac rehabilitation was supported by results of the current study. Retention findings imply that while any involvement is beneficial, completion leads to improvement in quality of life, BMI, and METS level. Thus it is critical to continue focusing on methods to enhance retention. Alternate cardiac rehabilitation-type services have been implemented by health care providers and may be recommended as options to enhance retention. These include telehealth (Hooper et al, 2001), home-based cardiac rehabilitation (Dollard et al., 2004), and creation of a cardiac rehabilitation education resource manual for rural and remote health care workers (Parker et al., 2002). Reported outcomes of these cardiac rehabilitation programs are varied, with
home-based care demonstrating the most compelling evidence for effectiveness (Dollard et al., 2004). Case management for home-based care via telephone and the internet have been found to offer easy communication with case managers and aide in counseling for risk factor reduction, while reducing cost and increasing accessibility (Gordon, 2003; Southard, Southard & Nuckolls, 2003). There is continued need for research that attempts to understand women’s experiences of CVD and cardiac rehabilitation, along with identification of female barriers to program attendance to enable cardiac rehabilitation for females to be improved. Researchers need to design strategies that educate women about the need for program participation, so that women understand that full participation is critical to their cardiac improvement. Finally, due to lower referral and retention rates, initial focus on referral may be necessary due to documentation of females having worse clinical presentations upon program entrance which may play a role in retention.

Future studies on cardiac rehabilitation may also need to focus more on referral strategies than retention, if participants continue to attend once enrolled. Future research needs to account for staff characteristics, group cohesiveness, staff expertise and/or age. Studies should also account for patient characteristics such as hardiness or self-motivation to determine if these variables also affect geographic variability.

Many obstacles to enhanced outcomes and participation cannot be changed, a fact that makes it necessary for modifiable factors to be addressed aggressively by professionals involved in cardiac care. In this way, health professionals working in cardiac rehabilitation will be able to lay the groundwork for better adherence (Sanderson
et al., 2003). In particular, health psychologists can be instrumental in addressing adherence-related risk factors in order to overcome barriers, increase retention, and improve outcomes. While retention continues to be an issue within cardiac rehabilitation, health psychologists can use their expertise to determine changes needed in areas such as availability of program times, assist in communication with doctors, and help with program supplementation using home-based or telecommunication programs. This may be helpful because many medical and exercise physiology staff have limited time for this level of involvement. The addition of health psychology on a programmatic basis may provide more individualized attention to participating patients and may serve to enhance the overall effect of cardiac rehabilitation by improving patient motivation to continue their participation and increasing retention in cardiac rehabilitation programs.
REFERENCES


APPENDIX A: CHART REVIEW FORM

Subject: ______________________

CARDIAC REHABILITATION MEDICAL CHART REVIEW

1. Program:

   _____ Urban
   _____ Rural

2. _____ Completer   _____ Non-Completer

3. Age ______

4. Gender ______

1. Marital Status:

   _____ Single
   _____ Widowed
   _____ Married
   _____ Divorced/Separated

1. Employed:

   _____ Yes
   _____ No

5. Number of Exercise Sessions Attended. _____________

6. Cardiac Condition (Please Check):

   _____ Myocardial Infarction
   _____ Angina
   _____ CABGx2
   _____ Stent Placement
   _____ Aneurysm
   _____ Pacemaker
   _____ Left Ventricle Hypertrophy
   _____ Mitral Valve Prolapse

   _____ PCTA
   _____ Hypertension
   _____ CABGx3
   _____ Stroke
   _____ Cardiomyopathy
   _____ Congenital Heart Disease

   _____ CHF
   _____ Arrhythmia
   _____ CABGx4
   _____ Peripheral Artery Disease
   _____ Other (Please List): __________________________________________________

7. Number of Comorbid Conditions _____________

   List Conditions (i.e. diabetes mellitus, hypercholesterolemia, renal insufficiency, pulmonary disease, previous cardiac event, peripheral vascular disease, etc.)
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

7. Number of Medications _____________
List Medications

7. Ejection Fraction (%) ___________  Ejection Fraction Classification ___________

7. Smoking Status ________________

8. Home Address _________________________

9. Address of Cardiac Rehabilitation Facility ________________

10. Address of Cardiac Specialist/Referring Provider ________________

11. Type of Insurance Provider

   ___ Medicare
   ___ Medicaid
   ___ Private Insurance
   ___ No Insurance

12. BMI Scores

   ___ Baseline BMI Score  ___ Follow-Up BMI Score

13. METS Scores

   ___ Baseline METS Score  ___ Follow-Up METS Score

14. SF-36 Scores

   (Baseline)  (Follow-Up)

   ___ Physical Functioning Score  ___ Physical Functioning Score
   ___ Role-Physical Score  ___ Role-Physical Score
   ___ Bodily Pain Score  ___ Bodily Pain Score
   ___ General Health Score  ___ General Health Score
   ___ Vitality Score  ___ Vitality Score
   ___ Social Score  ___ Social Score
   ___ Role-Emotional Score  ___ Role-Emotional Score
   ___ Mental Health Score  ___ Mental Health Score

15. BDI-II Scores

   ___ Baseline BDI-II Score  ___ Follow-Up BDI-II Score

16. ADDITIONAL RELEVANT INFORMATION (Please note below):

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________
Appendix B: Additional Information

Power Analysis

Previous studies examining the physical activity outcomes of cardiac rehabilitation revealed effect sizes ranging from $d = .68-.74$. Studies investigating BMI outcomes of cardiac rehabilitation revealed effect sizes ranging from $d = .08-.1$. Studies investigating quality of life outcomes of cardiac rehabilitation revealed effect sizes ranging from $d = .67-.93$. Thus a medium-effect size ($d = .6$) was chosen based on the reviewed literature (see Table 1). According to Cohen’s statistical table (1992) for a two-group, repeated measures research design, it was estimated that the sample size needed to detect a large-effect size ($d = 0.6$) with power of 80% and $\alpha = .05$ two-tailed, was a total sample of 230 participants.

Body Mass Index (BMI; Keys et al., 1972; Quelet, 1871). To determine participant’s BMI for the current study at the rural cardiac rehabilitation site, weight and height were obtained using a Befour Inc. low profile platform scale and a Seca stadiometer/height rod. In the urban program height and weight was obtained using a Healthometer 402 EXP beam scale with a height rod. The height rods were both set by manufacturing standards and were thus comparable. Additionally the scales were comparable as they were both manufactured to American College of Sports Medicine (ACSM) requirements. In both programs, participant’s weight was measured in pounds (which were converted to kilograms) and height was measured in inches (which were converted to meters). Measurements were obtained from participants in both programs when they were clothed and wearing shoes in the morning before exercise.
Metabolic Equivalents (METS; U.S. Department of Health and Human Services et al., 1999). METS is a widely accepted clinical tool for determining functional capacity that has clear relevance to the day-to-day activities of patients (Gibbons et al., 2002). Moreover, absolute exercise capacity measured in METS has been shown to be the most powerful predictor of long-term mortality in a large group of patients (Myers et al., 2002).

In the current study, rural participants MET levels were calculated during aerobic activity on the Precor Treadmills and NuStep Recumbent Ergometers. Machines were not regularly calibrated by exercise physiology staff. The Quinten Q-tel Telemetry Equipment registered participant MET levels when exercise physiology staff entered participant’s workload into the system. MET levels for the urban participants were calculated from aerobic activity on the Trotter and Cybex Treadmills. It was notable that the rural and urban treadmill equipment was comparable as they were all industrial strength treadmills, manufactured to standard, with speed ranging from 0.1-12 mph and 0-15% elevation levels. Machines at the urban program were also not calibrated on a regular basis by cardiac rehabilitation staff. ScottCare Cardiac Rehabilitation Telemetry Equipment calculated participant’s MET levels automatically. This was comparable to the rural program procedures as both programs were designed to utilize set ACSM equations to calculate METS. In both programs, maximum session METS was calculated from patient’s exercise sessions which were typically around 1 hour. Baseline METS were the maximum METS from the initial exercise session and Follow-Up METS were the maximum METS calculated at the patient’s final session.