1. Specific Aims

The ultimate goal of comprehensive rehabilitation for individuals with a disability is the attainment of an optimal level of independent living and quality of life. While innovative scientific research and improved medical techniques have increased the life spans of individuals with a disability, attention needs to be directed towards promoting healthy lifestyles and investigating methods to reduce the effects of aging with a disability. As with the non-disabled population, incorporating exercise into the lives of individuals with a disability enables them to enjoy the physical and psychological benefits of fitness and perform functional activities with less fatigue.

Although the effects of exercise training has been studied more in some impairment groups, such as spinal cord injured, other groups such as individuals with cerebral palsy and stroke survivors have received little attention with regards to fitness. Moreover, there has been little investigation into the ability of individuals with a disability to maintain long-term participation in an exercise program or the long-term effects of exercise on outcomes. In addition, little information exists describing the recreation and exercise patterns of persons with a disability. Nor have deterrents and barriers to participation in recreational activities been adequately investigated.

This project consisted of two studies. The first investigated the long-term effects of an exercise intervention on the physiological, metabolic, and psychological outcomes of individuals from three different impairment groups. Emphasis was placed on investigating the effects of this exercise intervention on women with disabilities and minorities, particularly African-American and Hispanic-American persons with a disability. We also examined the role of self-efficacy in influencing an individual’s participation in exercise. The second study studied the recreation, leisure, and exercise habits of individuals with a disability through the use of a survey. From this information, we determined the frequency of participation in recreation activities across a broad spectrum of impairment groups, and determine its effects on psychosocial outcomes.

Our project relied on the use of the well-equipped facility, the Helen M. Galvin Center for Health and Fitness based at the Rehabilitation Institute of Chicago. Established more than 4 years ago, RIC's Center for Health and Fitness has a wide range of adapted exercise equipment for use by a broad range of individuals with a disability. The Program has been successful in

promoting participation in physical activities for both competitive and noncompetitive disabled athletes. More the one-third of current registered participants in this program are women, and more than one-half are African-American and Hispanic. RIC's Center for Health and Fitness was one of the first programs to develop wellness, health, and nutrition programs for the disabled. The project staff lead by the Project Director, Jeff Jones, M.PE., consumers, and cardiology and exercise specialists will be central to the performance of the study, and provide a unique set of skills and experience in the implementation of this Project.

The specific objectives of this project were:

1. To investigate the long-term effects of an exercise fitness program on the physiologic, metabolic performance, and quality of life for individuals with spinal cord injury, stroke, and cerebral palsy.
2. To examine the role of self-efficacy in maintaining participation in an exercise fitness program.
3. To describe the types and frequency of recreation and fitness activities among individuals with a spinal cord injury, stroke, multiple sclerosis, and cerebral palsy.
4. To examine the relationships between participation in recreation and exercise programs and the health status, life satisfaction and depression in individuals with a spinal cord injury, stroke, multiple sclerosis, and cerebral palsy.
5. To delineate barriers and deterrents to participation in recreation and exercise programs that exist for a variety of impairment groups.
6. To disseminate the findings and innovations developed by this project to individuals with a disability, their families, and rehabilitation professionals.

2. Background and Significance

The research conducted in this Project has the potential to significantly influence the course of rehabilitation for individuals with a disability. Little investigation has been done on the effects of an exercise program on the physiologic and metabolic outcomes of persons with a disability. While short-term exercise interventions have been studied in some impairment groups, the long-term benefits and factors influencing long-term participation have not been studied. In addition, the relationships between exercise participation and quality of life have not been studied in a systematic manner. Of even greater concern, although some impairment groups have

been studied to some extent others, such as adults with cerebral palsy and stroke survivors, have received scant attention.

This research outlined in this project attempted to answer many of the questions needed to enable individuals with a disability to achieve optimal outcomes and healthier lifestyles. We studied the effects of an exercise program on long-term physiologic outcomes. We examined the relationships between exercise and psychosocial outcomes, including quality of life, life satisfaction, and depression.

The occurrence of a disability exerts a substantial impact on its survivors and their loved ones. While the precise estimates of the magnitude and extent of disability from spinal cord injury, stroke, and cerebral palsy vary among the many studies on the subject, the findings generally suggest that the majority of these individuals experience some decline in function and many persons have major disability.

Although spinal cord injuries (SCI) are relatively uncommon, they are costly in terms of hospital financing, loss of income, physical impairment, and the long lasting effects on the quality of life. Approximately 10,000-12,000 individuals in the United States sustain spinal cord injuries each year. A significant decline in mortality has resulted in a larger number of individuals with an SCI living in the U.S. today. At present the prevalence of spinal cord injury is estimated to be between 200,000 and 300,000 persons (Stover et al., 1995).

In recent years we have witnessed an increase in the mean age of persons who sustain a spinal cord injury, nonetheless SCI remains predominately a problem of youth (Stover et al, 1995). This means that most individuals sustain their disability before or during their most productive years.

Besides the primary impairment and disability caused by SCI, many individuals experience one or more medical complications during their lifetimes as a result of the injury. These secondary complications, such as pulmonary complications, cardiovascular problems, and urinary infections can seriously detract from the quality of life for these individuals.

Affecting approximately 500,000 people each year, stroke is currently the third leading cause of death and the second major cause of disability in adults. There are nearly 3 million stroke survivors alive in the United States today (AHCPR, 1995).

Although stroke is commonly thought of as a disease of aging, stroke strikes both young and old. The American Heart Association reports that 28% of all stroke survivors are under 65

years old. Among women under 45, stroke is more common than heart attack. While all segments of the population suffer strokes, African-Americans have a much greater incidence of strokes than whites or Hispanics. In addition, African-Americans are more likely to be disabled (Sullivan, 1992). Compared to whites, stroke risk is 40% higher in African-American women and 10% higher in African-American men. One in three African-American adults has hypertension, and while they take medication for hypertension as frequently as do white individuals, strokes claim twice as many of their lives.

Studies of stroke survivors six months or longer after onset of stroke indicate that residual motor deficits persist in 48-67% of individuals (Gresham et al, 1979). Cognitive, perceptual, and behavioral deficits are also common and problematic.

In the United States, there are an estimated 274,000 persons with cerebral palsy. Cerebral palsy is a non-progressive disorder in which an abnormality of the central nervous system can result in motor dysfunction resulting in paresis, involuntary movement, and incoordination. Cerebral palsy is the third leading cause of need for assistance with activities of daily living and the fifth leading cause of activity limitation (Anonymous, 1991). Although cerebral palsy occurs at birth, individuals with cerebral palsy can expect a relatively normal life span. However, these individuals face the cumulative problems of a sedentary life style from birth.

Epidemiological statistics such as those listed above are important. However, numbers alone do not reveal the human side of disability. When severe disability limits performance in accustomed living patterns, one's entire life style and appreciation of life are disrupted. Impairments alone are significant, but it is the recognition of their functional implications that demonstrate the true impact of a disability.

The role of rehabilitation then is to develop methods and techniques that will ameliorate the effects of disability and thereby improve the individual's ability to perform successfully in major life activities in varied environments throughout the entire life span.

The information derived from this Project is beneficial to individuals with a disability. Investigations into the effects of an exercise program on physiologic and psychosocial parameters are useful in developing effective programs to prevent cardiopulmonary disease. Information obtained about the ability of individuals with a disability to participate in exercise programs for more than a few weeks are helpful in developing strategies to encourage long-term participation. Learning which recreation and exercise activities individuals with a disability take

part in and the relationship this has to quality of life is also important.

The Project presents a coordinated effort to examine the effects of an active lifestyle and fitness intervention on the rehabilitation of individuals with a disability. We investigated the effects of an exercise training program, in this case a strength and conditioning program, on both the cardiopulmonary and quality of life outcomes of three groups of people with disabilities. We not only studied the immediate effects of this exercise program over a 12-week period, but we also attempted to study the long-term effects of exercise over the course of 18 months. In addition we examined the likelihood of these individuals maintaining participation in an organized fitness program over time.

A second part of this project studied the recreation, leisure-time physical activities, and exercise habits of individuals with a disability through the use of a survey and focus groups. From this information, we determined the frequency of participation in recreation and exercise activities across a broad spectrum of impairment groups. In the survey portion of the research we studied participation in a variety of physical activities, ranging from low-level activities to more intense physical activity. We examined the relationship of self-efficacy to participation in physical activity. We also compared physical activity and to quality of life. For both research endeavors we included women and minorities with a disability for participation.

2.A. Study 1: The long-term effects of an exercise fitness program on individuals with a disability

Prognosis for survival after the onset of a disability has continued to improve over the past forty years with advances in medical care and rehabilitation. As persons with disabilities age, they find themselves subject to the same debilitating effects of a sedentary lifestyle as the non-disabled population. In the general population, a lack of exercise is considered a leading risk for heart disease (Paffenbarger, 1993). Cardiovascular diseases are the second most frequent cause of death for individuals with a spinal cord injury (Stover, 1995), and of even greater concern is that cardiovascular disease has been reported to occur at younger ages in persons with a spinal cord injury (Whiteneck, 1992).

Reasons for the high incidence of cardiovascular problems are multiple. First, as individuals with SCI achieve longer life expectancies (DeVivo et al, 1993), they have more opportunities to develop coronary artery disease. Moreover, more elderly persons are sustaining and surviving trauma to the spinal cord, and this group tends to have a higher incidence of pre-

existing heart disease. Second, some physiologic result of the spinal cord injury itself and of the immobilization which ensues may contribute to the occurrence of cardiac disease.

Altered lipid profiles, glucose intolerance, insulin resistance, and obesity have also been reported to occur in significant numbers after a spinal cord injury (Duckworth et al, 1980; Bauman et al, 1992). Bauman and associates reported that although total cholesterol was lower in a group of veterans with spinal cord injuries, the levels of high-density lipoprotein (HDL) were lower than in controls whereas the levels of low-density lipoprotein (LDL) were the same as in controls (Bauman, 1992). Brenes found that the average levels of HDL in sedentary persons with SCI were sufficiently low enough to augment the risk of coronary artery disease by 60% relative to the general population. The depressed levels of HDL represent a significant risk for coronary artery disease (Stampfer, 1991).

Inactivity in persons with a spinal cord injury also favors the development of insulin resistance. Exercise has been shown in the non-disabled population to increase insulin sensitivity and thereby reduce the risk of diabetes and coronary artery disease (Leblanc et al, 1981).

Even though it would appear that the exertion from using a wheelchair would have a positive effect on the cardiovascular system, Hjeltnes and Vokac noted that the average physical exertion of everyday life was below the threshold for producing a significant increase in cardiac function. The heart rate elevation needed for a cardiovascular training effect was seen only while ambulating with crutches, propelling a wheelchair up an incline, or during arm ergometry training. Therefore, a systematic approach is needed for exercise training in order to prevent cardiopulmonary diseases.

Stroke survivors have associated medical conditions that may be preexisting medical complications, secondary post-stroke complications or both. The Framingham Heart Study (Gresham et al, 1979) reported that conditions such as hypertensive heart disease, coronary artery disease, obesity, and other illnesses were significantly more common among survivors of stroke than among age and gender matched control subjects. Roth and associates (1993) reported that between one-fourth and one-third of all stroke patients experience cardiac complications during rehabilitation.

The presence of comorbid conditions and the occurrence of medical complications have several implications for individuals with stroke during and after rehabilitation. First, chronic medical illnesses and acquired intercurrent medical complications may limit the ability of

patients to participate fully in rehabilitation, inhibit functional skill development, and reduce the likelihood of achieving favorable outcomes from rehabilitation. For this reason, it is not surprising that some medical problems, such as heart disease, have been found to adversely affect the course and outcome after stroke (Roth et al, 1988).

Even though exercise has been shown to have a positive effect on the cardiovascular system of non-disabled older adults (Hagberg et al 1989) little research has been done to investigate the effects of an exercise program on the fitness of stroke survivors. Potempa and associates (Potempa et al 1995) have examined the effects of a 10-week exercise program on nineteen moderately impaired hemiparetic stroke patients who were medically stable. They found that exercise training increased mean maximal VO2, but improvement was not uniform across all subjects. They also saw a decrease in systolic blood pressure in the exercise participants. Another study (Fletcher et al, 1994) studied the effects of a 6-month home exercise program in patients with coronary artery disease and a concurrent disability. In this study the concurrent disability for 63% of the treatment participants was a cerebrovascular accident. They found that the exercise training decreased resting heart rate. They also found decreased total cholesterol and an increase in HDL cholesterol; however, this was true for both the treatment and control groups.

As in other impairment groups, adults with cerebral palsy would seem to face the same risk factors and problems in preventing cardiopulmonary diseases. However, little research has been done to investigate the risks of cardiopulmonary disease or the effects of exercise training in this population. Bhambhani and associates have looked at the differences in wheelchair ergometry and bicycle ergometry in wheelchair athletes with cerebral palsy. They found that athletes who used wheelchairs as their primary mode of ambulation had higher VO2max values during wheelchair ergometry; whereas, those who used canes or no aids for daily ambulation had higher values on bicycle ergometry. Because of the specificity of the VO2max response, they recommended that the primary mode of mobility be considered when deciding on the testing method for evaluating cardiopulmonary fitness of persons with cerebral palsy.

In addition, to cardiovascular and pulmonary benefits, exercise training is associated with an improved mood state in the normal population. Few studies have been done to investigate the effects of exercise on quality of life or depressed mood in individuals with a disability.

When considering the effects of exercise training in the disabled population, what is

needed are long-term studies to determine which effects are brought about by the training and whether these effects can be maintained over time. In addition, some impairment groups, such as adults with cerebral palsy, have received little attention in evaluating the effect of exercise training on their physical fitness and quality of life.

In summary, while there have been many studies on the benefits of exercise on the fitness and quality of life in the non-disabled population, there been too few studies on individuals with a disability, particularly women and minorities with a disability.

2.B. Study 2: Assessment of recreation and exercise activities: Benefits and barriers

Despite the important benefits of exercise and physical activity on health, many Americans do not engage in exercise. In the non-disabled adult population the prevalence of no leisure-time physical activity has been estimated to be between 24% and 30%. Crespo and associates found that rates of inactivity were greater for women, older persons, non-Hispanic black and Mexican Americans (Crespo et al, 1996). Physical activity has been found to decrease after the onset of a disability (Kennedy and Smith, 1990; Drummond, 1990). Factors that influence this decline in physical activity include not just the physical impairment. Depression, loss of confidence, lack of facilities, and transportation are also important in determining participation in physical activity by individuals with a disability. In addition, the role of physical activity participation in the psychological and physical adjustment to disability has not been well studied.

3. Objectives and Hypotheses

Each study had its own objectives and hypotheses. The hypotheses for Study 2 were revised. The objectives and revised hypotheses are as follows:

3.A. Study 1

The purpose of this study to investigate the effects on a exercise intervention on the physiologic, metabolic, and quality of life outcomes of individuals with a disability.

Objectives:

The specific objectives of this study were:

Objective 1. To evaluate the improvement in cardiopulmonary fitness levels induced by an exercise training program as measured by oxygen uptake (VO2) resting heart rate (HR), changes in blood lipid profile and insulin sensitivity, changes in blood

pressure and body weight.

Objective 2. To assess improvement in strength from participation in a strength and conditioning program as measured by specialized dynamometers.

Objective 3. To assess the influence of exercise on life satisfaction as measured by the Life Satisfaction Questionnaire, on depression as measured by the Center for Epidemiological Studies Depression Scale (CESD-10), on health status as measured by the MOS 36-Item Short-Form Health Survey (SF-36), and to assess the influence of self-efficacy as measured by the Sallis Self-Efficacy Questionnaire.

Objective 4. To determine the long-term effects of exercise training program.

Hypotheses:

The hypotheses were:

Hypothesis 1. Participants will demonstrate an improvement in fitness levels as measured by a decrease in heart rate at rest and a greater increase in peak exercise VO2's. We anticipate greater improvements in cardiovascular and functional measures in the more deconditioned participants.

Hypothesis 2. Participants will demonstrate an increase in HDL and a decrease in total cholesterol. Participants will show an increase in sensitivity to insulin and have lower levels of fasting blood glucose.

Hypothesis 3. Participants will demonstrate an increase in muscle strength as measured by an increase in grip strength.

Hypothesis 4. Participants will demonstrate an improvement in life satisfaction, level of depression and quality of life as measured the Life Satisfaction Questionnaire, the Center for Epidemiological Studies Depression Scale (CESD-10) and the MOS 36-Item Short-Form Health Survey (SF-36). We predict that those who participate in a regular fitness program will have greater overall satisfaction with the quality of their life. We predict that subjects with greater self-efficacy will be more likely to maintain participation in an exercise program over time.

3.B. Study 2

The purpose of this study was to thoroughly investigate the recreation and exercise habits of individuals with a disability and examine the relationship between quality of life, health status,

self-efficacy, depression, and exercise patterns. In this study, we described the levels of recreation and leisure-time physical activities for four impairment groups, and measured the relationships between physical activity, self-confidence, and quality of life. Because we believe that women and minorities with a disability may have different levels of physical activity and may experience different barriers to participation, we made a special effort to see that they were represented in all phases of the study.

Objectives:

The specific objectives of this study were:

Objective 1. To evaluate levels of recreational and exercise activity in adult individuals with a disability across four different impairment groups: spinal cord injury, stroke, cerebral palsy, and multiple sclerosis.

Objective 2. To determine barriers to desired participation in recreation and exercise activities.

Objective 3. To measure the relationship between participation in recreation and physical activities and life satisfaction as measured by the Life Satisfaction Questionnaire.

Objective 4. To examine the relationship between participation in physical activity and self-confidence as measured by the Sallis Self-efficacy for Physical Activity Questionnaire.

Objective 5. To measure the relationship between participation in recreation activities and depression as measured by the Center for Epidemiological Studies Depression Scale (CESD-10).

Objective 6. To measure the relationship between participation in recreation activities and heath status as measured by the MOS 36-Item Short-Form Health Survey (SF-36).

Hypothesis

Because of changes in the environment from the time the proposal was written and when the design was implemented, a proper instrument was not designed to properly examine hypothesis 2. The second objective and hypothesis could not be tested. The other hypotheses were reframed into research questions.

The research questions are:

Question 1. How frequently do persons with disabilities participate in recreation and exercise activities and does the frequency of participation vary by impairment group?

Question 2. Is participation in leisure activities related to satisfaction with participation in these

activities, that is, do persons who participate more frequently express more satisfaction with their participation than those who participate less frequently?

Question 3. Do persons who participate in recreation and exercise activities on a regular basis demonstrate greater satisfaction with their life, greater self-confidence in their ability to participate in physical activity, and less depression than those who do not participate in these activities?

A summary of the interactions of the focus groups is discussed later in this report.

4. Research Design and Methods

This section presents a description of the research designs, the subjects, eligibility criteria, and sample sizes, the instruments and procedures, hypotheses, data collection, instrument calibration, data analyses and interpretation for each study.

4.A. Study 1

Design

This study used a treatment intervention design to study the efficacy of a specific rehabilitation intervention in the areas of neuromotor function, community function, and emotional adjustment to disability. The specific intervention in this study was a twelve-week exercise program consisting of both cardiovascular and strength training. We investigated the effects of participation in this program on the cardiopulmonary fitness and the quality of life of individuals with a disability. Each subject acted as his or her own control and multiple observations were taken prior to participation, at the end of the strength and conditioning program, and at regular intervals following treatment. Data analysis was performed to investigate the behavior prior to intervention for changes in levels, rate, and maintenance of change. Analyses of variance (ANOVA) were performed for the treatment initiation and end-time data collection periods to evaluate the immediate and short-term effects of the treatment intervention. Post treatment data were analyzed for temporal changes in the effect of treatment intervention. Long-term effects of the treatment intervention were also identified and quantified. Analyses of variance (MANOVA) were performed to study and quantify significant correlations between the dependent variables.

Prior to participating in the exercise program, participants underwent a pre-participation evaluation to identify persons at high risk for exercise-related injury or death, and obtain baseline

measurements of cardiopulmonary fitness, blood pressure, blood lipids, blood glucose, insulin, weight, quality of life, and confidence in performing physical activity.

All potential participants were asked to complete the Pre-participation Clearance Form (American College of Sports Medicine) and undergo a stress test. Participants who are identified prior to the test as being at risk for active cardiovascular disease were required to obtain permission from their primary physician in order to proceed with the stress test. Participants who were physically unable to independently operate an arm crank or stationary bicycle were ineligible for the study, but were referred to RIC's Center for Health and Fitness for participation in their standard exercise program.

The cardiopulmonary exercise stress test was performed using either an arm crank ergometer or a stationary bicycle or a treadmill, the arm crank being reserved only for those participants who cannot operate a stationary bicycle or a treadmill. The mode of exercise testing reflected the primary mode of ambulation for the participant. The mode of exercise testing used for the initial testing was used for all subsequent test evaluations. During their test, all participants were monitored by an exercise specialist using standard exercise electrocardiography (ECG) equipment. Heart rate and blood pressure were monitored before, during, and after the test. Cardiopulmonary fitness (VO2) was measured by use of a Sensor Medics Metabolic Cart. Test results were considered abnormal (having a high likelihood of having significant cardiovascular disease) if they meet any one of the following standard criteria (Elletad, 1996): 1) 1mm ST segment depression, flat or downward sloping, lasting at least 80 msec beyond the J point; 2) drop in systolic blood pressure of at least 10 mm Hg that persists over two consecutive stages of the exercise test to the next; or 3) significant ventricular arrhythmias including sustained and non-sustained ventricular tachycardia (at least 3 ventricular premature beats).

Participants with abnormal stress results were required to obtain clearance from their primary physician in order for them to participate in the study.

Sample

An attempt was made to recruit fifty subjects from each of three different impairment groups. A total of 131 subjects were eventually recruited to participate in this study. The impairment groups studied were spinal cord injury, stroke, and cerebral palsy. Participants were cleared by the pre-participation evaluation to participate in the strength and conditioning program. The subject pool came from referrals from the Rehabilitation Institute of Chicago and

community disability organizations. The strokes and spinal cord injuries occurred a minimum of six months prior to exercise testing to ensure that individuals have stabilized medically and neurologically. Special effort to include women and minorities were taken. Inclusion criteria were:

- older than 18 years
- medically stable (pass pre-participation evaluation)
- sufficient arm strength and mobility to operate an arm ergometer
- adequate sitting balance to sit on a stationary bicycle
- able to follow a 2-3 step command
- for stroke and spinal cord injury, 6 months post onset of the disability
- signed a consent form

Instruments

Cardiopulmonary fitness (maximal exercise capacity) was measured directly by gas collection, a "gold standard" method of assessing maximum oxygen consumption or VO2max (measured in ml 02/kg/min where 3.5 ml O2/kg/min equals one metabolic equivalent or MET (Bruce *et al*., 1973). Maximal VO2 was the highest level of consumption attained during the exercise test. The value was considered valid if the VO2 levels attained during the final two measurements of the test are within 2% of each other. If the final VO2 measurement was greater than the previous measure by more than 2%, the VO2 level was not be considered a true maximum (i.e., the participant had not reached his or her true maximal effort).

Other physiologic measurements were collected during a separate visit on all participants who qualified for the study after the exercise stress test. Study personnel were trained in proper methods of collecting blood pressure and body weight measurements. These measures included:

1. Blood pressure was measured using well-accepted criteria (Reeves *et al*., 1995). After the participant has been seated for 5 minutes blood pressures was measured using an appropriately sized blood pressure cuff (cuff bladder should cover at least 80% of upper arm circumference). Systolic blood pressure was defined as that pressure where the Phase I Korotkoff sound was heard, while diastolic blood pressure was defined as the pressure at which the pulse was no longer audible through the stethoscope (Phase V Korotkoff sound). The average of two consecutive blood pressure measurements was used, measured in the dominant arm.

2. Antropometric measurements (height, weight, and ratio of waist-to-hip circumference) were measured on each participant. Height and weight was measured on standardized scales. Waist circumference was defined as the minimal waist circumference and the hip circumference as maximal hip circumference, both measured in the supine position.
3. Fasting Lipid Profile (total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides) was measured on each participant from a venous sample, after the participant has fasted overnight. Analyses were performed in the Northwestern Memorial Hospital laboratory.
4. Fasting Blood Glucose and Insulin were also measured from a venous blood sample after an overnight fast. Glucose and insulin analyses were performed in the laboratory of Dr. James Young at Northwestern University Medical School.

Additional psychosocial outcomes were also measured, including quality of life, health status, depression, and self-confidence for performing and continuing with various exercise activities.

Quality of life was measured using the *Life Satisfaction Questionnaire* (Fugl-Meyer *et al*., 1991). This is a nine-question Likert Scale questionnaire designed to measure global and domain-specific satisfaction. Specific domains include: leisure, vocational, financial, sexual, family, friends, and spousal relationships. The Life Satisfaction Questionnaire possesses good psychometric properties and an internal consistency of .94.

The *MOS 36-Item Short-Form Health Survey* (SF-36) was used to measure health status, specifically physical and mental well-being, and is constructed for either self-administration or administration by a trained interviewer in person or by telephone (Ware and Sherbourne, 1992). The SF-36 includes one multi-item scale that assesses eight health concepts:

1. limitations in physical activities because of health problems
2. limitations in social activities because of physical or emotional problems
3. limitations in usual role activities because of physical health problems
4. bodily pain
5. general mental health (psychological distress and psychological well being)
6. limitations in usual role activities because of emotional problems
7. vitality

8. general health perceptions

The *Center for Epidemiological Studies Depression Scale* (CESD-10) was used as a measure of depression (Anderson and Malgren, 1994). This is a shorter version of the 20-question Center for Epidemiological Studies Depression Scale (CES-D). This scale has been tested in a relatively well population of older adults and has shown good predictive value when compared to the longer version. It has a high level of reliability and validity in screening for symptoms of depressed mood. Because several additional scales and questionnaires were being administered at the same time, we used this shorter version.

Confidence for participating in physical activities was measured using a modified version of the *Sallis Self-efficacy for Physical Activity Questionnaire* (Sallis and Hovell, 1993). Self-efficacy refers to the individual's belief that he or she can successfully execute a specific behavior necessary to produce a desired outcome (Bandura, 1977). This instrument was used to measure the likelihood of participants maintaining participation in an exercise program over time.

Exercise Prescription

While various health benefits have been documented from even low levels of physical activity, moderate levels of physical activity are necessary to produce benefits in cardiopulmonary fitness (exercise fitness) and to maximize other health benefits (i.e., improvements in blood pressure, blood lipids, glucose to insulin ratio, and body fatness). With this in mind, the training sessions were designed to include moderate levels of physical activity for study participants.

"Cookbook" exercise prescription is not possible even for individuals with the same disability. Because of the variety of impairments, functional abilities, and types of severity, it is not feasible to provide a specific regimen of exercise that all subjects will follow. To this effect, each subject acted as his or her own control. Moreover, because we wanted to study the likelihood of subjects maintaining participation in fitness program over time, we wanted them to participate in a program that allowed them some choice. However, as much consistency as possible was attempted. To all possible extent, duration, frequency, and intensity were consistent across subjects and diagnoses.

The training regimen included exercises aimed at improving cardiopulmonary fitness and strength. The exercise "dose" (intensity times duration) began at a low level and gradually

increased over the 12 weeks of the training program. During the first phase of the exercise program (week 1), participants were expected to attend 3 supervised exercise sessions. The schedule for these sessions included a 10-minute warm-up/stretching period, followed by a 20-30 minute exercise period, and followed by a 10-minute cool-down period. After this initial instruction and supervised period, participants were given an activity schedule that they were to follow at home (phase 2). During phase 2 all participants were encouraged to exercise daily and to attend at least one supervised exercise session at the study center.

Each participant had an individualized exercise prescription that included a least three types of exercise modes consisting of at least one aerobic exercise and one strength training exercise. The prescription also included guidelines for gradually increasing exercise intensity and duration over the 12 weeks of the study. “Starting low and going slow” helped participants gain confidence in their ability to exercise and also helped avoid unbearable muscle fatigue and soreness that can discourage continued participation in the program.

Exercise Modes

Conditioning Activities	**Weight Training Exercises**
Walking/Jogging	Weight machines
Stationery bicycle	Arm crank (ergometers)
Treadmill	Hand weights
Stairs/Stair machine	Calisthenics (push-ups & situps)

Exercise records were kept on each study participant including attendance at supervised session and exercises performed. At the end of the 12 week program participants again underwent the exercise stress test and all tests performed at the initial exercise stress test were repeated, including blood lipids, insulin, body weight, quality of life assessment and depression measurement.

At RIC's Center for Health and Fitness ambulatory participants had several equipment options for cardiovascular exercise. Stationary bicycles, stair steppers and treadmills were available. In each case, the exercise load and speed were adjustable in order to meet the physical constraints and abilities of each participant. Participants with lower extremity impairment had the use of several different types of upper extremity ergometers. Similar to the ambulatory

equipment, each ergometer allowed for variable resistance and progressive workloads. Wheelchair rollers were also available for the endurance-training portion of the program.

RIC's Center for Health and Fitness made available a variety of free weights and weight machines for strength training. Strength equipment had been chosen based on its universal design and ability for use with ambulatory and non-ambulatory participants. Participants using wheelchairs were able to access each exercise while remaining in their wheelchairs.

Equipment available provided a well-rounded approach to strength training, allowing for each major muscle group to be exercised. Equipment options included the following upper body exercises: bicep curl, tricep extension, chest press, shoulder press, lat pull down, lateral raise, and pectoral fly. Lower body exercises included: leg press, leg extension, and multi-hip exerciser (flexion, extension, abduction, and adduction).

Wrist and ankle wraps ranging from one-pound increments were available for participants requiring specialized programs. Wrist cuffs were available for participants with impaired hand function that were able to perform exercises with heavier loads. Dumb bells were available for participants who had both the hand function and upper body balance to perform free weight exercises.

Participants were encouraged to maintain the exercise prescription over the course of the next 18 months. They could have chosen to exercise at home, at RIC's Center for Health and Fitness or a combination of both. Participants were contacted by phone on a monthly basis to maintain contact with each participant and to gather information on levels of activity.

Data collection

At admission to the study, information regarding age, gender, onset of disability, current medications, dietary intake for the preceding 48 hours were collected. Cardiovascular and other physiologic measurements were collected during a separate visit on all participants who qualified for the study after the exercise stress test. Data on quality of life, health status, depression, and self-confidence for performing and continuing with various exercise activities were collected at admission to and completion of the study. At six month intervals all physiologic and quality of measurements were repeated.

Data preparation and calibration

We completed several preliminary steps before undertaking formal hypothesis testing: *Data Management.* Questionnaire data were scored with programs based on published scoring

criteria that were written by the data manager. The scored output and other principal variables composed a second level of data on which all further analyses were based. A master SPSS data file with all principal variables was created, archived and updated as additional cases were received.

Data Preparation. Exploratory analyses were employed to examine the accuracy of the data. For non-calibrated instruments, frequency distributions and scatter plots were used to check for anomalous responses and logical consistency between variables. Anomalies were resolved by verification of the responses with the original data sources.

Preliminary Data Analysis. Next, we examined the distributions of all primary variables. Categorical variables were described as frequencies and percentages, and interval/ratio level variables as means (averages). We computed both point estimates and confidence intervals to provide a clear picture of the characteristics of the sample. Histograms with confidence intervals were used to provide a graphic representation of the distributions of case characteristics. The data were examined for statistical power before proceeding with hypothesis testing. Recodes and transformations were carefully justified and recorded in a data management log.

Construction of Equal-Interval Measures. A state-of-the-art measurement procedure, rating scale (Rasch) analysis (Rasch, 1960/1980), was used to calibrate the responses to each of the psychosocial instruments and produce the equal interval measures required for parametric analyses. While this procedure produces meaningful measures even in the presence of missing data, cases in which more than 10% of the responses were missing were eliminated. To produce stable estimates of item difficulty, responses for both time points were calibrated together using the WINSTEPS (Wright & Linacre, 2000) software. Once the item estimates were obtained, separate person measures were estimated for each time point.

The results of the calibrations are presented in Appendix B. For each instrument, the table contains a summary of the psychometric characteristics (person and item reliability, item misfit, and rating scale structure) for the original and each subsequent calibration conducted to improve the measurement quality of the instrument, up to the final calibration.

Calibration results are reported in logits that range from minus to plus infinity; however, for ease of interpretation of the results of the subsequent analyses, these logits were transformed to a scale ranging from 0 (the lowest possible measure) to 100 (the highest possible measure). The transformed measures and other principal variables composed a second level of data on

which all further analyses were based. A master SPSS data file with all principal variables was created and archived.

Data Analysis

Descriptive statistics were obtained for all study variables. A 0.05 significance level was used for all tests. The study sample was described in terms of impairment group, age, gender, race, marital status, and education. Prior to performing multivariate analyses, correlations among dependent variables were examined; data reduction strategies were performed if correlations are high. Likewise, data reduction procedures were explored following assessment of multicollinearity in independent variables.

The variables and analyses used to test each hypothesis are listed below.

Hypothesis 1: Participants will demonstrate an improvement in fitness levels as measured by a decrease in heart rate at rest and a greater increase in peak exercise VO2's. We anticipate greater improvements in cardiovascular and functional measures in the more deconditioned participants.

The measures for the variables used to test the first hypothesis consisted of categorical variables for time (baseline, 12-week, 6- month follow-up, 12-month follow-up, or 18-month follow-up) and impairment group (stroke, spinal cord injury or cerebral palsy), and interval measures of heart rate at rest, two interval measures of oxygen consumption, the differences between baseline and follow-up in heart rate and oxygen consumption. The analyses performed consisted of repeated measures MANOVA with heart rate at rest and oxygen consumption as the dependent variables, time and impairment group as the independent variables, followed by univariate and post hoc analyses to identify significant effects. Pearson's product moment correlations were used to determine the relationship between baseline status in resting heart rate and oxygen consumption and changes in them at follow-up.

Hypothesis 2: Participants will demonstrate an increase in HDL, and sensitivity to insulin, and a decrease in total cholesterol, weight and fasting blood glucose.

The measures for the variables used to test the second hypothesis consisted of categorical variables for time and impairment group and interval measures of high-density lipoproteins, total cholesterol, sensitivity to insulin, fasting blood glucose, and weight. The analyses performed consisted of repeated measures MANOVA with HDL, total cholesterol, sensitivity to insulin, fasting blood glucose and weight as the dependent variables, time and impairment group as the

independent variables, followed by univariate and post hoc analyses to identify significant effects.

Hypothesis 3: Participants will demonstrate an increase in muscle strength.

The measures for the variables used to test the third hypothesis consisted of categorical variables for hand, time and impairment group and interval measures of grip strength. The analysis performed consisted of repeated measures MANOVA with grip strength as the dependent variable; hand, time and impairment group as the independent variables, followed by univariate and post hoc analyses to identify significant effects.

Hypothesis 4: Participants will demonstrate an improvement in life satisfaction, level of depression and quality of life. We predict that those who participate in a regular fitness program will have greater overall satisfaction with the quality of their lives and that subjects with greater self-efficacy will be more likely to maintain participation in an exercise program over time.

The measures for the variables used to test the fourth hypothesis consisted of categorical variables for time, impairment group and whether the subject completed the exercise program and interval measures of life satisfaction, physical and mental well-being, leisure activity satisfaction, depression, and self-efficacy. The analysis consisted of repeated measures MANOVA with life satisfaction, physical and mental well-being, leisure activity satisfaction and self-efficacy as the dependent variables, time and impairment group as the independent variables, followed by univariate and post hoc analyses to identify significant effects. In addition, a logistic regression of persistence to follow-up was conducted with life satisfaction, mental and physical well-being, activity satisfaction and self-efficacy as the independent variables.

4.B. Study 2

Design

A survey booklet containing demographic information and the psychosocial instruments was sent to participants in this study. A sample of the survey is included in Appendix A. A cover letter and consent form was included in the mailing. Whenever possible the survey was administered by way of a one-to-one personal interview. Surveys that were distributed by mail, include a stamped self-addressed return envelope.

Sample

Four disability groups were studied in this project: spinal cord injury, stroke, cerebral palsy, and multiple sclerosis. Subjects were 18 years and older and resided in a non-institutional setting. For individuals with spinal cord injury, stroke, or multiple sclerosis, the onset of the disability had occurred more than 6 months before participation. Participants were drawn from the outpatient population of the Rehabilitation Institute of Chicago and local community groups, such as stroke clubs, the Illinois Chapter of the National Spinal Cord Injury Association, and centers for independent living. We attempted to include individuals residing in urban, suburban, and rural locations and solicited participation from minorities and women, as these individuals may experience greater difficulty in accessing recreation and exercise activities in their area. The plan was to survey 75 individuals from each group, a sample size determined to be sufficient to distinguish difference among and between impairment groups.

Instruments

The instruments in the booklet measured frequency of and satisfaction with leisure activity participation, recreation and exercise activity participation, life satisfaction, physical and mental well being, depression, and self-efficacy.

Two subscales of the **Katz Adjustment Index** (Katz & Lyerly, 1963) were used to measure the frequency of leisure activity participation and satisfaction with involvement. The two subscales used were the Level-of-Free-Time Activities and Level of Satisfaction with Free-Time Activity (See Appendix A for copies of all instruments used). These two subscales have been found to be valid measures of involvement in social and recreational activities. This instrument measures primarily participation in activities requiring low levels of physical exertion, but does include some activities requiring more physical involvement. This instrument has been used to assess frequency and satisfaction of recreation and leisure participation in the stroke population, and was found to be reliable (Jongbloed and Morgan, 1991). The Index consists of 26 activity items ranging from watch television to participate in sports. Subjects were asked how often they participated in each activity. We repeated the list, asking whether the subject was satisfied with his or her participation in each activity.

The **Minnesota Leisure Time Physical Activity Questionnaire** was used to measure participation in activities requiring more physical exertion (Taylor *et al*., 1978). Activities on the questionnaire include: swimming, sailing, skiing, home exercise, bowling, etc. This instrument

was originally developed to measure energy expenditure during leisure-time physical activity. This instrument has been shown to have high reliability in assessing estimated exercise intensity in the able-bodied population (Folsom *et al.*, 1986).

Three other instruments that were used in the Study 1 were also used in this study. Quality of life was measured using the **Life Satisfaction Questionnaire** (Fugl-Meyer *et al.*, 1991). The **MOS 36-Item Short-Form Health Survey (SF-36)** was used to measure health status, specifically physical and mental well being (Ware, 1992). The **Center for Epidemiological Studies Depression Scale (CESD-10)** was used as a measure of depression (Anderson and Malgren, 1994). Confidence for physical activities was measured using a modified version of the **Sallis Self-efficacy for Physical Activity Questionnaire** (Sallis and Hovell, 1993). This instrument was used to measure an individual's confidence in participating in recreation and exercise activities and compared to their actual participation.

Data collection

Whenever possible the instruments were administered by personal interviews conducted by a trained, experienced interviewer and were 30 to 40 minutes long. The number of the interviews were conducted at the Center for Health and Fitness with individuals not involved in part 1 of the study. Other subjects were recruited through a variety of community-base organizations in attempt to collect information from a wide cross-section of individuals.

Data preparation and calibration

The same procedures for data preparation and calibration used in Study 1 were also used in Study 2. The descriptive analyses described above were also conducted for Study 2.

Data analysis

The variables and analyses used to answer each research question are as follows:

Question 1. How frequently do persons with disabilities participate in recreation and exercise activities, and does this frequency differ across impairment groups?

The measures for the variables used to answer the first question consisted of categorical variables for impairment group (stroke, spinal cord injury, cerebral palsy, and multiple sclerosis) recreational and exercise activity frequency (at least daily, at least monthly, at least yearly, and never). The analysis performed consisted of a chi-square analysis of activity category by impairment group.

Question 2. Is participation in leisure activities related to satisfaction with participation in these activities, that is, persons who participate more frequently express more satisfaction with their participation than those who participate less frequently?

The measures for the variables used to answer this question consisted of a categorical variable for impairment groups and interval measures of leisure activity frequency and satisfaction. The analyses performed consisted of Pearson's product moment correlations between leisure activity satisfaction and leisure activity frequency, for all impairment groups combined and separately by impairment group.

Question 3. Do individuals who participate in recreation and exercise activities on a regular basis demonstrate greater satisfaction with their life, greater self-confidence in their ability to participate in physical activity, and less depression than those who do not participate?

The measures for the variables used to answer this question consisted of the recreational and exercise activity categories and interval measures of satisfaction with life, physical and mental well being, and self-efficacy (the depression measure was dropped due to poor reliability). The analyses conducted consisted of two-way ANOVA with impairment group and activity category as the independent variables and life satisfaction, physical and mental well being, and self-efficacy as the dependent variables, followed by univariate and post hoc analyses to identify significant effects.

5. Results

5.A. Study 1

Descriptive Statistics

One hundred forty-three (143) individuals participated in the first study. Of these, the percentages by impairment group are relatively even: cerebral palsy (27.5%), spinal cord injuries (35.9%) and stroke (36.6%). The following descriptive statistics compare the samples by impairment group.

Age

The mean age of the overall sample is 42.8 years with a standard deviation of 13.7, but the mean age differs significantly ($F=36.1$; $p<.001$) by impairment group. As might be expected, the participants in the stroke sample are older (53.2 years) than the participants in the cerebral palsy (36.2) and SCI (37.1) samples.

Gender

Table 1 shows the gender distribution for the sample, broken down by impairment group. Overall, 72.7% of the sample is male, but the gender distribution across impairment groups is different. The participants in the SCI sample are overwhelmingly (88.2%) male while the participants in the other samples are less dominantly male: CP (59.0%) and the stroke (67.9%).

Table 1: Gender Distribution across Impairment Groups	**CP**	**SCI**	**Stroke**	**Total**
Male	23	45	36	104
Female	16	6	17	39
Total	39	51	53	143
Chi-Square Statistic				10.519
Degrees of Freedom				2
Significance				.005

Racial/Ethnic

The racial/ethnic distribution by impairment group is illustrated in figures found in Appendix C. Overall, 31.0% of the sample are Caucasian, 61.3% African-American, 5.6% are of Hispanic origin, and 2.1% are from other racial groups; the distribution does did not differ (X^2(df=8) = 14.97, NS) by impairment group.

Attrition Analyses

Initial interviews were conducted at the beginning of the exercise program and follow-up interviews were conducted at the end of the initial exercise program of 12 weeks, 6 months post-completion, 1 year post-completion, and 18 months post-completion. The exercise program and post-completion interview after 12 weeks was completed by 131 persons, the 6-month post-completion interview by 36 persons, the 12-month post-completion interview by 12 persons, and the 18-month post-completion interview by 5 persons. 0verall, 91% of the study participants completed at least the first follow-up interview, but retention rates vary across impairment groups. There are no dropouts in the CP sample, 6% of the SCI sample dropped out, and 17% of the stroke sample. There are no differences between persons who completed the exercise program and those who dropped out in terms of age (t=1.88, NS) and gender (X^2(df=1)=.74; NS), but Hispanic participants (100%) are more likely (X^2(df=4)=12.51; p=.014) to have completed

the program than Caucasian participants (89%).

Tests of Hypotheses

Due to the small sample size beyond exercise program completion, only short-term effects (before and after the 12-week program) were examined for this section of the report.

Hypothesis 1: It was hypothesized that participation in the exercise program would decrease resting heart rate and increase oxygen consumption. Figure 1 and Table 2 show the results of this analysis. Oxygen consumption is reported both in terms of peak capacity and peak capacity controlling for body weight. At baseline and completion of the exercise program, participants in the stroke sample have lower resting heart rate than participants in the CP and SCI samples. Similarly, participants in the CP sample have higher oxygen consumption than those in the SCI and stroke samples.

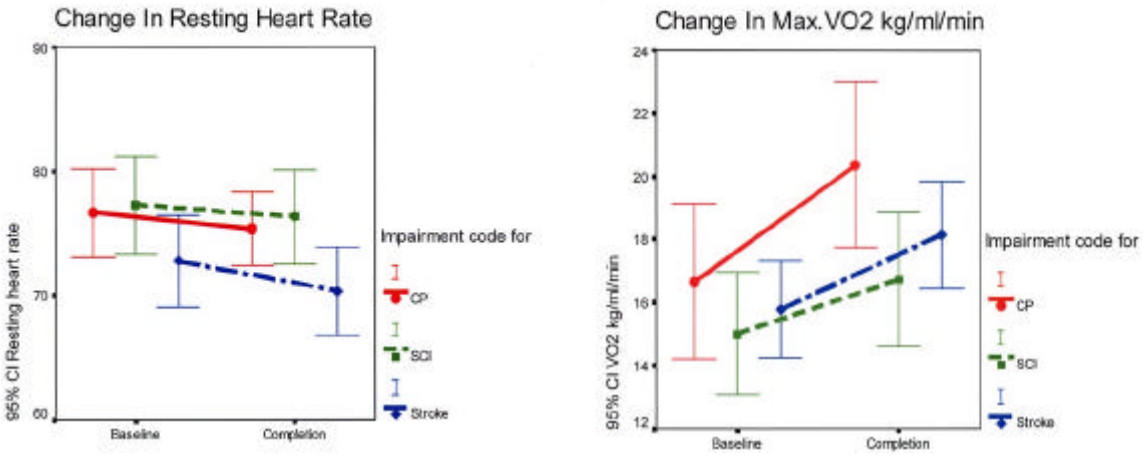

Figure 1: Heart Rate and Oxygen Consumption by Impairment Group

The analysis shows a significant main effect for the type of test (heart rate versus oxygen consumption) as well as significant interactions for type of test by impairment group and time, partially confirming the hypothesis. Univariate analyses shows nonsignificant differences in resting heart rate but significant increases in oxygen consumption, both controlling and not controlling for body weight, for the cerebral palsy and stroke samples, but not for the SCI sample.

Table 2: Change in Heart Rate and Oxygen Consumption			
	F	df	*p*
Effects			
Change over time	1.82	1	NS
Type of impairment	2.18	2	NS
Type of test	3812.63	2	<.001
Time by type of impairment	0.67	2	NS
Test by type of impairment	3.34	4	.011
Time by test	17.75	2	<.001
Time by test and type of impairment	0.94	4	NS

It was also hypothesized that the participants who achieved the greatest improvements were those who were most deconditioned at baseline. Table 3 shows the relationship between baseline status and amount of improvement in resting heart rate and oxygen consumption. There is a significant negative relationship between these variables, thus confirming the hypothesis. When examined separately by impairment group, more improvement in resting heart rate is related to lower baseline for all three groups, but more improvement in oxygen consumption is related to lower baseline status only for persons in the SCI sample.

Table 3: Change Related to Baseline Status		
	r	*p*
Effects		
Resting heart rate	-.42	<.001
Oxygen consumption	-.40	<.001
Oxygen consumption (controlling for body weight)	-.19	.03

Hypothesis 2: It was hypothesized that participation in the exercise program would produce improvements in other physiological measurements. Figure 2 and Table 4 shows the results of the analysis for high-density lipoproteins (HDLs), total cholesterol, fasting blood glucose and insulin sensitivity, and body weight. Initially, participants in the SCI sample had lower HDLs, total cholesterol and glucose levels than those in the CP and stroke samples, and participants in the CP sample had lower body weight than those in the SCI and stroke samples.

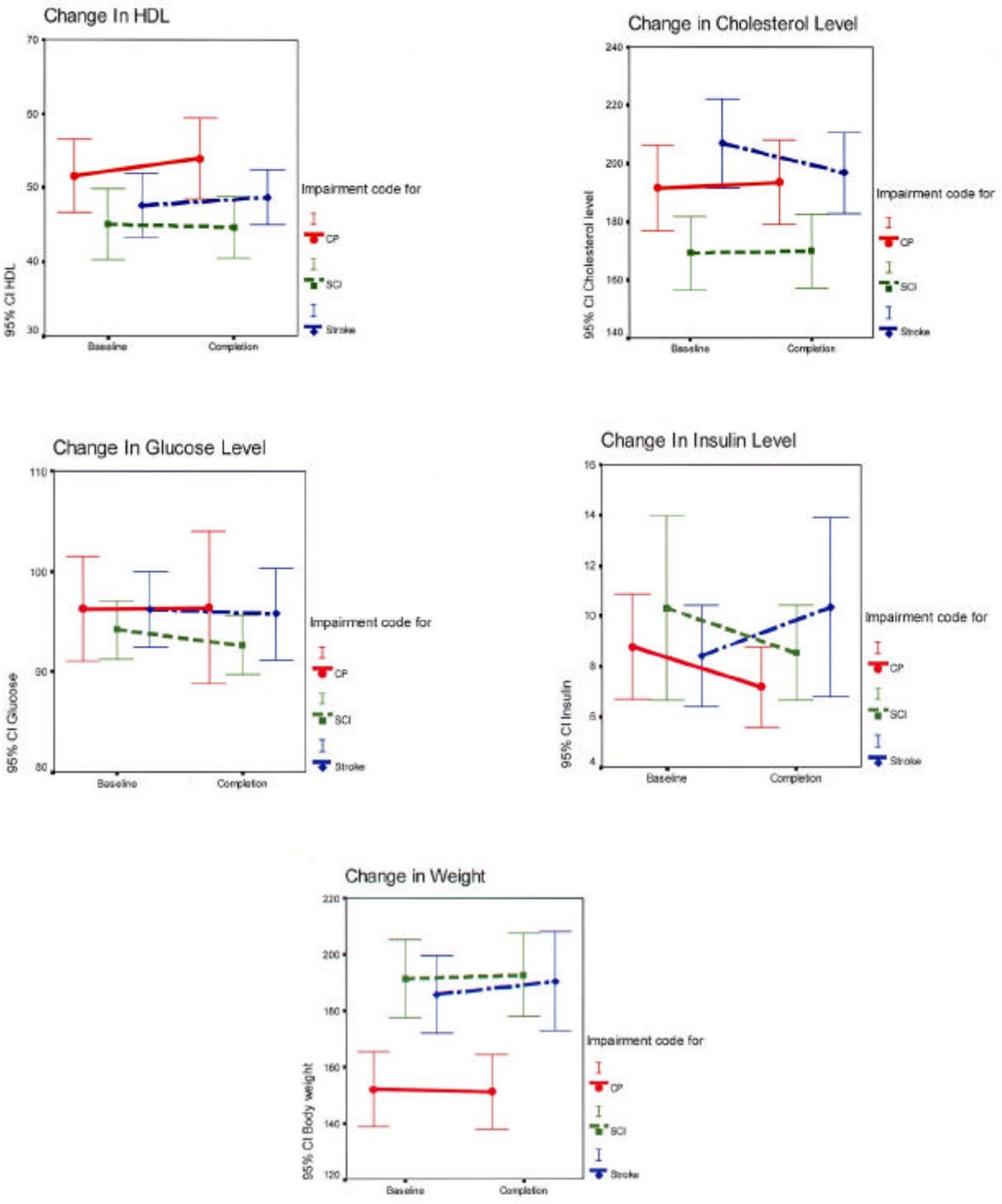

Figure 2: Physiological Measurements by Impairment Group

The analysis shows significant main effects by test (HDLs, total cholesterol, fasting blood glucose and insulin sensitivity, and body weight) and significant interaction effects for test by impairment group and test by time and impairment group, only partially confirming the hypotheses. Univariate analyses show a significant decrease in total cholesterol for participants in the stroke sample but nonsignificant changes in the remaining indicators.

Table 4: Change in Other Physiological Measures

	F	df	*p*
Effects			
Change over time	0.80	1	NS
Type of impairment	2.79	2	NS
Type of test	814.76	4	<.001
Time by type of impairment	0.26	2	NS
Test by type of impairment	.56	8	<.001
Time by test	0.49	4	NS
Time by test and type of impairment	1.78	8	.02

Hypothesis 3*:* It was hypothesized that participation in the exercise program would result in increased grip strength. Figure 3 and Table 5 show the results of this analysis. At baseline, participants in the SCI sample have greater grip strength in both hands than those in the CP and stroke samples.

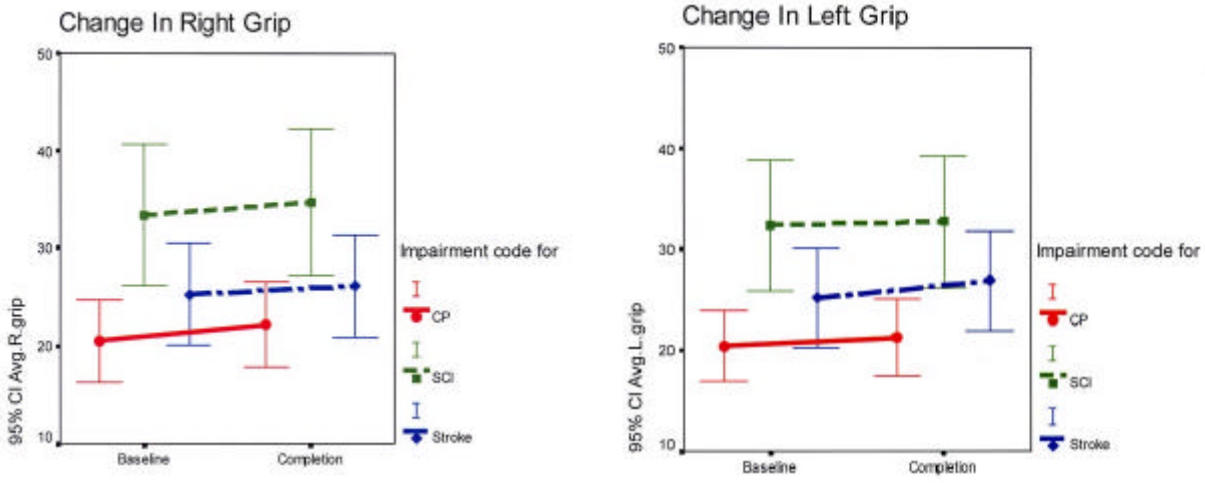

Figure 3: Grip Strength by Impairment Group

The results show significant main effects by impairment group and time. Regardless of impairment group and hand, the increases in grip strength are significant, confirming the hypothesis. Univariate analyses show significant improvement in right, but not left, hand grip strength for persons in the CP and SCI samples and nonsignificant differences for either hand for persons with stroke.

Table 5: Change in Grip Strength

	F	df	*p*
Effects			
Change over time	13.58	1	<.001
Type of impairment	6.62	2	.002
Type of test	0.12	1	NS
Time by type of impairment	0.26	2	NS
Test by type of impairment	0.11	2	NS
Time by test	0.50	1	NS
Time by test and type of impairment	1.81	2	NS

Hypothesis 4: Changes in quality of life outcomes, such as life satisfaction, self-efficacy, and physical and mental well being, were also examined. It was hypothesized that participants in the exercise program would report increased quality of life. Table 6 shows the results of these analyses. Figures depicting these analyses can be found in Appendix D. At baseline, participants report essentially the same life satisfaction, mental and physical well being but participants in the CP sample report lower self-efficacy than those in the SCI and stroke samples.

The results show significant main effects by impairment group and type of test (life satisfaction, self-efficacy, and physical and mental well-being) and a significant interaction of type of test by time, thus only partially confirming the hypothesis. The univariate analyses show nonsignificant changes across tests and impairment, with the exception of an increase in activity satisfaction for participants in the stroke sample.

Table 6: Change in Quality of Life	*F*	df	*p*
Effects			
Change over time	0.21	1	NS
Type of impairment	4.49	2	.01
Type of test	69.20	4	<.001
Time by type of impairment	0.72	2	NS
Test by type of impairment	1.87	8	NS
Time by test	3.92	4	<.01
Time by test and type of impairment	0.70	8	NS

5.B. Study 2

Descriptive Statistics

Two hundred eighty-three (283) persons with disabilities responded to the surveys in the second part of this study. The distribution by type of impairment is as follows: cerebral palsy (12.4%), multiple sclerosis (35.5%), spinal cord injury (29.1%); and stroke (23%). The following descriptive statistics compare the samples by impairment group.

Age

The mean age of the overall sample is 46.4 years with a standard deviation of 13.6; the mean age by type of impairment differs significantly (F = 38.4, p <.001), with respondents in the stroke (56.7 years) sample older than those in the other impairment groups and respondents in the MS (49.9 years) sample older than those in the CP (35.7 years) and SCI (38.8 years) samples.

Gender

Table 8 shows the gender distribution for the sample, broken down by type of impairment. Overall, 55.7% of the sample is male. The gender distribution of the respondents differs by impairment group (X^2(df=3) = 37.46, p <.001), with males constituting 77.8% of the respondents in the SCI sample, 64.6% in the stroke sample, 51.4% in the CP sample, and only 34% in the MS sample.

Racial/Ethnic

The racial/ethnic distribution by type of impairment is illustrated in Figure 6. Overall, 48.9% of the respondents are Caucasian, 37.5%% are African-American, 7.1% of Hispanic origin and 6.4% are from other racial/ethnic groups. The distribution differs by impairment group (X^2(df=15) = 39.75, p <.001), such that the respondents in the MS sample are more likely to be Caucasian and those in the stroke sample more likely to be African American.

Marital Status

The marital status of the sample is illustrated in Table 7 below. It shows that respondents tended to be either currently married or never married. Marital status differs (X^2(df=9) = 86.20, p <.001) across impairment groups, such that respondents in the MS sample were more likely to be married and respondents in the CP sample more likely to have never been married.

Table 7: Marital Status across Respondents

	CP	MS	SCI	Stroke	Total
Currently Married/Cohabitating	1	45	27	27	100
Previously Married	1	39	13	25	78
Never Married	32	16	42	13	103
Total	34	100	82	65	281
Chi-Square Statistic					86.20
Degrees of Freedom					9
Significance					p<.001

Education

The education level of the sample presented in Table 8 shows that 7.3% of the total sample has less than a high school education, 28.7% has a high school diploma or equivalent, and 60.4% has some college or a bachelor's degree. The groups differ (X^2(df=18) = 55.74, p <.001), in educational completion, such that respondents in the CP sample are less likely and respondents in the stroke samples are more likely to have more than a high school education.

Table 8: Education Level across Respondents

	CP	MS	SCI	Stroke	Total
Less than high school graduate	11	4	6	9	20
High school graduate	12	35	22	10	79
More than high school graduate	10	61	51	44	166
Total	33	100	79	63	275
Chi-Square Statistic					55.74
Degrees of Freedom					18
Significance					p<.001

Employment: The majority of the sample (77%) is not employed; of those who are employed, 10% hold part-time positions and 13% hold full-time positions. Approximately one-third (34%) of the sample does volunteer work, and 13% are students (equally split between part-time and full-time).

Living Arrangements: One-fifth (20%) of the sample live alone, 32% live with their parents, 26% with their children, and 22% with other family.

Transportation: Many (40%) persons in the sample drive their own car, fewer are passengers in private cars (37%) or use a private service (33%), and 32% use public transportation.

Activities of daily living: Less than a quarter of the sample (19%) can walk without assistance, 24% walk with assistance, but the majority uses a wheelchair (23% power and 34% manual). The average distance this group can ambulate is 69.75 yards (standard deviation = 7.78). The vast majority (82%) is independent in eating with 15% requiring some assistance and only 3% requiring a lot of assistance. The vast majority (79%) are also independent in bed transfers, with 8% using a sliding board (5% with no assistance and 3% with assistance), and 13% requiring some assistance (without a board). The average number of outpatient visits is 11.14 (standard deviation = 1.62).

Research Questions

Question 1: The frequency with which persons with disabilities who responded to this survey participate in exercise or fitness activities was examined. Twenty-seven percent of the respondents participate in such activities at least daily, 51% participate with less frequency, and 22% never participate in such activities. Table 9 shows the distribution of exercise activity across impairment group. Persons in the CP sample are more likely to never exercise and persons in the SCI and stroke samples are more likely to exercise daily.

Table 9: Exercise activity by impairment group

	CP	MS	SCI	Stroke	Total
Never	8	16	18	14	56
At least annually	5	10	1	5	21
At least monthly	11	45	30	18	104
Daily	5	17	26	21	69
Total	29	92	78	56	255
Chi-Square Statistic					21.45
Degrees of Freedom					9
Significance					p=.011

Question 2: The relationship between frequency of participation in leisure activities and satisfaction with this level was examined. The results show that, regardless of impairment group,

the relationship is negative (r = -.24; p <.001); that is, persons with less frequent activity are more satisfied with their leisure activity. The relationship is stronger for persons with multiple sclerosis (r = -.35; p <.001) and spinal cord injuries (r = -.32; p <.001), about the same as the overall group for persons with cerebral palsy (r = -.23; p <.001), but nonsignificant for stroke survivors.

Question 3: The quality of life of persons who participate in exercise and fitness activities was also examined. Tables 10 to 13 shows the results of these analyses. Table 10 shows the life satisfaction results by category of exercise activity and impairment group. There are nonsignificant main and interaction effects, indicating that life satisfaction is essentially the same regardless of impairment group and the extent to which persons engage in recreational and exercise activities.

Table 10: Relationship between exercise activity and life satisfaction

	F	df	*p*
Effects			
Frequency of activity	0.77	3	NS
Type of impairment	0.66	3	NS
Frequency by type of impairment	0.96	9	NS

Table 11 reports the results of the analysis of self-efficacy. There is a significant main effect for impairment group as well as a significant interaction between activity category and type of impairment. The univariate analyses show that there is a significant relationship between activity level and self-efficacy only for respondents in the CP sample; for this sample, the optimal level of exercise activity in terms of self-efficacy is monthly.

Table 11: Relationship between exercise activity and self-efficacy

	F	df	*p*
Effects			
Frequency of activity	1.95	3	NS
Type of impairment	6.97	3	<.001
Frequency by type of impairment	2.85	9	.003

Table 12 shows the results of the analysis of mental well-being. There is a significant

main effect for impairment group and a significant interaction between frequency and impairment group, but a nonsignificant effect of exercise activity. The univariate analyses show that effect of activity frequency on mental well being is greater for respondents in the SCI and stroke samples than those in the MS and CP samples.

Table 12: Relationship between exercise activity and mental well-being

	F	df	*p*
Effects			
Frequency of activity	0.66	3	NS
Type if impairment	4.02	3	.014
Frequency by type of impairment	1.31	9	NS

Table 13 shows the results of the analysis of physical well being. There is a significant main effect for impairment group but a nonsignificant main effect of exercise activity and a nonsignificant interaction between frequency and impairment group. The effect of activity frequency on physical well being is stronger for respondents from the stroke sample than from those in the MS sample.

Table 13: Relationship between exercise activity and physical well-being

	F	df	*p*
Effects			
Frequency of activity	0.90	3	NS
Type of impairment	10.33	3	<.001
Frequency by type of impairment	1.01	9	NS

6. Discussion of Results

6.A Study 1

The results of the data collection component of this study had a number of expected results that confirmed the various stated hypotheses. In a number of instances the data suggested positive trends that supported the hypotheses, but did not show statistical significance.

Our efforts to examine the long-term effect of exercise on the subjects were somewhat unsuccessful. Of the 143 subjects that participated in the initial 12 week exercise program, only 36 subjects continued on and completed the next 6 months phase of the study. A summary of the

data relating to these 36 subjects can be found later in this report. The summaries presented here refers to data collected during the initial 12 week exercise program. Figures illustrating these data are presented in Appendix C.

Hypothesis 1:

It was hypothesized that subjects would experience a decrease in resting heart rate and an increase in oxygen consumption. While resting heart rate declined from 77 to 75 beats per minute in the CP sample, 77 to 76 beats per minute in the SCI group and 73 to 70 beats per minute for the stroke subjects, these decreases were not statistically significant, but were similar to those found in stroke subjects by Fletcher et al (1994).

Significant results were found with maximal oxygen consumption. Oxygen consumption in the CP sample increased from 16.66 kg/ml/min to 20.37 kg/ml/min or 18%, while consumption for the stroke sample increased from a mean of 15.79 to 18.17 kg/ml/min or 13%. Both increases were statistically significant. An increase was also seen in the SCI sample from 15.01 to 16.73 kg/ml/min; however this increase was not significant. These findings were similar to those reported by Potempa et al (1995), where increases in oxygen consumption were not uniform across all subjects.

It was also hypothesized that greater improvements would be seen in subjects who were most deconditioned at the beginning of the study. For the purpose of this study, deconditioned was defined as those subjects with the higher resting heart rates and lower maximal oxygen consumption at the baseline measurement. This was hypothesis was confirmed. Greater improvements in resting heart rate were seen from the more deconditioned subjects in all three groups. However, with respect to improvements in oxygen consumption, this relationship was only seen in the SCI sample.

Hypothesis 2:

This portion of the study was investigating changes in other physiological measurements including changes in high-density lipoprotiens (HDL's), total cholesterol, fasting blood glucose, insulin sensitivity and body weight. It was hypothesized that subjects would experience an increase in HDL levels, a decrease in total cholesterol, an increase in sensitivity to insulin, lower levels of fasting blood glucose, and a decrease in weight.

The results indicated positive but not significant trends in all physiological areas except for insulin sensitivity in the stroke sample and total cholesterol levels for the CP and SCI

samples. Mean HDL levels increased in the CP sample from 52 to 54 MG/DL, from 44 to 46 MG/DL in the SCI group and from 48 to 49 MG/DL in the stroke group. Total cholesterol levels had a significant change for the better in the stroke group decreasing from 208 to196 MG/DL. However, total cholesterol levels increased in the CP and SCI samples 192 to 196 MG/DL, and from 169 to 170 MG/DL respectively. Although, these changes were non-significant, they were inconsistent with the changes seen in HDLs for the same groups and similar to results reported by Fletcher et al (1994) for stroke subjects.

When comparing values for fasting insulin (MIU/L) a lower level of resistance is desired. Therefore, for the purposes of this study lower point values demonstrate a positive trend. Decreases were seen in the CP sample from 8.8 to 7.6 MIU/L and from 10.3 to 8.4 MIU/L in the SCI group. These results were consistent with those reported by Leblanc et al (1981). However, the scores for the stroke sample increased from 8.9 to 10.5 MIU/L. A closer look at individual differences from baseline to test 1 suggests these figure were affected by 4 or 5 tests with unexplainably large changes in values. In addition, these differences might have been due to the fact that a number of the stroke subjects were diabetic.

The final component of the blood analysis involved looking at changes in fasting blood glucose. Positive but not significant changes were seen for all three groups. The values decreased for the SCI and stroke groups from 95 to 93 MG/DL and 97 to 96 MG/DL respectively, while they increased for the CP sample from 96 to 97 MG/DL. It should be noted that the blood component of the data collection presented the most difficult challenge with respect to subject compliance. A review of individual scores indicates that some subjects may not have fasted for the required twelve hours prior to the test. In addition, several subjects who completed all parts of the testing were non-compliant for the second blood work.

Positive significant changes in body weight were found in the SCI group where mean weight dropped from 198.3 lbs to 191.4 lbs, while the changes in the CP and stroke samples were non-significant. Mean body weight increased from 150.5 lbs to 151.5 lbs in the CP sample and from 189.4 to 190.5 lbs in the stroke sample. A possible explanation for this slight increase is that it is related to increase muscle weight. In future studies, including a measurement of body composition may suggest reasons for these changes.

Hypothesis 3:

It was hypothesized that participation in an exercise program would result in increases in grip strength. Baseline scores indicated that the SCI group had greater grip strength in both hands than did the CP and stroke samples. This difference in grip strength may be related to wheelchair population by the SCI group as compared to the predominately ambulatory CP and stroke groups. Also, it is likely that the frequency of hemiparesis affected the scores in the stroke and CP sample.

The data showed across the board increases in both right and left hand grip strength for all three groups. There were significant improvements in right hand grip strength in the CP and SCI groups with mean increases from 20.53 to 22.22 kg of force in the CP sample and 33.44 to 34.74 kg of force in SCI group. Increased scores for the left hand grip strength of CP and SCI and the left and right hands of the stroke grip were non-significant after 12 weeks of exercise.

Hypothesis 4:

We predicted that those who participated in a regular fitness program would have greater overall satisfaction with their quality of their life. We also predicted that those subjects with greater self-efficacy would be more likely to maintain participation in an exercise program over time. The results only partially confirmed this hypothesis. Levels of participation increased for the SCI sample with scores increasing 2% from 51.88 to 52.98. Scores for the stroke sample showed a negative relationship with a decrease in participation (2.57) and a increase in satisfaction (6.75), while the CP population showed a loss in satisfaction and a small gain in participation. Results of the SF 36 indicated a positive upward trend for all three groups in the physical health, suggesting that subjects overall felt better physically after the 12 week exercise period.

With respect to the second part of the hypothesis, an average subject with higher efficacy did tend to participate longer. The mean scores for the 36 subjects that did continue for another 6 months of exercise were compared to the mean scores for all subjects. Mean score for the 36 subjects at test 1 were 69.81 as compared to 59.97 for CP, 66.2 for Stroke and 50.52 for SCI.

Long Term Effects

Thirty-six subjects continued past the twelve-week intervention period to complete another six months of exercise. Of these subjects 21 (58%) were stroke survivors, 12 (33%) had spinal cord injuries, and three (8%) had cerebral palsy. Many issues contributed to the

overwhelming number of stroke survivors compared to the other groups, but the largest issue was transportation problems particularly in the CP population. It was not an issue of subject compliance. If the measures were available to provide transportation and (in the case of the CP subjects) continue transportation, we are confident the number of subject continuing past test 1 would have been greater.

A review of the results from the 9-month period found that 12 of the 36 subjects had positive changes in oxygen consumption after continuing the program, while fourteen subjects dropped in oxygen consumption. We attribute this drop to the fact that these subjects were no longer under a structured program that requires them to workout three days a week. Twelve subjects who had increases in oxygen consumptions also showed a drop in resting heart rate from the 9-month test, eight had increases in resting heart rate and sixteen had no significant changes. Just as in the comparison of the baseline to twelve-week test, there were significant increases in HDL from12 weeks to 9-months. Sixteen subjects showed gains, ten showed decreases, six stayed the same, and four tests were dropped due to incomplete data. Of the sixteen subjects that had gains in HDL, the majority (10) were from the stroke survivor populations.

While baseline to twelve-week comparison showed positive gains in total cholesterol, these levels from a twelve-week to nine-month period showed a negative trend by the majority of the subjects. We attribute this to a less structured exercise program. There were non-significant changes in HDL or glucose levels for the majority of subjects. Eighteen subjects had a decrease in insulin level, six increased, four showed no gains and eight had incomplete data. Results in grip strength showed very encouraging data with half of the subjects achieving a significant change in left and right grip. The largest increases were found in stroke survivors on their involved side. While the majority of the results at 9-months showed improvements over the subjects baseline measurements, overall the results from the twelve-week test to the nine-month test were not what we expected.

One of our main goals was retention of subjects past the twelve-week program. Only 36 of 143 (25%) subjects continued, which is much lower than we were hoping. We did not see overwhelming positive changes across the disabled populations, with the exception of grip strength. In future studies we believe that a few things will enable us to make this program a greater success. First of all, additional funding for transportation is needed and would enable

subjects to continue with the program without the worry of arranging transportation and having to pay for it. Secondly, additional funding for staff to not only ensure that tests (particularly blood tests) are not missed, but also to allow availability of a staff member to make weekly check-ups of the subjects program.

6. B. Study 2

The intent of Study 2 was to investigate the recreation and exercise habits of individuals in four disability groups: cerebral palsy, spinal cord injuries, multiple sclerosis and stroke survivors. The purpose was also to examine the relationship between quality of life, health status, self-efficacy and depression with the individuals exercise patterns.

The study initially called for a phone survey as the means of administering the multiple t questionnaires. Difficulty in identifying individuals with the required disabilities and their phone numbers led to a change in these methods. Whenever possible, a one-to-one personal interview was used. When personal interviews were not possible, the survey was mailed to potential subjects along with a self-addressed stamped envelope.

The goal of Study 2 was to include 75 responses from each of the four disability groups. More than four hundred surveys were distributed to various community health care organizations in our attempt to collect 300 surveys. We exceeded our goal with multiple sclerosis and spinal cord injured samples with 100 and 82 subjects, respectively. We almost met our goal stroke survivors with 65 responding, (86% of our initial goal). However, we only received 36 responses from individuals with cerebral palsy which represented only 48% of our goal. Implementation of this portion of the project had its inherent problems. The ideal solution would have been 300 individual one-to-one interviews. Phone interviews might have accomplished it, however, a lack of access to phone numbers and lack of staff time required the change.

The overall demographics of Study 2 subjects indicate an even cross section of society. The average age was 46.4 years, with stroke survivors being older (56.7 years) and the CP and SCI subjects being younger 35.7 years and 38.8 years respectively.

The gender split was almost even for the overall sample with 55.7% being male and 44.3% female. However, there were considerably more males (77.8%) in the SCI group and more female (67%) in the MS sample. Overall, almost half (48.9%) of the subjects were white and 51.1% were African American, Hispanic or other racial group. The biggest difference in

race was seen in the MS and stroke samples. The MS sample was more likely to be white, while the stroke sample was more likely to be African American.

Overall, except for the CP sample the respondents were more likely to be married and more likely to have had some college education (60.4%). The most striking statistic was that 77% were not employed. This seems especially high given the apparent functional level of the sample. Results indicate that 82% where independent in eating and 84% independent in bed transfers, which suggests high levels of overall function.

Question 1:

The frequency of which one participates in exercise or fitness activities showed 73% of the sample exercised at least monthly, and, 27% exercised daily. The data showed that 37.5% of the stroke sample and 33.3% of the SCI sample exercised daily as compared to only 18.4% of MS subjects and 17.2% of the CP sample.

Question 2:

The relationship between frequency of participation in leisure activities and one's satisfaction with that level was examined and unexplainable result was found. The relationship had a negative correlation, that is, the less frequently the subject participated the more satisfied they were with their level of participation.

6.C. Focus Groups

The focus groups designed to identify barriers to participation were held inconjunction with a series of education sessions held at RIC's Center for Health and Fitness. Sessions ranged in topics from first aide, nutrition, wheelchair maintenance to community recreation opportunities and treatment of secondary conditions.

Discussions were held at each session regarding fitness and recreation opportunities and barriers that prevented individuals from participating. Barriers were divided into several general categories including transportation, availability, accessibility, staff knowledge, personal interest and cost.

Transportation was the primary cause preventing participation. Less than 40% of the participants have access to their own transportation. Public and private medical transportation is often unreliable or only used for medical related appointments. When available the process for securing a daily ride are often on a first-come first-serve basis.

Availability and accessibility of exercise and recreation programs for individuals with disabilities are two major barriers. Unfortunately, there is not the number of community-based program there should be for individual, with disabilities especially within the city of Chicago. One reason why RIC's Center for Health and Fitness and the 18 different programs it offers is so successful (26,000 programs visits last year) is that the Chicago Park District offers very few programs designed for individuals with disabilities. In additional programs that are offered within park district facilities are often in non-accessible facilities.

The issue of accessibility and availability do not change with respect to commercial facilities. Health clubs cater to the young, non-disabled client. Machines, although state-of-the-art are more often not designed for individuals with disabilities. Staff trained in general fitness principles in many cases, know little about designing program for individual with disabilities. Personal interest and cost were also barriers expressed by individuals in the focus groups. Too often individuals are unaware of the opportunities available to them after acquiring a disability. The misconception that "dis-ability" means "un-able" is very prevalent. People with disabilities to better understand the opportunities that are available.

With more than 70% of our participants unemployed, the cost to participate in recreation programs is another barrier. Most recreation and fitness programs have some cost associated with them. When someone has to choose between food and recreation, the choice is simple.

Solutions to eliminate their barriers are difficult. Advocacy for more program and better accessibility needs to be ongoing. Better education of fitness, recreation and health care professionals will lead to greater program opportunities. More thorough community re-entry programs and better education of individuals during their outpatient programs will increase independence of individuals with disabilities which will lead to increase use of community-based resources.

6.D. Limitations of the Study

Although there were documented positive trends in almost all areas of the study, including a number that were statistically significant, we were disappointed in the overall outcomes. Given the opportunity to duplicate the project several components of the study would be done differently to ensure greater overall success.

Subject Recruitment

Recruitment of eligible and cooperative subjects was a much more difficult task than expected. Our final numbers of 143 required us to interview over 270 individuals. Screening of potential subjects for medical and functional concerns resulted in 82 individuals being rejected as subjects. Medical concerns were primarily heart and lung conditions and an insufficient amount of time since onset. Potential subjects were carefully screened for cardio-pulmonary conditions that might present a concern during the exercise and/or testing portions of the study. Additionally, study protocols required subjects to be at least six months post onset. Functional concerns related to an individual's ability to perform on a treadmill, exercise bike or ergometer at the level required for the study were also a reason for rejection. It should be noted that in all cases individuals rejected as potential subjects were invited to participate in RIC's Center for Health and Fitness. That program remained open to all individuals regardless of their status within the study. Although individual concerns over health issues were still monitored during general use of RIC's Fitness Center, participation by non-subjects is possible at a much lower level of extertion.

We experienced 62 dropouts, individuals who started the study, had the baseline test taken and for a number of reasons could not or would not meet the requirements of the exercise protocol (exercising 3 times per week.). In hopes of preventing subjects from dropping out prior to the 12 week cut off. We changed our subject payment schedule early in the study from separate $50.00 payments for the baseline and follow-up tests to a single payment of $100 for the completion of both tests and the 12 week exercise program. Although we did experience additional dropouts after implementing this change the rate was significantly reduced.

Recruitment of individuals with spinal cord injuries and stroke survivors was accomplished much easier than the recruitment of individuals with cerebral palsy. Our ability to continue the study through a no-cost extension allowed us to concentrate specifically on the CP component of the study which required a much more extensive community outreach. In addition, funds had to be allocated for transportation costs in order to ensure subject participation. Given all of that, only 39 subjects with cerebral palsy were recruited. Unlike individuals who have experienced a spinal cord injury or survived a stroke, adult individuals with cerebral palsy for the most part, do not have an ongoing relationship or association with rehabilitation facilities. Whereas a majority of the spinal cord injury and stroke subject involved

were referred from within RIC's system of care, the majority of the subjects with CP were recruited from outside sources.

Exercise Prescription

This study required each subject to follow an individualized exercise prescription. Subjects progress was self-monitored with limited staff supervision. It is suggested that more direct staff intervention be used in future studies. We found that self-monitoring does not always provide the best results. Our program was limited in staffing which prevented a one-to-one personal training arrangement with every subject. Although, we are confident that study subjects performed the required exercises, it is felt that the level of exertion would have been higher if staff supervision could have been increased.

It was apparent that for many of the subjects this study was their first opportunity to participate in an organized exercise program. This fitness inexperience contributed to the inability to subjects to function self-sufficiently within the fitness facility, preventing self-monitoring from providing optional results. An increased amount of professional assistance and one-to-one guidance during exercise sessions would have motivated subjects to perform at higher levels of exertion.

Transportation

Grant funds did not allow for transportation for all subjects. It wasn't until the fourth year (no-cost extension) when it was determine that limited funds should and could be used for transportation of cerebral palsy subjects. One of the biggest obstacles to participating in an exercise program facing individuals with disabilities is transportation. Our facility currently works with over 40 transportation services. Participant rides are often late interfering with scheduled testing and workouts. It is not uncommon for transportation services to not pick up the participants at all or to be 2-3 hours late. In order to increase overall compliance it is suggested that transportation funding be incorporated into future studies.

Blood Analysis

The data received from the blood tests provided crucial information with respect to changes in cholesterol levels, fasting glucose level and insulin ratio. The difficulty we encountered was ensuring that subjects fasted for the required twelve hours and that they showed up for their scheduled their follow-up tests. Test scores not consistent with the mean score, suggested that proper fasting did not take place. Secondly, blood draws were not a popular

procedure. We had difficulty getting some subjects to complete the second round of blood tests. In the future informing a household member or care provider ahead of time of the need for the subject to fast, may improve compliance.

Survey Measures

It may be suggested that varying levels of literacy contributed to the conflicting results found in the survey/questionnaire portion of the study. Embarrassment about illiteracy and a lack of understanding of the questions may have resulted in individuals marking answers just to get the survey over with. In order to ensure correct interpretation of pencil and paper questionnaires by the subjects in the future, it is suggested that a staff member should be made available to read through and clarify any misinterpretations.

6.E. Clinical Implications

The long-term clinical implications of this study suggests a new direction in clinical rehabilitation health care. Trends toward shorter hospital stays on average and fewer outpatient follow-up therapies continue to be documented. Post-rehabilitation exercise programs such as RIC's Center for Health and Fitness Program, provide an effective continuation of the rehabilitation process. Although this study excluded individuals who were less than six months post injury, perhaps referrals from inpatient facilities to outpatient programs could include an exercise component and participation in such programs begin as soon as possible.

As health care improves and individuals with disabilities live longer or, concerns over secondary conditions are issues that health care professionals must address for a much longer period of time. With spiraling health care costs, the long-term economics of prevention and the role that exercise can play in that prevention are topics that need to be considered. Health care providers will need to consider the long-term cost of caring for secondary conditions as compared to prevention programs that include fitness and exercise programs.

It is important to note the fitness and exercise programs should include an array of services. Offering exercise classes is only the initial phase of a comprehensive program. A diversified education component, an active community re-entry program and transportation services all need to be included as part of a multi-disciplinary approach to rehabilitation.

6.F. Future Directions

Although our results were not all statistically significant, positive trends in almost all areas suggest that post-rehabilitation exercise programs are beneficial for individuals with disabilities.

The data generated by this study suggests that exercise for individuals with disabilities is a valuable contribution to living a healthy and active lifestyle. Too often health care providers do not associate the concepts of health, fitness and exercise with individuals with disabilities. Similarly, individuals with disabilities, their family members and/or care providers do not think in terms of wellness or fitness. Disability too often suggests illness, weakness and inability. Individuals adjusting to the challenges of a newly acquired disability do not consider exercise and fitness as a primary concern in the early stages of the rehab process.

Continued emphasis must be placed on education and dissemination of accurate information. Practical and scientific information about fitness and exercise for individuals with disabilities must be generated and distributed to health professionals, researchers, practitioners, and consumers. In addition to the continued research, practical solutions to increasing participation in wellness and fitness programs must be developed. Issues of facility and equipment accessibility, transportation services and program availability must be addressed, in order to increase the availability of fitness and exercise programs to individuals with disabilities.

A considerable number of hospitals have been diversifying into the area of wellness and fitness. Hospital based wellness centers have become big business. Prevention through fitness is very popular with non-disabled patients. This trend needs to continue and needs to include the rehabilitation field.

Appendix B

Calibration of Instruments

Instrument/ Calibration	Average person measure	Person separation (reliability)	Item separation (reliability)	Step structure	Item fit	Comments
CES-D #1 (10 items)	-.74; well targeted across steps	1.31 (.63)	6.43 (.98)	Inversion in categories 2/3 in rescored items	#5 (REV feel hopeless) misfits (1.49)	Delete #5 and recalibrate
CES-D #2 (9 items)	-.84; targeting unchanged	1.29 (.62)	6.15 (.97)	Inversion in categories 2/3 in rescored item	#8 (REV unhappy) now misfits (1.53)	Delete #8 and recalibrate
CES-D #3 (8 items)	-.86; targeting unchanged	1.33 (.64)	6.63 (.98)	No inversions	No misfit	Best solution but still unacceptable
Katz-P #1 (22 items)	.16; well targeted across steps	1.68 (.74)	11.63 (.99)	No inversions	#22 (go to school) and #2 (gardening) misfit (1.54 and 1.35)	Delete #22 and recalibrate
Katz-P #2 (22 items)	.15; targeting unchanged	1.64 (.73)	12.15 (.99)	No inversions	#2 (gardening) still misfits (1.37)	Separation not improved; retain items
Katz-S #1 (22 items)	-1.10; ceiling effect	2.07 (.81)	4.96 (.96)	No inversions	#4 (radio), #5 (TV), #20 (sit and think) misfit (1.33, 2.07, 1.57)	Recode rating scale (231) to reflect amount desired
Katz-S #2 (22 items)	1.05; targeting unchanged	1.69 (.74)	5.84 (.97)	No inversions	#2 (gardening) misfits (1.53)	Recode scale (321) to reflect increasing satisfaction
Katz-S #3 (22 items)	1.10; targeting unchanged	2.07 (.81)	4.96 (.96)	No inversions	#4 (radio), #5 (TV), #20 (sit and think) still misfit	Recode scale (211) to reflect satisfaction or dissatisfaction
Katz-S #4 (22 items)	-.16; targeting improved	1.87 (.78)	6.50 (.98)	No inversions	No misfit	Best solution; scale makes more sense
LSQ #1 (9 items)	.28; well targeted	1.96 (.79)	8.82 (.99)	No inversions	#2 (able to manage self-care) misfits (1.55)	Delete #2 and recalibrate
LSQ #2 (8 items)	.25; targeting unchanged	1.94 (.79)	9.27 (.99)	No inversions	No misfit	Separation not improved; retain item

Instrument/ Calibration	Average person measure	Person separation (reliability)	Item separation (reliability)	Step structure	Item fit	Comments
SSEE #1 (12 items)	1.01; ceiling effect	1.89 (.78)	5.95 (.97)	Rescored 11223; no inversions	#1 (get up early to exercise) misfits (1.52)	Delete #1 and recalibrate
SSEE #2 (11 items)	.92; targeting unchanged	1.90 (.78)	3.79 (.93)	No inversions	No misfit	Separation not improved; retain item
SF-36 MWB #1 (14 items)	.71; well targeted across steps	1.97 (.80)	7.25 (.98)	Slight inversion in one item (#4)	#6 (very nervous) misfits (1.60)	Delete #6 and recalibrate
SF-36 MWB #2 (13 items)	.72; targeting unchanged	1.97 (.79)	7.47 (.98)	No inversions	#7 (down in dumps) misfits slightly (1.35)	Separation not improved; retain item
SF-36 PWB #1 (23 items)	.05; well targeted	2.06 (.81)	10.36 (.99)	No inversions	#20 (get sick easily) misfits slightly (1.32)	Delete #16 and #19 and recalibrate
SF-36 PWB #2 (21 items)	-.03; targeting unchanged	2.01 (.80)	10.00 (.99)	No inversions	#20 (get sick easily) and #17 (bodily pain) misfit (1.40 and 1.37)	Separation not improved; retain items