

ACCOMMODATING PAIN-FREE EXERCISE THERAPY FOR PERIPHERAL  
ARTERIAL DISEASE

By

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Abstract of Thesis Presented to the Graduate School  
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ACCOMMODATING PAIN-FREE EXERCISE THERAPY FOR PERIPHERAL  
ARTERIAL DISEASE

By

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Chair: Christine E. Stopka-Boyd  
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The purpose of this study was to determine the effects of the accommodating pain-free (APF) walking exercise therapy program on exercise performance in patients with intermittent claudication (IC) due to peripheral arterial disease (PAD). The procedures of the study consisted of examining the improvements in walking performance before, during and after the implementation of the APF walking exercise therapy program. Group A (n = 28) participated in the program for two to nine weeks, group B (n = 30) participated in the program for 10-14 weeks, and group C (n = 26) participated in the program for 15-94 weeks. An average of the dependent variables from pretest to midpoint to post-test was calculated. The research design used was a pretest post-test randomized group design for three testing sessions. The dependent variable was exercise performance. The independent variable was the APF walking exercise therapy. Measurements taken include walking distance, walking duration, and walking rate. The protocol included the following: blood pressure and heart rate measurements taken before

and after walking, hold-relax proprioceptive neuromuscular facilitation stretching before and after walking, walking continually on a treadmill for 30 to 50 minutes below the participant's individualized walking pain threshold, and a recording on the participant's training log of total time and total distance walked. The statistical program SPSS 12.0 was used to analyze the data and examine changes in the pretest, midpoint, and post-test walking performance variables using a repeated measures design (ANOVA) with an alpha level of .05 to determine statistical significance. If there was a significant F-value, the Tukey Post Hoc Test (TPHT) was used to determine further significance between the groups. All data are presented as mean, standard deviation and percent improvement. The participants in Group A increased the amount of distance, duration, and rate walked from pretest to post-test by 80% ( $p < .001$ ), 27% ( $p < .001$ ), and 37% ( $p < .001$ ) respectively. The TPHT found a significant difference between the post-test and pretest and between the midpoint and pretest. The participants in Group B increased the amount of distance, duration, and rate walked from pretest to post-test by 122% ( $p < .001$ ), 56% ( $p < .001$ ), and 43% ( $p < .001$ ) respectively. The TPHT found a significant difference between the pretest and post-test and pretest and midpoint variables of both the distance and duration variables. The TPHT further revealed that rate was significant from post-test to midpoint, post-test to pretest, and midpoint to pretest. The participants in Group C increased the amount of distance, duration, and rate walked from pretest to post-test by 26% ( $p = .002$ ), 22% ( $p = .002$ ), and 5% ( $p = .541$ ) respectively. The TPHT found a significant difference between the midpoint and pretest data of both the distance and duration variables. To achieve the best results in distance, duration, and rate improvements, a program of 10-14 weeks is the optimal length.

## CHAPTER 1 INTRODUCTION

The purpose of this study was to determine the effects of the accommodating pain-free walking exercise therapy program on exercise performance in patients with intermittent claudication (IC) due to peripheral arterial disease (PAD). The null hypothesis of this study was that the exercise program will not have an effect on exercise performance. The alternative hypothesis of this study was that the exercise program will have an effect on exercise performance. It is hypothesized that improvements in exercise performance will occur and hopefully reduce cardiovascular morbidity and mortality based on a review of the literature.

### **Definition of Terms**

The following terms will be used frequently throughout the text, which are defined as follows:

**Accommodating pain-free (APF)** refers to the exercise therapy protocol used in this study. The belief held by researchers is that symptoms of peripheral arterial disease (PAD) can be relieved by simply slowing down the walking speed at an individualized level.

**High-intensity exercise** refers to walking on a treadmill at 80% maximum workload.

**Intermittent claudication (IC)** refers to the symptom often felt by patients with PAD. It is essentially pain in the legs upon exertion.

**Low-intensity exercise** refers to walking on a treadmill at 40% maximum workload.

**Near-maximal pain** refers to walking on a treadmill to near-maximal pain tolerance, resting until pain subsides, then resume walking.

**Peripheral arterial disease (PAD)** refers to a disease that causes the peripheral arteries to become occluded and restrict blood flow.

### **Literature Review**

The Centers for Disease Control (2005b) found that in 2002 there were 93,000 discharges of patients from hospitals in the United States listing peripheral arterial disease (PAD) as their first-listed diagnosis. PAD consists of occlusions in the peripheral arteries of the legs and it affects approximately 8 million to 10 million people in the United States (Criqui, 2001; Stewart, Hiatt, Regensteiner, and Hirsch, 2002). PAD does not directly cause mortality but it is a manifestation of coronary and cerebrovascular disease which do cause mortality (Fuster, Moreno, Fayad, Corti, and Badimon, 2005b). PAD is more specifically defined as a manifestation of systemic atherothrombosis (Hiatt, 2004). Systemic atherothrombosis is an arterial disease involving the intima (innermost coat of an organ consisting of an endothelial layer backed by connective tissue and elastic tissue) of large and medium sized arteries such as the carotid, aorta, coronary, and peripheral (Fuster, Moreno, Fayad, Corti, and Badimon, 2005a). The manifestation of this disease is defined as plaque build-up due to the following components: “1) connective tissue extracellular matrix, including collagen, proteoglycans, and fibronectin elastic fibers; 2) crystalline cholesterol, cholesteryl esters, and phospholipids; 3) cells such as monocyte-derived macrophages, T-lymphocytes, and smooth-muscle cells; and 4) thrombotic material with platelets and fibrin deposition” (Fuster et al., 2005a, p. 937).

Hiatt (2004) clearly explained how to identify PAD by taking blood pressure measurements in the ankles. A Doppler ultrasound device is used to obtain the systolic blood pressures in the posterior tibial and dorsalis pedis vessels in the ankles and the brachial pressure in the arm. The value is a ratio of ankle pressure to arm pressure. Values of  $< 0.90$  are indicative of PAD. In other words, when the blood pressure in the ankle is lower than the blood pressure in the arm, this indicates an occlusion in the peripheral arteries.

Intermittent claudication (IC) is the earliest and most frequent presenting symptom of PAD that causes pain in the legs upon exertion (Ouriel, 2001). The pain is a result of ischemic conditions occurring due to low amounts of blood supply to the peripheral arteries during movement. Thirty percent of patients with IC die within five years of the onset of symptoms (Carlson, Morlino, and Maiolino, 2003). Those with claudication have had myocardial infarction or stroke in 20% to 30% of cases and coronary disease in 50% to 70% of cases (Fuster et al., 2005b). In the United States, an estimated 1.3 million elderly individuals will develop IC every two years for the next 50 years (Kakkos, Geroulakos, and Nicolaides, 2005). IC is the most common new problem referred to vascular surgeons (Cheetham et al., 2004; Chong, Golledge, Greenhalgh, and Davies, 2000).

Methods of managing IC include: lifestyle modifications, medications, surgery, and exercise. Lifestyle modifications can include, but are not limited to, smoking cessation (Hiatt, 2004), diet modification, and weight loss. Medications can include, but are not limited to, aspirin (anti-platelet therapy), statins (lipid lowering agents) (Kakkos et al., 2005; Cheetham et al., 2004; Pasupathy, Naseem, and Homer-Vanniasinkam, 2005;

Hiatt, 2004), anti-hypertension, diabetic therapy (Cheetham et al., 2004; Hiatt, 2004), and propionyl-L-carnitine (Hiatt, 2004). Surgeries can include, but are not limited to, bypass and percutaneous transluminal angioplasty (PTA) (Krankenber, Sorge, Zeller, and Tubler, 2005). Due to the underlying atherothrombosis that accompanies IC, many patients are not candidates for surgery because the surgery may present further complications.

Exercises can include, but are not limited to, treadmill walking at an accommodating pain-free intensity (Barak, 2004; Boyd et al., 1984; Marburger, 1992; Martinez et al., 2005, Martinez, Stopka, and Stradley, 2006; Stopka et al., 1998), low and high accommodating intensities (Slordahl et al., 2004; Gardner, Montgomery, Flinn, and Katzel, 2005) and non-accommodating high intensities (Gardner and Poehlman, 1995). Heel raises and cycle ergometers have been used as methods of exercise (Ng, Hollingsworth, Luery, Kumana, and Chaloner, 2005), as well as resistance training.

### **Exercise**

Exercise is a common treatment of IC and the effects have been studied for decades. Exercise is considered one of the most effective interventions available for the treatment of IC (Carlson et al., 2003; Treat-Jacobson and Walsh, 2003). Several mechanisms are involved in this process: 1) peripheral blood flow redistribution, 2) inhibition of the progression of atherosclerosis, 3) favorable hematologic alterations 4) metabolic changes, 5) changes in muscle cell cytology and morphology, and 6) an increased pain threshold (Carlson et al.; Remijnse-Tamerius, Duprez, De Buyzere, Oeseburg, and Clement, 1999; Tan, De Cossart, and Edwards, 2000). Walking is the preferred mode of exercise and improves the symptoms of claudication in several ways (Ekroth, Dahllof, Gundeval, Holm, and Schersten, 1978; Foley, 1957; Larsen and

Lassen, 1966; Skinner and Strandness, 1967; Spronk, Dolman, Beolhouwer, Veen, and den Hoed, 2003).

### **Near-Maximal Pain**

As a result of extensive literature searches performed on PubMed and Science Direct databases using PAD and exercise as search words, it appears that the near-maximal pain method is the most widely used walking exercise therapy to date. The belief held by many researchers and other medical professionals is that symptoms of IC can be relieved by rest. Since the pain felt when walking is caused by an inadequate blood supply to the muscles during exercise, it is relieved when activity ceases (Treat-Jacobson et al., 2003). Therefore the walking therapy used by physicians and researchers calls for the patients to walk to near-maximal pain tolerance, rest until pain subsides, and then resume walking (Carlson et al., 2003; Gardner and Poehlman, 1995; Hiatt, Regensteiner, Hargarten, Wolfel, and Brass, 1990; Hiatt, Wolfel, Meier, and Regensteiner, 1994; Izquierdo-Porrera, Gardner, Powell, and Katzel, 2000; Lundgren, Dahllof, Schersten, and Bylund-Fellensiu, 1989; Mannarino, Pasqualino, Menna, Maragoni, and Orlandi, 1989; Santilli, Rodnick, and Santilli, 1996).

Exercise therapy used by Izquierdo-Porrera et al. (2000) required patients to walk at 2 mph until their pain reached a level 3 on a 0 to 4 pain scale (0 = no pain, 1 = onset of pain, 2 = moderate pain, 3 = intense pain, and 4 = maximal pain), after which they rested. Five minutes of cycling on a stationary bicycle were used as warm-up and cool down in each session. It is important to note that the American College of Sports Medicine (ACSM) recommends the use of a maximal pain method as the only exercise therapy for the treatment of IC (Mahler, Froelicher, Miller, and York, 1995).

### **Accommodating Pain-Free (APF) Walking Exercise Therapy**

Accommodating pain-free (APF) walking exercise therapy for IC has recently been introduced as an alternative method for walking exercise therapy (Martinez et al., 2006). The belief held by researchers and other medical professionals is that symptoms of IC can be relieved by simply slowing down the participant's walking speed. Many authors suspect that exercise beyond the pain threshold might worsen blood flow or that ischemia might induce the inflammation-mediated progression of atherosclerosis (Carlon et al., 2003; Tisi and Shearman, 1998; Turton et al., 1998).

Those who use the accommodating pain-free method believe that further stress on the arteries through a near-maximal pain walking therapy may only exacerbate other underlying conditions such as cardiovascular events. For example, Carlon et al. (2003) used the near-maximal pain therapy and excluded one patient because of their onset of heart failure during the 10th exercise session. But the objective to involve oxidative tissue through continuous aerobic training, plus the logic of more motivation and less risky training has allowed for the emergence of an alternative training method.

This method, which was used in this study, calls for the patients to walk below their maximal pain tolerance, slow down their walking when pain is barely felt, and then increase their walking speed when the pain is no longer felt (Barak, 2004; Boyd et al., 1984; Marburger, 1992; Martinez et al., 2005; Stopka et al., 1998).

Specifically, the exercise therapy used by Martinez et al. (2005) required patients to walk continuously on a treadmill at a comfortable speed until their legs reached an uncomfortable level of 0.5 on a 0 to 4 pain scale (0 = no symptoms, 0.5 = tiredness, heaviness or tightness in legs without pain, 1 = tightness with definite, but mild pain, 2 = starting to hurt with moderate, but distractible pain, 3 = definitely hurts with

severe, nondistractible pain, and 4 = must stop now with excruciating, unbearable pain) after which they slowed down but did not stop walking. The patients were instructed to walk as fast as possible without pain. When the patients felt pain they were instructed to slow down their walking speed on the treadmill until they no longer felt pain. Once the patients' pain had diminished they were instructed to increase their walking speed, again. This process was repeated throughout the exercise session, comfortable training speeds after the slower recovery walking, typically reach speeds higher than what had just elicited the pain response.

### **Accommodating High and Low Intensity Training**

Recent studies by Gardner et al. (2005) and Slordahl et al. (2004) have investigated low-intensity versus high-intensity walking therapy. Gardner et al. defined low-intensity as 40% of the participant's maximal workload while high-intensity was defined as 80% of the participant's maximal workload. The therapy Gardner et al. used remains unclear if an accommodating approach was used during exercise sessions. However, Slordahl et al. defined low-intensity and high-intensity exactly the same as the previous Gardner et al. example, but did clearly use an accommodating approach to the exercise sessions, "since VO<sub>2</sub> peak and work economy adapt to training, the work load had to be adjusted during the training period to maintain the relative intensity level" (p. 246). But overall, these methods seem very similar to the near-maximal pain therapy discussed above.

### **Pathophysiology**

The interaction between the muscles and their much needed blood supply is very specific. Factors such as muscle phenotype, muscle metabolic demands, arterial thrombus formation, and arterial platelet activation are all very important factors in the

pathophysiology of the PAD. Understanding the pathophysiology behind PAD allows researchers to relate improved fitness to other factors such as improved muscular efficiency/oxygen use unlike the opinion of Ng et al. (2005) who believed that the pathophysiology in improved fitness needed to remain a separate issue.

Askew et al. (2005) found that muscle phenotype is altered when patients with PAD are compared with non-PAD controls. Specifically patients with PAD have a lower amount of type I muscle fibers. Type I muscle fibers are classified as endurance fibers; they are fatigue resistant and are found to be in great demand during marathons for example. Unfortunately what patients with PAD have been shown to have are high amounts of type II fibers. Type II fibers are used for a burst of energy such as a 100 meter track race. Type II fibers lead to fatigue and ultimately pain if used for a prolonged period of time. This finding explains why a person with IC feels pain when walking.

Hiatt (2004) stated that blood flow can't meet the metabolic demand of the muscles in patients with IC. He stated that an increase in the level of acylcarnitine in blood plasma of claudicants would indicate a metabolic disruption. Acyl-coenzyme A (CoA) is an intermediate used in the Krebs's cycle for complete oxidation. An accumulation of acyl-CoA would indicate incomplete oxidation or incomplete utilization. Hiatt determined that a supplement of propionyl-L-carnitine would aid in the treatment of IC by supplying needed nutrients to satisfy the metabolic demand of the muscles.

Killewich, Macko, Montgomery, Wiley, and Gardner (2004) stated that "progression of atherosclerosis is also associated with thrombus formation" (p. 741) which in turn reduces endogenous fibrinolysis. Fibrinolysis is "the system by which the body lyses excess or inappropriately formed thrombus" (p. 741). Killewich et al.

determined that patients with PAD have impaired fibrinolytic activity but exercise training reduced these impairments. Specifically exercise can increase tissue plasminogen activator activity (tPA) and decrease plasminogen activator inhibitor-1 activity (PAI-1) which will in turn allow the body to lyse the thrombus formation and essentially reduce the plaque build up in the peripheral arteries.

Pasupathy et al. (2004) stated that “exercise appears to induce an inflammatory response in patients with claudication” (p. 50). High levels of platelet-leucocyte aggregation (PLA) and platelet-neutrophil aggregation (PNA) may contribute to morbidity and mortality in patients with PAD. The authors determined that levels of PLA and PNA are increased after exercise in patients with claudication but diminished when a warm-up was used. A warm-up was shown to delay claudication pain and therefore improve the overall exercise capacity of the patients in the study. Clearly, further study comparing low intensity training (eg. APF) to the currently recommended high intensity (eg. Near-maximal pain) training on the inflammatory response is indicated.

### **Purpose**

The purpose of this study was to determine the effects of the accommodating pain-free (APF) walking exercise therapy program on exercise performance in patients with intermittent claudication (IC) due to peripheral arterial disease (PAD). The null hypothesis of this study was that the exercise program will not have an effect on exercise performance. The alternative hypothesis of this study was that the exercise program will have an effect on exercise performance. It is hypothesized that improvements in exercise performance will occur and hopefully reduce cardiovascular morbidity and mortality based on a review of the literature.

## CHAPTER 2 MATERIALS AND METHODS

### **Principal Investigator**

The principal investigator (P.I.) for this study has accumulated over 2400 hours working with a variety of aspects concerning the accommodating pain-free (APF) walking exercise therapy program. The P.I. began her involvement in 2003 when the program was implemented at Fit for Life Fitness Center, Inc. From that point on, the P.I. has been involved with patient training, volunteer training, data compilation, data analysis, and submission of written and oral reports about the program. The P.I. was personally involved with at least 20 of the participants in this study and the rest of the data was collected by the research supervisor. It is important to note that this study is a branch of a larger study that has been conducted for 25 years by the same research supervisor.

### **Participants and Setting**

#### **Participants**

All participants were referred from Gainesville, FL and Charlottesville, VA area vascular surgeons and were screened for heart disease and found to have a present history of peripheral arterial disease (PAD) with symptoms of intermittent claudication (IC). The participants were recruited between 1980 and 2005 (1980-2003; research supervisor's data and 2003-2005; P.I.'s data). Table 1 provides the general characteristics of the study population.

The protocols for this study were approved by the Institutional Review Board at the University of Florida and the University of Virginia to protect the rights and welfare of the human participants involved. The participants were counseled on their rights as well as potential risks and benefits of the program, prior to signing an informed consent form.

Table 1. General characteristics of the study population (n = 84)

	M	SD
Age (years)	68.73	9.19
Diabetes (%)	27.4	
Female (%)	34.5	
Heart Disease (%)	41.70	
Hypercholesterol (%)	19	
Hypertension (%)	47.6	
Smoker (%)	12	
Stroke (%)	7	
Weeks in program	17	17

### Instruments

The instruments used in the study consisted of the following:

**Treadmills:** in the following fitness centers: Fit for Life Fitness Center, Inc., Gainesville, FL and Living Well at the University of Florida, Gainesville, FL. Treadmills at a University of Virginia research lab were also used. The treadmill speed began at 0.1 mph and increased in increments of 0.1 mph to a maximum speed of 12 mph.

**Blood pressure equipment:** standing, calibrated, manual aneroid manometer. The blood pressure was measured in a seated position on the left upper arm with the palm of the hand facing up.

**Heart rate:** to determine heart rate, the manual radial method was employed. The heart rate was measured in a seated position on the left forearm just below the left wrist. A 10-s pulse count was performed and the digit outcome was multiplied by 6 to determine the participant's heart rate.

### **Exercise Settings**

The APF walking exercise therapy program took place at Fit for Life Fitness Center, Inc., Gainesville, FL, Living Well at the University of Florida, Gainesville, FL, and at the Applied Physiology Laboratory in the Center for Physical Fitness at the University of Virginia.

### **Procedures**

The procedures of the study consisted of examining the improvement in walking performance before, during and after the implementation of the APF walking exercise therapy program. Group A (n = 28) participated in the program for two to nine weeks, group B (n = 30) participated in the program for 10-14 weeks, and group C (n = 26) participated in the program for 15-94 weeks.

The participants were notified by their physicians about the study. On the very first day of the treatment program, the participants were oriented on the treatment program goals and the rationales were carefully explained. Written copies of the goals and rationale were given to the participants for their records (see Appendix A). The participants then completed the Claudication Questionnaire to assess and document the nature of their pain (see Appendix B). The participants also completed a Medical History Questionnaire from the therapy facility to evaluate the safety of the participants' involvement in an exercise program (see Appendix C). Further demographic information was also obtained for administrative purposes (see Appendix D). Finally, if the

participants were still interested in joining the exercise program, they were instructed to read and sign the Informed Consent form (see Appendix E). The participants kept a signed Informed Consent form for their records and a signed Informed Consent form was kept in their files at the therapy facility.

Upon completion of the treatment orientation, the first exercise session was conducted. It was made very clear that the program once started could be discontinued by the participants at any time and that the program was free of charge for the first six weeks of treatment. Following the first six weeks of treatment, the participants were asked to become a member of Fit for Life Fitness Center, Inc. or pay a guest fee to continue with the accommodating pain-free walking exercise therapy program. The participants were not asked to become members at the other therapy facilities.

### **Treatment Protocol**

The treatment protocol used in this study was the APF Walking Exercise Therapy for PAD where the IC symptoms can be relieved by simply slowing down the participant's walking speed (Martinez et al., 2006).

At the beginning of each treatment session blood pressure and heart rate measurements were conducted. Immediately before walking on the treadmill, the participants actively participated in a series of therapeutic stretches with the contraction enhancing hold-relax method of proprioceptive neuromuscular facilitation (PNF) (see Appendix F). The purpose of the therapeutic stretches was to help relax the muscles and prevent injury from the treadmill regimen, as well as to treat any pre-existing muscular imbalances, hypertonias, etc.

The participants walked on a treadmill immediately after stretching. The participants began and ended with a warm-up and cool down phase respectively. Each

phase lasted approximately 7 minutes. The warm-up and cool down phase consisted of walking at a slow rate when compared to the participant's "normal speed." After a warm up, the speed of the treadmill was increased by increments of 0.1 mph or 0.2 mph in 5 to 7 minute intervals. The participants found an optimal speed of the treadmill and stayed at that speed for 10-15 minutes. When IC pain was felt by the participants to a degree of 0.5 to 1 on the IC Pain Scale (see Table 2) the speed of the treadmill was reduced by approximately 0.5 mph. The participants continued to walk with the reduced speed until the symptoms of IC pain diminished. Time until the pain diminished varied from 1 to 5 minutes. When the pain diminished, the treadmill speed gradually increased until the participants were walking 0.1 mph, or higher, than the original speed that elicited the IC symptoms. This speed adjustment protocol continued throughout the session to ensure that the participants were always walking at their optimal (aerobic, continuous) training rate (as fast as possible without pain). An accommodating intensity walking cool down ended the walking session. The walking sessions ranged from 30 to 50 minutes. The exercise sessions were conducted twice a week for approximately 60 minutes. The data obtained before, during, and after the exercise session were recorded on an exercise training log (see Appendix G).

### **Measures**

The measure used in the study consisted of the following:

1. Pretest: Average of first and second session
2. Midpoint: Average of first and second midpoint session
3. Post-test: Average of next to last and last session
4. Walking rate (mi/hr): total distance / total duration
5. Percent improvement:  $(\text{post exercise value} - \text{pre exercise value}) / \text{pre exercise value} \times 100$

## **Research Design**

Observations were obtained during each treatment meeting of the participants. An average of the dependent variables from pretest to midpoint to post-test was calculated. The research design used was a pretest post-test randomized group design for three testing sessions.

### **Variables**

The purpose of this study was to determine the effects of the accommodating pain-free walking exercise therapy program on exercise performance in patients with IC due to PAD. To investigate this question, EP (exercise performance) served as the dependent variable and was measured on an interval/ratio scale. The APF walking exercise therapy served as the independent variable and was measured on a nominal/ordinal scale.

### **The EP Dependent Variables (Exercise Performance)**

To examine the changes throughout the treatment program the following EP variables were analyzed:

**Walking distance:** recorded directly from the treadmill's screen at the end of the exercise.

**Walking duration:** recorded directly from the treadmill's screen at the end of the exercise session.

**Walking rate:** was calculated using the data obtained from the previous two variables.

### **Independent Variable**

The independent variable used in the study consisted of the APF Walking Exercise Therapy program (Martinez et al., 2006).

### **Data Analysis**

The general characteristics of the study population (see Table 1) were generated from Epi Info Version 3.3.2. Epi Info is a computer program used by epidemiologists and other public health and medical professionals to rapidly develop questionnaires, customize the data entry process, and enter and analyze data (Centers for Disease Control, 2005a)

The statistical program SPSS 12.0 was used to analyze the data and examine changes in the pretest, midpoint, and post-test walking performance variables using a repeated measures design (ANOVA) with an alpha level of 0.05 to determine statistical significance. If there was a significant F-value, the Tukey Post Hoc Test was used to determine further significance between the groups. Repeated measures ANOVA was used due to the following assumptions: the means were acquired with random selection, the data was normally distributed, the sample means and sample standard deviations were known, the population standard deviations and means were not known, the dependent variable was on an interval/ratio scale, and the independent variable was on a nominal/ordinal scale.  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there will be a difference between improvements in exercise performance and the APF exercise therapy program. All data are presented as mean, standard deviation and percent improvement.

Table 2. Intermittent claudication (IC) pain scale

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0	<b>NO SYMPTOMS</b>
0.5	<b>TIREDNESS, HEAVINESS OR TIGHTNESS IN LEGS</b> without pain
1	<b>TIGHTNESS</b> with definite, but mild pain
2	<b>STARTING TO HURT</b> with moderate, but distractible pain
3	<b>DEFINITELY HURTS</b> with severe, nondistractible pain
4	<b>MUST STOP NOW</b> with excruciating, unbearable pain

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Note: From Stopka et al., 1998

## CHAPTER 3 RESULTS

### **Group A**

Group A (n = 28) participated in the program for 2 to 9 weeks.

#### **Total Distance Walked**

Table 3 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ .  $F$  was equal to 30.45, therefore the  $F$ -value is greater than the critical region,  $30.45 \geq 3.17$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the accommodating pain-free (APF) exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 4 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = .15$ . The mean difference of the post-test and pretest was greater than the  $T$ -value,  $.47 > .15$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the  $T$ -value,  $.37 > .15$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance

and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $.1 < .15$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_o: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 5 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest distance was .59 miles while the mean midpoint distance was .96 miles, and the mean post-test distance was 1.06 miles. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest distance and the midpoint and pretest distance was significant.

### **Total Duration Walked**

Table 6 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ . F was equal to 15.34, therefore the F-value is greater than the critical region,  $15.34 \geq 3.17$ . The null hypothesis was rejected,  $H_o: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 7 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = 4.42$ . The mean difference of the post-test and pretest was greater than the T-value,  $9.78 > 4.42$ , reject  $H_o: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest

was greater than the T-value,  $7.16 > 4.42$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $2.62 < 4.42$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 8 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest duration was 25.95 minutes while the mean midpoint duration was 33.11 minutes, and the mean post-test duration was 35.73 minutes. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest duration and the midpoint and pretest duration was significant.

### **Total Walking Rate**

Table 9 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ . F was equal to 14.64, therefore the F-value is greater than the critical region,  $14.64 \geq 3.17$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 10 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = .27$ . The mean difference of the post-test and pretest was greater than

the T-value,  $.48 > .27$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the T-value,  $.33 > .27$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $.15 < .27$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 11 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest rate was 1.31 mi/hr while the mean midpoint rate was 1.64 mi/hr, and the mean post-test rate was 1.8 mi/hr. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest rate and the midpoint and pretest rate was significant.

### **Group B**

Group B ( $n = 30$ ) participated in the program for 10 to 14 weeks.

#### **Total Distance Walked**

Table 12 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ .  $F$  was equal to 34.32, therefore the  $F$ -value is greater than the critical region,  $34.32 \geq 3.17$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between

improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 13 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = .2$ . The mean difference of the post-test and pretest was greater than the T-value,  $.62 > .2$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the T-value,  $.56 > .2$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $.06 < .2$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 14 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest distance was .51 miles while the mean midpoint distance was 1.07 miles, and the mean post-test distance was 1.13 miles. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest distance and the midpoint and pretest distance was significant.

### **Total Duration Walked**

Table 15 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ .  $F$  was equal to 25.91, therefore the  $F$ -value is greater than the critical region,  $25.91 \geq 3.17$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 16 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = 4.99$ . The mean difference of the post-test and pretest was greater than the  $T$ -value,  $11.14 > 4.99$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the  $T$ -value,  $14.09 > 4.99$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the  $T$ -value,  $-2.95 < 4.99$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 17 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest duration was 19.73 minutes while the mean

midpoint duration was 33.82 minutes, and the mean post-test duration was 30.87 minutes. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest duration and the midpoint and pretest duration was significant.

### **Total Walking Rate**

Table 18 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.17$  and the critical region (C.R.) was  $|F| \geq 3.17$ .  $F$  was equal to 26.53, therefore the  $F$ -value is greater than the critical region,  $26.53 \geq 3.17$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 19 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = .22$ . The mean difference of the post-test and pretest was greater than the  $T$ -value,  $.64 > .22$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the  $T$ -value,  $.36 > .22$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was greater than the  $T$ -value,  $.28 > .22$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy

program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 20 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest rate was 1.48 mi/hr while the mean midpoint rate was 1.84 mi/hr, and the mean post-test rate was 2.12 mi/hr. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the post-test and pretest rate and the midpoint and pretest rate and the post-test and midpoint rate was significant.

### **Group C**

Group C ( $n = 26$ ) participated in the program for 15 to 94 weeks.

#### **Total Distance Walked**

Table 21 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.18$  and the critical region (C.R.) was  $|F| \geq 3.18$ .  $F$  was equal to 7.4, therefore the  $F$ -value is greater than the critical region,  $7.4 \geq 3.18$ . The null hypothesis was rejected,  $H_o: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 22 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = .22$ . The mean difference of the post-test and pretest was less than the  $T$ -value,  $.19 < .22$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_o: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest

was greater than the T-value,  $.35 > .22$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $-.16 < .22$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 23 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest distance was .72 miles while the mean midpoint distance was 1.07 miles, and the mean post-test distance was .91 miles. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the midpoint and pretest distance was significant.

### **Total Duration Walked**

Table 24 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.18$  and the critical region (C.R.) was  $|F| \geq 3.18$ . F was equal to 6.9, therefore the F-value is greater than the critical region,  $6.9 \geq 3.18$ . The null hypothesis was rejected,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The alternative hypothesis was assumed,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program.

Table 25 provides a summary of the Tukey Post Hoc Test. The Tukey Post Hoc Test found that  $T = 5.72$ . The mean difference of the post-test and pretest was less than the T-value,  $5.1 < 5.72$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between

improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the midpoint and pretest was greater than the T-value,  $8.74 > 5.72$ , reject  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The mean difference of the post-test and midpoint was less than the T-value,  $-3.64 < 5.72$ , reject  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. Assume  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 26 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest duration was 22.82 minutes while the mean midpoint duration was 31.56 minutes, and the mean post-test duration was 27.92 minutes. The repeated measures ANOVA and Tukey Post Hoc Test found that the difference between the midpoint and pretest duration was significant.

### **Total Walking Rate**

Table 27 provides a summary of the repeated measures ANOVA test. The critical value (C.V.) was  $F = 3.18$  and the critical region (C.R.) was  $|F| \geq 3.18$ . F was equal to .62, therefore the F-value is less than the critical region,  $.62 < 3.18$ . The alternative hypothesis was rejected,  $H_a: \mu_1 \neq \mu_2 \neq \mu_3$ ; there is a difference between improvements in exercise performance and the APF exercise therapy program. The null hypothesis was assumed,  $H_0: \mu_1 = \mu_2 = \mu_3$ ; there is no difference between improvements in exercise performance and the APF exercise therapy program.

Table 28 provides a summary of the pretest, midpoint, and post-test means and standard deviations. The mean pretest rate was 1.8 mi/hr while the mean midpoint rate was 1.92 mi/hr, and the mean post-test rate was 1.89 mi/hr. The repeated measures ANOVA test found that the difference between the post-test, midpoint, and pretest rate was not significant.

Table 3. Summary ANOVA for differences in pretest, midpoint, and post-test distance (miles) markers in the APF walking exercise therapy for PAD. Group A

Source	SS	df	MS	F
Treat	3.42	2	1.71	30.45*
Within	17.23	81	0.21	
Between Subjects	14.21	27	0.53	
Error	3.03	54	0.06	
Total	20.65	83		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 4. Ordered mean differences on the effects of the APF exercise walking therapy for PAD on group A distance (miles) performance using a Tukey Post Hoc Test

Group Means (distance walked)			
Post-test	Midpoint	Pretest	Mean Diff
1.06	0.96		0.1
1.06		0.59	0.47*
	0.96	0.59	0.37*

\* $p < .05$ ;  $T(.05) = .15$

Table 5. Group A's mean and standard deviation of distance (miles) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	0.59	0.96	1.06
SD	0.35	0.53	0.49

Table 6. Summary ANOVA for differences in pretest, midpoint, and post-test duration (minutes) markers in the APF walking exercise therapy for PAD. Group A

Source	SS	df	MS	F
Treat	1436	2	718	15.34*
Within	8305	81	102	
Between Subjects	5776	27	214	
Error	2529	54	46.84	
Total	9741	83		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 7. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on duration (minutes) performance using a Tukey Post Hoc Test. Group A

Group Means (duration walked)			
Post-test	Midpoint	Pretest	Mean Diff
35.73	33.11		2.62
35.73		25.95	9.78*
	33.11	25.95	7.16*

\* $p < .05$ ;  $T(.05) = 4.42$

Table 8. Group A's mean and standard deviation of duration (minutes) walked From pretest, midpoint, to post-test.

	Pre	MP	Post
M	25.95	33.11	35.73
SD	8	10.56	11.49

Table 9. Summary ANOVA for differences in pretest, midpoint, and post-test rate (mi/hr) markers in the APF walking exercise therapy for PAD. Group A

Source	SS	df	MS	F
Treat	3.46	2	1.73	14.64*
Within	26	81	0.33	
Between Subjects	20	27	0.75	
Error	6.38	54	0.19	
Total	29.46	83		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 10. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on group A rate (mi/hr) performance using a Tukey Post Hoc Test

Group Means (walking rate)			
Post-test	Midpoint	Pretest	Mean Diff
1.79	1.64		0.15
1.79		1.31	0.48*
	1.64	1.31	0.33*

\* $p < .05$ ;  $T(.05) = .27$

Table 11. Group A's mean and standard deviation of rate (mi/hr) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	1.31	1.64	1.8
SD	0.55	0.6	0.57

Table 12. Summary ANOVA for differences in pretest, midpoint, post-test distance (miles) markers in the APF walking exercise therapy for PAD. Group B

Source	SS	df	MS	F
Treat	7.08	2	3.54	34.32*
Within	21.94	87	0.25	
Between Subjects	15.95	29	0.55	
Error	5.98	58	0.1	
Total	29.02	89		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 13. Ordered mean differences on the effects APF walking exercise therapy for PAD on group B distance (miles) performance using a Tukey Post Hoc Test

Group Means (walking distance)			
Post-test	Midpoint	Pretest	Mean Diff
1.13	1.07		0.06
1.13		0.51	0.62*
	1.07	0.51	0.56*

\* $p < .05$ ;  $T(.05) = .2$

Table 14. Group B's mean and standard deviation of distance (miles) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	0.51	1.07	1.13
SD	0.31	0.55	0.6

Table 15. Summary ANOVA for differences in pretest, midpoint, and post-test duration (minutes) markers in the APF walking exercise therapy for PAD. Group B

Source	SS	df	MS	F
Treat	3310	2	1655	25.91*
Within	9654	87	110	
Between Subjects	5949.56	29	205	
Error	3705	58	63.89	
Total	12964	89		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 16. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on group B duration (minutes) performance using a Tukey Post Hoc Test

Group Means (walking duration)				
	Post-test	Midpoint	Pretest	Mean Diff
	30.87	33.82		-2.95
	30.87		19.73	11.14*
		33.82	19.73	14.09*

\* $p < .05$ ;  $T(.05) = 4.99$

Table 17. Group B's mean and standard deviation of duration (minutes) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	19.73	33.82	30.87
SD	7.61	11.89	11.56

Table 18. Summary ANOVA for differences in pretest, midpoint, and post-test rate (mi/hr) markers in the APF walking exercise therapy for PAD. Group B

Source	SS	df	MS	F
Treat	6.09	2	3.04	26.53*
Within	33.78	87	0.39	
Between Subjects	27	29	0.94	
Error	6.66	58	0.12	
Total	39.87	89		

\* $p < .05$ ;  $F(.05) = 3.17$

Table 19. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on group B rate (mi/hr) performance using a Tukey Post Hoc Test

Group Means (walking rate)			
Post-test	Midpoint	Pretest	Mean Diff
2.12	1.84		0.28*
2.12		1.48	0.64*
	1.84	1.48	0.36*

\* $p < .05$ ;  $T(.05) = .22$

Table 20. Group B's mean and standard deviation of rate (mi/hr) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	19.73	33.82	30.87
SD	7.61	11.89	11.56

Table 21. Summary ANOVA for differences in pretest, midpoint, and post-test distance (miles) markers in the APF walking exercise therapy for PAD. Group C

Source	SS	df	MS	F
Treat	1.59	2	0.79	7.4*
Within	23.33	75	0.31	
Between Subjects	17.97	25	0.72	
Error	5.37	50	0.11	
Total	24.92	77		

\* $p < .05$ ;  $F(.05) = 3.18$

Table 22. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on group C distance (miles) performance using a Tukey Post Hoc Test

Group Means (distance walked)			
Post-test	Midpoint	Pretest	Mean Diff
0.91	1.07		-0.16
0.91		0.72	0.19
	1.07	0.72	0.35*

\* $p < .05$ ;  $T(.05) = .22$

Table 23. Group C's mean and standard deviation of distance (miles) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	0.72	1.07	0.91
SD	0.53	0.58	0.56

Table 24. Summary ANOVA for differences in pretest, midpoint, and post-test duration (minutes) markers in the APF walking exercise therapy for PAD. Group C

Source	SS	df	MS	F
Treat	1002	2	501	6.9*
Within	10609	75	141	
Between Subjects	6976	25	279	
Error	3632	50	72.66	
Total	11611	77		

\* $p < .05$ ;  $F(.05) = 3.18$

Table 25. Ordered mean differences on the effects of the APF walking exercise therapy for PAD on group C duration (minutes) performance using a Tukey Post Hoc Test

Group Means (minutes walked)			
Post-test	Midpoint	Pretest	Mean Diff
27.92	31.56		-3.64
27.92		22.82	5.1
	31.56	22.82	8.74*

\* $p < .05$ ;  $T(.05) = 5.72$

Table 26. Group C's mean and standard deviation of duration walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	22.82	31.56	27.92
SD	10.07	11.44	13.87

Table 27. Summary ANOVA for differences in pretest, midpoint, and post-test rate (mi/hr) markers in the APF walking exercise therapy for PAD. Group C

Source	SS	df	MS	F
Treat	0.22	2	0.11	0.62
Within	36.83	75	0.49	
Between Subjects	28	25	1.13	
Error	8.67	50	0.17	
Total	37.05	77		

$p > .05$ ;  $F(.05) = 3.18$

Table 28. Group C's mean and standard deviation of rate (mi/hr) walked from pretest, midpoint, to post-test.

	Pre	MP	Post
M	1.8	1.92	1.89
SD	0.75	0.72	0.62

## CHAPTER 4 DISCUSSION

The alternative hypothesis of this study was that the accommodating pain-free (APF) walking exercise therapy for peripheral arterial disease (PAD) would have an effect on exercise performance in patients with intermittent claudication (IC) due to PAD. The results indicate that the walking program did indeed have an effect on exercise performance.

### **Group A**

The participants increased the amount of distance, duration, and rate walked from pretest to post-test by 80% ( $p < .001$ ), 27% ( $p < .001$ ), and 37% ( $p < .001$ ) respectively. The Tukey Post Hoc Test found a significant difference between the post-test and pretest and between the midpoint and pretest. A goal of this therapy program is to increase the participants' distance, duration, and rate from their first session to their last session, so it is expected that the findings are significant from pretest to post-test. Also, significance was found between the pretest and midpoint which implies that for this group of participants their exercise performance is improving significantly by the midpoint of their therapy.

The program length for this group of participants was 2 to 9 weeks. Therefore, a program that has a similar time span could feel confident that the length is optimal and positive results can be ascertained as soon as the midpoint of the program.

### **Group B**

The participants increased the amount of distance, duration, and rate walked from pretest to post-test by 122% ( $p < .001$ ), 56% ( $p < .001$ ), and 43% ( $p < .001$ ) respectively. The Tukey Post Hoc Test found a significant difference between the pretest and post-test and pretest and midpoint variables of both the distance and duration variables. These findings indicate that once again the goal of increasing exercise performance from pretest to post-test was in fact met as well as increasing exercise performance from pretest to midpoint was met in accordance with Group A. The Tukey Post Hoc Test further revealed that rate was significant from post-test to midpoint, post-test to pretest, and midpoint to pretest.

It appears that a program length of 10-14 weeks is the most efficient length to produce significant rate results throughout the duration of the program. Group B's rate results are very positive. Recall that the population in this study is defined as elderly and one of their limitations other than walking with pain is that they walk too slow. Many of the patients reported to the P.I. under informal conditions that they would like to be able to walk with their grandchildren rather than feel as if they are holding the children back. Therefore, a person attending the program from 10-14 weeks could expect to increase their rate through the duration of the program.

### **Group C**

The participants increased the amount of distance, duration, and rate walked from pretest to post-test by 26% ( $p = .002$ ), 22% ( $p = .002$ ), and 5% ( $p = .541$ ) respectively. The Tukey Post Hoc Test found a significant difference between the midpoint and pretest data of both the distance and duration variables. The rate for this group was not found to be significant at all. This group participated in the program from

15-94 weeks. The data for this group can be misleading and can be misinterpreted. The reason for such a lack of improvement percentage and/or a lack of significance of the findings is simply due to the participants' maintenance of the program.

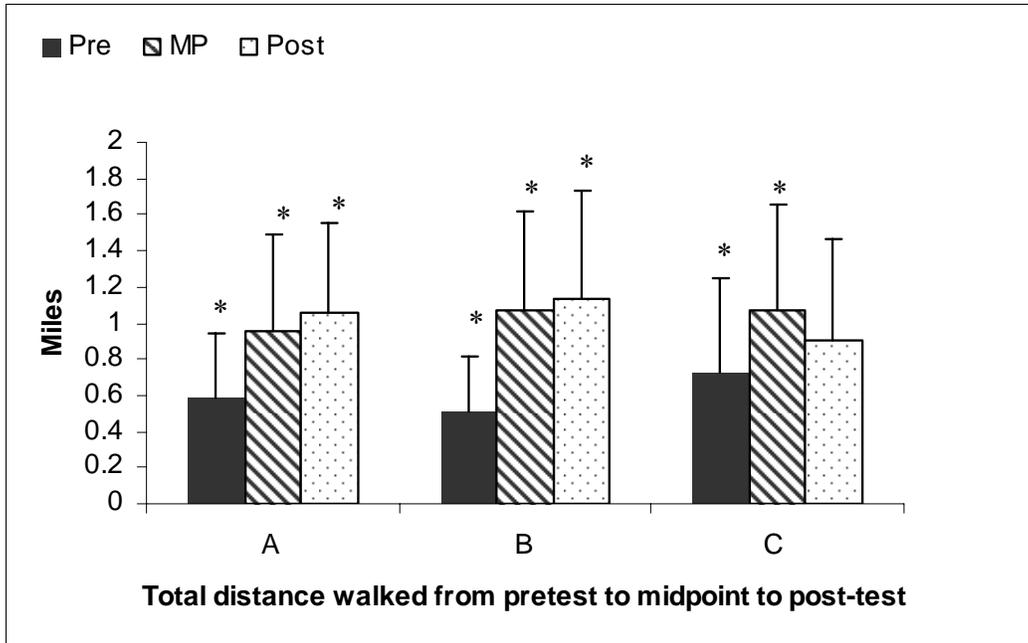
Once the participants have become accustomed to the program and have trained their minds and bodies to walk without pain they stop improving and start maintaining their new level of exercise. Leisure athletes maintain their exercise levels, they generally find a point that they can maintain week after week and stay there unless they are training for a race. So essentially group C represents the maintenance stage of the program. The participants may not be walking as fast as they were during their midpoint but they are still walking without pain and maintaining all of their improvements in exercise performance. Furthermore, if the participants were to continue to increase their rate, they would probably be jogging instead of walking.

### **Groups A, B, and C**

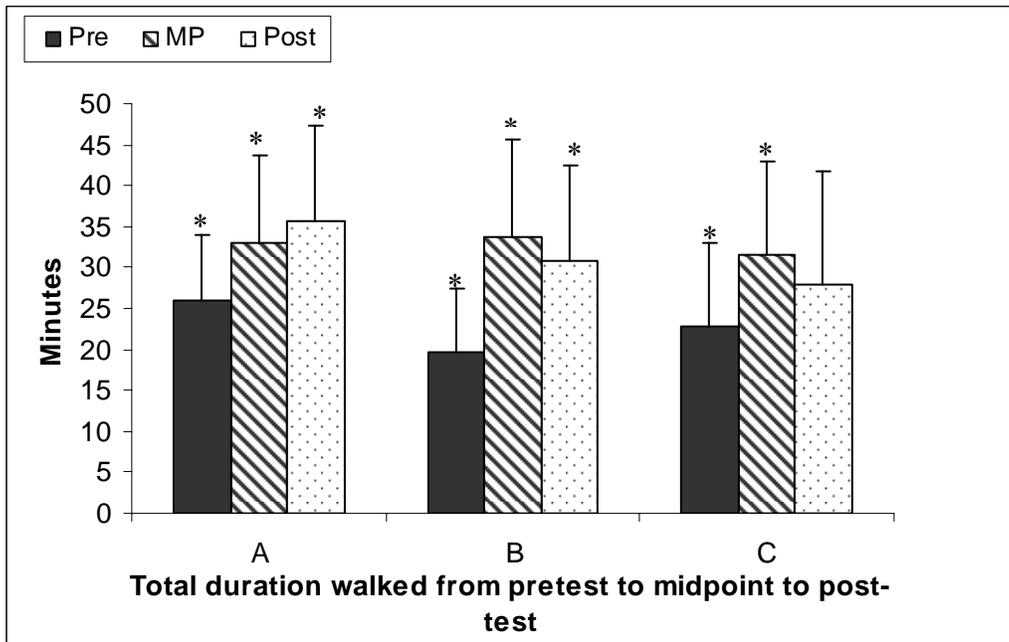
“The three goals of the APF exercise therapy are as follows: To have the participants walk farther, longer, and faster without pain to improve their functional ability and social interaction” (Martinez et al., 2006, p. 46).

Groups A, B, and C increased their distance walked by 80% ( $p < .001$ ), 122% ( $p < .001$ ), and 26% ( $p = .002$ ) respectively. Figure 1 contains the distance totals for each group from pretest to midpoint to post-test. The groups increased their duration walked by 27% ( $p < .001$ ), 56% ( $p < .001$ ), and 22% ( $p = .002$ ) respectively. Figure 2 contains the duration totals for each group from pretest to midpoint to post-test. Finally, the groups increased their rate walked by 37% ( $p < .001$ ), 43% ( $p < .001$ ), and 5% ( $p = .541$ ). Figure 3 contains the rate totals for each group from pretest to midpoint to post-test.

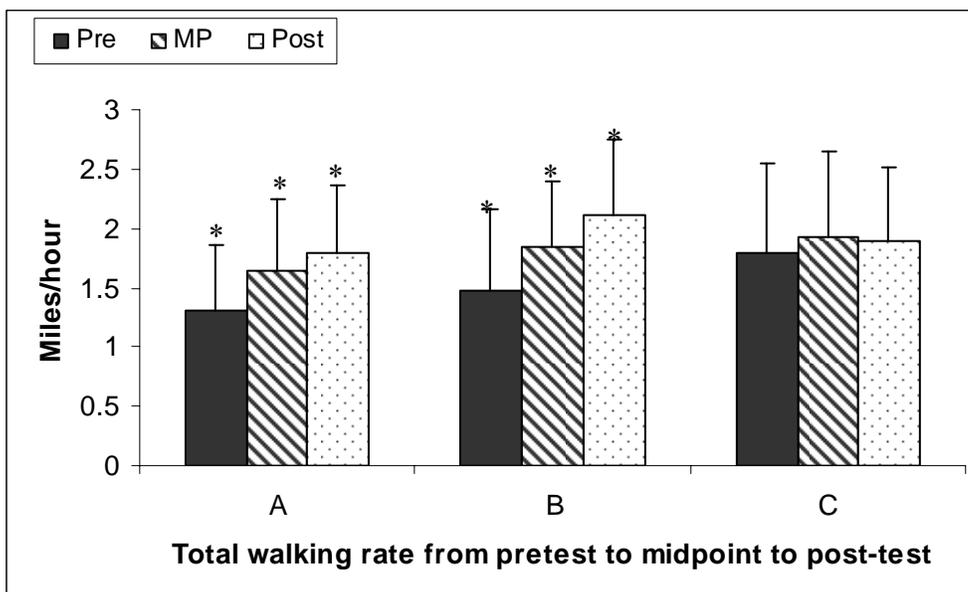
Clearly, in order to produce the most improvement in exercise performance the optimal program length is 10-14 weeks (Group B). To produce the second best improvement in exercise performance the optimal program length is 2-9 weeks (Group A). Once the participants have reached 15 weeks and beyond they should be considered in a maintenance stage and analyzed accordingly.



**Figure 1.** Effects of the APF walking exercise therapy for PAD on the amount of distance (miles) walked from pretest to midpoint to post-test. Group A represents program participation from 2-9 weeks. Group B represents participation from 10-14 weeks. Group C represents program participation from 15-94 weeks. \* =  $p < .05$ .



**Figure 2.** Effects of the APF walking exercise therapy for PAD on the amount of duration (minutes) walked from pretest to midpoint to post-test. Group A represents program participation from 2-9 weeks. Group B represents participation from 10-14 weeks. Group C represents program participation from 15-94 weeks. \* =  $p < .05$ .



**Figure 3.** Effects of the APF walking exercise therapy for PAD on the amount of velocity (mi/hr) walked from pretest to midpoint to post-test. Group A represents program participation from 2-9 weeks. Group B represents participation from 10-14 weeks. Group C represents program participation from 15-94 weeks. \* =  $p < .05$ .

Every group accomplished the first goal of the program which was to walk a farther distance than they had been walking before the start of the program. The patient population has difficulty walking around the grocery store without having to stop because of leg pain. So if this program can at least allow the individual to walk through the store without pain then the person has indeed increased their quality of life.

Further, the groups all accomplished the second and third goals of the program which is to walk longer and faster. Therefore, the program participants can not only walk through the grocery store without pain, they can also walk faster and longer to keep up with their grandchildren.

Martinez et al. (2006) reviewed three studies that used the APF protocol:

Study one (Pena, Stopka, and Todorovich, 2003) had 13 participants ( $n = 13$ ) with an average age of 71 years. The participants met for six weeks, twice a week and had an average of 10 visits. Study two (Barak, Stopka, Todorovich, and Siders, 2004) had 12 participants ( $n = 12$ ). The participants met for six weeks, twice a week. Study three (Martinez and Stopka, 2005) had 10 participants ( $n = 10$ ) with an average age of 73 years. The participants met for 8 weeks, twice a week. (p. 45)

The distance improvements were 148%, 105%, and 116% for studies 1, 2, & 3 respectively ( $p \leq .05$ ). The duration improvements were 94%, 56%, and 50% for studies 1, 2, & 3 respectively ( $p \leq .05$ ). The rate improvements were 34%, 41%, and 32% for studies 1, 2, & 3 respectively ( $p \leq .05$ ). The improvements found from Martinez et al. are consistent with the findings from this study.

Stopka et al. (1998) used the APF exercise therapy and found an improvement of 408.5% ( $p < .01$ ) in distance, an improvement of 163.3% ( $p < .01$ ) in duration, and an improvement of 94.4% in rate ( $p < .01$ ). The participants ( $n = 46$ ) attended therapy twice a week for 9 weeks. The findings in the Stopka et al. study are

clearly much higher than the findings from the present study. However, both studies had significant improvements in all the exercise performance factors and serve as further demonstration of the quality of the APF program for improving exercise performance.

Gardner and Poehlman (1995) determined through their meta-analysis that the optimal program for treating IC due to PAD is three sessions per week for six months walking at near-maximal pain. The results of their meta-analysis found that the distance would improve by 122% ( $p < .001$ ) if using their suggested program. All of the APF studies cited in this discussion have either been close to, been exactly the same (Group B of this study), or have usurped the expected 122% improvement of the near-maximal pain training as advocated by Gardner and Poehlman (1995). Clearly the findings from the APF protocol are consistent, or much stronger, with the findings from the Gardner and Poehlman (1995) protocol considering the APF protocol was done twice a week versus 3 times a week; the APF protocol was 10-14 weeks versus 6 months. The main difference is that the Gardner and Poehlman (1995) protocol elicits near-maximal pain while the APF protocol advocates pain-free walking at all times.

A new trend in the literature is taking place now. Studies are starting to look at the effects of low-intensity and high-intensity therapy (as noted in the introduction). Gardner et al. (2005) looked at the distance improvements of both a low and high intensity program. They found that after a 6 month program of 3 times a week that absolute distance improved by 61% ( $p < .01$ ) in the low-intensity group and by 63% ( $p < .01$ ) in the high-intensity group and initial distance improved by 109% ( $p < .01$ ) in both the low and high-intensity groups. The results of the APF studies used and cited in this

study are once again either slightly lower or greatly higher than the results of the Gardner et al. study.

### **Limitations**

First, repeated measures ANOVA was used based on a number of assumptions. One of the assumptions stated in the data analysis subsection of the methods and materials section was that the means were acquired with random selection. This assumption is false. The participants were chosen for the program based on their current diagnosis of IC and were not randomly selected. Further, the means were not acquired randomly; they were specifically chosen to satisfy the parameters of the research question. For example, the means for the pretest were chosen based on the participants' first and second session.

Second, many experimental researchers believe that studies done without a control group is invalid because control groups allow the researcher to compare. The study here did not use a control group. Literature reviews have shown that exercise for this population is imperative. This study would find it ethically wrong to exclude patients from the program because they are controls. Those very controls could experience further morbidity and/or mortality simply for serving as controls in our study. Therefore, this study understands the importance of including everyone. Furthermore, the research design used in this study is a valid, reliable, and established design and should not be given less respect because of the lack of a comparison group.

Third, the P.I. did not take all of the original data from each participant. The data were taken from over 20 years of program participants. However, the basic method for compiling the data over the years was essentially the same (and supervised by the same researcher). Therefore, the P.I. was able to successfully access and analyze the

needed data. Further, the volunteers involved with the program changed frequently over the years and that could have made an impact on the success of the participants.

Fourth, all of the participants volunteered to be a member of the program. Therefore, the participants may have already had a positive inclination towards exercise.

## CHAPTER 5 CONCLUSION AND FUTURE DIRECTIONS

### **Conclusion**

The above discussion clearly indicates that the accommodating pain-free (APF) protocol is at the very least comparable if not better than the near-maximal and low and high-intensity programs. The most important fact to remember when choosing between the different protocols is to determine whether or not the participants will want to feel pain while exercising. It has been evidenced by the P.I. in this study that elderly individuals prefer not to feel pain while exercising and will stay with the program longer when they enjoy themselves, as evidenced by the 26 participants in Group C who were involved with the program in this study for 15-94 weeks. Finally, to achieve the best results in distance, duration, and rate improvements, a program of 10-14 weeks is the optimal length and this has great relevance for third party reimbursement policies due to the briefer frequency and duration of sessions needed for improvement. It is hypothesized the improvements demonstrated in exercise performance will hopefully reduce the cardiovascular morbidity and mortality of all the participants based on a review of the literature.

### **Future Directions**

It is important to note that the pathophysiology stated in the introduction is based on near-maximal pain exercise therapy. Boyd et al., 1984 used the APF protocol and found that after 12 weeks, three times a week with eight participants that their distance increased by 138% and their duration increased 103%. Boyd et al., 1984 further

found significant increases in pulse volume amplitude in the left calf and ankle. The author suggested that further research be done to “examine the possibility of a large vessel response to low level training intensities” pg. 120. The study also found significant mean pre to post-training muscle blood flow increases.

To date, Boyd et al., 1984 is the only study found that has looked at the pathophysiology of the APF protocol. There is a clear need to do more studies that directly focus on the various pathophysiologies mentioned in the introduction as related to the APF protocol. Until then, APF researchers can only speculate the reasons for exercise performance while comparing to the established literature pathophysiology.

## APPENDIX A GOALS AND RATIONALE

### EXERCISE THERAPY FOR INTERMITTENT CLAUDICATION

Program Director: Dr. Christine Stopka

#### Definition of Intermittent Claudication

Intermittent Claudication is a term used to describe the development of pain in the legs due to poor circulation. The pain is usually caused by an imbalance between the body's demand of the muscles and their blood supply during exercise. The pain usually manifests itself in the calf, thigh, or hips during exercise.

#### Purpose

The purpose of this project is to improve functional capacity which includes improving distance, rate, and time of your exercise, decreasing your claudication symptoms during exercise and improving the efficiency of your working muscles so that more exercise can be done without pain. This will enable you to increase your ability to perform activities of daily living and pursue your interest with as little pain as possible.

#### The Program

The program consists of 9 to 12 weeks of **LOW INTENSITY, PAIN FREE** exercise on the treadmill. The secret is to walk as fast as possible **WITHOUT PAIN**; when pain begins, **SLOW DOWN** until it goes away. You will find you can walk faster, further and longer every week if you stick with this **PAIN FREE** training program. A flexibility and general conditioning program is included and an upper body strength training program can be included as well if so desired. All participants are asked to exercise two days a week for approximately 45 minutes.

#### Results

For our forty participants since 1991, results revealed a **402% improvement in pain free walking distance** after only nine weeks of training (twice per week). Mean walking duration and speed also increased 169% and 98% respectively. Our participants showed an average improvement of **over one mile of pain free walking!**

#### **IT REALLY WORKS!!**

**Our technique allows you to exercise continuously with very little or no pain.** People look forward to coming to a program that does not hurt them and helps improve their functional capacity.

For more information, please contact Dr. Stopka at (352) 392-0585 Ext. 259

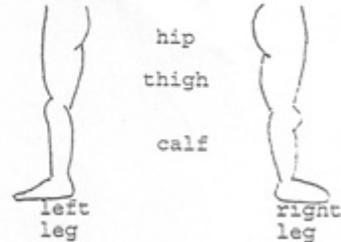
## APPENDIX B CLAUDICATION QUESTIONNAIRE

### Claudication Questionnaire

Please place a check ( ) by the appropriate answer below:

1. How many blocks can you walk on level ground before having to stop?  
(1 block=100 yards)  
 1 block,  2 blocks  3 blocks  4 blocks  no limit.  
     or less
2. Do you have cold feet? (For example, cold to the touch, toes turning white, etc.)  
 never  seldom  about half  most of  generally  
     the time                      the time                      always
3. Do you feel leg or hip pain? (eg, tightness, fatigue, cramping, muscle soreness)  
 Yes  No If you answered 'No' go to question #6 and continue.
4. What are you usually doing when you feel this pain?  
 lying  sitting  standing  exercising (walking, climbing stairs, etc.)
5. Please describe and circle that part of your leg where you feel the pain:

Description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



6. If an experimental exercise treatment program for the leg pain, cold feet, and restricted walking distance were available, would you want someone to contact you to describe this program? Yes  No
7. Do you have diabetes? Yes  No
8. Name \_\_\_\_\_ Age \_\_\_\_\_ Phone \_\_\_\_\_  
 Address \_\_\_\_\_  
 Name of physician who cares for you \_\_\_\_\_

Thank you!

## APPENDIX C MEDICAL HISTORY QUESTIONNAIRE

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Fit For Life, Inc. Medical History Questionnaire

First, we must decide if it is safe for you to participate in an exercise program, thus we need you to answer a few questions.

In completing the fitness assessment, there are potential risks to the client such as abnormal heart beats, fainting, dizziness, abnormal blood pressure, fatigue, muscle soreness, and other which all of the exercise specialists are aware of. Please feel free to ask a staff member or your physician if you have any questions regarding these or other potential risks. For safety reasons, please answer the following questions to the best of your knowledge so your fitness assessment is safe and enjoyable.

Please check the appropriate answer:

**Yes      No**

- ( ) ( ) 1. Has your physician ever said you have heart or cardiovascular disease?  
 ( ) ( ) 2. Do you ever have pain or pressure in your chest, shoulders, or arms?  
 ( ) ( ) 3. Do you have unusual shortness of breath upon exertion?  
 ( ) ( ) 4. Do you have a history of dizziness or fainting spells?  
 ( ) ( ) 5. Has your physician ever said you have high blood pressure?  
 ( ) ( ) 6. Are you 55 years of age or older?  
 ( ) ( ) 7. Are you currently taking any medications?

If YES, please list: \_\_\_\_\_

- ( ) ( ) 8. Have you ever had an exercise stress test?  
 If YES, please explain results: \_\_\_\_\_  
 ( ) ( ) 9. Have you an orthopedic condition that may be aggravated or made worse by exercise?  
 If YES, what type of injury/condition occurred and when?  
 \_\_\_\_\_

What kind of treatment did you receive? (i.e. surgery, physical therapy, medications)  
 \_\_\_\_\_

What symptoms/difficulties are you still experiencing due to the injury?  
 \_\_\_\_\_

What physician/P.T. recommended restrictions still remain?  
 \_\_\_\_\_

- ( ) ( ) 10. Are you pregnant? If YES, how many months? \_\_\_\_\_  
 ( ) ( ) 11. Do you know of any other physical condition that might be influence your ability to engage in a regular exercise program?  
 \_\_\_\_\_

If you answered NO to questions 1-6, you may be a good candidate to take the fitness assessment. However, the fact that you answered NO to all of the above questions is no guarantee that you will not have an abnormal response to exercise.

If you answered YES to any of questions 1-6, you may need a physician referral form filled out and signed by your doctor before participating in Fit For Life's fitness assessment and exercise program.

This form allows us to learn about your medical history. Please read carefully and answer to the best of your knowledge.

Mark (X) in the brackets which apply to your personal history:

- ( ) Anemia
- ( ) Arthritis
- ( ) Asthma
- ( ) Bronchitis
- ( ) Cancer
- ( ) Cirrhosis
- ( ) Diabetes
- ( ) Drug dependence
- ( ) Epilepsy
- ( ) Gout
- ( ) Heart disease \_\_\_\_\_
- ( ) High blood pressure
- ( ) Kidney disease
- ( ) Lung disease
- ( ) Nervous/emotional problems
- ( ) Overweight
- ( ) Phlebitis
- ( ) Stroke
- ( ) Surgery \_\_\_\_\_
- ( ) Thyroid problems
- ( ) Tuberculosis
- ( ) Ulcers
- ( ) Other injuries or disabilities

In the past 12 months have you had any of these symptoms:

- ( ) Pain or discomfort in chest
- ( ) Heart palpitations or flutter
- ( ) Unusual shortness of breath with exertion
- ( ) Pain in legs with exertion
- ( ) Poor tolerance for exercise
- ( ) Dizziness or fainting
- ( ) Cough on exertion
- ( ) Frequent back pain
- ( ) Swollen, stiff or painful joints
- ( ) Excessive fatigue
- ( ) Frequent headaches
- ( ) Broken bones
- ( ) Any other unusual discomfort?

Do you smoke? \_\_\_\_\_

If YES, how much per day? \_\_\_\_\_

If NO, have you ever? \_\_\_\_\_

If YES, how long ago? \_\_\_\_\_

Any orthopedic concerns? \_\_\_\_\_

What is your present weight? \_\_\_\_\_

What do you consider a good weight for yourself? \_\_\_\_\_

Have any of your close relatives (mother, father, siblings, grandparents) had any of the following? If so, please indicate the age of the relative when the condition developed.

	Siblings	Parents	Grandparents
( ) Heart or cardiovascular disease	_____	_____	_____
( ) High blood pressure	_____	_____	_____
( ) High cholesterol	_____	_____	_____
( ) Diabetes	_____	_____	_____
( ) Stroke	_____	_____	_____

I hereby state that I have answered the above questions to the best of my ability.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Exercise physiologist:

APPENDIX D  
DEMOGRAPHIC INFORMATION

Month/day/year: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

Patient name: \_\_\_\_\_

DOB: \_\_\_\_\_

Disability/illness: \_\_\_\_\_

Functional level: \_\_\_\_\_

Exercise prescription: \_\_\_\_\_

Contraindications: \_\_\_\_\_

Emergency information:

Doctor: \_\_\_\_\_

Allergies: \_\_\_\_\_

Meds: \_\_\_\_\_

Contact person: \_\_\_\_\_ Phone number: \_\_\_\_\_

## APPENDIX E INFORMED CONSENT

### INFORMED CONSENT FORM

To be a participant in the Special Physical Education Program of Exercise Activities you will first need to be referred here by a physician. (The physician referral form is attached). We will then formulate the most appropriate activity prescription for you related to safety as well as addressing your most needed areas for improvement such as strength, endurance, and/or flexibility. Activity examples include treadmill walking, stationary cycling, stairclimbing, and the use of various weight equipment. Sport and recreational opportunities such as swimming, tennis skills, croquet, bowling, shuffleboard, golf, and other activities, to name a few, sometimes available. We will do all we can to make any needed adaptations in equipment or program design to best meet your individual needs.

This special physical education program of activities is routine and medically approved and prescribed by your physician. No discomforts or risks are expected. You are not being kept from receiving any alternative procedures. The expected benefits include a noticeable increase in your walking ability, overall physical fitness levels, skill performance levels, and/or feelings of well being and confidence. The approximate duration of your participation is one to two semesters.

If information is reported from this study, your name will not be used (in order to protect your privacy). The research may be in the form of small group studies or single study case analyses. The purpose of this research is to learn and report activities undertaken that are especially beneficial to participants with various temporary or permanently disabling conditions. We will use this information to improve the our program services to you and others in the future.

If you have any questions at any time, please feel free to ask.\* You may feel free to participate in the program as long as you and your physician would like you to. You are free to withdraw your consent for participation at any time without any prejudice by any of the staff. There is no compensation. If you have any questions or concerns about your rights as a research participant you may contact the University of Florida Institutional Review Board (UFIRB) office at 98A Psychology Building, Box 112250, University of Florida, Gainesville, FL 32611-2250; phone/fax: (352)392-0433 (e-mail is IRB2@ufl.edu). If you are injured during this study, as a result of the negligence of the principal investigator, the University of Florida, the Board of Regents of the State of Florida and the State of Florida shall be liable only as provided by law. You should inform the principal investigator of this incident, then you may seek appropriate compensation for the injury by contacting the Insurance Coordinator at 316 Stadium, UF, (352) 392-2556.

I have read the procedure described above. I voluntarily agree to participate in this program and I have received a copy of this description.

Participant	Date	Witness	Date
Relationship if other than participant	Date	Principal Investigator's name	Date

\*Christine Stopka, Ph.D., ATC/L, CSCS, CAPE, MTAA  
Professor; Box 118210  
5A Florida Gym; University of Florida  
Gainesville, FL 32611 (352) 392-0583; ext 1259

Approved By  
University of Florida  
Institutional Review Board 02  
Protocol # 2001-U-958  
For Use Through 12/15/2005

## APPENDIX F THERAPEUTIC STRETCHES

### Calf Stretch

Place your hands on the wall and step back with the leg to be stretched. Start by placing only the ball of the foot on the ground and by keeping the knee straight. Push the heel of the stretching leg down to the ground, keeping the toes and foot pointing directly forward, until you feel the stretch in back of the leg. Hold 10 counts. Contract the muscle by pushing your toes and the ball of your foot into the ground without lifting the heel. Hold 5 counts. Relax the contraction, hold the leg in the same position, and slide the foot further behind you in order to gain more stretch. Hold 10 counts.



### Sit and Reach (Hamstrings and Lower Back Stretch)

Sit on the floor or ground with your legs in front of you, together, and with the knees flat on the ground. Bend forward and grasp the underside of your ankles or shins and pull yourself attempting to touch your nose to your knees. You will feel the stretch in the lower back and in the back of the thigh. Contract the muscles by trying to lean back with your hands preventing you from moving. Hold 5 counts. Relax and pull yourself down farther into the stretch. Hold 10 counts.



### Butterfly (Groin) Stretch

Sit on the floor or ground with the soles of your feet together. Grasp your ankles, pull your heels toward you, and place your elbows on your knees. Use your elbows to push your knees down toward the floor until you feel the stretch in the inner thigh. Hold 10 counts. Contract the muscles by pushing your knees into your elbow without letting the knees come closer together. Hold 5 counts. Relax and push the knees farther toward the floor. Hold 10 counts.



### Knee to Chest (Gluteal) Stretch

Lie flat on your back. Bend one knee and pull your leg toward your chest. Grasp the back of the thigh (hands between your thigh and calf) and pull the leg closer to your chest until you feel the stretch in the buttocks. Hold 10 counts. Contract the muscles by trying to move your leg away from your chest but with your hands preventing any movement. Hold 5 counts. Relax and pull your leg closer to your chest. Hold 10 counts.



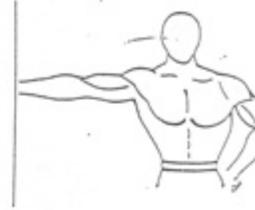
### Quadriceps Stretch

Place one hand on a wall and stand only on the opposite leg. Bend the other knee and grasp the ankle with the free hand. Bend the knee further back attempting to touch the heel to the buttocks. Try to hold the leg so the thigh hangs straight down toward the floor and do not lean forward. Hold 10 counts. Contract the muscle by trying to straighten the knee with the hands preventing any movement. Hold 5 counts. Relax and pull your heel closer to your buttocks. Hold 10 counts.



**Chest Stretch**

Stand arm's length away from the wall.  
 Raise one arm straight out so that your hand is flat against the wall.  
 Turn your body away from the wall until you feel a stretch in your chest. Be sure that the stretch is not in the wrist or forearm.  
 Hold 10 counts.  
 Contract the muscle by pressing into the wall but do not let your body twist back toward the wall. Hold 5 counts.  
 Relax and stretch further by twisting away from the wall. Hold 10 counts.

**Rear Deltoid Stretch**

Raise one arm in front of you and reach for the opposite shoulder.  
 With your other arm, grasp just behind the elbow of the first arm.  
 Pull the arm further across your body until you feel a stretch in the back of the shoulder. Hold 10 counts.  
 Contract the muscle by pushing your elbow into your hand as if you were moving the arm back to its natural position. Hold 5 counts.  
 Relax and pull your elbow farther into the stretch. Hold 10 counts.

**Triceps Stretch**

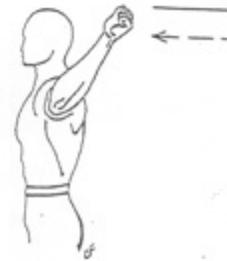
Raise one arm straight over your head.  
 Bend the elbow of the raised arm so your hand falls behind your head.  
 With your other arm, grasp your elbow and pull the arm closer to your head. Hold 10 counts.  
 Contract the muscle by pushing your elbow into your hand as if you were bringing the elbow away from the head. Hold 5 counts.  
 Relax and pull your elbow farther into the stretch. Hold 10 counts.

**External Rotator Cuff Stretch**

Place the back of your hand flat against the middle-lower portion of your back.  
 Reach as high up on your back as possible.  
 To assist you in stretching, hold a towel with both hands so that the towel is behind the opposite shoulder. Pull the towel up and across your back so that you feel stretch in the front of your shoulder. Hold 10 counts.  
 Contract the muscle by pressing the back of your hand into your back. Hold 5 counts.  
 Relax and bring your hand higher across your back. Hold 10 counts.

**Internal Rotator Cuff Stretch**

Stand in a doorway or next to a stationary object.  
 Bend your elbow so that your hand is flat against the object / wall and keep your elbow at your side.  
 Turn your body away from the wall/object until you feel a stretch in the front of your shoulder. Hold 10 counts.  
 Contract the muscle by pressing your hand into the wall but do not let your body twist back toward the object / wall. Hold 5 counts.  
 Relax and stretch further by twisting away from the wall again. Hold 10 counts.





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