THE EFFECTS OF A 10-WEEK EXERCISE INTERVENTION ON BODY MASS AND BODY COMPOSITION IN POSTPARTUM WOMEN

by

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ABSTRACT

The purpose of this study was to investigate the effects of a 10-week exercise intervention on changes in body mass and body composition in postpartum women. The sample included 15 women that were 6 weeks to 10 weeks postpartum. All participants had a single birth and an uncomplicated pregnancy. Body mass and skinfold measures were taken at pre- and post-test. In addition, a nutrition log was utilized to determine caloric intake throughout the exercise program. Dietary intake was recorded on one weekend day and two weekdays at pre-test, 5 weeks, and post-test. The exercise intervention consisted of 2 days a week of light strength training and walking or running, as well as 1 day of water exercise. Participants also walked or ran two times a week at home. A one-way MANOVA was conducted between the experimental and control groups on the linear combination of difference scores between pre- and post-tests on body mass and body fat percentage. Body mass was not statistically significant (p = .073) although there was a difference in body mass loss between control and experimental groups. However, the change in body fat was statistically different between groups (p = .002). These data indicate that interactive exercise interventions can be helpful for postpartum women. Research is sparse in this population and this study may serve as a pilot program to hopefully help future research with this population.

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CHAPTER I

INTRODUCTION

Pregnancy is a time when significant physiological changes occur in a woman's body. For some women, pregnancy may also represent the beginning of weight control issues (Rooney, Schauberger, & Mathiason, 2005). Furthermore, many obese women attribute their adult weight gain to pregnancy (Linne, Dye, Barkeling, & Rossner, 2003). Linne and Rossner (2003) stated that 73% of the females at their obesity clinic indicated pregnancy was a trigger for marked weight gain and the majority of the women gained more than 10 kg after each pregnancy. There are several factors that may be involved in the course of weight development after pregnancy (Linne et al.).

One of the strongest factors for retaining weight after pregnancy is the amount of weight gained during pregnancy (Linne et al., 2003). At least in the short term, high weight gain during pregnancy is associated with high weight retention after pregnancy (Linne et al.). Other factors that have been studied are smoking cessation, socioeconomic factors such as low income, and changes in activity leading to a more sedentary lifestyle after pregnancy (Linne et al.).

Excess weight gain during pregnancy and lifestyle changes postpartum are likely to be significant contributors to weight retention and obesity among women. Rooney and Schauberger (2002) measured weight change in 540 women during pregnancy and then 5 years to 10 years after delivery. They reported that women who lost their pregnancy weight by 6 months postpartum gained 2.4 kg in the following 8.5 years compared to an

8.3 kg gain in women who retained weight at 6 months. In addition, women with the smallest weight gain breastfed their infants for longer than 12 weeks or participated in aerobic exercise (Rooney & Schauberger). These data support the idea that the postpartum period is a good time for implementing an exercise and diet program if the goal is to minimize future weight gain. Even though exercise and diet may improve maternal health, their effect on infant growth and health during lactation must be considered (Pivarnik et al., 2006).

Although breastfeeding has been discussed as a factor that may help control postpartum weight development, there is surprisingly little research evidence (Linne & Rossner, 2003). In fact, according to Linne et al. (2003), there is no clear evidence that breastfeeding helps women lose more weight after pregnancy. Because some data have shown that a high frequency of breastfeeding is related to less weight retention, while other studies show the opposite, there is a clear need for additional work on this issue and how it relates to weight loss.

Women who plan subsequent pregnancy several years after their first pregnancy have no reason to assume that the weight gain during subsequent pregnancies will be higher than before (Linne & Rossner, 2003). Furthermore, women who had no problems losing weight after their first pregnancy should otherwise have no problems losing weight in subsequent pregnancies. However, Linne and Rossner did show that women who had increased considerably in weight (17.9 kg +/- 2.5 kg) during their first pregnancy or retained a substantial amount of weight (5.7 kg +/- 4.7 kg) postpartum are at some risk for similar weight problems with subsequent pregnancy.

In addition to the benefits exercise can have on a woman's weight and body composition, exercise may also help reduce postpartum depression. There is consistent evidence of improved mood with physical activity. Researchers have also suggested that exercise can be effective in preventing and treating mild to moderate depression and anxiety (Dunn, Trivedi, & O'Neil, 2001). Thus, the influence of physical activity during pregnancy on postpartum depressive symptoms could have significant clinical implications for preventing postpartum depression (Pivarnik et al., 2006). Recent evidence also suggested that a postpartum exercise intervention may be an effective means in reducing symptoms of depression (Armstrong & Edwards, 2003).

Besides the link to depressive symptoms, physical inactivity is also a risk factor for coronary artery disease (CAD), obesity, and type II diabetes, which are all on the rise (Pivarnik et al., 2006). Obesity and gestational diabetes mellitus (GDM) are closely linked, and the prevalence of GDM in obese women is 17% (Pivarnik et al.). Overweight women have a 1.8 - 6.5 times greater risk of developing GDM than normal weight women (Linne, 2004). The American Diabetes Association (2004) suggested that women without medical or obstetrical contraindications be encouraged to start or continue a program of moderate exercise as part of treatment for GDM. In addition, research has shown that the most physically active women have the lowest prevalence of GDM (Pivarnik et al.).

During the postpartum period there are many barriers that can also cause a woman to retain her pregnancy weight. Lack of time and lack of childcare can be a concern for postpartum women wanting to participate in an exercise program. Therefore, barriers such as these need to be taken into consideration when designing exercise programs for postpartum women.

The mode of exercise is also an important consideration when designing an exercise intervention. The American College of Sports Medicine (ACSM) exercise guidelines for adults who are obese includes non-weight bearing exercise, walking, swimming, and resistance training (1997).

Resistance training can help individuals lose weight and improve body composition when guidelines provided by the ACSM are followed (ACSM, 2006). ACSM recommendations for resistive training were incorporated into the current study and participants also had an opportunity to take part in water aerobics. The participants for the current study exercised five times a week. There were two sessions with the principal investigator that consisted of resistance training and cardiovascular endurance work. Additionally, two times a week participants walked or jogged at home. The last exercise session incorporated water aerobics. The frequency and duration of the training sessions were in accordance with the ACSM's updated Position Stand on weight loss and prevention of weight gain for adults which stated that overweight adults should increase their activity to approximately 45 minutes of exercise per day, which correlates to 200 minutes to 300 minutes per week (ACSM, 2006).

To date, there is little research conducted on water aerobics and postpartum women. However, water aerobics provides a great medium for exercise, especially with postpartum women. Water exercise provides components such as buoyancy, resistance, and hydrostatic pressure. The buoyancy can assist with balance and make the person working out feel lighter. Water also provides exercise without gravitational forces therefore; it is much easier on the joints. During pregnancy women develop a hormone-induced laxity and motility of joints, which causes an exaggerated elasticity of connective and collagen tissue. Even though this laxity is not permanent, water aerobics may provide a comfortable and ideal mode for exercise. In addition, hydrostatic pressure adds to the amount of resistance during exercise. Exercising in deep water adds greater resistance than shallow water. Therefore, the present investigation included deep water aqua jogging, in addition to shallow water resistance exercises.

In summary, exercise during postpartum may be an integral part of avoiding excess weight retention that could lead to health concerns. There is limited research on the potential benefits of exercise for postpartum women. However, postpartum seems to be a time that women should be exercising due to the positive benefits that can be achieved.

Purpose

The purpose of this investigation was to determine whether a 10-week exercise intervention would positively impact a postpartum woman's body mass and percentage of body fat.

Research Hypotheses

Following the exercise intervention, there would be a significant difference between the experimental group and the control group on the linear combination body mass and body fat. The following two nested hypotheses were also tested.

1. Following the exercise intervention, the experimental group had a greater decrease in body fat percentage than those in the control group.

2. Following the exercise intervention, the experimental group had a greater loss of body mass than those in the control group.

Definition of Terms

For the purpose of this study, terms that may be unfamiliar have been defined:

1. Nutrition log: Participants will keep a written journal on 2 weekdays and 1 weekend day three times during the study to track caloric intake.
2. Breastfeeding: For this study, breastfeeding was considered a mother nursing for at least 6 weeks.
3. Uncomplicated pregnancy: A mother who did not suffer from an incompetent cervix, preeclampsia, cardiac disease, or hypertension during pregnancy.

Basic Assumptions

The researcher made the following assumption:

1. It was assumed that all participants honestly self-reported information in the nutrition log and on the questionnaires.

Delimitations

1. Only postpartum women between the ages of 18 years and 40 years were included in the sample.
2. Only women who were 6 weeks to 10 weeks postpartum were included in the sample.
3. Only women who have not participated in an exercise regimen regularly 6 months prior to pregnancy were included in the sample.
4. Women in the control group will be told not to exercise during the 10-week intervention.

5. Only women with an uncomplicated pregnancy and single birth were included in the sample.

Significance of the Study

Postpartum can be a difficult time in a woman's life. There are many joys for the family, but it is also a period where there is a lot of transition and change for the family. Parents have a new schedule to keep which often involves less sleep and less time. Along with these life changes, there are also physiological changes. Some women struggle to lose the weight gained during pregnancy. An exercise program may be an excellent way of combating additional pregnancy weight. Exercise sessions also offer the new mother a break for herself and time to possibly bond with other women in the same situation.

Exercise interventions with postpartum women are sparse. There has been a greater focus on exercise during pregnancy. This investigation helped in gaining more knowledge about women during this significant time in their lives. This 10-week exercise intervention included light strength training and water aerobics which to our knowledge have not been researched. It is recognized that excess weight gain and obesity can contribute to heart disease and some forms of cancer. This study may aid in establishing guidelines for future exercise protocols including intensity, duration, and mode for postpartum women.

CHAPTER II

LITERATURE REVIEW

In 2005, there were over 4 million births in the United States by women 15 years to 44 years of age (Centers for Disease Control and Prevention [CDC], 2006). Pregnancy is associated with dramatic physiological changes including weight gain. Promoting exercise after pregnancy can assist in losing excess pregnancy weight and decreasing the risk of diseases such as obesity, heart disease, and some cancers. Exercise prescription guidelines during and following pregnancy have evolved significantly over the last 50 years with more research on exercise during pregnancy than postpartum. The physiological changes that take place during pregnancy will be explored in this chapter including specific changes that occur in the endocrine, gastrointestinal, integumentary, musculoskeletal, cardiovascular, and respiratory systems. In addition, the evolution of exercise prescription guidelines during and following pregnancy will be reviewed. Nutritional modifications with exercise, modes of monitoring exercise, and exercise intensity will also be explored. Furthermore, research concerning postpartum changes, weight gain, and exercise during pregnancy and postpartum will be reviewed. Lastly, barriers to exercise such as lack of childcare and lack of support and its effect on the new mother will be mentioned. The chapter ends with an overall summary and a review of the purpose of the study.

Physiological Changes during Pregnancy

Many physiological changes occur during the normal human gestation period of 265 days (Jensen & Bobak, 1985). The average weight gain is 12 kg at full term (Jensen & Bobak). The fetus may weigh approximately 3.5 kg and the uterus 1.0 kg. The breasts may gain an additional 1.5 kg. The placenta and fluids are about 3.3 kg and the increased maternal adiposity is approximately 2.5 kg. The following paragraphs contain a description of the physiologic changes in a pregnant female by each body system.

Endocrine System

Profound changes take place in the endocrine system that are essential for pregnancy maintenance, normal fetal growth, and postpartum recovery (Jensen & Bobak, 1985). Human chorionic gonadotrophin (HCG) is a hormone released by the placenta covering membranes of the embryo. This hormone supports the corpus luteum early in pregnancy and stimulates it to secrete estrogen and progesterone (Carola, Harley, & Noback, 1990). Prolactin is produced by the anterior pituitary and stimulates milk production in the mammary glands. Oxytocin is produced by the posterior pituitary and causes uterine contraction as well as milk ejection from the mammary glands. Estrogen and progesterone levels also increase during pregnancy. Their significance on physiological functions will be addressed by body system in the following sections.

Gastrointestinal System

During early pregnancy the appetite increases, nausea and vomiting may occur, and the absorption of nutrients is enhanced. The gastrointestinal system, like the endocrine system, adapts and changes relative to gestation. The gums in the mouth become hyperemic, spongy, and swollen. They tend to bleed easily due to the rising level of estrogen which increases vascularity and connective tissue proliferation (Carola et al., 1990). The elevated levels of HCG along with emotional factors or hypoglycemia may contribute to morning sickness, which can occur at any time of the day (Jensen & Bobak, 1985). The increased basal metabolism associated with pregnancy and secondary to the all day fetal and maternal body functions, predisposes women to a state of hypoglycemia, especially after a period of fasting, from the evening meal until breakfast (Jensen & Bobak). This type of morning nausea tends to disappear if a high-protein snack is consumed at bedtime. In 15% to 20% of pregnancies, a hiatal hernia may occur after the seventh or eighth month of pregnancy (Jensen & Bobak). Due to an increase in progesterone production, there is decreased tone of smooth muscles so there may be esophageal regurgitation. A second reaction in this system, due to an increase in progesterone, may also be an increase in water absorption from the colon leading to constipation (Jensen & Bobak).

Integumentary System

Alterations in hormonal balance and mechanical stretching are responsible for several changes in the integumentary system during pregnancy. The skin thickens and subdermal fat is increased (Carola et al., 1990). Hyperpigmentation develops and there is a notable increase in hair and nail growth in many women. Sweat and sebaceous gland activity are accelerated (Carola et al.). There is increased circulation and vasomotor activity. Cutaneous allergic responses are enhanced and vascular permeability is increased. There is a greater fragility of cutaneous elastic tissues, resulting in stretch marks (Jensen & Bobak, 1985). Alterations in hormonal balance and mechanical stretching are a major factor in elasticity changes of collagen tissue during pregnancy.

Musculoskeletal System

Along with the exaggerated elasticity of connective tissue and collagen tissue, the musculoskeletal system undergoes a unique transformation during pregnancy. The gradually changing body and increasing weight of the pregnant woman cause noticeable alterations in posture and walking. Abdominal distention, decreased abdominal muscle tone, and an increase in weight, especially in late pregnancy require a realignment of the spinal curvatures (McArdle, Katch, & Katch, 2001). The ligamentous and muscular structures of the middle and lower spine may be severely stressed. Approximately 50% of women experience some low back pain during pregnancy (Jensen & Bobak, 1985). Due to weight gain, alterations in gait, posture, balance and proprioception are all likely changes during pregnancy.

Cardiovascular System

Maternal adjustments to pregnancy involve extensive changes in the cardiovascular system. These adaptations serve to protect the woman's normal physiologic functioning; meeting the metabolic demands pregnancy imposes on her body, and providing for fetal development and growth needs (Jensen & Bobak, 1985). Slight cardiac hypertrophy is noted during pregnancy. This is probably secondary to an increase in blood volume and cardiac output (Jensen & Bobak). As early as 5 weeks, there is an increase in heart rate and stroke volume. By 12 weeks, cardiac output is 35% above pre-pregnancy levels and is even more amplified for women who exercise before pregnancy (Morris & Johnson, 2005). Blood volume increases 40% to 50% due to increases in aldosterone, and sodium and water retention. The increased level of progesterone causes a generalized relaxation of smooth muscle and arteriolar dilation, which results in vasodilation. This increased capacity of the vascular bed accommodates the increase in blood volume, while maintaining a normal blood pressure (McArdle et al., 2001).

Respiratory System

Similar to the cardiovascular system, the respiratory system adaptations during pregnancy occur to provide for maternal and fetal needs. Maternal oxygen requirements increase in response to the acceleration in metabolic rate and the need to add to tissue in the uterus and breasts. The fetus requires oxygen and a way to eliminate carbon dioxide. Respiratory rate increases by about two breaths a minute (Jensen & Bobak, 1985). However, a pregnant woman breathes deeper, increasing tidal volume. Functional residual capacity and residual volume are decreased because of elevation of the diaphragm. The increase in tidal volume and decrease in residual volume result in more efficient and more rapid exchange of lung gases in the alveoli and an increase in minute oxygen uptake (Jensen & Bobak). During pregnancy, changes in the respiratory center result in a lowered threshold for carbon dioxide. Progesterone and estrogen are presumed to be responsible for the increased sensitivity of the respiratory center (McArdle et al., 2001). It is evident that many systems of the body go through extensive adaptations in order for the mother to provide and care for the fetus. Considering the physiological changes that take place and the additional weight gained during pregnancy, more recently, exercise has been utilized throughout pregnancy and postpartum as a means to improve the health and quality of life for women. In addition, exercise during pregnancy and postpartum has become more accepted and prescription guidelines for exercise have evolved dramatically.

Pregnancy and Exercise in the Past and Present

In the past 50 years, there have been many changes in exercise recommendations in regards to pregnancy. In the 1950's, the American College of Obstetricians and Gynecologists' (ACOG) recommendations for activity during pregnancy were limited to walking only 1 mile per day, divided into multiple sessions. In 1985, the ACOG suggested that 15 minutes to 20 minutes of exercise limited to 3 days a week was safe during an uncomplicated pregnancy. Then, in 1994, recommendations from the ACOG became more open-ended, stating that women could continue mild to moderate exercise if they had an already established pre-pregnancy program. Most recently, in 2002, the ACOG announced that moderate exercise, 30 minutes or more per day, on most, if not all, days of the week was recommended for women with low-risk pregnancy. Also, sedentary women could start a new exercise program during pregnancy (Morris & Johnson, 2005).

The current recommendations are similar to recommendations for a healthy individual who is not pregnant. Today, it is estimated that 40% or more women in the United States exercise during pregnancy (McArdle et al., 2001). The ACOG's recommendation for pregnancy and postpartum is regular exercise, at least three times a week. In the absence of medical and obstetrical complications, 30 minutes to 40 minutes or more of moderate activity, on most, if not all days of the week is recommended. More recently, researchers have begun to consider the role of exercise as a means to prevent chronic disease for both mother and offspring (Pivarnik et al., 2006). Not only are there modifications made to exercise during pregnancy, but there are also nutritional modifications as well.

Nutritional Adaptations and Exercise

Nutritional intake should be modified by pregnant women, especially those who are exercising. The basal metabolic rate, when expressed as kilocalories per minute, is about 20% higher in pregnant women than in non-pregnant women (Jensen & Bobak, 1985). Pregnancy requires an additional 300 kcals per day to maintain metabolic homeostasis (Jensen & Bobak). Energy required for activity essential for ordinary living, as well as for planned exercise, is probably the most variable contributor to energy expenditure. While exercising, a pregnant woman must ensure an adequate diet; therefore, more than the additional 300 kcals are needed. The additional energy required for activity per kilogram of body weight is the same in pregnant and non-pregnant women to maintain weight (Jensen & Bobak).

Increased nutritional demands of lactation should also be considered. A fat storage of 2 kg or 3 kg during pregnancy provides the mother with a reservoir of 14,000 to 24,000 kcal for lactation needs (Jensen & Bobak, 1985). Typically, fat stores will be gradually utilized for the first 4 months to 6 months of lactation (Jensen & Bobak). However, without these stores, the nursing mother faces the difficult task of increasing food consumption 50% to be able to provide the 1,000 kcals required for production of 800 ml to 900 ml of milk (Jensen & Bobak).

Moreover, pregnant women who exercise should augment heat dissipation by adequate hydration, appropriate clothing, and optimal environmental surroundings during exercise. Lastly, many of the physiologic and morphologic changes of pregnancy persist 4 weeks to 6 weeks postpartum (Jensen & Bobak, 1985). Pregnancy exercise routines should be resumed gradually postpartum based on a woman's physical capability (ACSM, 2006).

Initiating Programs and Monitoring Exercise Intensity

There are various methods for monitoring exercise intensity during and after pregnancy. The PARmed-X for Pregnancy questionnaire is an example of a tool used to screen women interested in participating in physical activity during pregnancy (Davies, Wolfe, Mottola, & MacKinnon, 2003). This questionnaire supplies obstetric care providers with pertinent medical history and a recent patient activity profile. This questionnaire can help to provide women with practical prescriptions for participating in aerobic and strength-conditioning activities (Davies et al.). Other useful tools used to monitor exercise during pregnancy include modified heart rate target zones for aerobic exercise and Borg's rating of perceived exertion (Morgan & Borg, 1976). The modified heart rate target zone utilizes maternal age and beats per minute or beats every 10 seconds. The Borg scale is used often by exercise clinicians and a rating of 12 to 14 is appropriate for most pregnant women (ACSM, 2006). This would be the fairly light to somewhat hard range of perceived exertion. The previously mentioned monitors during pregnancy and exercise should be used for the well-being of mother and fetus. Safe and monitored exercise has been shown to provide many healthy benefits.

Benefits and Contraindications of Exercise during Pregnancy

Exercising during pregnancy may help the mother have a greater sense of well-being, increase energy, improve sleep, and assist with weight control. A decrease in back pain and enhanced muscular strength and muscular endurance have also been noted (Larsson & Lindqvist, 2005). Exercise may also lead to shorter labor and fewer obstetric interventions as well as improve glycemic control in gestational diabetes, especially in obese women (Larsson & Lindqvist).

Even though exercise has many positive outcomes, there are a few special considerations during pregnancy. Activities should be chosen that minimize loss of balance and fetal trauma. Ideal exercises may involve water immersion, weight support, and minimal center of gravity displacement. Exercise intensity and duration should not be increased during the third trimester to avoid conflicting maternal-fetal demands. As well as special considerations during exercise, there are activities that should be avoided during pregnancy.

Some activities that the pregnant mother should avoid are horseback riding, downhill skiing, ice hockey, gymnastics, and cycling. These activities involve a higher risk for falling and can put mother and fetus at risk. Scuba diving is also unsafe during pregnancy due to the hyperbaric stress. Bikrim yoga is also unsafe due to the hyperthermic environment. Similarly, hot tubs should be avoided. Lastly, martial arts that include sparring should be avoided due to risk of abdominal trauma.

Contraindications for exercising during pregnancy are preterm labor, preterm rupture of membrane, pregnancy-induced hypertension, incompetent cervix, persistent second to third trimester bleeding, and intrauterine growth retardation (Pivarnik et al., 2006). Uncontrolled Type 1 Diabetes, thyroid disease, or other serious cardiovascular, respiratory, or systemic disorders are also contraindications. Lastly, a growth restricted fetus and multiple gestations of triplets or higher may be contraindications for exercise during pregnancy (ACSM, 2006).

Maternal and Fetal Response to Exercise

Uterine blood flow, heat dissipation, fuel availability, future birth weight, and gestational age are all concerns in fetal response to exercise. As research has advanced, many concerns have lessened due to adaptations the body makes during exercise and pregnancy. Uterine blood flow to the fetus has been of great concern. During exercise, there is vasoconstriction causing a decreased blood flow to the uterus and an increased blood flow to skeletal muscle, heart, and skin in order to provide oxygen and nutrients for the increased work of exercise. Researchers have shown that there are compensatory mechanisms that help maintain fetal oxygenation (Morris & Johnson, 2005). There is a preferential shift of blood flow to the placenta and an increase in oxygen extraction (Morris & Johnson). Also, conditioning may lessen the exercise-induced decrease in uterine blood flow (Clapp, 2000).

Exercise induced hyperthermia or heat dissipation is another concern for an exercising mother. It has been found that most cases of exercise-induced hyperthermia are related to febrile illnesses and hot tub exposure (Morris & Johnson, 2005). However, intensity and duration of exercise may still be important factors. There are several physiologic mechanisms that may decrease thermal stress during exercise and ultimately protect the fetus (Morris & Johnson). An increase in weight during pregnancy also may help in heat dissipation because more heat needs to be generated in order to raise body temperature (Clapp, 1991).

Research regarding exercise, birth weight, and gestational age is limited. There are inconsistent data with regard to the effect maternal exercise has on birth weight. There are various authors reporting an increase, a decrease, and no difference in fetal birth weight using control groups (Clapp, 2000). In addition, data on the impact of exercise on maternal fitness, symptoms of pregnancy, maternal weight gain, and labor and delivery outcomes are varied and limited.

Current Research on Exercise during Pregnancy

Despite advances in knowledge regarding the physiology of exercise during pregnancy, there is still a general lack of consensus regarding the effect of exercise during pregnancy on pregnancy outcome (Sternfeld, Quesenberry, Eskenazi, & Newman, 1995). The few, relatively large-scale prospective, observational studies have had contradictory results (Sternfeld et al.). The overall results of a meta-analysis conducted by Lokey, Tran, Wells, Myers, and Tran (1991) indicated that a pregnant woman could exercise up to an average of three times per week for 43 minutes per session at a heart rate of 144 beats per minute without appearing to harm herself or her unborn child. However, more research is needed in which there is a greater variation in the exercise prescription, including the intensity, duration, and frequency to determine the safety of greater exercise stress (Lokey et al.).

In a study of 388 women participating in aerobic exercise during pregnancy, aerobic exercise at a level great enough to produce or maintain a physiological training effect did not adversely impact birth weight or other pregnancy outcomes (Sternfeld et al., 1995). Over the past decades, women have become physically more active in recreational and competitive sports. When they become pregnant, many athletes wish to continue light training while others want to perform hard exercise (Kardel, 2005). In Kardel's study, 41 healthy athletes who had performed exercise regularly prior to conception were followed from gestational week 17 until 12 weeks postpartum while they performed standardized exercise programs. The training program included strength training, aerobic interval training, and aerobic endurance training. Well-trained women benefited substantially from training at high volumes during an uncomplicated pregnancy, therefore facilitating a rapid return to competitive athletics and physically active lifestyles after pregnancy. In contrast, not all women are athletic and physically active before pregnancy. Many women live more sedentary lifestyles before and after pregnancy.

A randomized trial was conducted to evaluate the effects of aerobic training on submaximal cardiorespiratory capacity in overweight pregnant women. Santos et al. (2005) evaluated 132 overweight, but otherwise healthy volunteers. The participants' body mass index (BMI) was between 26 kg/m^2 and 31 kg/m^2. The intervention consisted of three 1 hour aerobic exercise sessions per week, while the control group received weekly relaxation and focus group discussions. At final testing, pregnant women allocated to the aerobic exercise program were approximately five times more likely to be classified as having a good or medium physical capacity than those in the control group (Santos et al.). A good or medium capacity was based on oxygen consumption value at the anaerobic threshold in an exercise test after intervention. The researchers concluded that aerobic training, when performed by overweight and predominantly sedentary women, significantly improved submaximal exercise capacity, reducing the negative effects of pregnancy upon aerobic capacity (Santos et al.). Pivarnik et al. (2006) stated that in their review of actual outcomes observed, concerns regarding maternal physical activity are not warranted, and most forms of exercise during pregnancy appear to provide some benefit rather than risk to the fetus. Exercise appears to be beneficial for women throughout pregnancy and also postpartum. Today, many women are starting to exercise during pregnancy and will continue to exercise postpartum. This study, however, excluded women who had been avid exercisers before and during pregnancy. Because of all of the new changes that occur to a woman following pregnancy, the postpartum period is an ideal time for an exercise regimen.

Postpartum Changes

The postpartum period is a time for tremendous change for a new mother. Not only is it a time for physical change, adapting to the new role as a mom, but it is also a time of vast emotional and physiological change. Therefore, this particular stage in a women's life provides the opportunity for multiple health promotion strategies and interventions (Levitt et al., 2004). A new mother's life can be chaotic with limited sleep. It is a period of juggling and balancing responsibilities and often times, this transition period is a time when a new mother is not always taking care of herself.

When examining the prevalence of physical inactivity by sex and age, women over the age of 25 years are at an increased risk for sedentary behavior (Cramp & Brawley, 2006). Childbearing and motherhood have been explored as one possible explanation for this increased risk (Cramp & Brawley). Due to the lack of exercise and physical activity, weight-retention is often a characteristic of postpartum women. Another possibility may be that, out of habit, women may still be consuming additional calories that were required during pregnancy.

Leermakers, Anglin, and Wing (1998) reported that there is a great degree of variability in the amount of weight retained after pregnancy. For example, 12% of a sample of 1,599 women retained 4 kg to 6 kg 10 months to 18 months postpartum, and

14% of the women retained greater than 6.4 kilograms (Keppel & Taffel, 1993). An excessive amount of postpartum weight retention may be a contributor to the development of obesity.

One postpartum population that is largely affected by weight retention is women with gestational diabetes mellitus (GDM). GDM is defined as a form of diabetes first diagnosed during pregnancy (American Diabetes Association, 2004). The prevalence of GDM in obese women is 17%, and overweight women have 1.8 - 6.5 times greater risk of developing GDM than normal weight women (Pivarnik et al., 2006). A sedentary lifestyle is a risk factor for developing GDM and thus, a common link between obesity and GDM is physical inactivity.

Another problem facing many postpartum women is depression. Postpartum depression (PPD) is a complex issue characterized by major changes in physical, social, and emotional health (Armstrong & Edwards, 2004). PPD affects 12% - 15% of childbearing women and appears to encompass a variety of conditions such as the "baby blues" and postnatal depression (Armstrong & Edwards, 2003). Physical exercise has been associated with improvements in mood, self-esteem, and reductions in depression and anxiety in postpartum women (North, Corth, McCullagh, & Vutran, 1990).

Exercise in the Postpartum Period

While some research has been conducted regarding the role of exercise during pregnancy, much less is known about the postpartum period (Beilock, Feltz, & Pivarnik, 2001). In addition, while many epidemiological studies report that average pregnancy related weight retention ranges from only 0.5 kg to 3.0 kg, 15% - 20% of women are at least 5 kg heavier at 6 months to 18 months postpartum than they were before pregnancy (Pivarnik et al., 2006).

Rooney and Schauberger (2002) examined 540 women that were observed through pregnancy and 6 months postpartum. The researchers wanted to examine factors that affected weight loss. Weight was then also recorded 5 years to 10 years later. Women who lost all pregnancy weight by 6 months postpartum gained 2.4 kg in the following 8.5 years compared to an 8.3 kg gain in women who did not. In addition, women who breastfed and women who participated in aerobic exercise also had significantly lower weight gains (Rooney & Schauberger). However, while exercise and caloric restriction may improve maternal health during lactation, their effect on milk volume and composition must be considered (Pivarnik et al., 2006).

Results from studies performed on breastfeeding women suggest that exercise improves aerobic fitness; however, exercise alone without caloric restriction does not promote weight loss (Pivarnik et al., 2006). Once lactation has been established, overweight women may restrict energy intake by 500 kcal a day to promote a weight loss of 0.5 kg a week without affecting milk volume and composition (Pivarnik et al.). Pivarnik and colleagues suggested that further research is needed in order to determine the most effective way to implement these lifestyle changes during the postpartum period.

Another longitudinal study by Rooney et al. (2005) on 484 women whose weight was recorded at their first prenatal visit, 6 months postpartum, and was available through medical record review at 4, 10, and 15 years later discovered that women who breastfed beyond 12 weeks and participated in postpartum aerobic exercise had a lower body mass index and weight gain 15 years later. Lastly, women who gained more than recommended, retained pregnancy weight at 6 months postpartum, breastfed for a short duration or not at all, did not participate in aerobic exercise, or were obese at pregnancy had the highest body mass index at follow-up (Rooney et al.).

Linne and Rossner (2003) conducted the Stockholm Pregnancy and Women's Nutrition study (SPAWN). Their findings indicated that women who were overweight before pregnancy did not have any higher risks of postpartum weight retention than normal weight women. In addition, weight gain during pregnancy and weight retention 1 year after delivery may be a predictor for the weight development in the second pregnancy (Linne & Rossner). Therefore, women who plan their subsequent pregnancy several years after their first pregnancy have no reason to assume that the weight development during subsequent pregnancies will be greater than before. On the other hand, women who increased in weight considerably during the first pregnancy or retained weight after delivery have a higher risk in subsequent pregnancies and should receive the appropriate advice and support through counseling (Linne & Rossner).

There are many factors that can contribute to weight retention postpartum. Eating and physical activity patterns may contribute to both excessive weight gain and postpartum retention (Thornton et al., 2006). Social support is another influential factor that may play a significant role in weight retention and become a barrier to exercise (Thornton et al.).

Barriers to Exercise

Support from other family members and childcare are important barriers to postpartum exercise. In a study conducted by Beilock et al. (2001), athletes, who are usually highly motivated individuals, demonstrated the need for increased social support in terms of both childcare and training encouragement following delivery. In a study on Latino women, Thornton et al. (2006) supported the premise that husbands and some female relatives were primary sources of emotional and informational support for weight, diet, and physical activity. In addition, absence of mothers, other female relatives, and friends to provide childcare, companionship for exercise, and advice about food were prominent barriers that limited women's ability to maintain healthy practices during and after pregnancy (Thornton et al.). For a new mother, finding time to exercise may be difficult, especially early postpartum. The primary investigator for the current investigation promoted exercise for women who are postpartum by allowing a flexible workout schedule and also provided babysitters whenever there was interest.

Overall Summary

There are many physiological adaptations that take place during and after pregnancy. In addition, it is evident that for some women, pregnancy may represent the advent of weight control issues. There are few times in a woman's life that she is encouraged to gain 25 pounds. However, maternal physical activity appears to provide more benefits than risks to mother and offspring, and may help in weight loss postpartum. Many researchers have concluded that more research is needed to gain a better understanding and insight on the postpartum woman. More interventions need to transpire involving different modes of exercise, sedentary woman, and woman at the extremes of reproductive age (Pivarnik et al., 2006). Therefore, the purpose of this study was to determine if a 10-week exercise intervention will assist in body mass reduction and decrease body fat composition in postpartum women.

CHAPTER III

METHODOLOGY

Participants

Women between 6 weeks and 10 weeks postpartum were recruited for this study. Participants for this study had an uncomplicated pregnancy. Participants' ages ranged from 20 years to 38 years of age and were recruited from the Murfreesboro, TN and Morgantown, WV areas. Recruiting locations included: obstetricians offices, Middle Tennessee Medical Center, Murfreesboro Health Department, local churches, and daycare centers. Participants were randomly assigned to either the experimental exercise group or the control group. Persons assigned to the control group had the option to participate in the exercise program following the 10-week intervention.

Instrumentation

Body mass and height. Body mass was measured in kilograms, without shoes and socks, to the nearest 0.1 kg. Body mass was taken at the same time of day for pre-test and post-test. Participants were also weighed without eating within 2 hours. Women wore shorts and a t-shirt for pre-test and post-test measurements. Body mass was taken on a digital scale (SECA model 770, Vogel & Halke, Hamburg, Germany). The same scale was used for all participants. Height was measured in centimeters, without shoes and socks, to the nearest 0.5 cm. Height was assessed using the same stadiometer (Invicta Plastics Limited, Leicester, England) for all participants.

Body composition. A calibrated Harpenden caliper (Creative Health Products, Ann Arbor, Michigan) was used to measure skinfold thickness to the nearest 0.2 millimeter on the right side of the body in serial fashion by the primary investigator. The skinfold sites used were: chest, subscapular, triceps, abdomen, midaxillary, suprailiac, and thigh. Body density was calculated using the Jackson and Pollock (1985) equation: (1.097- 0.00046971 (sum of seven skinfolds) + 0.00000056 (sum of seven skinfolds)^2 – 0.00012828 (age). Body density was then converted to percent body fat according to age and race (Heyward & Stolarczyk, 1996). The skinfold thickness was based on the average of two trials. A third measurement was taken if measurements at a particular site were not within 1 mm. The same pair of calipers was used for all participants.

Nutrition log. Participants kept a nutrition log of daily food intake three times over the course of the 10-week intervention. Each nutrition log included 2 week days and 1 weekend day. Participants also received handouts before the first nutrition log was due that explained how to measure portion sizes. The first log occurred the first week of the intervention. The second log was during the midway point at week five. Participants mailed or faxed the nutrition log to the principal investigator on week five if they were in the control group. The last nutrition log was completed at week 10 of the intervention. The nutrition logs were used to determine average daily caloric intake. The primary investigator used mypyramid.gov for caloric values on food.

Procedures

Approval was obtained from the Middle Tennessee State University's Institutional Review Board (see Appendixes A-D) and West Virginia University's (WVU) Institutional Review Board (see Appendix E). Participants that took part in exercise had to get approval from their obstetrician/gynecologist prior to the pre-test (see Appendix F). All participants were informed of the procedures of the study and signed an informed consent form. All forms and questionnaires, as well as anthropometric measurements, were completed in the University's Exercise Science Lab or Healthworks in Morgantown, West Virginia pre- and post-intervention.

Pre-test measures. The experimental and control groups had body mass, height, and body fat measured prior to the start of the 10-week exercise intervention. The first nutrition log was also completed at home at this time. For the control group, nutrition logs were mailed or electronically sent to the primary investigator.

Intervention. The experimental group participated in an exercise program that consisted of resistive training, water aerobics, and walking or running at a frequency of five times a week. There were two days that consisted of resistance training and a cardiovascular component of walking or running. These resistance training sessions occurred on Mondays and Fridays. Water aerobics was performed once a week on Wednesdays and included resistance and cardiovascular activities. In addition, the experimental group walked or ran at home for two additional days. Based upon data from past studies, it was decided that an intervention period of 10 weeks would be sufficient to observe changes in body mass and body composition (Dewey, Lovelady, Nommsen-Rivers, McCrory, & Lonnerdal, 1994).

Training sessions during the 10-week intervention were in group format and supervised by the principal investigator, who holds a Master of Science in Exercise Science, is a licensed and certified Athletic Trainer, a certified lifeguard, and is a certified American Red Cross CPR and First Aid instructor. Other assistants included exercise science majors at the University. Training sessions took place at the University or at Healthworks in Morgantown, West Virginia. The resistance training program utilized strength training machines and dumbbells, and included exercises to work each major muscle group (bicep curl, triceps extension, leg press, lunges, lat pull down, abdominal curls, military press, and bench press). All exercises were initially performed at a weight that could be lifted for two sets of 10-12 repetitions. Resistance was increased (based on the progressive resistance principle) as the repetitions became easier. Upper body exercises were increased in 2.5 pound increments for machines and 2 to 3 pound increments for free weights. The leg press was increased in 5 pound increments.

A cardiovascular component on the indoor track or outside, when weather permitted was also a component of the exercise intervention twice a week with the principal investigator following resistance training. Intensity of walking or running was monitored with FS1 Polar heart rate monitors (Polar Electro Oy, Kempele, Finland). Participants worked at a range between 60% and 80% of their age predicted maximal heart rate in accordance with ACSM guidelines (2006). Participants walked or ran for at least 20 minutes initially and increased in duration steadily as the program progressed. Duration increased to 40 minutes towards the end of the intervention by adding 5 minutes every 2 weeks.

Once a week, water aerobics was another mode of exercise within the intervention. It included both resistive and cardiovascular activity and lasted for a total of 60 minutes a session. The cardiovascular component was achieved by aqua jogging with buoyancy belts in the deep end of the pool. Duration was increased similar to that on land but with an increase of 2 minutes per week. The resistive training component included water weights and noodles to incorporate upper and lower body resistance exercises. Intensity was monitored using the same FS1 Polar heart rate monitors (Polar Electro Oy, Kempele, Finland) that were used for cardiovascular sessions on land. Heart rates during exercise in the water were lower than heart rates during land exercises.

Participants walked or ran at home on their own 2 days each week. New Lifestyles pedometers (NL-2000, Kansas City, Missouri) were worn at the participant's waist and measured step count and were checked by the principal investigator weekly. Participants were also educated on monitoring target heart rate. Duration started at 20 minutes and gradually increased to 40 minutes with a 5 minute increase every 2 weeks.

Post-test measures. After the 10-week prescribed exercise intervention, participants in both the experimental and control group had body mass, height, and body fat measured using the same instrumentation and procedures that was used in the pre-test. The nutrition log was also completed at home for the last time and brought to the post-test.

Data Analyses

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 17.0. Physical descriptive data were reported using means and standard deviations. The nutrition log data were analyzed to determine caloric intake. Multivariate Analysis of Variance (MANOVA) was used to determine if there were differences on the linear combination of body mass and body fat between the experimental and control group. Subsequent univariate Analyses of Variance (ANOVAs) were conducted on each dependent variable. The alpha level was controlled at .05 family wise for the univariate ANOVAs.

CHAPTER IV

RESULTS

In order to test the effect of the exercise intervention, one main hypothesis and two nested hypotheses were evaluated in this investigation.

General Hypothesis

1. Following the exercise intervention, there would be a significant difference between the experimental group and the control group on the linear combination of loss of body mass and body fat.

Nested Hypotheses

1. Following the exercise intervention, the experimental group had a greater decrease in body fat percentage than those in the control group.
2. Following the exercise intervention, the experimental group had a greater loss of body mass than those in the control group.

Description of Participants

Data were collected from 15 postpartum women. There was 93% compliance to the intervention within the full sample. Participants were randomly placed into the experimental group and the control group.

Participants had a mean age of 31.8 years (± 4.4 years). Furthermore, mean height for the full sample was 167.3 cm (± 9.3 cm). Vaginal delivery occurred for 11 participants while and 4 had a cesarean section. There were 12 participants who were breastfeeding from the full sample and 6 first-time mothers. The average gain in body mass during pregnancy for the full sample was 17.3 kg. Additional descriptive statistics are presented in Tables 1 and 2.

Findings of ANOVA and MANOVA Analyses

A one-way MANOVA was conducted between the experimental and control groups on the linear combination of difference scores between pre- and post-tests for body mass and body fat values. The two groups were significantly different on the linear combination of difference in body mass and difference in body composition, $F(4, 24) = 5.53$, $p = .003$, Wilks Lambda = .271. The observed power for the test was .945. Thus, the general hypothesis was supported. Because the general hypothesis was confirmed, the two nested hypotheses were tested through subsequent univariate ANOVA's.

The first univariate ANOVA revealed a significant difference between the two groups for body fat percentage, $F(2, 13) = 9.98$, $p = .002$, $R^2 = .606$. Over 60% of the variance in body fat was explained by the independent variable, which was the exercise intervention. Thus, the first nested hypothesis that the experimental group would have a greater decrease in body fat was supported. Body mass was not significantly different between the two groups although it approached statistical significance, $F(2, 13) = 3.229$, $p = .073$, $R^2 = .332$. Therefore, both groups lost body mass during the intervention as one can see from Table 1. However, the experimental groups' loss of body mass was not statistically significant thus not supporting the second nested hypothesis. This result may be due to low sample size. A summary of the changes in body mass and body fat across groups appears in Table 3.

Table 1

Descriptive Statistics for Study Variables

	Pretest		Posttest	
Variable	*M*	*SD*	*M*	*SD*
Full sample ($N = 15$)				
Body mass (kg)	75.7	10.9	74.4	11.2
Body fat (%)	26.1	4.6	25.2	4.9
Experimental group ($n = 7$)				
Body mass (kg)	73.1	14.1	71.2	13.9
Body fat (%)	24.3	5.5	22.1	5.2
Control group ($n = 8$)				
Body mass (kg)	77.9	7.3	77.2	8.0
Body fat (%)	27.6	3.2	28.0	2.5

Table 2

Average Caloric Intake from Nutrition Logs

Variable	Calories
Weekday	
Experimental	1789
Control	1850
Weekend	
Experimental	1880
Control	1954

Note. Weekday = average caloric consumption for 2 days at pre-test, week 5, and post-test. Weekend = average caloric consumption for 1 day at pre-test, week 5, and post-test.

Table 3

Difference Scores for Study Variables

Variable	*M*	*SD*
Body mass (kg)		
Experimental	1.9	2.3
Control	0.8	2.0
Body fat (%)		
Experimental	2.2*	1.2
Control	-0.4	1.5

Note. * $p = .002$

CHAPTER V

DISCUSSION

The postpartum period is a critical transition time for women. This period can affect both the physical and mental health of a new mother. Besides caring for a new member of the family, there is also the thought of getting back to pre-pregnancy weight. Both pregnancy and the postpartum periods have been suggested as important contributors to increased health problems such as obesity among women. Interventions to help women exercise regularly could have a positive impact on their health. Diet and exercise interventions have been shown to be successful in other populations. However, there is little known about how effective such interventions may be for postpartum women (Sebert Kuhlmann, Dietz, Galavotti, & England, 2008).

The purpose of the present study was to determine the effects of a 10-week exercise intervention on body mass and body fat among postpartum women. The training program consisted of supervised sessions, 1 hour in length, three times per week. One of the sessions was an aquatic workout while the other sessions included light resistance training and cardiovascular exercise. Additionally, training group participants walked or ran on their own with a pedometer, twice weekly. All training group participants except 1 participant finished the intervention. This participant stopped attending exercise sessions due to travel costs and time. She lived 45 minutes from the location of the intervention. No adverse outcomes or events occurred during the study.

Overview of the Literature

Pregnancy can be considered the only time a woman is encouraged to gain 25 pounds in her lifetime. However, an excess weight gain during pregnancy is associated with increased health problems such as hypertension, delivery complications, and postpartum weight retention (Institute of Medicine and the National Research Council, [IOM], 2007). Furthermore, maternal weight gain and prepregnancy BMI have been positively correlated with birth weight (Mottola et al., 2010). Larger babies are at a greater risk for obesity later in life, which can also include health concerns such as type II diabetes (Mottola et al.). The American College of Obstetrics and Gynecologists recommends an aggressive approach to preventative weight management in all overweight and obese women before conception, during pregnancy, and after delivery (ACOG, 2005). This statement solidifies the importance of weight management for maternal age women. It is understandable that the postpartum period is a difficult transition time in a new mother's life, including changes with the daily routine and new responsibilities. It is also a critical time to maintain or begin, in some cases, a healthy lifestyle including physical activity.

It is suggested that excessive gestational weight gain and postpartum weight retention may predispose women to long-term weight and health problems (Kinnunen et al., 2008). While most women return to their pre-pregnancy weight within 1 year of delivery, 15% - 20% retain 5 kg or greater (Gunderson & Abrams, 1999). An interactive postpartum exercise intervention may help women to lose pregnancy weight and decrease the chance of future health problems such as obesity, heart disease, and some cancers.

Research has shown the importance of lifestyle behaviors such as physical activity and diet to a wide variety of health outcomes and lifestyle interventions can have a positive impact on these outcomes (Sebert Kuhlmann et al., 2008). However, little work has been done with pregnant and postpartum women, and few intervention models consistent with the particular needs and concerns of these women have been evaluated. Hence, the current study is an attempt to begin to examine this population and its complexities.

Description of the Sample

The sample included 15 postpartum women. Sebert Kuhlmann et al. (2008) conducted a review of randomized controlled trials of weight-management interventions for pregnant or postpartum women. Only three studies met the inclusion criteria and, in these studies, the refusal and attrition rates were high. Out of the three studies, only one conducted by O'Toole, Sawicki, and Artal (2003) resembles the current investigation. Their study included a 12 week, self-directed diet and physical activity intervention with much less interaction with participants. The participants in the O'Toole et al. study were between 6 weeks and 6 months postpartum and had pre-pregnancy BMI values between 25 kg/m^2 and 29.9 kg/m^2 and gained greater than 15 kg during pregnancy. There were 40 participants initially enrolled and only 17 finished the study.

Participants in the current sample were between 6 weeks and 10 weeks postpartum and had uncomplicated single deliveries. In the current sample, 80% of the women breastfed for 6 weeks or longer. Less than half of the sample included first-time mothers (40%) while 73% had a vaginal delivery. Lastly, the average weight gain during pregnancy for the sample was 17.3 kg.

The current study had positive results similar to the O'Toole et al. (2003) study. However, participants in the current study only included postpartum women between 6 weeks and 10 weeks postpartum. In contrast, the participants in the O'Toole et al. study were women between 6 weeks and 6 months. Although one major goal, to reduce pregnancy-related weight retention, was the same between the two studies, the O'Toole et al. study had women who were already categorized as overweight prior to pregnancy. The current study didn't have any criteria for body mass prior to pregnancy to be able to participate in the intervention. The main outcome measure by O'Toole et al. was weight retention at 1 year postpartum, whereas the current investigation included measures following the 10-week exercise intervention. Lastly, the O'Toole et al. study had a retention rate of 42%, whereas the current study had a retention rate of 93%. The rate may have been higher in the present study due to the interactive approach to the exercise program compared to a more self-directed intervention.

Overall, there are few studies on the postpartum population which makes it difficult to generate wide-spread comparisons in regards to results and conclusions. As such, the present study may serve as a model for future researchers to launch exercise interventions aimed at assisting new mothers in returning to a healthy weight and level of body composition.

Anthropometric Measures

In the current investigation the focus was on decreases in body mass and body fat as indicators of the success of the 10-week exercise intervention. It is well established that being overweight is a precursor for many health risks. In addition, pregnancy is a potential contributing factor to overweight and obesity among women (Ostbye et al., 2008). Excess weight gain during pregnancy is also associated with increased health problems such as delivery complications, hypertension, gestational diabetes, and postpartum weight retention. It is believed that more than 1/3 of the women in the United States gain more weight during pregnancy than is recommended by the Institute of Medicine (IOM, 2007).

Gunderson and Abrams (1999) suggested that up to 20% of postpartum women are 11 pounds - 14 pounds heavier 6 months – 18 months postpartum than they were before pregnancy. In the current study, women in the exercise group lost an average of 2 kg whereas the control group lost 0.7 kg during the 10-weeks. Although the univariate ANOVA failed to reveal a significant statistical effect of exercise on body mass loss, the R^2 of .332 indicates that over 33% of the variance in body mass loss was explained by the exercise intervention. This non-significant result may be from the fact that the current study had only 15 participants in the sample. Notwithstanding, the average body mass loss for the experimental group was indicative of a successful program. Participants in the exercise program were pleased with their decrease in body mass. Perhaps greater loss of body mass would have resulted through counseling on dietary intake. Nutrition logs were collected three times throughout the study and the only education received was regarding portion sizes prior to collection of the first nutrition log.

The closest study for comparison of these results is, again, the O'Toole et al. (2003) study. O'Toole et al. examined weight retention 1 year postpartum and the intervention group decreased from 78.6 kg at baseline to 71.3 kg 1 year postpartum. There was a non-significant decrease from 85.4 kg to 84.1 kg among women in the control group. The exercise intervention in the current study was lead by the primary investigator. This may be more beneficial than a self-directed intervention because more motivation and support can be provided during each workout session. Many participants mentioned the fact that having a person to work out with was a great motivator for them to exercise. Besides providing motivation, having exercise leadership allowed for monitoring of proper technique which was important in participants avoiding unnecessary injury.

Body fat was the second measure examined in the current investigation. Body fat percentages of the exercise group in the 10-week intervention decreased significantly compared to the control group. The exercise group had an average of 24.3% body fat during pre-test and lowered their percentage to 22.1% at post-test. On the other hand, the control groups' percentage actually increased after the 10-week intervention time period. They started at an average of 27.6% body fat and increased to an average of 28.0% at post-test. It is evident that the exercise protocol helped to decrease fat mass in the experimental group. The light resistance training and water workouts most likely contributed to this positive change. Utilizing both light resistive training and cardiovascular fitness in the current investigation may have led to an increase in muscle mass and explain the change in body mass and body fat results. High body fat composition can lead to health risk concerns such as cancers and heart disease. Therefore, the reduction in body fat percentage among the experimental group is an important health outcome. Surprisingly and unfortunately, the primary investigator has found no other research for comparison that involves body fat percentages with an exercise intervention in postpartum women.

Nutrition logs were utilized in the current study for participants to track their eating habits. This occurred for both the exercise participants and control participants twice on a weekday and once on a weekend at pre-test, 5-weeks, and post-test. Although these measures were not analyzed statistically, it was apparent that caloric intakes were similar for both groups.

Overall, barring any errors due to recording and reporting, dietary intake was low for participants. Participants averaged 1,820 calories on a weekday and just fewer than 1,900 calories over a weekend. For both groups, average caloric intake on the weekend days was higher than on weekdays. Many participants stated that they tended to eat out more on the weekend. Eating out can often lead to higher caloric consumption when compared to fixing a meal at home. It was also reported by participants that they felt like they had less time to sit down and eat after the birth of the baby. With a new baby comes many new responsibilities and finding time for oneself, including time to eat regular meals, can be difficult.

Many of the participants (n = 12) breastfed during the study. Most women build up a store of 2 kg to 4 kg of body fat for the extra energy requirements of breastfeeding (Jones & Jones, 2004). This provides the mother with a reservoir of 14,000 to 24,000 kcal for lactation needs (Jensen & Bobak, 1985). Typically, fat stores will be gradually utilized for the first 4 months to 6 months of lactation (Jensen & Bobak). Additionally, during lactation, an extra 500 calories on top of the basic 2,000 calories to 2,200 calories a day is recommended to be consumed by the mother (Jones & Jones). Participants in the current study that were breastfeeding were not consciously consuming additional calories. Again, when considering the additional caloric demand associated with breast feeding, caloric intake of the participants was lower than expected. Pivarnik et al. (2006) summarized in a consensus statement that results from studies performed on breastfeeding women suggest that exercise improves aerobic fitness; however, exercise alone, without caloric restriction, does not promote weight loss. Determining how exercise and breast feeding interact in impacting weight loss in postpartum women is an area in need of further research.

This major event in a new mother's life is a delicate balance of taking care of her family including a newborn, but also remembering to take care of herself. With more to do and less time, beginning an exercise program and eating healthily can be challenging for the postpartum woman.

Barriers to Exercise

Exercise has many benefits both physically and mentally. For the postpartum population, exercise can be a positive outlet. Not only are the physical outcomes to an exercise program being met, but the postpartum woman also has valuable time to herself. Unfortunately, many postpartum women have conflicts at home and work and have difficulty getting into an exercise routine.

In the current investigation, the overall exercise adherence rate was above 80%. This included both exercise sessions with the investigator and at home exercise sessions that were reported. A self-reported exercise session was counted in the intervention as long as it met intensity and duration guidelines set forth by the primary investigator in accordance with ACSM guidelines. Therefore, if a workout session completed at home was shorter in duration than they had been accustomed to during the same week at group exercise it was not counted as a session. Intensity was also checked by comparisons of step count and heart rates between self-directed exercise and exercise with the primary investigator.

In the current investigation, childcare was offered to the participants. A Certified CPR and First Aid babysitter was available on days when a spouse or friend could not watch the baby or other siblings. This aspect of the study was utilized on a few occasions throughout the intervention. Husbands' schedules or babysitters' schedules changed and instead of cancelling the exercise session, the participant brought the baby to the training session. Childcare is an important issue for a family and is also as important for exercise interventions to be successful with this population. However, even if a woman is getting the mental support and encouragement from loved ones to practice a healthy lifestyle, she may not be getting the adequate amount of help with childcare which poses a barrier to exercise time. Thornton et al. (2006) examined the role of social support among postpartum Latino women. They suggested that informational and emotional support of husbands have the most important and consistent influence on a participants' weight, eating, and physical activity practices.

In addition to the support at home, a woman may find support from the other women in the intervention that are going through the same life events. Social support is one of the most prominent influences on physical activity behavior and is an important determinant of success in altering health habits (Keller, Allan, & Tinkle, 2006). Therefore, social support and childcare assistance are key elements for a successful exercise intervention with this population.

Implications of the Study and Future Research

There was a 93% retention rate for the full sample across the 10-week study and there was over 80% adherence to the exercise program in the experimental group. In addition, no ill effects such as injury occurred during the study. Furthermore, there was a statistically significant decrease in body fat percentage and a meaningful decrease in body mass.

This study demonstrates that participation in a supervised exercise program can have a positive impact on health for postpartum women. The positive physical outcomes not only improve the body in regards to body mass and fat mass, but also help to combat heart disease, diabetes, and some forms of cancer. The exercise sessions are also an emotional outlet for the new mom to get out and away from baby for a while. Camaraderie among women in the same stage of life can also be another beneficial result. This may lead to contacts for more emotional support at a critical and evolving time in a woman's life.

Many women in the current study were introduced to aquatic exercise for the first time. Most of these participants had never taken part in a water class prior to the intervention. All exercise participants were positively influenced by the water routine and seemed encouraged enough to want to continue with exercise in that particular mode. The physical properties of water including buoyancy, resistance, and hydrostatic pressure are most likely some of the reasons for the popularity. The 10-week postpartum intervention is likely a stepping stone for a hopeful continuation of exercise for the women that participated.

Many opportunities exist to work with women at this stage of their lives. However, little work has been done, and few intervention models consistent with the particular concerns and needs of these women have been evaluated (Sebert Kuhlmann, et al., 2008). Pivarnik et al. (2006) stated that Healthy People 2010 indicates that increasing physical activity and reducing obesity are the greatest priorities for enhancing women's health. Future randomized clinical trials will help to sort out the appropriate exercise regimens that will optimally help prevent chronic disease and obesity in women.

Future researchers should examine utilizing more of an interactive approach with postpartum women and exercise interventions. However, childcare should be an option for a successful exercise program. There are many specific variables to include or exclude in data collection: whether or not the participant is breastfeeding, are they a first-time mother, and how many weeks postpartum they are at the time of the intervention. Research is still needed to determine the effects on breastfeeding and weight loss postpartum. First-time mothers and postpartum women with children may already be different when it comes to weight retention considering that a woman with children may still have retained weight from subsequent pregnancies. Lastly, future research should investigate caloric intake versus estimated caloric expenditure. With the many modes included in this investigation, it would be difficult to include estimated caloric expenditure.

Overall Conclusions

The postpartum population is an important group that needs special attention. The complexities of pregnancy, a new birth, and the period following are all major events in a woman's life. Consequently, it is difficult to get participants from this population and once they are found it is hard to keep them from dropping out. This population is sparsely researched and, in actuality, it is a population that needs assistance when it comes to the benefits of exercise and living a healthy lifestyle. This population needs future research interventions especially using an interactive approach examining both physical activity and nutrition. Weight retention is a common problem among women and can lead to obesity as well as other health problems later in life. Postpartum exercise groups, just like pregnancy exercise groups, should be explored by insurance companies, fitness clubs, and sports medicine clinics.

REFERENCES

American College of Obstetricians and Gynecologists. (2005). *Obstetrician and Gynecology, 106,* 671-674.

American College of Sports Medicine. (1997). *ACSM's guidelines for exercise testing and prescription* (5th ed.). Baltimore: Lippincott, Williams & Wilkins.

American College of Sports Medicine. (2006). *ACSM's guidelines for exercise testing and prescription* (7th ed.). Baltimore: Lippincott, Williams & Wilkins.

American Diabetes Association. (2004). Gestational diabetes mellitus. *Diabetes Care, 27,* S88-90.

Armstrong, K., & Edwards, H. (2003). The effects of exercise and social support on mothers reporting depressive symptoms: A pilot randomized controlled trial. *International Journal of Mental Health Nursing, 12,* 130-138.

Armstrong, K., & Edwards, H. (2004). The effectiveness of a pram-walking exercise program in reducing depressive symptomatology for postnatal women. *International Journal of Nursing Practice, 10,* 177-194.

Beilock, S. L., Feltz, D. L., & Pivarnik, J. M. (2001). Training patterns of athletes during pregnancy and postpartum. *Research Quarterly for Exercise and Sport, 72*(1), 39-46.

Carola, R., Harley, J. P., & Noback, C. R. (1990). *Human anatomy & physiology.* New York, NY: McGraw Hill.

Centers for Disease Control and Prevention. (2006). New report shows teen births drop to lowest level ever. Retrieved March 5, 2010, from http://www.cdc.gov/Media/pressrel/r061121.htm?s_cid=mediarel_r061121

Clapp, J. F. (1991). The changing thermal response to endurance exercise during pregnancy. *American Journal of Obstetrics & Gynecology, 165,* 1684-1689.

Clapp, J. F. (2000). Exercise during pregnancy: A clinical update. *Clinician and Sports Medicine, 19,* 273-286.

Cramp, A. G., & Brawley, L. R. (2006). Moms in motion: A group mediated cognitive behavioral physical activity intervention. *International Journal of Behavioral Nutrition and Physical Activity, 3,* 23-33.

Davies, G. A. L., Wolfe, L. A., Mottola, M. F., & MacKinnon, C. (2003). Joint SOGC/CSEP clinical practice guideline: Exercise in pregnancy and the postpartum period. *Canadian Journal of Applied Physiology, 28*(3), 329-341.

Dewey, K. G., Lovelady, C. A., Nommsen-Rivers, L. A., McCrory, M. A., & Lonnerdal, B. (1994). A randomized study of the effects of aerobic exercise by lactating women on breast-milk volume and composition. *New England Journal of Medicine, 330,* 449-453.

Dunn, A. L., Trivedi, M. & O'Neil, H. A. (2001). Physical activity dose-response effects on outcomes of depression and anxiety. *Medicine in Science in Sports and Exercise, 33,* S587-S597.

Gunderson, E. P., & Abrams B. (1999). Epidemiology of gestational weight gain and body weight changes after pregnancy. *Epidemiological Review, 21,* 261-275.

Heyward V. H., & Stolarcczyk L. M. (1996). *Applied body composition assessment.* Champaign, IL: Human Kinetics.

Institute of Medicine and the National Research Council. (2007). Influence of pregnancy weight on maternal and child health. Washington, D. C.: The National Academies Press.

Jackson A. S., & Pollack M. L. (1985). Practical assessment of body composition. *Physician and Sports Medicine, 13*(3), 76-90.

Jensen, M. D., & Bobak, I. M. (1985). *Maternity and gynecologic care.* (3rd ed.). St. Louis, MO: C. V. Mosby Company.

Jones, S., & Jones M. (2004). *Great expectations: Your all in one resource for pregnancy and childbirth.* New York, NY: Sterling Publishing Company.

Kardel, K. R. (2005). Effects of intense training during and after pregnancy in top-level athletes. *Scandinavian Journal of Medicine & Science in Sports*, *15*(2), 79-86.

Keller, C., Allan, J., & Tinkle, M. B. (2006). Stages of change, processes of change, and social support for exercise and weight gain in postpartum. *Journal of Gynecology and Neonatal Nurses, 35,* 232-240.

Keppel, K. G., & Taffel, S. A. (1993). Pregnancy-related weight gain and retention: Implications of the 1990 Institute of Medicine guidelines. *American Journal of Public Health, 83,* 1100-1103.

Kinnunen, T. I., Aittasalo, M., Koponen, P., Ojala, K., Mansikkamaki, K., Weiderpass, E., et al. (2008). Feasibility of a controlled trial aiming to prevent excessive pregnancy-related weight gain in primary health care. *BMC Pregnancy and Childbirth, 8,* 37-45.

Larsson, L., & Lindqvist, P. G. (2005). Low impact exercise during pregnancy- A study of safety. *Acta Obstetricia et Gynecologica Scandinavica, 84*, 34-38.

Leermakers, E. A., Anglin, K., & Wing, R. R. (1998). Reducing postpartum weight retention through a correspondence intervention. *International Journal of Obesity, 22,* 1103-1109.

Levitt, C., Shaw, E., Wong, S., Kaczorowski, J., Springate, R., Sellors, J., et al. (2004). Systemic review of the literature on postpartum care: Methodology and literature search results. *Birth, 31*(3), 196-201.

Linne, Y. (2004). Effects of obesity on women's reproduction and complications during pregnancy. *Obesity Review, 5,* 137-143.

Linne, Y., & Rossner, S. (2003). Interrelationships between weight development and weight retention in subsequent pregnancies: The SPAWN study. *Acta Obstetricia et Gynecologica Scandinavica, 82,* 318-325.

Linne, Y., Dye, L., Barkeling, B., & Rossner, S. (2003). Weight development over time in parous women: The SPAWN study-15 years follow-up. *International Journal of Obesity, 27,* 1516-1522.

Lokey, E. A., Tran, Z. V., Wells, C. L., Myers, B. C., & Tran, A. C. (1991). Effects of physical exercise on pregnancy outcomes: A meta-analytic review. *Medicine and Science in Sports and Exercise, 23*(11), 1234-1239.

McArdle, W. D., Katch, F. I., & Katch, V. L. (2001). *Exercise physiology.* (5^{th} ed.). Baltimore: Lippincott, Williams & Wilkins.

Morgan W., & Borg G. A. (1976). Perception of effort in the prescription of physical activity. *American Medical Association,* 126-129.

Morris, S. N., & Johnson, N. R. (2005). Exercise during pregnancy. *The Journal of Reproductive Medicine, 50*(3), 181-188.

Mottola, M. F., Giroux, I., Gratton, R., Hammong, J., Hanley, A., Harris, S., et al. (2010). Nutrition and exercise prevent weight gain in overweight pregnant women. *Medicine and Science in Sports and Exercise,* 42(2), 265-272.

North, T., Corth, T. C., McCullagh, P., & Vutran, Z. (1990). Effect of exercise on depression. *Exercise and Sport Sciences Reviews, 18,* 379-415.

Ostbye, T., Krause, K. M., Brouwer, R. J., Lovelady, C. A., Morey, M. C., Bastian, L. A., et al. (2008). Active mothers postpartum (AMP): Rationale, design, and baseline characteristics. *Journal of Women's Health, 17*(10), 1567-1575.

O'Toole, M. L., Sawicki, M. A., & Artal, R. (2003). Structured diet and physical activity prevent postpartum weight retention. *Journal of Women's Health, 12,* 991-998.

Pivarnik, J. M., Chambliss, H. O., Clapp, J. F., Dugan, S. A., Hatch, M. C., Lovelady C. A., et al. (2006). Impact of physical activity during pregnancy and postpartum on chronic disease risk. *Medicine and Science in Sports and Exercise, 38*(5), 989-1006.

Rooney, B. L., & Schauberger, C. W. (2002). Excess pregnancy weight gain and long term obesity: One decade later. *Obstetrics and Gynecology, 100*(2), 245-253.

Rooney, B. L., Schauberger, C. W., & Mathiason, M. A. (2005). *Obstetrics and Gynecology, 106*(6), 1349-1356.

Santos, I. A., Stein, R., Fuchs, S. C., Duncan, B. B., Ribiero, J. P., Kroeff, L. R. et al. (2005). Aerobic exercise and submaximal functional capacity in overweight pregnant women; a randomized trial. *Obstetrics & Gynecology*, *106*(2), 243-249.

Sebert Kuhlmann, A. K., Dietz, P. M., Galavotti, C., & England, L. J. (2008). Weight-management interventions for pregnant or postpartum women. *American Journal of Preventative Medicine, 34*(6), 523-528.

Sternfeld, B., Quesenberry, C. P., Eskenazi, B., & Newman, L. A. (1995). Exercise during pregnancy and pregnancy outcome. *Medicine and Science in Sports and Exercise*, *27*(5), 634-640.

Thornton, P. L., Kieffer, E. C., Salabarria-Pena, Y., Odoms-Young, A., Willis, S. K., Kim, H. et al. (2006). Weight, diet, and physical activity-related beliefs among pregnant and postpartum Latino women: The role of social support. *Maternal and Child Health Journal, 10*(1), 95-104.

APPENDICES

APPENDIX A

MTSU Institutional Review Board Approval Letter

April 3, 2008

Michelle Dell Pruett, Jenny Hutchens & Dr. Jennifer Caputo
Department of Health and Human Performance
mld2w@mtsu.edu, jhutchens576@bellsouth.net, jcaputo@mtsu.edu

Re: Protocol Title: "The Effects of 10-Week Exercise Intervention on Weight..."
Protocol Number: 08-283 **Expedited Research**

Dear Investigator(s):

I have reviewed the research proposal identified above and determined that the study poses minimal risk to participants and qualifies for an expedited review under 45 CFR 46.110 Category 4 & 7. Approval is for one (1) year from the date of this letter for **100** participants.

According to MTSU Policy, **a researcher is defined as anyone who works with data or has contact with participants**. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance before they begin to work on the project. **Any changes to the protocol must be submitted to the IRB before implementing this change.**

Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 as soon as possible.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting and analyzing data. Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date. Please allow time for review and requested revisions. **Your study expires April 3, 2009.**

Please note, all research materials must be retained by the PI or **faculty advisor (if the PI is a student)** for at least three (3) years after study completion. Should you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Tara M. Prairie
Compliance Officer

APPENDIX B

Revision to MTSU Institutional Review Board Approval

July 8, 2008

Michelle Dell Pruett, Jenny Hutchens & Dr. Jennifer Caputo
Department of Health and Human Performance
mld2w@mtsu.edu, jhutchens576@bellsouth.net, jcaputo@mtsu.edu

Re: Protocol Title: "The Effects of 10-Week Exercise Intervention on Weight..."
Protocol Number: 08-283 **Expedited Research**

Dear Investigator(s):

I have reviewed your research proposal identified above and your requested changes. I have received a permission letter from Dr. Joseph Castelli of Murfreesboro Medical Clinic to recruit C-section patients and approve of same.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. **If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance before they begin to work on the project. Any changes** to the protocol must be submitted to the IRB before implementing this change.

Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 as soon as possible.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting and analyzing data. **Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date.** Please allow time for review and requested revisions. Your expiration date is **April 3, 2009.**

Please note, **all research materials must be retained** by the PI or **faculty advisor (if the PI is a student)** for at least **three (3) years after study completion**. Should you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Tara M. Prairie
Compliance Officer

APPENDIX C

Second Revision to MTSU Institutional Review Board Approval

October 17, 2008

Michelle Dell Pruett, Jenny Hutchens & Dr. Jennifer Caputo
Department of Health and Human Performance
mld2w@mtsu.edu, jhutchens576@bellsouth.net, jcaputo@mtsu.edu

Re: Protocol Title: "The Effects of 10-Week Exercise Intervention on Weight..."
Protocol Number: 08-283 **Expedited Research**

Dear Investigator(s):

I have reviewed your research proposal identified above and your requested changes. I have received a permission letter from HealthWorks Rehab & Fitness to recruit subjects and approve of same.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. **If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance before they begin to work on the project. Any changes** to the protocol must be submitted to the IRB before implementing this change.

Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 as soon as possible.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting and analyzing data. **Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date.** Please allow time for review and requested revisions. Your expiration date is **April 3, 2009.**

Please note, **all research materials must be retained** by the PI or **faculty advisor (if the PI is a student)** for at least **three (3) years after study completion**. Should you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Tara M. Prairie
Compliance Officer

APPENDIX D

Extension of MTSU Institutional Review Board Approval

December 10, 2009

Michelle Dell Pruett, Jenny Hutchens & Dr. Jennifer Caputo
Department of Health and Human Performance
mld2w@mtsu.edu, jhutchens576@bellsouth.net, jcaputo@mtsu.edu

Re: Protocol Title: "The Effects of 10-Week Exercise Intervention on Weight..."
Protocol Number: 08-283 **Expedited Research**

Dear Investigator(s):

I have reviewed your research proposal identified above and your request for continued review. Approval for continuation is granted for one (1) year from the date of this letter.

Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting data and you are ready to submit your thesis and/or publish your findings. Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date. Please allow time for review and requested revisions. Your study expires **December 10, 2010**.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance before they begin to work on the project.

Please note, **all research materials must be retained** by the PI or **faculty advisor (if the PI is a student)** for at least **three (3) years after study completion**. Should you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Leigh Gostowski
Compliance Officer
Middle Tennessee State University

APPENDIX E

WVU Institutional Review Board Approval Letter

West Virginia University
Office of Research Compliance

Expedited - IRB Protocol - Approval

To:	Pruett, Michele
From:	WVU Office of Research Compliance
Date:	Friday, March 13, 2009
Subject:	No action required
Tracking #:	H-21546
Title:	The Effects of a 10-Week Exercise or Education Intervention on Weight Retention in Postpartum Women

The research study referenced above was reviewed by The West Virginia University [! boardname] Board for expedited review on 3/13/2009; on 03/13/2009, Barbara White approved this study via expedited review procedures.

While no action is required on your part, the IRB made the following findings:

This protocol was reviewed using the following:
Initial Expedited Review Checklist (210a)
Regulatory Criteria Checklist (210q)
Informed Consent - Only Minimal Risk Checklist (210z)

The following documents have been approved and validated for use in this study and are available in the BRAAN system:

Consent Form

Thank you.

Barbara A. White

APPENDIX F

Request for Medical Clearance

Date: ______________

Dear Dr. __________:

This letter is to inform you that your patient ________________________ wants to participate in a free 10-week exercise intervention consisting of light resistive training, cardio (walking or jogging), and water aerobics. She may be put on a wait list initially, however I am asking for your approval, as her doctor, that she may participate. Please include any special considerations or concerns you may have about the program or feel free to call me at 615 427-1077.

Thanks,

Michele D Pruett, MS, ATC