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EFFECTS OF RESISTANCE TRAINING ON ARTERIAL ELASTICITY AND C-REACTIVE PROTEIN IN PREMENOPAUSAL WOMEN

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EFFECTS OF RESISTANCE TRAINING ON ARTERIAL
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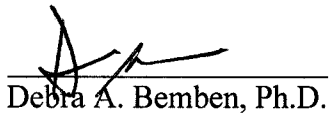
A DISSERTATION APPROVED FOR THE
DEPARTMENT OF HEALTH AND EXERCISE SCIENCE

BY



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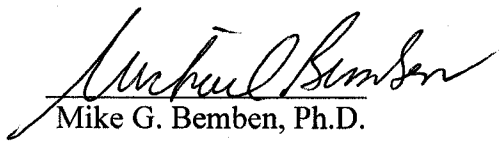

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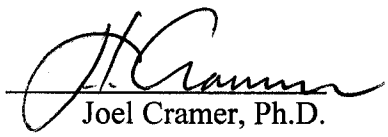

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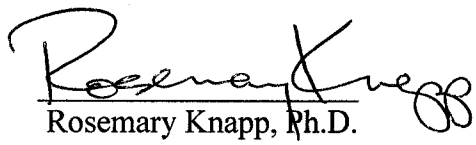

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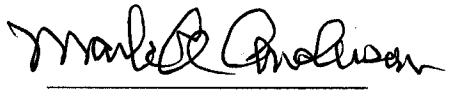

Mark Anderson, Ph.D.

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CHAPTER I

INTRODUCTION

Introduction

Over the last decade there has been an increasing interest in vascular stiffness, the loss of blood vessel wall elasticity in the major arteries, because it is a risk factor for cardiovascular events, especially stroke [38]. Arterial compliance is defined as the ability of an artery to expand and recoil with cardiac pulsation and relaxation [3]. The human aorta gradually becomes stiffer with age, with the process of arteriosclerosis developing even if there are no other concurrent diseases [79]. The cardiovascular structure and function include thickening of the vessel wall, a decrease in systemic arterial compliance and cross-sectional distensibility of the large elastic arteries. These changes lead to an increased cardiovascular disease risk in elderly subjects [42].

The increased prevalence of obesity in the United States has reached epidemic proportions, and is still increasing among all age-groups [29, 82]. Obesity may negatively affect cardiovascular function through associations with hypertension, dyslipidemia [129], and inflammation [21, 134]. Increased stiffness of the arteries is often seen in patients with autoimmune or inflammatory disorders, in terms of increased concentrations of various inflammatory markers. The chronic state of raised inflammatory concentration can have detrimental effect on the vasculature. Over time, this can lead to decreased nitric oxide bioavailability, vascular wall damage and ultimately decrease the ability of the arteries to dilate, thereby increasing the propensity for an adverse cardiovascular event [11].

The early detection of atherosclerotic changes in the aorta may have a clinical significance for prediction of cardiovascular disease [79]. Arterial stiffness can be assessed noninvasively with the use of pulse contour analysis (PCA) measurements. This device can measure the velocity of the pulse wave to travel a given distance between two sites of the arterial system [10].

Physical exercise has shown to be beneficial for protection against atherosclerotic vascular damage in elderly male athletes compared to elderly sedentary males [32], and to attenuate the age-related changes in arterial stiffness in elderly male athletes [43], which may reduce the risk of having a cardiovascular event [69, 120]. Habitual exercise has been associated with a decrease in arterial stiffness in women and these benefits were associated with lack of increase in systolic and arterial pulse pressures [101]. Furthermore, Kingwell et al. showed that aerobically trained middle-aged athletes had lower stiffness than their sedentary counterparts, and time to exhaustion on treadmill testing in older subjects correlated positively with arterial compliance [48].

Conflicting findings have been reported for the effects of resistance training on arterial stiffness. Kingwell et al. demonstrated that a 30-min bout of moderate intensity cycling using both legs decreased Pulse Wave Velocity (PWV), which is an index of arterial stiffness [49]. A low-intensity single-leg exercise intervention also yielded a significant decrease in PWV in the exercised leg, but not in the control leg, suggesting the decrease in stiffness was induced by some exercise-related localized factor [107]. Both cross-sectional studies [74] and intervention resistance training studies [75] have reported decreases in large artery elasticity in healthy men.

Although exercise seems to have a beneficial effect on the vasculature, this effect is not maintained in the absence of exercise [31], suggesting the importance of maintaining a physically active life to sustain a healthy vascular function.

Cardiovascular disease is an exponentially growing problem in our society. The seriousness of this problem will only continue to grow unless we can propose appropriate therapies and interventions to counteract this problem. Based on previous literature, it is evident that endurance-type exercise has beneficial effects on the vasculature, in terms of down-regulating and decreasing various risk factors associated with endothelial dysfunction, such as hypertension, diabetes, obesity, and inflammation. Resistance training has a profound effect on the musculoskeletal system, contributing to maintenance of muscle strength and bone health [45]. However, the effect of resistance training on the cardiovascular system is still unclear, with the majority of examinations completed only in men.

Purpose

The primary purpose of this study was to examine the effect of twelve weeks of resistance training on large (C1) and small (C2) arterial elasticity in premenopausal healthy women, and in healthy controls. The secondary purpose was to examine the relationship between the inflammatory marker C-reactive protein (CRP), and arterial elasticity in premenopausal healthy women, and in healthy controls.

Research Questions

1. Will twelve weeks of lower leg resistance training change arterial elasticity and levels of CRP in premenopausal women?
2. What is the relationship between CRP and arterial elasticity in premenopausal women?

Hypotheses

1. Twelve weeks of lower leg resistance training will change arterial elasticity.
2. It is expected that there will be a negative relationship between C-reactive protein concentrations and arterial elasticity measures.

Significance

The significance of this study was to provide greater insight into the effect of resistance training on various cardiovascular parameters, specifically arterial elasticity. Aerobic exercise has been shown to increase arterial elasticity [32, 43, 112, 115], whereas the effects of resistance training still remain controversial [74, 75, 95, 107]. Information collected in this study will help us gain insight into how the large and the small arteries are affected by resistance training, and whether it has an effect on the inflammatory marker C-reactive protein.

Most studies have focused on inflammatory markers and their association with whole body resistance training, mostly in men, and have not examined the various cardiovascular parameters in depth. To our knowledge, this is the first

investigation to examine large and small arterial elasticity in adult women after 12 weeks of lower leg resistance training.

Assumptions

1. All subjects gave maximum effort during 1-RM testing.
2. All subjects completed the recorded sets and repetitions.
3. All subjects answered the questionnaires truthfully.
4. All subjects fasted for at least eight hours prior to blood draws.
5. All subjects were both fasted and rested for at least eight hours prior to pulse contour analysis measurement.
6. The subjects cooperated with the researcher to maximize the validity of each measurement.
7. The researchers were experienced testers on the specific instruments that were used for this investigation.

Delimitations

1. This study included premenopausal women between the ages of eighteen and fifty years.
2. All subjects were free of any history of cardiovascular disease, coronary heart disease, peripheral arterial disease.
3. The subjects did not take antihypertensive drugs, hormone replacement therapy, or hormonal birth control.
4. The subjects participated in the resistance-training program for twelve weeks.

5. The HDI/Pulsewave™CR-2000 CardioVascular Profiling System (Hypertension Diagnostic, Inc., Eagan, Minnesota, USA) was used to measure arterial elasticity.
6. The subjects were recruited from the University of Oklahoma, Norman campus and the surrounding areas.

Limitations

1. Daily physical activity outside the training session was not controlled. However, subjects were asked to continue their normal daily activity that did not include resistance training.
2. Pulse Contour Analysis (PCA) is a noninvasive measurement that allows only an estimate of the distance traveled by the pulse. The most accurate measurement of this distance can be obtained only with invasive procedures.

Operational Definitions

1. Dual energy x-ray absorptiometry (DXA) – Measures the attenuation of energy passing through bone, lean tissue, and fat. DXA is used to measure bone mineral density (BMD), bone mineral content (BMC), and soft tissue composition [23].
2. Arterial Stiffness – The loss of blood vessel wall elasticity [38].

3. Endothelial Dysfunction – The functional and reversible alteration of endothelial cells, resulting from impairment of nitric oxide availability [28].
4. Large Artery (C1) – Proximal vessel such as the aorta [91].
5. Small Artery (C2) – Distal vessel such as the small arteries and arterioles [91].
6. Pulse Contour Analysis (PCA) – Noninvasive method to assess vascular compliance [98]. A modified Windkessel model is used to estimate the large and the small arterial elasticity, which also includes other cardiovascular parameters [2].
7. C-Reactive Protein (CRP) - Inflammation blood marker that is predictive of atherosclerosis [130] and future cardiovascular events [70, 134].
8. One Repetition Maximum (1-RM) – The maximal amount of weight that can be lifted during one complete repetition [89].
9. Muscular Strength – Maximum force that can be generated by a muscle or muscle group [89].
10. Premenopausal – Women that have regular menstrual cycles that have not changed in length [35].

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Cardiovascular disease (CVD) is the leading cause of death and disability in the developed world, and might soon overtake infectious diseases as the precursor of death worldwide [78]. Atherosclerosis is an important contributor to this increased risk of CVD [10]. It has been suggested that atherosclerosis is a progressive disease originating from a combination of endothelial dysfunction and damage, thrombosis and inflammation [111].

Endothelial dysfunction is often seen in patients with inflammatory diseases in terms of increased concentrations of inflammatory markers, which over years can lead to vascular deterioration and reduced nitric oxide bioavailability. Such endothelial and vascular wall cell damage can impair the ability of the arteries to dilate, promoting increased stress and pressures on the vascular tree, and leading to potential detrimental cardiovascular events [11]. Other risk factors for increased stiffness of the arteries are adiposity [64, 109, 125], diabetes [15], hypertension [10, 92], atherosclerosis [10], hypercholesterolemia [126], and smoking [61]. Inflammation is a potent vascular risk factor in the general population and is associated with endothelial dysfunction [62].

Elevated levels of concentration of inflammatory markers has been seen in autoimmune disease, such as multiple sclerosis [105], and rheumatoid arthritis (RA) [130]. Reduced arterial elasticity has been shown in RA patients with elevated

levels of inflammatory markers [130]. Given the relationship of inflammation to atherosclerosis, elevated levels of inflammatory markers might be associated with decreased arterial elasticity. C-reactive protein (CRP) has been associated with increased pulse wave velocity (PWV), hence stiffer arteries [131]. Increased PWV or decreased pulse contour analysis (PCA) is associated with increased risk for cardiovascular disease and mortality rates [71].

The arteries become stiffer with advancing age [114], and these changes are related to various pathological states common to older individuals, such as hypertension [10, 92], chronic heart failure [110], ischemic stroke [108], and future cardiovascular events, such as death [71].

Arterial elasticity can be assessed noninvasively using the HDI/Pulsewave™ CR-2000 Research CardioVascular Profiling System (Hypertension Diagnostics, Inc.). This device consists of an oscillimetric blood pressure module, an Arterial Pulsewave™ Sensor Analyzer, and a computer system. The CR-2000 reads and analyses the blood pressure waveforms from the Arterial Pulsewave™ Sensor Analyzer. A profile report is generated, and includes systolic, diastolic, and mean arterial blood pressures, pulse pressure, pulse rate, estimated cardiac ejection time, estimated stroke volume and index, estimated cardiac output and index, large and small arterial elasticity indices, systemic vascular resistance, and total vascular impedance [91].

While the subject maintains a supine position on a therapy table, a blood pressure cuff is placed on the upper left arm, and a plastic rigid wrist stabilizer is placed on patient's right wrist to minimize any movement and stabilize the radial

artery during the 30-sec collection of blood pressure waveform. The Arterial Pulsewave™ Sensor Analyzer is placed on the surface of the skin right on the radial artery with just enough pressure without occluding the radial artery. This technique is reported to be a reliable [57] and a repeatable [91] index of aortic stiffness, independent on arm used for the analysis [2].

This literature review will cover the pathophysiology of endothelial dysfunction, and explore the relationship of arterial elasticity with age, gender, hypertension, obesity, and inflammation. We will further examine the effect of various types of training on the vasculature, such as endurance training, resistance training, and finally a combination of endurance training and resistance training.

Pathophysiology of Endothelial Dysfunction

The endothelium is comprised of a thin cellular layer that lines the inner surface of the blood vessels, separating the circulating blood from the tissues. The endothelium works as a receptor-effector organ and responds to various stimuli with the release of appropriate substances which help maintain tissue homeostasis. The endothelium thus modulates the vascular smooth muscle cells producing relaxation or contraction, and thereby vasodilation or vasoconstriction. Homeostasis of the endothelium is generated by controlling the production of various thrombotic components, such that it intervenes in cell proliferation and migration, regulates monocyte and leukocyte adhesion and activation, and the inflammatory processes.

Cardiovascular risk factors causes oxidative stress, or reduced nitric oxide bioavailability, that changes the capacity of endothelial cells to maintain a healthy vasculature, leading to endothelial dysfunction, and therefore reducing the capacity

of the endothelium to maintain homeostasis. When endothelial cells lose their ability to maintain homeostasis, the tissue environment is right for the endothelium to be invaded by lipids and leukocytes. The inflammatory response is stimulated and fatty streaks appear, which is the first step in formation of atherosclerotic plaques. If the plaque build up persists and is exposed to rupture, this can set the stage for thrombogenesis and vascular occlusion [24].

The functional impairment associated with a decrease in arterial elasticity is exacerbated by endothelial dysfunction, which is often associated with aging and hypertension. Endothelial dysfunction is characterized by impaired endothelium-dependent vasodilation [33, 113], due to a decreased nitric oxide production, which is due to an increased oxidative stress, which then leads to decreased nitric oxide synthase activity [46, 99, 113].

The vessel wall alters its structure and function in response to direct injury and/or tensile and shear stress [34, 77, 133]. The characteristics of arterial remodeling depend on the magnitude of stress the vessel is exposed to and on the presence of an intact endothelium [118, 119]. Blood flow is the primary determinant of arterial wall stretch and tensile stress. With increased blood pressure or arterial radius, tensile stress is maintained within physiological range by thickening of the vessel wall with retention of normal internal diameter. Changes in blood flow result in changes in shear stress within the blood vessel, which is responsible for the dragging frictional force. Experimental and clinical studies suggest that acute and chronic augmentation of arterial blood flow induce proportional increases in the vessel lumen, whereas decreasing blood flow reduces the arterial inner diameter [44, 53].

Age and Arterial Elasticity

Advancing age is associated with changes in the arterial structure and function, such as thickening of the vessel wall [86], and a reduced arterial compliance and distensibility of the large arteries [114]. A decrease in arterial compliance or an increase in arterial stiffness commonly occurs with advancing age in both men and women [72], even in the absence of other concurrent diseases [121].

The decrease in functional capacity of the cardiovascular system with advancing age is a repercussion of primary and secondary aging. Primary aging is due to progressive and age-related structural and functional deterioration in the cardiovascular system over time. Secondary aging, on the other hand, is attributed to hypertension, coronary artery disease, diabetes mellitus, and physical inactivity that stimulate the age-related decline in cardiovascular reserve capacity [14].

The decrease in arterial elasticity with advancing age is characterized by arterial distension and increased arterial wall thickness [51]. These structural changes are the result of intimal growth and changes in the middle layer of the artery, the media. There is a higher fibronectin content, increased collagen concentration stimulated by the release of growth factors, increased collagen cross-linking, decreased elastin, and smooth muscle cell proliferation, which result in increased media thickness and stiffness of the arteries [6, 51].

The age-related arterial changes that lead to decreased arterial elasticity are heterogeneous, being more pronounced in the aorta and central large, elastic-type, capacitative arteries than in the peripheral, muscular-type arteries [5].

Gender Differences

There seem to be a gender difference in arterial stiffness, with women having stiffer arteries than their male counterparts both before puberty [1] and after menopause [1, 121]. These results are attributed to hormonal differences, with women having a greater prevalence of systolic hypertension [8]. Distensibility or compliance of the large arteries is negatively affected by natural menopause in apparently healthy women [123], and hormone replacement therapy seems to attenuate arterial stiffness in postmenopausal women [73, 76, 93].

The underlying physiological mechanism by which menopause affects arterial elasticity remains unclear. It has been hypothesized that estrogen might change the structure of the arterial wall. In vitro examinations and animal studies have shown that estrogen decreases collagen production and the elastin/collagen ratio [97]. Regardless of menopausal status, highly physically active women do not experience the age-related increases in central arterial stiffness as seen in sedentary women, emphasizing the importance of exercise [114]. This study also showed that central, but not peripheral, arterial stiffness increases with advancing age in sedentary healthy females, which is in agreement with other examinations [115]. Similarly, peripheral arterial elasticity is not different between sedentary and resistance trained individuals [74]. It has been suggested that the physiological mechanism behind the decrease in arterial elasticity with increasing age are more rapid in the large elastic arteries compared to the small muscular arteries [40]. The large arteries have a cushioning function that damps fluctuations in flow, whereas the small arteries do not exhibit the same extent of pulsatile changes in diameter, and may not undergo the adaptations leading to decreased elasticity of the artery [13].

Hypertension and Arterial Elasticity

The arterial remodeling and stiffness of the arterial wall that occur with advancing age, induce systolic hypertension, pulse pressure, and a reduction in diastolic blood pressure [6, 51]. Elevated arterial blood pressure is more prevalent with an increase in age [102], sedentary lifestyle [25], and a decrease in arterial elasticity [54]. Several epidemiological studies have reported an inverse relationship between blood pressure and habitual physical activity either assessed by questionnaire or interview, or measured objectively [25].

Decreased arterial elasticity is associated with changes in blood pressure profile, such as isolated systolic hypertension and pulse pressure. Increased pulse pressure could be a result of increased systolic hypertension and or a decreased diastolic pressure which is common in advanced arteriosclerosis and is responsible for the diastolic pressure stabilization or decline that is often seen after the age of 60 years [30]. Systolic hypertension among the elderly can be considered an expression of advanced arterial stiffness, which is a major component of cardiovascular aging [6].

Arterial elasticity is "pressure-dependent" [63], and in hypertensive patients, the decrease in arterial elasticity is partially due to increased distending blood pressure rather than thickening of the arterial wall and changes in intrinsic biomaterial stiffness [55]. Systolic blood pressure and pulse pressure during maximal exercise has been shown to be associated with impaired endothelial vasodilator function in the brachial artery, independent of resting blood pressure and arterial stiffness [106].

Obesity and Arterial Elasticity

Obese individuals with excess abdominal fat are at a particular risk for negative health consequences [59]. Studies have shown that adipose tissue in general, and visceral adiposity in particular, are key regulators of inflammation [132]. The inflammatory response to the body's increased amount of fat may have a negative effect on endothelial physiology, which may lead to the formation of atherosclerotic plaque [4]. Adipose tissue secretes proinflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α) and interlukin-6 (IL-6), and influences endothelial function by promoting the expression of adhesive molecules, which are central in the early stages of the atherosclerotic process [134].

Ziccardi et al. examined the effect of weight loss on circulating levels of proinflammatory cytokines and on endothelial function in healthy obese women [134]. The main finding from this study was that circulating levels of TNF-α, IL-6, vascular cellular adhesive molecule-1 (VCAM-1), intracellular adhesive molecule-1 (ICAM-1), and P-selectin were elevated in obese women and positively correlated with central adiposity. Weight loss in these subjects resulted in a significant down regulation of the inflammatory state and ameliorating endothelial dysfunction. These results agree with Tchernof et al. who examined the effects of weight loss on plasma CRP levels in obese postmenopausal women. They found that fat loss was associated with proportional reductions in CRP levels [116]. Another study found that body fat measures were among the strongest predictors of large arterial stiffness in young and older adults [125]. There also existed a strong association between weight gain and progression of arterial stiffness, as well as between weight loss and regression of arterial stiffness [124].

These findings suggest that weight loss could be a safe way to down regulate the expression of inflammation in an attempt to preserve the integrity of the vasculature.

Inflammation and Arterial Elasticity

It has been shown that there is a reduced arterial elasticity in patients with autoimmune and inflammatory diseases, such as rheumatoid arthritis [130]. Inflammation is a cardiovascular disease risk factor often associated with endothelial dysfunction [62], and loss of arterial compliance in both the large and the small arteries [130]. Advancing age is associated with increased expression of various inflammatory markers in the vascular wall interleukin-1 (IL-1), interleukin-6 (IL-6), and Tumor Necrosis Factor-α (TNF-α), leading to vascular wall changes and eventually nitric oxide bioavailability [122]. The up regulation of the expression of adhesion molecules in the vascular wall is the initiating event in this process and allows leukocytes and monocytes to penetrate into the subendothelium space where TNF-α, IL-6, and other cytokines are released, resulting in additional circulating cytokines [21]. High sensitive C-reactive protein (hsCRP) is a systemic marker for inflammation that has been associated with the risk for cardiovascular disease [12], and is released by the liver in response to IL-6 [21]. Duprez et al. support the hypothesis that hsCRP is associated with large arterial, but not with small arterial elasticity in asymptomatic individuals [21].

Wong et al. examined both large and small arterial elasticity in patients with rheumatoid arthritis (RA) and in healthy controls [130]. In addition, vascular health was compared and related to traditional vascular risk factors and measures of RA

disease activity and inflammation. As expected, hsCRP and VCAM-1 values were significantly elevated in RA subjects compared to controls. There was an inverse association with large and small arterial elasticity in both groups, with RA patients having a lower average large and small arterial elasticity. These values were also inversely correlated with markers of inflammation. This study found that vascular function is abnormal in RA, with reduced large and small arterial elasticity, and inversely associated with measures of inflammation. A study by Grey et al. showed that a reduction in large arterial elasticity of 2 ml/mmHgX10 was associated with a 33% increase in cardiovascular events [36].

The early detection of vascular damage and the identification and treatment of vascular inflammation and inflammatory diseases may reduce the personal and economic burden of increased disorders secondary to inflammatory diseases. Tools such as PCA can be used easily to noninvasively examine the integrity of the vasculature, and hsCRP can be measured with a simple blood test to examine any potential systemic inflammation.

Aerobic Exercise and Arterial Elasticity

Regular exercise could influence endothelial function and may improve the cardiovascular risk profile. The cardiovascular benefits of exercise are well established, including improving endothelial function in patients with, hypercholesterolemia [60], metabolic syndrome [56], lowering blood levels of low density lipoprotein cholesterol (LDL-C) [22], and decreasing risk for chronic heart failure [37].

It has been suggested that aerobic exercise improves endothelial function in different vascular beds. However, the beneficial effects on the vasculature were not maintained in the absence of exercise, hypothesizing the importance of continuous exercise [31]. Physical conditioning has beneficial effects on the cardiovascular system and the immune system [103]. Regular exercise diminishes the occurrence of developing ischemic heart disease, and reduces the chance of coronary mortality or morbidity after an acute myocardial infarction [7]. Several examinations have provided strong evidence that regular physical exercise attenuates the age-related vascular changes [32, 43, 112, 115], proposing that physical exercise can counterbalance the effects of aging on the atherosclerotic vascular process. Jensen-Urstad et al. examined the elasticity of large arteries in elderly men with and without a life-long history of regular strenuous endurance exercise [43]. Arterial elasticity was measured using ultrasound. They found that subjects with a life-long history of exercise had more elastic arteries than their control counterparts. However, this study only investigated very physically fit and sedentary individuals, had a very small sample size, and limited their analysis to only men. The results from this study cannot be generalized to other physical activity levels or populations.

The suggested mechanism for the increase in arterial compliance with aerobic exercise is that the increased pulse pressures and mechanical distension during the exercise sessions "stretches" collagen fibers and modifies their cross-linking, thereby increasing arterial compliance. Arterial compliance can also be altered over a short time period, even acutely, via modulation of the sympathetic-adrenergic tone of smooth muscle cells in the arterial wall [115].

Regular aerobic exercise training is efficient in delaying and attenuating arterial stiffness in healthy adults [114, 115]. However, the specific effect of resistance training on the vasculature still remains controversial.

Resistance Exercise and Arterial Elasticity

In recent years, resistance exercise prescription has become more widely acceptable in the various therapy settings, including cardiac rehabilitation settings. This type of exercise prescription is used most often in the prevention and attenuation of loss of bone mineral density and other related risks, such as predisposition for falling and functional disability [26]. Resistance training is strongly recommended as a preventative intervention in the elderly to enhance quality of life and activities of daily living [88]. It is reasonable to suggest that with increased muscular strength and greater bone mass, the elderly would be more physically active and gain some of the same beneficial effects on the vasculature as seen with endurance exercise.

However, a cross-sectional study by Miyachi et al. demonstrated that resistance training was associated with lower central arterial compliance, and that the age-related reductions in arterial compliance were greater in the resistance trained men than in sedentary men, suggesting that resistance exercise does not have similar favorable effects as endurance training [74]. Another study by the same author [75] examined a resistance training intervention lasting four months. The subjects participated in three supervised sessions each week for four months and detraining for a subsequent four months. The control group was instructed not to alter their normal levels of activity throughout the training period. The study

showed that arterial elasticity decreased in the resistance-training group, but not in the control group. The decrease in arterial elasticity returned to baseline levels during the detraining period, confirming that the change in arterial elasticity was due to the resistance training. While these past two studies only examined men, it has been shown that similar vascular responses with resistance training also can be observed in healthy women [19].

A possible explanation for this reduced central arterial compliance in resistance trained men may be that the acute intermittent elevations in arterial blood pressure in the cardiothoracic region during resistance exercise may result in chronic increases in the smooth muscle content of the arterial wall and the load-bearing properties of collagen and elastin. During each bout of resistance exercise, arterial blood pressure is known to increase as high as ~320/250mmHg. Another potential physiological mechanism is that the higher sympathetic nervous system activity in resistance-trained men may have acted to reduce arterial compliance by providing chronic restraint on the arterial wall through greater sympathetic adrenergic vasoconstrictor tone [74].

Cortez-Cooper et al. examined the effects of 11 weeks of high intensity resistance training on arterial stiffness and wave reflection in women [19]. They examined 23 healthy women (29 ± 1 years) that were either sedentary or recreationally active, but that did not participate in resistance training. The subjects performed a variety of lower and upper body exercises. The first 4 weeks of the training program, the subjects performed three sets of ten-repetition exercises until concentric failure. The following 4 weeks, three sets of five-repetition exercises

were completed. The last 3 weeks of the training intervention consisted of supersets, upper body exercise paired with lower body exercise, using six sets of five repetitions in which the weights increased for four sets followed by a decrease for two sets. Carotid augmentation index and pulse wave velocity as a measure of large arterial stiffness, increased significantly for the training group compared to that of the control group. Carotid-femoral PWV increased significantly in both groups, and was attributed to a possible increased physical activity for the control subjects due to seasonal variations.

One recent study showed that twelve weeks of resistance training performed five times per week did not alter central arterial compliance, suggesting a dose response relationship with resistance training [95]. There still exist gaps involving the physiological mechanism(s) responsible for the changes in the vasculature with resistance training. Other studies have examined the acute effects of resistance training on arterial compliance. During exercise, plasma norepinephrine levels are elevated after an acute bout of resistance exercise, which may suggest the possibility that sympathetic vasoconstrictor tone may also be elevated after exercise [80]. With this as background information, DeVan et al. examined the acute effects of one bout of resistance exercise on central arterial compliance [20]. Sixteen healthy sedentary or recreationally active adults were studied under parallel experimental conditions on 2 separate days. The order of experiments was randomized between resistance exercise (9 exercises at 75% of 1RM) and sham control (seated rest in the exercise room). Arterial compliance was determined noninvasively with a combination of ultrasound imaging at the common carotid artery with simultaneous applanation of

tonometrically obtained arterial pressures from the contralateral carotid artery. Central arterial compliance was decreased immediately and 30 minutes after resistance exercise. These measurements returned to baseline levels within 60 minutes after resistance exercise. So, the acute effects of resistance exercise on arterial stiffness are transient in nature, and the reduced elastic properties of the large arteries could be a result of the chronic effects of resistance exercise training.

Examining additional regional arterial stiffness effects after exercise, Kingwell et al. showed that a 30-minute bout of moderate cycling using both legs, increased arterial elasticity 30 minutes after the exercise [49]. They hypothesized the possible influence of systemic (e.g. sympathetic nervous activity, circulating hormones) and regional (e.g. endothelial-derived vasoactive substances) factors in changing the vascular tone. So, Sugawara et al. hypothesized that the exercise-induced decrease in arterial stiffness would mainly be caused by regional factors [107]. The effects of low-intensity single-leg exercise on regional stiffness were examined in young men. Their findings suggest that the acute decrease in stiffness in the midsized conduit artery with a low-intensity, short-duration exercise may be mediated by regional factors rather than by systemic factors.

Bertovic et al. suggested that resistance training was associated with increased arterial stiffness and high blood pressure [9]. They also suggested the possibility that the higher blood pressure among the resistance trained individuals promoted increases in arterial stiffness. Other studies have reported that the blood

pressure response during eccentric contractions is smaller than that during concentric contractions [85, 117].

With the previously information at hand, Okamoto et al. examined the effects of eccentric resistance training and concentric resistance training on arterial stiffness in 29 healthy female adults [83]. This study also examined the change in arterial stiffness after detraining to understand the effect of resistance training better. The subjects were randomized into an eccentric training group, concentric training group, or a sedentary group. The training groups performed resistance training three times per week for eight weeks. The nondominant arm was selected for training to minimize the effects of daily activities. The training consisted of 5 sets of 10 repetitions of an arm curl. Prior to the training, 1RM in arm curling was determined. The load was set to 100% of 1RM for eccentric training and 80% of 1RM for concentric training. Brachial blood pressure, brachial-ankle pulse wave velocity (baPWV), carotid artery intima-medial thickness (IMT) and carotid arterial lumen diameter was determined before and after training and after detraining. The baPWV before training did not differ between the groups. After eight weeks of resistance training, the arterial stiffness in the concentric group increased compared with the eccentric group and the sedentary group. However, baPWV, IMT and carotid lumen diameter in the eccentric and concentric groups were unchanged by eight weeks of resistance training. This suggests that eccentric resistance training may be effective as an exercise prescription for this population. More studies are needed in the future to examine the effect of whole body eccentric resistance training in an older population.

Maeda et al. examined the effect of leg resistance training on arterial stiffness in older men [65]. The subjects completed three sets of knee extension and flexion (10 repetitions at 60% 1 RM) twice per week for 12 weeks. Resistance training had no effect on arterial stiffness as assessed by aortic pulse wave velocity.

Aerobic Exercise and Resistance Exercise Combined

Regular aerobic exercise and resistance training are often recommended for the prevention and treatment of cardiovascular disease and frailty associated with aging. Regular endurance-type exercises seem to have beneficial effects for preventing or attenuating arterial stiffness in middle-aged and older adults [76, 115]. In contrast to the beneficial effects seen with endurance exercise, resistance training is associated with an increase, rather than a decrease in arterial stiffness [74]. So, regular aerobic exercise and resistance training seem to exert opposite effects on the elastic properties of the arterial wall. The following studies will examine the effects of performing a combination of endurance and strength training on arterial elasticity.

Cook et al. examined central and peripheral arterial compliance in middle-aged and older rowers and in age-matched sedentary controls [18]. They used a cross-sectional design to determine arterial compliance of 15 healthy, habitual rowers and 15 healthy sedentary controls. The mean age for the two groups was 50 years and 52 years, respectively. The rowers had been training for approximately five years, once per week. The two groups were matched for age, body composition, blood pressure, and metabolic risk factors. Central arterial compliance was determined with simultaneous ultrasound and applanation tonometry on the common carotid

artery. Central arterial compliance and carotid β-stiffness index was lower in rowers than in sedentary controls. There were no group differences in peripheral arterial compliance. These results suggest that regular rowing exercise in middle-aged and older adults is associated with a favorable effect on central arterial compliance, and that simultaneous performed endurance training may negate the stiffening effect often seen with resistance training.

The combined effect of endurance and resistance training has also produced favorable effects in other cardiovascular aspects. Four months of combined endurance and resistance training has shown to have an anti-inflammatory effect in patients with moderate to severe heart failure due to coronary artery disease [17]. After eight weeks of training involving a combination of cycle ergometry, treadmill walking and resistance training, there was an improvement in resistance vessel endothelial vasodilator function in patients with type 2 diabetes [67]. Another examination by the same author, concluded that a combination of aerobic and resistance training improves endothelium-dependent and –independent vascular function in patients with chronic heart failure [68]. Kawano et al. examined the effects of moderate resistance training as well as a combination of resistance and endurance training on arterial compliance [45]. Thirty-nine healthy young men were assigned either to moderate intensity training, combination resistance training and endurance training or a sedentary control group. Carotid arterial compliance (assessed by simultaneous carotid ultrasound and applanation tonometry) decreased approximately 20% after the moderate resistance training, with no changes observed in the combination or control group. This suggests a combination of resistance and

endurance training should be performed in order to negate the stiffening of the arteries.

Summary

A growing body of evidence suggests that obese individuals with excess abdominal fat are at higher risk for cardiovascular disease [59]. Furthermore, visceral adiposity in particular has been identified as a key regulator of inflammation, as is secreting proinflammatory cytokines, such as TNF-α, IL-6, and CRP. These markers further induce endothelial expression of adhesion molecules, which are central in the beginning stages of atherosclerotic plaque build up [134]. Studies have reported higher circulating levels of proinflammatory cytokines in obese men [27] and women [134]. Obesity is associated with hypertension and increased concentration of circulating inflammatory markers [27, 134], which further is associated with atherosclerosis and hardening of the arteries, i.e. arterial stiffness [111].

Weight loss has been shown to down regulate the inflammatory state and ameliorate endothelial function in women [134], and in hypertensive and normotensive men [27]. Endurance training has been shown to decrease blood pressure [25] and increase arterial elasticity in young healthy men in both cross-sectional, [81] and intervention studies [16, 50, 81]. The effect of resistance training on arterial elasticity is still unclear, with reports of no effect [65, 95], as well as an observed increase in arterial stiffness in both cross-sectional [74, 84] and intervention [75] studies. The newest approach introduced in the literature is to perform a combination of both endurance and strength training, as this has showed favorable outcomes thus far [18, 45].

CHAPTER III

METHODOLOGY

The primary purpose of this study was to examine the effect of twelve weeks of resistance training on large (C1) and small (C2) arterial elasticity in premenopausal women, and a group of healthy controls. The secondary purpose was to examine the relationship between C-reactive protein and arterial elasticity in these women. Subjects were healthy women between the ages of 19 and 48 years, and who were not taking hormone replacement therapy, antihypertensive drugs, or hormonal birth control. Measurement variables included large and small arterial elasticity, the inflammatory marker, CRP, and muscular strength (1-RM) for seven resistance exercises.

Subjects

The subjects for this study were healthy, premenopausal women between the ages of 19 and 48 years of age (n = 32). The subjects were recruited from the University of Oklahoma, Norman campus and the surrounding areas via recruitment flyers posted in public areas and flyers mailed to prospective subjects at the University of Oklahoma, Norman campus (Appendix A). Subjects read and signed a written informed consent as approved by the University of Oklahoma Institutional Review Board (Appendix B). All methods and procedures were approved by the University of Oklahoma Institutional Review Board (IRB No. 11551) (Appendix C). Approximately half of the subjects enrolled in the study in the fall, whereas the other half enrolled after Christmas break and trained through the spring. Most of the control subjects were recruited after Christmas.

Inclusion Factors

1. The subjects were healthy premenopausal women between the ages of 18 and 50 years.
2. Subjects were free of cardiovascular disease, peripheral arterial disease, coronary heart disease, non-smokers, not pregnant, not on hormone replacement therapy, not taking antihypertensive drugs or any hormonal birth control.
3. Subjects had the cognitive ability to give written consent and to follow the given guidelines.

Exclusion Factors

1. Subjects with a history of cardiovascular disease, coronary heart disease, and peripheral arterial disease were not allowed to participate.
2. Women with diabetes mellitus were not allowed to participate.
3. Those who were currently taking hormone replacement therapy or taking antihypertensive drugs, hormonal birth control, or were pregnant, were not allowed to participate.

Research Design

This study employed a mixed factorial repeated measures design as a control group and a training group was assessed before and after the 12 week training period. The subjects were screened during a telephone interview, where the procedures were reiterated again. Once cleared, the subjects were assigned either to a resistance-training group (T, n = 21) or a control group (C, n = 11). The training subjects were assigned either to a morning session (6:30am; 7:15am) or an afternoon session (4:30pm; 5:15pm) based on the subject's availability. The

training sessions were held on Monday, Wednesday, and Friday in the Neuromuscular Laboratory, located in the Department of Health and Exercise Science on the University of Oklahoma-Norman campus.

The first visit to the Bone Density Laboratory, also located at the Department of Health and Exercise Science on the University of Oklahoma-Norman campus, consisted of completing the informed consent and questionnaires about calcium intake, menstrual history, health status questionnaire (Appendix D), a baseline total body DXA scan, and baseline measures of large and small arterial elasticity. Following the first visit, an appointment was made to visit Goddard Health Center at the University of Oklahoma-Norman campus for a baseline blood draw. The subjects began a twelve week supervised resistance-training program at the Neuromuscular Laboratory at the Department of Health and Exercise Science. Strength was assessed by 1-RM at baseline, after six weeks of training to apply progressive overload, and then at twelve weeks. Blood draws, DXA scans, and measures of arterial elasticity were assessed at baseline and at the end of twelve weeks of training.

Resistance Training

The resistance training exercises primarily targeted sites at the hip and leg, and lower leg muscle groups. The following exercises were selected:

* Hip flexion (standing position on a multi-hip machine)
* Hip extension (standing position on a multi-hip machine)
* Hip abduction (standing position on a multi-hip machine)
* Hip adduction (standing position on a multi-hip machine)

* Supine leg press

* Biceps curl (using dumbbells)

* Triceps extension (using dumbbells)

* Calf (using a plate-loaded weight machine)

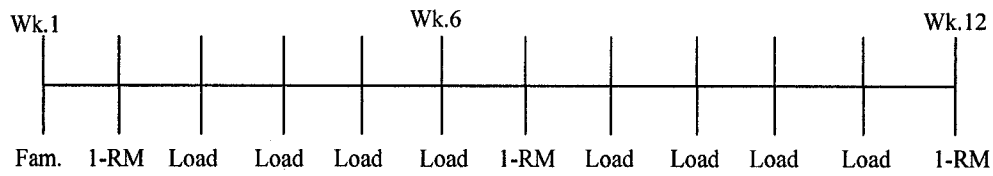
* Shin (using a plate-loaded weight machine)

The resistance exercises were performed using isotonic weight training equipment (Cybex Inc., Medway, MA) with a concentration on the hips, tibialis anterior and soleus muscles. The first week was familiarization of the equipment and exercises to prevent potential injuries. Trained personnel demonstrated proper use of equipment, and on week two, a 1-RM was determined. The biceps curl and the triceps extension exercises were not tested for 1-RM, and the weight selected for the exercises was chosen at the subject's own discretion. A proper warm-up was encouraged before the each exercise session, either walking or riding the stationary bicycle. The 1-RM was obtained by finding the maximum load that the subject could move with good form through the entire range of motion. Two warm-up sets with 8-10 repetitions and 3-5 repetitions with progressing load were completed before the first 1-RM attempt. The 1-RM was found within 5 attempts, with 1-minute rest between each attempt. The 1-RM testing was supervised and recorded by trained personnel (Appendix E).

The subjects performed two sets of eight repetitions at 80% of their 1-RM for all hip exercises. The remaining exercises consisted of three sets of eight repetitions at 80% of their 1-RM. Each exercise session was completed in about 30 minutes. During each training session, the subject personally recorded the number

of repetitions, amount of weight lifted and the number of sets for each of the exercises on a computer-generated work out log that specified the correct amount of weight to be used (Appendix E). Trained personnel supervised all exercise sessions, encouraged participants, and helped to change the weights whenever necessary. The first week of training consisted of familiarization with light weights for the subjects. During the second week, a 1-RM was obtained over two training sessions. The subjects performed 1-RM for half the exercises during session one and lifted weights for the resistance exercises not tested that day. The reminder of the 1-RMs were performed during session two with subjects lifting weights for the exercises tested during session one. The third session of the second week was the subjects first day of training at 80% of their 1-RM. The same protocol was followed for the mid-and post testing.

The week by week training schedule is depicted below.



Body Composition Measurements

Dual energy x-ray absorptiometry (DXA) (GE Medical Systems, Lunar Prodigy) was used to determine body composition before and after the training period. DXA is a noninvasive measuring tool, which requires little participation from the subjects. The subjects were asked to remove any metal or clothing containing metal, before laying down in a supine position on the DXA platform.

The subject must lie still as the scanner arm moves across the body in a posterior to anterior direction.

The DXA scan is based on high and low energy levels of X-ray passing through tissue, and the exposure to radiation is minimal. The low energy beam can only pass through the soft tissue, whereas the high-energy beam can pass through bone. Standard protocol was followed to ensure high accuracy. The analyses of the scans were analyzed using the encore software (GE Medical Systems, version 8.50.093) (Appendix F). Quality Assurance procedures were performed every day to ensure proper calibration prior to scanning.

The DXA scan provided information on the subject's BMD (g/cm^2), bone mineral content (g), and percent body fat. Qualified technicians performed all scans and analyses. The coefficient of variation for total body BMD using DXA in the Bone Density Research Laboratory is 1%.

Pulse Contour Analysis (PCA)

Arterial stiffness was measured using the HDI/Pulsewave™CR-2000 and the CVProfilor™ DO-2020 CardioVascular Profiling System (Hypertension Diagnostic, Inc., Eagan, Minnesota, USA). The device consisted of an oscillometric blood pressure module, a noninvasive Arterial PulseWave™ Sensor and a 486-75 MHz computer and medical electronics, which included a touch screen and software. The blood pressure cuff that was placed around the patient's left upper arm was connected to the rear panel of the unit with a hose.

The height and weight was measured and entered into the 486-75 MHz computer. The subject rested in a supine position for approximately five minutes.

An appropriate-sized cuff was wrapped around the subject's upper left arm. A rigid plastic wrist stabilizer was placed on the subject's right wrist to minimize any movement and stabilize the radial artery during the three 30-sec collection of blood pressure waveform data (Appendix G). A non-invasive Arterial PulseWave™ Sensor was positioned on the surface of the skin overlying the right radial artery at the point of the strongest pulsation to capture an analog blood pressure waveform. The sensor was adjusted to the highest relative signal strength, without occluding the artery. Three consecutive trials were performed, since one-way analysis of variance showed no significant differences between the trials, the trials were averaged for the subsequent analyses.

This noninvasive instrument has proven to be a reliable [57, 92] [52, 91] measurement of large and small arterial elasticity, and useful in its method for assessing atherosclerosis [58]. The investigator's precision of the PCA measurements was determined by measuring 9 healthy men and women two different times, 2-3 days apart. To avoid potential diurnal variations, the subjects were tested in a fasted and rested state at the same time of day for both visits. The coefficient of variation for C1 and C2 measurements obtained by the same operator, were 12% and 12%, respectively. The intraclass correlation coefficients for C1 and C2 were 0.797 and 0.984, respectively.

Blood Sampling

Venipuncture blood collection from the antecubital vein occurred in the morning after at least eight hours of fasting, and with the subjects in a resting condition. A certified phlebotomist or a registered nurse at Goddard Health Center

performed the blood draws. A sample of 6 ml of blood was collected. The samples were centrifuged and serum samples were aliquoted into 0.5 ml vials and frozen at -70°C until the time of the C-reactive protein (CRP) assays. To reduce protein degradation, the serum was only thawed once prior to the assays.

Biochemical Assays

CRP was measured in duplicate by enzyme-linked immunosorbent assay (ELISA) kits (Alpco Diagnostics, Salem, NH). The enzyme absorbance was determined using a spectrophotometer (Packard, Downers Grove, IL) and the CRP concentration was calculated using a standard calibration curve. CRP units are reported in mg/l. The normal range for healthy adults is 0.068 – 8.2 mg/l. The intra-assay coefficient of variation was 6.7% and 8% and the inter-assay coefficient of variation was 16%.

The CRP assay protocol was completed according to the following guidelines (Appendix H):

1. Allow serum and kit to come to room temperature.
2. Wash Buffer: (1:10) 450 ml dH2O + 50 ml wash buffer.
3. Antibody Solution: (1:100) 100 µl antibody + 10 ml wash buffer.
4. Sample Dilution (1:100) 10 µl sample + 990 µl dilution buffer.
5. Pipette 10 µl of the Standards (A-F), Controls (high and low), and Unknowns followed by 100 µl of the antibody solution.
6. Cover microwell samples with sealing tape, place and attach with foam and tape onto Innova 2000 platform shaker (New Brunswick Scientific,

Edison, NJ), and incubate at room temperature for 60 minutes at 300 rpm.

7. The microwells are washed 5 times with 250 µl of wash solution using the MultiWash Microplate Washer (Tri Continent, Grass Valley, CA). After the wash the microwells are blotted dry.
8. Add 100 µl of the diluted antibody to each well and incubate for 60 minutes on the Innova 2000 platform shaker as previously described.
9. The microwells are washed 5 times with 250 µl of wash solution as previously described.
10. Add 100 µl of Substrate Solution to each well and incubate at room temperature for 10 minutes in the dark.
11. Add 50 µl of Stop Solution to each well.
12. Read absorbance at 450 nm in the Spectracount Plate Reader (Packard, Downers Grove, IL).

Data Analyses

All descriptive analyses were reported in mean ± standard error (SE) for the dependent variables. The effects of the training on large and small arterial elasticity and CRP were analyzed by two-way (group X time) repeated measures analysis of variance (ANOVA). Pearson Product Moment Correlation Coefficients were computed to determine the relationships among the arterial elasticity variables and CRP. Percent changes from baseline in arterial elasticity, CRP and strength were calculated (%Δ = (post-pre/pre)*100) and a one-way ANOVA was used to examine any significant group differences. Analysis of Covariance (ANCOVA) was used to

examine large arterial elasticity responses after adjusting for body weight, BMI, and % body fat. The level of significance was set at $p \leq 0.05$. All statistical procedures were performed by SPSS 11.5 software (Chicago, IL).

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to examine the effects of a 12-week resistance training program on large (C1) and small (C2) arterial elasticity and the inflammatory marker C-reactive protein (CRP). Subjects were healthy premenopausal women, between the ages of 19 and 48 years, who were not taking any hormonal contraceptives. Primary outcome measures included large and small arterial elasticity and the biochemical marker of inflammation, CRP.

Subject Characteristics

A total of 43 subjects were recruited, however 7 subjects did not start the program for a variety of reasons. The reasons were time commitment, a primary focus on lower body exercises in the training program, and not being able to contact subjects after the first visit. Two training subjects had to withdraw after eight weeks due to family illness and one control could not participate in post testing due to family illness. Thirty-four subjects completed the 12 weeks; however, two control subjects could not participate in the 1-RM post testing due to physical injuries outside the study, and were excluded from the statistical analyses. Thirty-two subjects completed the 12 weeks of the study and were used in the analyses. The subjects in the intervention group completed ~ 85 % of the scheduled training sessions.

Subjects were assigned to experimental groups based on their availability to train in the morning or in the afternoon. Table 1 displays the baseline physical

characteristics. There were no significant differences ($p > 0.05$) between groups for these variables at baseline.

Table 1. Physical Characteristics at Baseline for each Group.

	Group	
Variable	Training (n = 21)	Control (n = 11)
Age (yrs)	33.2 ± 2.1	36.8 ± 3.2
Body Weight (kg)	74.2 ± 4.5	67.0 ± 3.3
Height (cm)	166.1 ± 1.1	165.6 ± 2.1
BMI (kg/m^2)	26.6 ± 1.4	24.4 ± 1.1
Body Fat (%)	36.5 ± 1.8	35.7 ± 3.1
BSA (m^2)	1.8 ± .05	1.7 ± .04
FFM (g)	42684 ± 1735.3	39103 ± 1254.3

Values are means ± SE. BMI; Body Mass Index, BSA; Body Surface Area, FFM; Fat Free Mass.

There were no significant ($p > 0.05$) changes from baseline in BMI, weight, %body fat, or fat free mass for any of the groups.

Cardiovascular Responses to Training

Table 2 shows the mean baseline and post-test cardiovascular measures for the training and the control groups. Repeated measures ANOVA (time x group) revealed that diastolic blood pressure had no significant group ($p = 0.828$), or group*time interaction effects ($p = 0.947$), but did show a significant time effect ($p = 0.049$). Diastolic blood pressure decreased over time for both groups. Systolic blood pressure showed no group ($p = 0.641$) or group*time interaction effects ($p = 0.665$), but did show a trend for time effect ($p = 0.073$). Heart rate, pulse pressure, systemic vascular resistance, and total vascular impedance did not significantly ($p > 0.05$) change from baseline to the end of the training period. The percent changes of these variables are shown in Table 3.

Table 2. Cardiovascular Variables.

	Group			
	Training (n = 21)		Control (n = 11)	
Variable	Pre	Post	Pre	Post
RHR (beats/min)	66.3 ± 1.9	65.2 ± 2.4	61.7 ± 2.9	58.9 ± 3.1
SBP (mmHg)	118.9 ± 2.4	116.2 ± 3.0	117.9 ± 3.0	113.6 ± 2.1
DBP (mmHg)	69.0 ± 2.0	66.6 ± 2.1*	69.6 ± 2.7	67.4 ± 2.1*
Hypertension (%)	19	9.5	18	9
PP (mmHg)	49.8 ± 1.2	49.5 ± 1.3	48.2 ± .9	46.1 ± .8
C1 (ml/mmHg x 10)	15.9 ± .6	17.2 ± 1.1*	16.0 ± .9	18.1 ± 1.3*
C2 (ml/mmHg x 100)	7.6 ± .5	7.8 ± .6	8.2 ± .9	8.6 ± .9
CRP (mg/L)	2.2 ± .7	2.53 ± .6	1.3 ± .6	1.5 ± .8
SVR dyne·sec·cm^{-5}	1263.9 ± 63.2	1167.4 ± 47.6	1334.0 ± 57.2	1284.6 ± 44.9
TVI dyne·sec·cm^{-5}	126.5 ± 6.4	120.2 ± 5.4	128.4 ± 5.3	120.5 ± 3.9

*p < 0.05, Values are mean ± SE. RHR; Resting Heart Rate, SBP; Systolic Blood Pressure, DBP; Diastolic Blood Pressure, Hypertension defined as SBP/DBP > 130/85 mmHg, PP; Pulse Pressure,C1; Large Arterial Elasticity, C2; Small Arterial Elasticity, CRP; C-Reactive Protein, SVR; Systemic Vascular Resistance,TVI; Total Vascular Impedance.

Table 3. Mean ± SE Percent Change in Cardiovascular Variables After Training.

	Group	
Variable	Training (n = 21)	Control (n = 11)
RHR (beats/min)	-1.03 ± 3.51	-4.52 ± 1.85
SBP (mmHg)	-2.04 ± 2.01	-3.38 ± 1.38
DBP (mmHg)	-3.16 ± 1.77	-2.61 ± 2.29
PP(mmHg)	0.18 ± 2.92	-4.21 ± 1.03
SVR dyne·sec·cm^{-5}	-5.38 ± 3.67	-3.15 ± 2.47
TVI dyne·sec·cm^{-5}	-2.34 ± 4.84	-5.16 ± 3.44

RHR; Resting Heart Rate, SBP; Systolic Blood Pressure, DBP; Diastolic Blood Pressure, PP; Pulse Pressure, SVR; Systemic Vascular Resistance, TVI; Total Vascular Impedance.

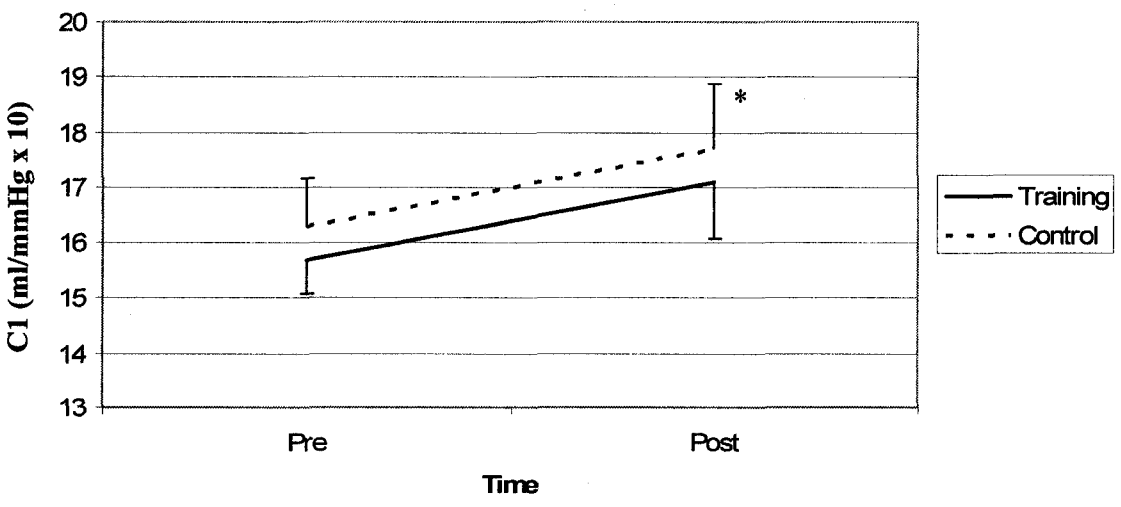
Large and Small Arterial Elasticity

Based on the two-way (time x group) repeated measures ANOVA, there was no significant group effect for C1 (p = 0 .723), but a significant time effect with an increase in C1 (p = 0 .023) from pre to post test, and no significant interaction

between time*group (p = 0.634). The same analyses for C2 revealed no significant group (p = 0.497), time (p = 0.537), or significant time*group interaction effects (p = 0.764). C1 showed an increase of 9% for the training group and 13% for the control group, whereas C2 revealed a non-significant (p > 0.05) increase of 5.8% and 11.5% for the training group and the control group, respectively. The relative changes in C1 for both groups exceeded the CV for C1 (6.7%) determined in the precision analysis.

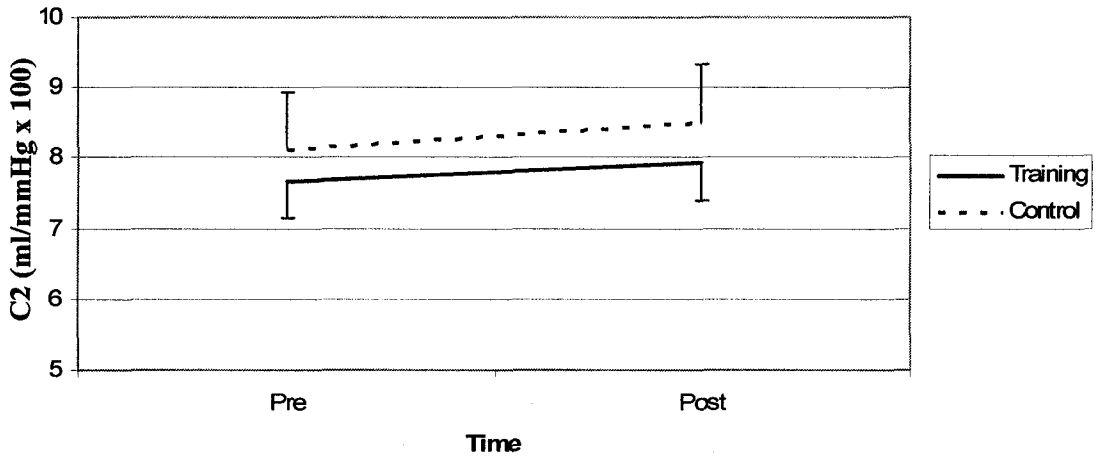
After using Analysis of Covariance (ANCOVA) to adjust for body weight, BMI, and percent body fat in separate analyses, there was no longer a significant time effect for C1 (p > 0.05). After adjusting for age, there still was a significant time effect for C1 (p = 0.043), but no significant group (p = 0.377) or group*time interaction effects (p = 0.468). The unadjusted C1 and C2 responses to 12 weeks of training are presented in Figure 1 and Figure 2.

Figure 1. Large Arterial Elasticity (C1) Responses to 12 Weeks of Training.



* Significant time effect, p < 0.05, Values reported as Mean ± SE.

Figure 2. Small Arterial Elasticity (C2) Responses to 12 Weeks of Training.

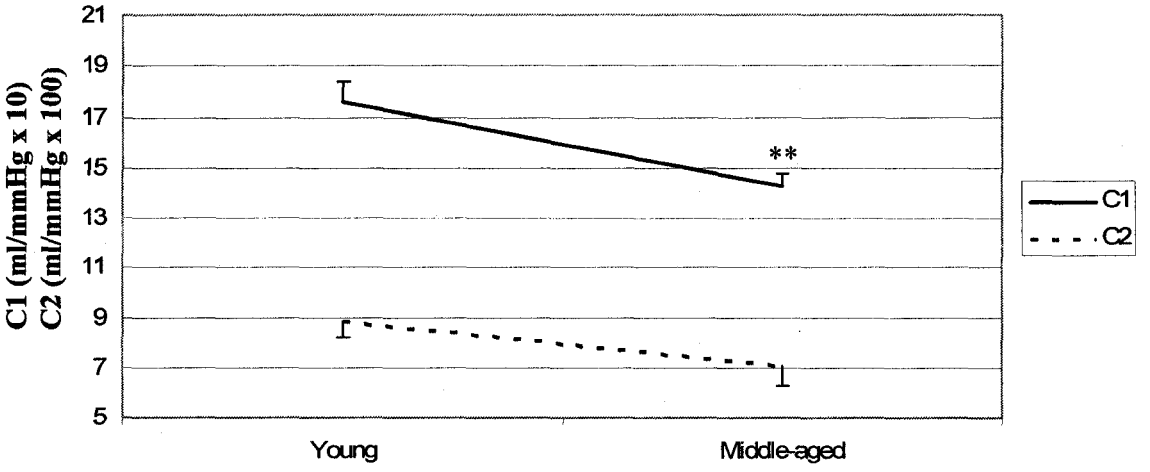


No significant differences, $p > 0.05$. Values reported as Mean ± SE.

Age and Arterial Elasticity

Since there was a large age range the study, the relationships between age and arterial elasticity variables were examined using Pearson Product Moment Correlation Coefficients. There was a significant negative correlation between C1 and age ($r = -0.381$, $p = 0.032$), indicating as age increased the elasticity of the large arteries decreased. There was no significant relationship between age and small arterial elasticity ($r = -0.101$, $p = 0.581$). After grouping the subjects into two age-groups; (1): 19-33 years ($n = 16$) and (2): 34-48 years ($n = 15$), a one-way ANOVA revealed that the older group had significantly stiffer large arteries ($p = 0.002$), but not small arteries ($p = 0.119$) compared to the younger group. Figure 3 shows the age group differences for large and small arterial elasticity.

Figure 3. Baseline Age Group Differences for Large and Small Arterial Elasticity.

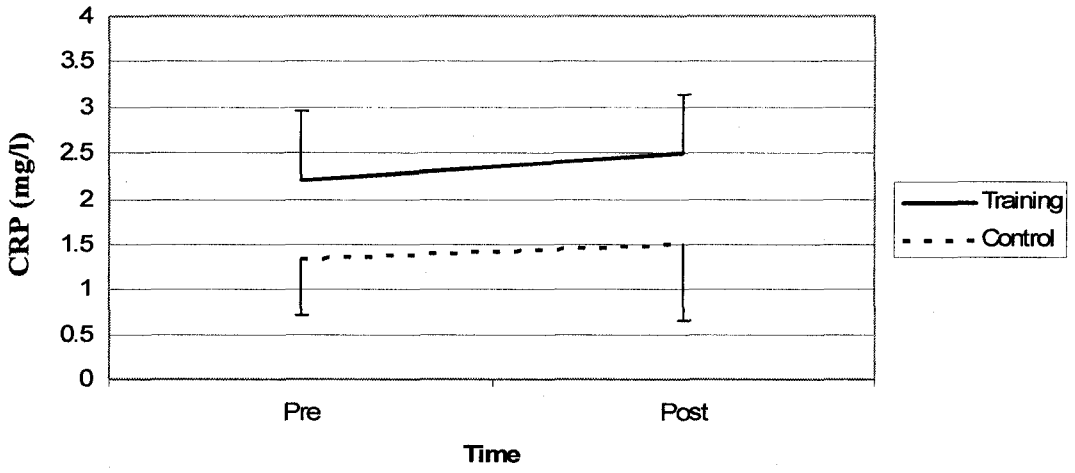


** $p<0.01$; Age group differences. Values reported as Mean ± SE.

CRP Responses to Training

Two-way Analysis of Variance with repeated measures (time x group) was completed to examine CRP responses to training. There were no significant group ($p = 0.346$), time ($p = 0.641$), or time*group interaction effects ($p = 0.899$). The non- significant percent change in CRP was 83.9% and 9.1% for the training group and the control group, respectively. After excluding three outliers, the percent change in CRP was 46.8% for the training group. Figure 4 displays the CRP responses to training.

Figure 4. CRP Responses to 12 Weeks of Training.



Values reported as Mean ± SE.

Pearson Product Moment Correlation Coefficients were computed to examine the relationships between CRP and cardiovascular and body composition variables. As shown in Table 4, body weight, BMI, and percent body fat were positively related ($p < 0.05$) with CRP.

Table 4. Baseline CRP Correlations for All Subjects.

	C-Reactive Protein (mg/L)	
Variable	*r*	*p-value*
Age (yrs)	0.116	0.528
SBP (mmHg)	0.313	0.081
DBP (mmHg)	0.197	0.279
Pulse Pressure (mmHg)	0.306	0.089
SVR dyne·sec·cm^{-5}	-0.089	0.628
TVI dyne·sec·cm^{-5}	0.035	0.848
Body Weight (kg)	0.44	0.012*
BMI (kg/m^2)	0.474	0.006**
Body Fat (%)	0.507	0.003**
C1 (ml/mmHg x 10)	-0.163	0.373
C2 (ml/mmHg x 100)	-0.183	0.317

**p<0.01, *p<0.05. SBP; Systolic Blood Pressure, DBP; Diastolic Blood Pressure, SVR; Systemic Vascular Resistance, TVI; Total Vascular Impedance, BMI; Body Mass Index, C1; Large Arterial Elasticity, C2; Small Arterial Elasticity.

Muscular Strength Responses to Training.

The mean muscular strength values (kg) for the seven exercises (hip flexion, hip extension, hip abduction, hip adduction, leg press, calf raises, and shin exercise) are shown in Table 5. There were no significant differences ($p > 0.05$) between groups at baseline for any of the strength variables, and the relative changes in strength are presented in Figure 5 and 6.

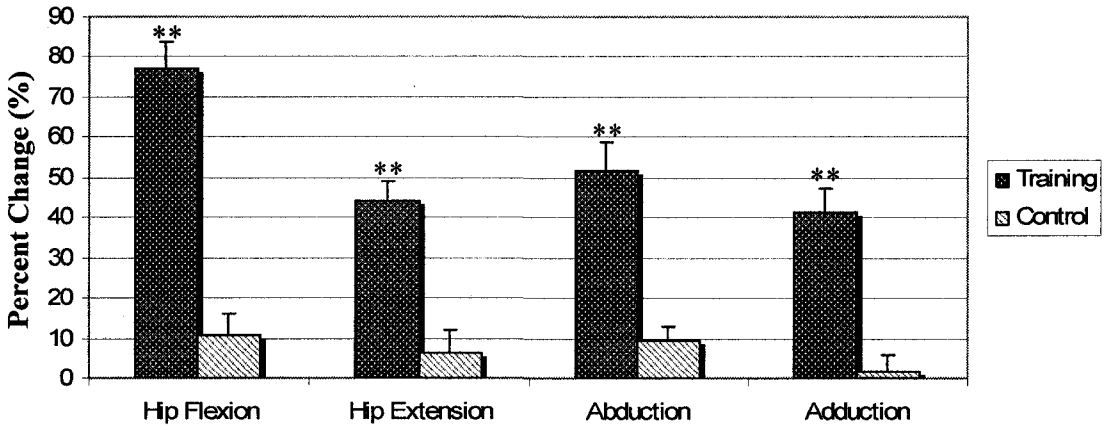
Table 5. Muscular Strength at Baseline and After 12 Weeks of Training.

	Group			
	Training (n = 21)		Control (n = 11)	
Variable	Pre	Post	Pre	Post
Hip Flexion	48.8 ± 1.9	85.4 ± 3.7**††‡	51.6 ± 2.0	57.0 ± 3.8
Hip Extension	65.3 ± 2.9	95.2 ± 3.2**‡	72.3 ± 4.0	75.4 ± 4.8
Hip Abduction	39.6 ± 1.2	59.2 ± 2.5**††‡	40.2 ± 2.0	43.9 ± 2.4
Hip Adduction	49.2 ± 1.8	69.0 ± 3.3**‡	52.4 ± 2.0	53.2 ± 2.7
Leg Press	107.3 ± 4.4	144.5 ± 8.0**†‡	101.2 ± 6.1	111.1 ± 4.7
Calf Raises	51.6 ± 2.7	88.5 ± 4.5**††‡	46.2 ± 3.4	58.4 ± 5.7
Shin Exercise	17.9 ± 1.1	25.8 ± .8**‡	19.6 ± 1.3	20.3 ± 1.0

†p<0.05, ††p<0.01 Group effect; **p<0.01Time effect, ‡p<0.01 Group*Time interaction. Values reported as Mean ± SE. Values are expressed in kilograms.

Two-way (time x group) repeated measures ANOVA was carried out to examine the muscular strength changes. There were significant group ($p = 0.004$), time ($p = 0.000$), and group*time interaction effects ($p = 0.000$) for hip flexion strength, with the training group becoming significantly stronger compared to the control group during the course of the training period. The training group increased in hip flexion strength 76.9% from baseline whereas the control group only increased 10.5%. There was no group effect ($p = 0.130$), but a significant time effect ($p < 0.01$), and a significant group*time interaction ($p < 0.01$) were found for hip extension strength. The training group improved their strength by 44.1% from baseline whereas the control group only increased 6.0%. The hip abduction exercise showed significant group ($p = 0.011$), time ($p = 0.000$), and group*time interaction effects ($p = 0.000$), with a 51.5% increase in strength observed for the training group and a 9.4% increase for the control group. Hip adduction strength showed no significant group effect ($p = 0.087$), however it did show a significant time effect ($p = 0.000$) and group*time interaction ($p = 0.000$). The training group increased their strength 41.6% from baseline and the control group increased 1.7%.

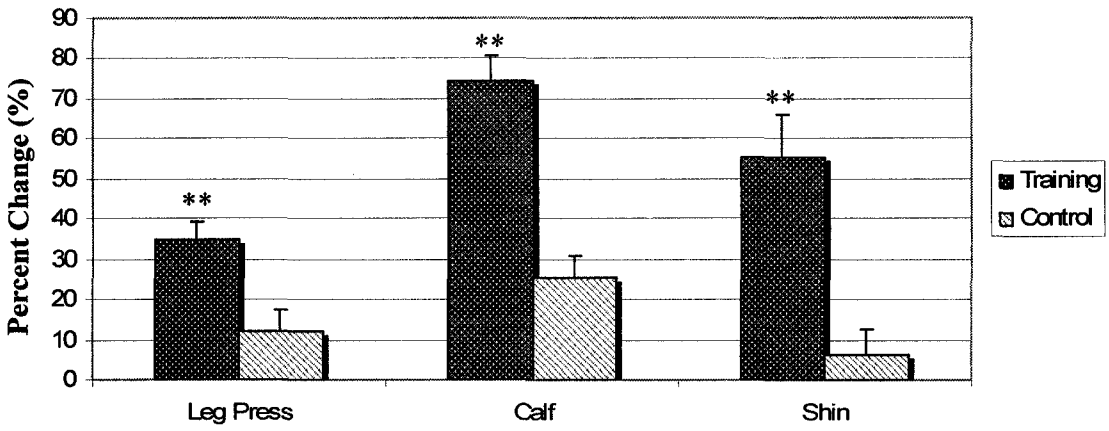
Figure 5. Percent Changes for Hip Exercises from Baseline for Both Groups.



**p < 0.01, Values reported as Means ± SE.

The same analyses were carried out to examine leg press, calf raise and shin exercise strengths. Leg press showed significant group ($p = 0.034$), time ($p = 0.000$), and group*time interaction effects ($p = 0.003$), with a 34.6% increase from baseline for the training group versus 12% for the control group. When examining calf raises, the analyses showed significant group ($p = 0.004$), time ($p = 0.000$) and group*time interaction effects ($p = 0.000$). There was a 74.3% increase in calf strength from baseline for the training group and a 25% increase for the control group. After examining shin strength, no significant group effect was detected ($p = 0.174$), however there was a significant time effect ($p = 0.000$), and group*time interaction ($p = 0.001$). The training group had a 55.2% increase in shin strength from baseline, whereas the control group increased 6.2%.

Figure 6. Percent Changes from Baseline for Leg Press, Calf Raises and Shin Exercise.



** $p < 0.01$, Values reported as Means ± SE.

The relationship between total workload and C1, C2, and CRP for the training group was examined using Pearson Product Moment Correlation Coefficients. The analyses revealed no relationship between total workload and C1 ($r = -0.10$, $p = 0.965$), C2 ($r = -0.159$, $p = 0.492$), and CRP ($r = 0.083$, $p = 0.721$).

Discussion

The current study examined the effects of resistance training on large and small arterial elasticity and the inflammatory marker, CRP, in healthy premenopausal women. The uniqueness of this study is the examination of arterial elasticity following lower leg resistance training in women. It has been well documented in previous research that endurance training increases arterial elasticity [31, 32, 43, 112, 115], whereas the effect of resistance training on arterial elasticity is still unclear, with contradictory results documented [9, 19, 20, 74, 75, 83, 85, 94, 95]. Most of the

studies have shown a decrease in arterial elasticity following resistance training[19, 74, 75], whereas others have shown no changes [95], or an increase in arterial elasticity [49]. The wide range of results leads us to speculate there may be a dose response impact that needs further attention.

This study provides some interesting results in regards to the effect of resistance training on arterial elasticity in women. To our knowledge, this is the first study that examined arterial elasticity after 12 weeks of lower leg resistance training in women. The current study did not find the negative effect on the arteries that has been previously reported with resistance training. There are studies that have reported an increase in arterial stiffness after 4 months of resistance training [75], whereas other have found arterial elasticity unchanged after 12 weeks of training [95]. The exact mechanism in which arterial elasticity is modified during resistance training is not well understood. It has been suggested that the frequent increase in arterial blood pressure [74] and shear stress [94] in the arterial wall during resistance training are contributing factors to the often observed decrease in arterial elasticity. Other suggestions are greater sympathetic nerve activity, decreased nitric oxide bioavailability, and increased levels of vasoconstrictor hormones [19].

Arterial Elasticity

The subjects for this study were healthy, premenopausal women, who did not take any hormonal contraceptives. This study showed a significant increase over the 12 weeks in large arterial elasticity ($p < 0.05$) for both groups. Since there was an increase in arterial elasticity in both the training and control groups, the changes cannot be attributed to the resistance training. A similar study which also

examined the effects of 12 weeks of leg resistance training on arterial function, found no change in arterial elasticity with training [65]. This study only examined men, had a relatively small sample size (n = 11), and did not have a control group for comparison. Since the subjects only exercised twice per week at 60% of 1-RM, the resistance training program may not have been strenuous enough to elicit a modification in the vasculature. Cortez-Cooper et al. examined arterial stiffness after 11 weeks of high-intensity resistance training in young women [19]. The first 4 weeks the subjects performed three sets of ten repetitions until failure, followed by another 4 weeks of three sets of five repetitions. In the last three weeks of the intervention, upper and lower body exercises were paired and incorporated using six sets of five repetitions in which the weights were increased for four sets then decreased for two sets. They found an increase in large arterial stiffness in the training group compared to that of the control group. This study did not agree with our findings, which could possibly be due to a more strenuous training program and the inclusion of upper body resistance exercises. Recreational resistance training program or a therapy program is usually not as strenuous, which might explain some of the variation seen in arterial elasticity with resistance training. This suggests that there may be a dose response issue that needs to be further examined, and that moderate intensity resistance training may not produce the negative effects on the arteries, which is often observed with high intensity resistance training.

Kawano et al. examined the effects of moderate resistance training as well as the combined resistance and endurance training on large arterial elasticity [45]. Thirty-nine healthy men were assigned to either the moderate-intensity training

(MODE) group, the combined resistance and endurance training (COMBO) group or the sedentary control (CONTROL) group. The subjects trained 3 times per week for 4 months followed by another 4 months of detraining. The COMBO group completed three sets of 8-12 repetitions at 80% of 1-RM and the MODE group completed three sets of 14-16 repetitions at 50% of 1-RM. The COMBO group performed a cycle exercise at 60% of the maximal heart rate for a duration of 30 minutes, immediately after completing the resistance training protocol. This study found a significant decrease in arterial compliance of approximately 20% after MODE training, contrary to our results, and no significant changes were observed in the COMBO or CONTROL groups. The study further showed that large arterial compliance returned to baseline following the detraining period. Small arterial elasticity did not change in any of the groups, which is in agreement with our study. This study concluded that simultaneously performed endurance exercise and resistance exercise could prevent the stiffening effect of the arteries that is often seen with resistance training alone.

Our results are not in agreement with Miyachi et al. who showed that arterial elasticity decreased after 2 months of resistance training [75]. The subjects were non-obese men aged 20-38 years old and trained 3 days per week, who completed 3 sets of 8-12 reps at 80% of 1-RM, which is very similar to our study. However, this study resistance trained both lower and upper body, compared to our focus on lower body exercises.

For our study, the relative changes in C1 were 9% and 13% for the training group and the control group, respectively. The changes observed in C1 are not

believed to be due to measurement error as the coefficients of variation were small. The increase in large arterial elasticity observed in the current study from pre to post in both groups, could possible be due to increased physical activity with spring approaching. Perhaps the subjects became more active outside the training study, although they were instructed to continue their normal daily activity. Physical activity outside the study was not controlled, which is a limitation, and it is possible that if both the training group and the control group engaged in more endurance type of activities, this could have had a positive effect on the elasticity of the arteries. Recreational physical activity has been associated with increased arterial elasticity [38, 102], however, it is important to note that other studies have not found this relationship [100].

Our study found no significant changes in small arterial elasticity ($p > 0.05$), which is in agreement with two other studies that found no differences in small arterial elasticity between sedentary and resistance trained men [74] and women [19]. It has been suggested that the decrease in arterial elasticity is more rapid in the large arteries compared to the small [40], and that may explain why we did not observe any changes in small arterial elasticity in just 12 weeks of training. Perhaps a training program of longer duration is necessary to detect any changes in the peripheral arteries.

Estrogen Status and Arterial Elasticity

Although the current study only examined premenopausal women, natural menopause in healthy women has been shown to decrease arterial elasticity [123], whereas hormone replacement therapy seems to attenuate this process in

postmenopausal women [73, 76, 93]. Previous studies have documented that healthy premenopausal women have greater arterial elasticity compared to their postmenopausal peers [123]. The exact mechanism in which menopause exerts its effect on the cardiovascular system remains unclear. In animal studies, it has been hypothesized that estrogen has a vasodilatory effect on the vasculature, resulting in greater elasticity of the arteries [128]. Further, studies have shown that postmenopausal women who take hormone replacement therapy have more elastic arteries compared to postmenopausal women who do not take any hormone replacement therapy, further suggesting the beneficial effect of estrogen supplementation. Another limitation of this study is that hormone supplementation, menopausal status and physical activity was based on self-report, which often are subject to recall bias and misclassification. Studies have reported that different phases of the menstrual cycle can have an impact on arterial elasticity [39], whereas others have not found this relationship [127]. My study did not examine baseline and post-test arterial elasticity in the same phase of the subject's menstrual cycle, which could pose as a limitation of this study.

The current study only examined premenopausal women who were not taking any hormonal contraceptives, so the slight increase in large arterial elasticity in both the training group (9%) and the control group (13%), could not be attributed to the intervention or hormone supplementation. It is possible that natural estrogen levels in the subjects had a protective effect that resulted in a greater increase in large arterial elasticity, contrary to similar studies completed in men [9, 75].

C-Reactive Protein

The current study examined the inflammatory marker C-reactive protein (CRP), which is a marker of inflammation and is considered a risk factor for cardiovascular disease [12]. At baseline, there were no differences in CRP levels between the training group and the control group ($p > 0.05$), and there were no significant ($p > 0.05$) differences after the training period for any of the groups. This study revealed a weak and non-significant ($p > 0.05$) relationship between CRP levels and large and small arterial elasticity both at baseline and after the training period. This is not in agreement with other studies, which found that raised concentrations of CRP are associated with a decreased arterial elasticity or increased stiffness of the arteries in healthy individuals [21, 70, 131] and in hypertensives [47, 66]. Why our data do not support the studies mentioned above is unclear. It could possibly be due to technical error during the arterial elasticity measurement, the subjects not complying with the proposed fasting and resting assumptions or too small of a sample size to detect a significant relationship.

Further analyses showed that after twelve weeks of resistance training there were no significant changes in CRP concentrations in any of the groups ($p > 0.05$). However, CRP levels had a non-significant increase of 83.9% for the training group and 9% for the control group. This large percent change was in part due to one subjects' increase in CRP levels from pre to post, but it is important to note that this subject was still within the normal ranges for an adult. Just one other study was found that examined CRP before and after resistance training in premenopausal women. Cortez-Cooper at al. found no changes in CRP after 11 weeks of resistance training, which is in agreement with our study [19]. This study used a high-intensity

strength training program, which was designed for the subjects to perform each set of ten repetitions until failure. Most of the other studies are cross-sectional, examined men and focused on different inflammatory markers.

Rall et al. also examined the effects of 12 weeks of resistance training on various cytokines, including inflammatory markers such as TNF-α, IL-1, IL-2, and IL-6 [96]. The resistance trained male subjects performed 8 repetitions (80% 1-RM), 3 sets, twice per week for 12 weeks. They reported that high-intensity resistance training did not affect the concentrations of inflammatory markers, which is in accordance with our study, although we measured a different marker.

Petridou et al. had their subjects perform 3 sets of 10 resistance exercises with 10-12 repetitions at 70-75% of 1-RM in a circuit training fashion [87]. This study examined serum concentrations of vascular cell adhesion molecule-1 (VCAM-1), intercellular cell adhesion molecule-1 (ICAM-1), E-selectin, P-selectin and L-selectin. No changes were observed in the concentrations of these cell adhesive molecules, suggesting no negative effect on immune function. This study examined a small sample of young men, and did not investigate CRP.

For this study there was concern regarding the lapse in time between the last 1-RM and the blood draw, and whether or not this was a biological error in regards to the results of the CRP concentrations Several cross-sectional studies have examined various inflammatory markers that have shown minor changes in plasma cytokine concentrations [41], whereas others have shown that post-exercise changes in cytokines do occur 72-144 hours after high-intensity resistance exercise, but when compared to strenuous endurance exercise, they are generally of smaller magnitude

and occur at a later time after the termination of exercise [104]. With these conflicting results, it is difficult to predict if it would have made a difference if the subjects had their last blood draw a few days after completing their last 1-RM.

Muscular Strength

Muscular strength was assessed by 1-RM (kg) for seven exercises targeting the lower body. The seven exercises tested were hip flexion, hip extension, hip adduction, hip abduction, leg press, calf raises, and shin strength. There were no significant ($p > 0.05$) differences in strength between the groups at baseline. From baseline, the training group significantly ($p < 0.05$) increased 1-RM strength for hip flexion, hip abduction, leg press, and calf raises at week 12 compared to the control group. There were significant ($p > 0.05$) increases in strength from baseline for hip extension, hip adduction, and shin exercise in both the training group and the control group.

The training group had a significantly ($p < 0.01$) greater percent change for the seven exercises compared to the control group. The greater percent increase in hip flexion, hip extension, hip adduction and hip abduction compared to the control group were 66%, 38%, 40%, and 42%, respectively. For the remaining exercises (leg press, calf raises, and shin exercise), the training group had the following greater increases in strength: 22%, 49%, and 49%, respectively, compared to the control group.

Prabhakaran et al. had premenopausal women participate in resistance training sessions (80% 1-RM), three days a week for 14 weeks [90]. The control group did not take part in any structured exercise during the training period. The

training comprised of loading the major muscle groups (legs, arms, trunk, and lower back). Subjects performed two sets of eight repetitions and went to exhaustion on the third set. Fourteen weeks of resistance training resulted in a total increase in strength for the eight exercises by 27%, whereas the control group either remained unchanged or significantly decreased. This study has similarities to the current study, however, the subjects in our study were on average a little older, and did not exercise to exhaustion in the third set.

Another study by Cortez-Cooper et al. examined high-intensity and power resistance training in healthy young women (mean age 29 years) [19]. The training study lasted 11 weeks using a light-day/heavy-day periodized approach. The specific exercises included bench, press, overhead press, weight-assisted parallel bar dip, dumbbell crossover pull, dumbbell rowing motion, deadlift, medicine ball drills latissimus dorsi pulldown, dumbbell curls, and abdominal exercises. The first 4 weeks the subjects performed three sets of ten repetitions to failure. The subsequent 4 weeks, three sets of five repetitions were performed, and the last three weeks of the intervention consisted of paired upper and lower body exercises using six sets of 5 repetitions which the weights increased for four sets then decreased for two sets. The training group increased their maximal muscle strength by 20% for bench press and 13% in squat. However, contrary to our study, this study did not have their control group perform 1-RM exercises for comparison.

CHAPTER V

CONCLUSIONS

The purpose of this study was to examine the effects of twelve weeks of resistance training on large (C1) and small (C2) arterial elasticity in premenopausal healthy women, and in a group of healthy controls. The secondary purpose was to examine the relationship between the inflammatory marker C-Reactive Protein (CRP), and arterial elasticity in premenopausal healthy women, and in a group of healthy controls.

The following research questions were examined: 1) Will twelve weeks of lower leg resistance training change arterial elasticity and levels of CRP in premenopausal women? 2) What is the relationship between CRP and arterial elasticity in premenopausal women?

Research Hypothesis 1. Twelve weeks of lower leg resistance training will change arterial elasticity.

No, the results of this study did not support this hypothesis. Large arterial elasticity significantly increased ($p < 0.05$) from pre to post for both groups, thus the change cannot be attributed to the treatment. The training group had a 9% increase, and the control group had a 13% increase ($p > 0.05$). There were no significant changes in small arterial elasticity for any of the groups ($p > 0.05$). Non-significant increases ($p > 0.05$) were 5.8% for the training group and 11.5% in the control group. Furthermore, there were no significant changes in CRP levels after the twelve week training protocol ($p > 0.05$).

Research Hypothesis 2. It is expected that there will be a negative relationship between C-Reactive Protein concentrations and arterial elasticity measures.

Yes, this study does support this hypothesis; however the relationships were weak and non-significant ($p > 0.05$). There was a weak correlation between CRP and C1 ($r = -0.163$, $p = 0.373$), and C2 ($r = -0.183$, $p = 0.317$).

Clinical Significance

The current study explored arterial elasticity after 12 weeks of lower body exercises, and found an increase in large arterial elasticity for both the training group and the control group, but these results can not be attributed to the resistance training alone. This might suggest that resistance training alone may not have the same effect on arterial elasticity in women as often observed in men. Further, if this is correct, this could be a good approach for postmenopausal women who want to preserve bone mass and muscle mass and at the same time keep their cardiovascular system healthy. More research is needed examining whole body resistance training and arterial elasticity in postmenopausal women.

Future Research Directions

Most of the arterial compliance research until now has primarily focused on men, with women receiving very little attention. In the future it is important to examine arterial elasticity in women and the various effects of training. With advancing age and natural menopause, there seem to be a decrease in arterial elasticity with the loss of estrogen. Future research should focus on: 1) exercise interventions that will explore arterial elasticity in both premenopausal and

postmenopausal women, and 2) the effect of a combination of endurance and resistance training on arterial elasticity over time in both men and women. More specifically; future studies should monitor physical activity outside the study, measure estrogen levels and their association with arterial elasticity, incorporate whole body resistance training, and explore a potential dose-response relationship in terms of intensity and duration of the intervention. Examinations like this may play an important role in determining what strategies to explore to achieve the most beneficial effects on all aspects of health. With the limited data available on the combination approach, we may speculate that the vasculature will improve with endurance training and possibly prevent future cardiovascular events. Concurrently, the resistance training aspect will enhance bone mass and muscular strength, combined giving these subjects more independence and a greater quality of life.

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APPENDICES

Appendix A. Recruitment Flyer

Appendix B. Informed Consent, Authorization to Use or Disclose Protected Health Information For Research, Bone Density Laboratory Informed Consent

Appendix C. Institutional Review Board Approval Letter

Appendix D. Menstrual History, Calcium Intake, Health Status Questionnaire

Appendix E. Weekly Training Log, 1-RM Training Log

Appendix F. DXA Scan Sample Report

Appendix G. Pulse Contour Analysis Sample Profile Report

Appendix H. CRP Elisa Instructions

Appendix I. Data

Appendix A.

Recruitment Flyer

Weight Training Study

The Department of Health and Exercise Science at the University of Oklahoma, Norman is performing a study to examine the effects of 16 weeks of resistance training on blood vessel function in adult women.

Pre-menopausal women between the ages of 18 years and 40 years, non-pregnant and free of cardiovascular disease are needed as volunteers to complete this study. You will receive information regarding your cardiovascular function, bone density, body composition, and muscle strength.

Please contact Anette S. Fjeldstad
408-6642 (cell), or
***e-mail:* Anette.S.Fjeldstad-1@ou.edu**
for more information.

Appendix B.

Informed Consent, Authorization to Use or Disclose Protected Health Information For Research, Bone Density Laboratory Informed Consent

INFORMED CONSENT
TO PARTICIPATE IN A RESEARCH STUDY

PROJECT TITLE:	**EFFECTS OF RESISTANCE TRAINING ON ARTERIAL ELASTICITY AND C-REACTIVE PROTEIN IN PREMENOPAUSAL WOMEN**
PRINCIPAL INVESTIGATOR:	**Dr. Debra Bemben**
CONTACT INFORMATION:	**Debra Bemben, PhD** **Department of Health and Exercise Science** **1401 Asp Avenue, Room 119, Norman, OK 73019** **Telephone (405) 325-2709** **Email: dbemben@ou.edu**
CO-Principle Investigator:	**Anette S. Fjeldstad, PhD Candidate**
Contact Information:	**Department of Health and Exercise Science** **1401 Asp Avenue, Room 112, Norman, OK 73019** **Telephone (405) 408-6642** **Email: Anette.S.Fjeldstad-1@ou.edu**
Co-Investigator:	**Dr. Michael Bemben**
Contact Information:	**Department of Health and Exercise Science** **1401 Asp Avenue, Room 120, Norman, OK 73019** **Telephone (405) 325-2717** **Email: mgbemben@ou.edu**

You are being asked to volunteer for a research study. This study is being conducted at the University of Oklahoma, Norman Campus. You were selected as a possible participant because you fit the inclusion criteria. Please read this form and ask any questions that you may have before agreeing to take part in this study.

Purpose of the Research Study

The purpose of this study is to examine the effects of twelve weeks of resistance training on arterial elasticity, which is an indicator of blood vessel function, in premenopausal women. The secondary purpose is to examine the relationship between measures of arterial elasticity and an indicator of inflammation (C-reactive protein) found in the blood. Resistance training has shown to have cardiovascular benefits, but the specific effects of this type of exercise on blood vessel function are not clear. It is important to examine the effects of exercise on blood vessel function because the loss of arterial elasticity with age is associated with cardiovascular diseases. Participants must be between the ages 18 and 50 years, be premenopausal, not pregnant, and not taking hormonal birth control or blood pressure medicine.

Exclusion Criteria

1) Women who are pregnant, **2)** women not in the age group 18-50 years of age, **3)** males, **4)** those with a history of cardiovascular disease, coronary heart disease, or peripheral arterial disease, **5)** current smokers, **6)** women who are postmenopausal, and **7)** those who take hormonal birth control or blood pressure medicine.

Procedures

If you agree to be in this study, you will be asked to do the following things:

a. You will be required to read and sign an informed consent form before the testing takes place.
b. You will fill out a menstrual history questionnaire providing information about current menstrual status, and past menstrual history.
c. You will fill out a health status questionnaire providing information about your medical history and health-related behaviors.
d. Blood vessel function measurements (Pulse Contour Analysis) will be obtained in the morning following an overnight fast of at least eight hours, and before participating in any strenuous physical activity. After resting for 10 minutes on a therapy table, blood vessel function will be obtained using the HDI/Pulsewave™CR-2000 CardioVascular Profiling System (Hypertension Diagnostic, Inc., Eagan, Minnesota, USA). An automatic blood pressure cuff will be wrapped around my upper left arm, and a rigid plastic wrist stabilizer to minimize movement of the right wrist will be used during the blood vessel measurement. While lying on the therapy table, a steel analyzer will be placed on the pulse of the right wrist. Measurement will be obtained and averaged over three consecutive 30-second trials. In addition to the blood vessel measurements, height and weight will be measured and recorded. This is a noninvasive measure of blood vessel function, and requires that you lie still during the measurements.
e. A bone scan will be performed by Dual Energy X-Ray Absorptiometry (DXA) at the Bone Density Laboratory in the Department of Health and Exercise Science. This test will include two scans performed at baseline (the initial session), and at 12 weeks (the end of the training program). This test is noninvasive and only requires that you lie still for the test to be completed. Your total body will be measured for bone mineral content, and percent body fat will be determined. This research study involves exposure to radiation from two DXA scans, which is a type of x-ray procedure. More detail about this risk is described below in the risks and benefits section.
f. A resting blood sample of about 6ml (about 1.5 teaspoons) will be taken from the inside of your elbow (venipuncture) by qualified personnel at The University of Oklahoma at baseline (initial session) and at 12 weeks (the end of the training program). These samples will be used to measure an inflammation substance called C-reactive protein. The safety of the subject is of outmost importance during the blood draws, therefore standard precautions will be used including cleaning of the venipuncture site with alcohol, the use of new sterile disposable needles/syringes and changing of disposable gloves in between subjects by the registered nurse/phlebotomist. The subjects do NOT have to pay for this procedure. The blood sample will be collected twice and used to measure C-reactive protein.
g. Maximum strength testing (1RM) will be conducted by trained personnel at the Neuromuscular Laboratory in the Department of Health and Exercise Science. This test will be performed at monthly intervals and requires that you give maximum effort for each exercise.
h. If you are assigned to the control group, you will maintain your normal daily activities that do not involve resistance training.
i. If you are assigned to the resistance training group, you will report to the Neuromuscular Laboratory in the Department of Health and Exercise Science for resistance training

sessions for about 30 minutes a day, 3 days a week, for a total of 12 weeks. The hip exercises will consist of 2 sets of 8 repetitions at a high intensity (80% 1-RM) performed on 1 resistance exercise machine targeting the major muscle groups of the lower body. The rest of the exercises will consist of 3 sets of 8 repetitions. The leg press exercise will be performed at 80% 1-RM, whereas the two arm exercises and the calf and shin exercise will be performed at a light intensity.

Risks and Benefits of Being in the Study

The study has the following risks.
You understand that when performing any of the requirements for this project, there will be qualified personnel present at all times, but you should be aware of the following:
a. There is a possibility of brusing from blood draws. It should be noted that all blood collection procedures will be done in a clean environment by qualified personnel (i.e., nurse or phlebotomist). The safety of the subject is of utmost importance during the blood draws, therefore standard precautions will be used including the cleaning of the venipuncture site with alcohol, the use of new sterile disposable needles/syringes and changing of disposable gloves in between subjects by the phlebotomist.
b. This research study involves exposure to radiation from two DXA scans, which is a type of x-ray procedure. This radiation procedure is not necessary for medical care, and is for research purposes only. You will receive radiation exposure from each DXA scan that is equivalent to the radiation exposure Americans receive in several days from natural background radiation (~300mrem/year) from sources such as radioactivity in the soil. Any risk from this amount of radiation is too small to be measured directly. Altough the amount of radiation exposure received in the study is minimal, it is important for you to be aware that the risk from radiation exposure is cumulative over a lifetime. If you participate in the research you will receive 2 DXA scans that you would not receive if you chose not to participate.
c. You may experience minor discomfort during the measurement of arm blood pressure due to the inflation of the blood pressure cuff. However, the trained personnel will make sure that the blood pressure cuff is completely deflated between each trial.

Pregnant women should not be exposed to radiation. Therefore, I verify that I am not pregnant (if participant is uncertain about pregnancy, then she should not perform this test). Radiation safety levels for fetuses have not been established and therefore no additional exposure whatsoever can be considered safe.
I verify that I have read and understood the above radiation warning.
Initials: _____

The benefits to participation are that you will receive information about your blood vessel function, bone density, percent body fat, and muscle strength. No therapeutic value should be expected from participating in the research.

Compensation

You will not be reimbursed for your time and participation in this study. In case of injury or illness resulting from this study, emergency medical treatment is available. However, you or your insurance company may be expected to pay the usual charge for this treatment. The University of Oklahoma Norman Campus has set no funds aside, to compensate you in the event of injury.

Confidentiality

The records of this study will be kept private. In published reports, there will be no information included that will make it possible to identify the research participant. Research records will be stored securely. Confidentiality will be maintained by coding all information with individual identification numbers. The master list will be kept in a locked file cabinet in the PI's (Dr. Debra Bemben and Co-PI, Anette S. Fjeldstad) office. Dr. Debra Bemben and Anette S. Fjeldstad will have access to the medical screening questionnaire. In addition, the two investigators will share data collected during the DXA scan (a form of x-ray), blood samples, and all other questionnaires. Only qualified research personnel and University of Oklahoma Institutional Review Board (IRB) will have access to database containing study information. All study data are entered into statistical analyses and publication reports will refer to group mean data. No individual or group other than the research team will be given information, unless specifically requested by you. All subject-related materials and data will be held confidential and will be stored in the PI's records for a period not less than 5 years. After this time, all subject-related materials and data will be destroyed.

Voluntary Nature of the Study

Participation in this study is voluntary. Your decision whether or not to participate will not result in penalty or loss of benefits to which you are otherwise entitled. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researcher(s) conducting this study can be contacted at Dr. Debra Bemben and Anette S. Fjeldstad, University of Oklahoma, Department of Health and Exercise Science, 1401 Asp Avenue, Room 109, Norman, OK 73019. Telephone (cell) (405) 408-6642, E-mail: Anette.S.Fjeldstad-1@ou.edu. You are encouraged to contact the researcher(s) if you have any questions.

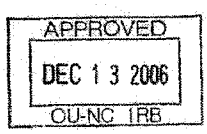
If you have any questions about your rights as a research participant, you may contact the University of Oklahoma – Norman Campus Institutional Review Board (OU-NC IRB) at (405) 325-8110 or irb@ou.edu.

You will be given a copy of this information to keep for your records. If you are not given a copy of this consent form, please request one.

STATEMENT OF CONSENT

I have read the above information. I have asked questions and have received satisfactory answers. I consent to participate in the study.

Signature of subject_____ Date_____



UNIVERSITY OF OKLAHOMA – NORMAN CAMPUS
INSTITUTIONAL REVIEW BOARD

AUTHORIZATION TO USE or DISCLOSE PROTECTED HEALTH INFORMATION FOR RESEARCH

An additional Informed Consent Document for Research Participation may also be required.

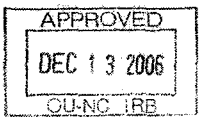
Title of Research Project:	**EFFECTS OF RESISTANCE TRAINING ON ARTERIAL ELASTICITY AND C-REACTIVE PROTEIN IN PREMENOPAUSAL WOMEN**
Principal Investigator:	**Dr. Debra Bemben**
IRB Number:	
Address:	**1401 Asp Ave. Huston-Huffman Center, Norman, OK 73019**
Phone Number:	**(405) 325-2709**

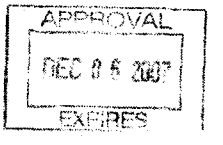
If you decide to join this research project, University of Oklahoma (OU) researchers *may use or share (disclose) information* about you that is considered to be protected health information for their research. Protected health information will be called private information in this Authorization.

Private Information To Be Used or Shared. Federal law requires that researchers get your permission (authorization) to use or share your private information. If you give permission, the researchers may use or share with the people identified in this Authorization any private information related to this research from your medical records and from any test results. Information, used or shared, may include all information relating to any tests, procedures, surveys, or interviews as outlined in the consent form, medical records and charts, name, address, telephone number, date of birth, race, and government-issued identification number.

Purposes for Using or Sharing Private Information. If you give permission, the researchers may use your private information to help us gain insight into how resistance training affects various cardiovascular parameters in premenopausal women. This can lead to interventional strategies to improve cardiovascular function in premenopausal women.

Other Use and Sharing of Private Information. If you give permission, the researchers may also use your private information to develop new procedures or commercial products. They may share your private information with the research sponsor, the OU Institutional Review Board, auditors and inspectors who check the research, and government agencies such as the Food and Drug Administration





(FDA) and the Department of Health and Human Services (HHS). The researchers may also share your private information with the other Principal Investigator.

Confidentiality. Although the researchers may report their findings in scientific journals or meetings, they will not identify you in their reports. The researchers will try to keep your information confidential, but confidentiality is not guaranteed. Any person or organization receiving the information based on this authorization could re-release the information to others and federal law would no longer protect it.

YOU MUST UNDERSTAND THAT YOUR PROTECTED HEALTH INFORMATION MAY INCLUDE INFORMATION REGARDING ANY CONDITIONS CONSIDERED AS A COMMUNICABLE OR VENEREAL DISEASE WHICH MAY INCLUDE, BUT ARE NOT LIMITED TO, DISEASES SUCH AS HEPATITIS, SYPHILIS, GONORRHEA, AND HUMAN IMMUNODEFICIENCY VIRUS ALSO KNOWN AS ACQUIRED IMMUNE DEFICIENCY SYNDROME (AIDS).

Voluntary Choice. The choice to give OU researchers permission to use or share your private information for their research is voluntary. It is completely up to you. No one can force you to give permission. However, you must give permission for OU researchers to use or share your private health information if you want to participate in the research and if you revoke your authorization, you can no longer participate in this study.

Refusing to give permission will not affect your ability to get routine treatment or health care from OU.

Revoking Permission. If you give the OU researchers permission to use or share your private information, you have a right to revoke your permission whenever you want. However, revoking your permission will not apply to information that the researchers have already used, relied on, or shared.

End of Permission. Unless you revoke it, permission for OU researchers to use or share your private information for their research will continue. You may revoke your permission at any time by writing to:

Privacy Official
University of Oklahoma
1000 Stanton L. Young Blvd., STE 221, Oklahoma City, OK 73117
If you have questions call: (405) 271-2511

APPROVED
DEC 1 3 2006
OU-NC IRB

APPROVAL
DEC 0 6 2007
EXPIRES

Giving Permission. By signing this form, you give OU and OU's researchers led by Dr.Debra Bemben and Anette S. Fjeldstad, permission to share your private information for the research project called "EFFECTS OF RESISTANCE TRAINING ON ARTERIAL ELASTICITY AND C-REACTIVE PROTEIN IN PREMENOPAUSAL WOMEN".

Subject Name:

_____ _____

Signature of Subject Date
or Parent if Subject is a child

Or

_____ _____

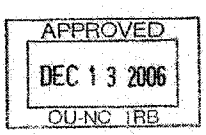
Signature of Legal Representative** Date

**If signed by a Legal Representative of the Subject, provide a description of the relationship to the Subject and the Authority to Act as Legal Representative:

_____

OU may ask you to produce evidence of your relationship.

A signed copy of this form must be given to the Subject or the Legal Representative at the time this signed form is provided to the researcher or his representative.



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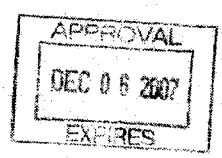


Bone Density Research Laboratory
Department of Health and Exercise Science
University of Oklahoma, Norman, OK 73019-0615
Individual's Consent Form—Dual Energy X-Ray Absorptiometry (Lunar Prodigy)

Introduction
This is to certify that I, _____ agree to volunteer as a participant for bone scans to be performed by Dual Energy X-Ray Absorptiometry (DXA) (Lunar Prodigy) at the Bone Density Research Laboratory on the Norman Campus under the supervision of Dr. Debra A. Bemben, Certified Clinical Densitometrist.

Description
A bone scan will be performed by DXA at the Bone Density Research Laboratory by qualified and trained personnel. This test involves exposure to radiation from the DXA scan which is a type of x-ray procedure. The bone scans will not be used for diagnostic purposes. This test is non-invasive and requires only that you lie still for the test to be completed. Your total body will be measured for bone mineral density and body composition. You will lay on the DXA table for approximately 15 minutes for the scan.

Risks
You will be exposed to minimal radiation during the total body DXA scan, which is a type of x-ray procedure. This radiation exposure is not necessary for medical care, and is for research purposes only. You will receive radiation exposure from each DXA scan that is equivalent to the radiation exposure Americans receive in several days from natural background radiation (about 300 mrem/year) from sources such as radioactivity in the soil. This radiation procedure is not necessary for medical care, and is for research purposes only. Any risk from this amount of radiation is too small to be measured directly. Altough the amount of radiation exposure received in the study is minimal, it is important for you to be aware that the risk from radiation exposure is cumulative over a lifetime.

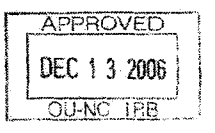
Pregnant women should not be exposed to radiation. **Therefore, I verify that I am not pregnant** (if participant is uncertain about pregnancy, then she should not perform this test). Radiation safety levels for fetuses have not been established and therefore no additional exposure whatsoever can be considered safe. I verify that I have read and understood the above radiation warning. _____ Initials

Compensation for Injury
There will be no compensation will be available to you from the University of Oklahoma unless you otherwise qualify for the University's Health Insurance or other employee benefits. This University will provide emergency medical treatment in the form of first aid, CPR, and contacting medical personnel. No other financial aid will be provided for any long-term medical problems that may occur from the bone scan.

Subject Assurances
You are free to refuse to participate in any procedure or refuse to answer any questions at any time without prejudice. Further more, by agreeing to have the bone scan and signing this form, you do not waive any of your legal rights.

I understand that Dr. Debra Bemben will answer any of my questions about the scanning procedures, my rights as a participant, and procedure-related injuries at any time.

_____	_____
Date	Signature of Participant
_____	_____
Date	Debra A. Bemben, Ph.D., Laboratory Supervisor
_____	_____
Date	Witness



Appendix C.

Institutional Review Board Approval Letter

The University of Oklahoma

OFFICE FOR HUMAN RESEARCH PARTICIPANT PROTECTION

IRB Number: 11551
Meeting Date: December 07, 2006
Approval Date: December 13, 2006

December 14, 2006

Debra Bemben, Ph.D.
Health & Exercise Science
1401 Asp Avenue, HHC 104
Norman, OK 73019

RE: Effects of Resistance Training on Arterial Elasticity and C-Reactive Protein in Premenopausal Women

Dear Dr. Bemben:

The University of Oklahoma Norman Campus Institutional Review Board (IRB) reviewed the above-referenced research protocol at its regularly scheduled meeting on December 07, 2006. It is the IRB's judgement that the rights and welfare of the individuals who may be asked to participate in this study will be respected; that the proposed research, including the process of obtaining informed consent, will be conducted in a manner consistent with the requirements of 45 CFR 46, as amended; and that the potential benefits to participants and to others warrant the risks participants may choose to incur.

On behalf of the IRB, I have verified that the specific changes requested by the convened IRB have been made. Therefore, on behalf of the Board, I have granted final approval for this study.

This letter documents approval to conduct the research as described:

Priv - Research Auth 1 Dated: November 29, 2006
Survey Instrument Dated: November 29, 2006 Health Status questionnaire
Survey Instrument Dated: November 29, 2006 Medical History/Telephone questionnaire
Survey Instrument Dated: November 29, 2006 Menstrual History questionnaire
Survey Instrument Dated: November 29, 2006 One Repetition Max Sheet
Survey Instrument Dated: November 29, 2006 Resistance Training Sheet
IRB Application Dated: December 12, 2006 Revised
Consent form - Subject Dated: December 12, 2006 Revised
Consent form - Other Dated: December 12, 2006 DXA procedure
Advertisement Dated: December 12, 2006 Revised
Protocol Dated: December 12, 2006 Revised - Summary of study activities

As principal investigator of this protocol, it is your responsibility to make sure that this study is conducted as approved by the IRB. Any modifications to the protocol or consent form, initiated by you or by the sponsor, will require prior approval, which you may request by completing a protocol modification form.

The approval granted expires on December 06, 2007. Should you wish to maintain this protocol in an active status beyond that date, you will need to provide the IRB with an IRB Application for Continuing Review (Progress Report) summarizing study results to date. The IRB will request a progress report from you approximately two months before the anniversary date of your current approval.

If you have questions about these procedures, or need any additional assistance from the IRB, please call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Lynn Devenport, Ph.D.
Vice Chair, Institutional Review Board

Ltr_Prot_Fappv_B

660 Parrington Oval, Suite 316, Norman, Oklahoma 73019-3085 PHONE: (405) 325-8110 FAX: (405) 325-2373

Appendix D.

Menstrual History, Calcium Intake, Health Status Questionnaire

Bone Density Reserach Laboratory
Department of Health and Exercise Science
University of Oklahoma

MENSTRUAL HISTORY QUESTIONNAIRE

Name: _____ Date: _____

We are asking you to give us as complete a menstrual history as possible. All information you provide will be strictly confidential.

SECTION A: CURRENT MENSTRUAL STATUS

1. Approximately how many menstrual periods have you had during the past 12 months?

2. Circle the months in which your period occurred. This means from this time last year until the present month.

   JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

3. What is the usual length of your menstrual cycle (first day menses to first day next menses)

   _____ days. Today is day _____ of your present menstrual cycle.

4. What was the date of your last period?

5. When do you expect your next menstrual period?

6. What is the length (number of days) of your menstrual flow on the average?

   How many of these days would you term "heavy"

7. Do you experience cramps during menstruation (dysmenorrhea)? If yes, how many days does this last?

8. Do you experience symptoms of premenstrual syndrome (i.e., weight gain, increased eating, depression, headaches, anxiety, breast tenderness)? If yes, list the symptoms.

9. Do you take oral contraceptives or any other medication that includes estrogen and/or progesterone? If no, skip to question 10.

If yes, how long have you been taking the birth control pill?

What is the brand name and dosage of the oral contraceptive you are taking?

Has the pill affected your menstrual cycle (regularity, length and amount of flow, length of cycle)? If yes, indicate changes.

10. Have you taken oral contraceptives in the past? If no, skip to SECTION B.

If yes, what was the brand name and dosage?

When did you start taking the pill; for how long; and when did you stop taking it?

11. If you answered yes to 9 or 10, did you experience a weight gain and/or a change in appetite as a result of oral contraceptive use? If so, please indicate amount of weight gain.

12. If you are perimenopausal, are you experiencing menopausal symptoms? Please list your symptoms (i.e., hot flushes, mood swings, headaches etc.)

BONE DENSITY LABORATORY
DEPT. OF HEALTH AND SPORT SCIENCES UNIVERSITY OF OKLAHOMA

CALCIUM INTAKE ESTIMATION

NAME:_____ TODAY'S DATE:_____

Complete this form (where indicated) to represent your dietary intake in the past year.

				I EAT THIS FOOD: EVERY WEEK	EVERY DAY
Tally *(office use only)*	Score *(office use only)*	Food Type	serving size	write in # servings/week	write in # servings/day
	300	Milk- whole, 2%, skim	1 cup		
	150	Cheese food or spread	1 oz		
	150	Cheese sauce	1/4 cup		
	150	American cheese	1 slice		
	150	Cottage cheese	1 cup		
	250	Ricotta cheese	1 oz		
	150	Blue cheese	½ cup		
	200	Natural cheese (except cream cheese) includes cheddar, Swiss, mozzarella, and so forth	1 oz		
	285	Buttermilk	1 cup		
	300	Yogurt, flavored or plain	1 cup		
	450	Fast Food Milkshake	12 oz		
	165	Cocoa from mix	1 packet		
	330	Eggnog	1 cup		
	280	Chocolate milk	1 cup		
	250	Macaroni and cheese, cheese souffle, lasagna, quiche, cannelloni, pizza	1 serving		
	180	Cream soup or chowder with milk	1 cup		
	115	Almonds	1/3 cup		
	180	Broccoli	1 cup		
	85	Beet greens, spinach	½ cup		
	160	Baked beans	1 cup		
	100	Figs	5 dried		
	140	Scalloped potatoes	1 cup		
	150	Soybeans	1 cup		
	150	Tofu	½ cup		

Tally *(office use only)*	Score *(office use only)*	Food Type	serving size	write in # servings/week	write in # servings/day
	30	Bread, white or whole grain	1 slice		
	120	Waffle or pancake	1 large		
	50	Muffin, biscuit, cornbread	1 medium		
	40	Rolls, buns	½		
	225	Egg McMuffin	1		
	130	Fast food cheeseburger or hamburger	1		
	110	Enchilada or bean burrito	1		
	125	Creamed fish and meats	1 cup		
	130	Shellfish, cooked	4 oz		
	200	Canned salmon with bones	½ cup		
	200	Sardines, smelts, herring	½ cup		
	100	Fudgesicle	1		
	125	Custard pie	1 slice		
	175	Ice cream or ice milk	1 cup		
	190	Pudding with milk	½ cup		
	200	Frozen yogurt	1 cup		

Please list any dietary supplements (single and multi-vitamins, calcium, herbal etc.) you take below, including the brand name and amount (mg).

1. _____
2. _____
3. _____
4. _____
5. _____

Bone Density Laboratory
OU Department of Health and Sport Sciences
Health Status Questionnaire

Instructions Complete each question accurately. All information provided is confidential.
(NOTE: The following codes are for office use only: RF; MC; SLA; SEP)

Part 1. Information about the individual

1. _____ _____
Social Security no. Date
2. _____ _____
Legal name Nickname
3. _____ _____
Mailing address Home phone
_____ _____
Business phone

4. Gender (circle one): Female Male (RF)

5. Date of birth: _____ Age _____
Month Day Year

6. Number of hours worked per week: Less than 20 20-40 41-60 Over 60

(SLA) More than 25% of time spent on job (circle all that apply)

Sitting at desk Lifting or carrying loads Standing Walking Driving

Part 2. Medical history

7. (RF) Circle any who died of heart attack before age 50:

Father Mother Brother Sister Grandparent

8. Date of: Last medical physical exam: _____ Last physical fitness test: _____
Year Year

9. Circle operations you have had:

Back (SLA) Heart (MC) Kidney (SLA) Eyes (SLA) Joint (SLA) Neck (SLA)
Ears (SLA) Hernia (SLA) Lung (SLA) Other _____

10. Please circle any of the following for which you have been diagnosed or treated by a physician or health professional:

Alcoholism (SEP)
Anemia, sickle cell (SEP)
Anemia, other (SEP)
Asthma (SEP)
Back strain (SLA)
Bleeding trait (SEP)
Bronchitis, chronic (SEP)
Cancer (SEP)
Cirrhosis, liver (MC)
Concussion (MC)
Congenital defect (SEP)
Diabetes (SEP)
Emphysema (SEP)
Epilepsy (SEP)
Eye problems (SLA)
Gout (SLA)
Hearing loss (SLA)
Heart problems (SLA)
High blood pressure (RF)
Hypoglycemia (SEP)
Hyperlipidemia (RF)
Infectious mononucleosis (MC)
Kidney problem (MC)
Mental illness (SEP)
Neck strain (SLA)
Obesity (RF)
Osteoporosis
Phlebitis (MC)
Rheumatoid arthritis (SLA)
Stroke (MC)
Thyroid problem (SEP)
Ulcer (SEP)
Other _____

Blood thinner (MC)	Epilepsy medication (SEP)	Nitroglycerin (MC)
Diabetic pill (SEP)	Heart-rhythm medication (MC)	Estrogen
Digitalis (MC)	High-blood-pressure medication (MC)	Thyroid
Diuretic (MC)	Insulin (MC)	Corticosteroids
Asthma	Other _____	

12. Any of these health symptoms that occurs frequently is the basis for medical attention. Circle the number indicating how often you have each of the following:

1 = Practically never 2 = Infrequently 3 = Sometimes 4 = Fairly often 5 = Very often

a. Cough up blood (MC)
1 2 3 4 5

b. Abdominal pain (MC)
1 2 3 4 5

c. Low back pain (SLA)
1 2 3 4 5

d. Leg pain (MC)
1 2 3 4 5

e. Arm or shoulder pain (MC)
1 2 3 4 5

f. Chest pain (RF) (MC)
1 2 3 4 5

g. Swollen joints (MC)
1 2 3 4 5

h. Feel faint (MC)
1 2 3 4 5

I. Dizziness (MC)
1 2 3 4 5

j. Breathless with slight exertion (MC)
1 2 3 4 5

Part 3. Health-related behavior

13. (RF) Do you now smoke? Yes No

14. If you are a smoker, indicate number smoked per day:

Cigarettes:	40 or more	20-39	10-19	1-9
Cigars or pipes only:	5 or more or any inhaled		Less than 5, none inhaled	

15. Weight now: _____lb. One year ago: _____lb.. Age 21: _____lb.

16. Thinking about the things you do at work, how would you rate yourself as to the amount of physical activity you get compared with others of your age and sex?

1. Much more active
2. Somewhat more active
3. About the same
4. Somewhat less active
5. Much less active
6. Not applicable

17. Now, thinking about the things you do outside of work, how would you rate yourself as to the amount of physical activity you get compared with others of your age and sex?

1. Much more active
2. Somewhat more active
3. About the same
4. Somewhat less active
5. Much less active
6. Not applicable

18. Do you regularly engage in strenuous exercise or hard physical labor?

1. Yes (answer question # 19) 2. No (stop)

19. Do you exercise or labor at least three times a week?

1. Yes 2. No

Appendix E.

Weekly Training Log, 1-RM Training Log

Resistance Training Sheet

Name: _____ Week: 1

		Monday			Wednesday			Friday		
		Record Actual Reps Completed			Record Actual Reps Completed			Record Actual Reps Completed		
Hip Flexion	Load:	Set 1	Set 2		Set 1	Set 2		Set 1	Set 2	
	Goal Reps: 8									
Hip Extension	Load:	Set 1	Set 2		Set 1	Set 2		Set 1	Set 2	
	Goal Reps: 8									
Hip Abduction	Load:	Set 1	Set 2		Set 1	Set 2		Set 1	Set 2	
	Goal Reps: 8									
Hip Adduction	Load:	Set 1	Set 2		Set 1	Set 2		Set 1	Set 2	
	Goal Reps: 8									
Leg Press	Load:	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
	Goal Reps: 8									
Bicep Curl	Load:	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
	Self Select									
	Goal Reps: 8									
Tricep Extension	Load:	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
	Self Select									
	Goal Reps: 8									
Shin	Load:	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
	Goal Reps: 8									
Calf	Load:	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
	Goal Reps: 8									
Comments:										

One Repetition Max Sheet

Name: _____ Week: 1,

	Warm up	Max Load	x % Max =	New Work Load
Hip Flexion (right)			0.8	0
Hip Extension (right)			0.8	0
Hip Abduction (right)			0.8	0
Hip Adduction (right)			0.8	0
Leg Press			0.8	0
Shin			0.8	0
Calf			0.8	0
Comments:				

Appendix F.

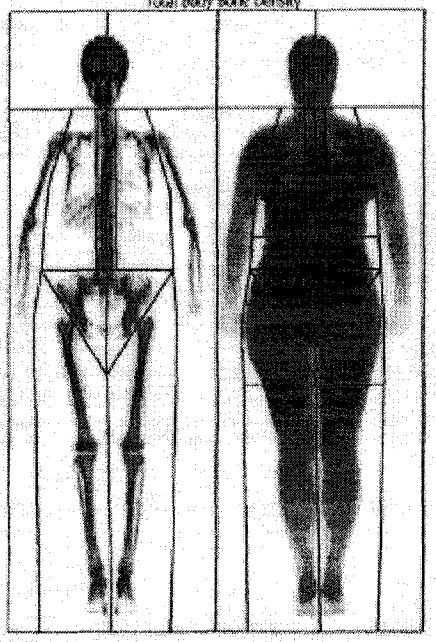
DXA Scan Report

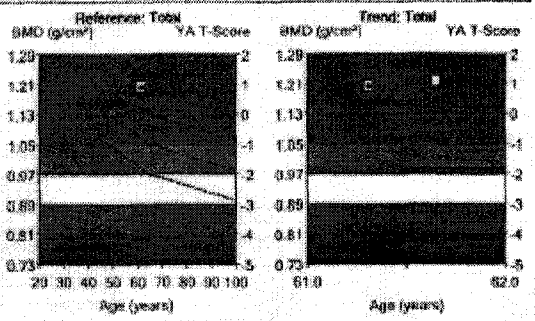
Bone Density Laboratory

Dept. of Health & Sport Sciences
University of Oklahoma, Norman, OK. 73019

Patient:		**Patient ID:**	VR009
Birth Date:	04/19/1944 61.3 years	**Physician:**	
Height / Weight:	164.0 cm 70.4 kg	**Measured:**	08/10/2005 9:13:30 AM (8.80)
Sex / Ethnic:	Female White	**Analyzed:**	12/12/2005 9:42:29 AM (8.80)

Total Body Bone Density





Region	1 BMD (g/cm²)	2 Young-Adult (%)	2 Young-Adult T-Score	3 Age-Matched (%)	3 Age-Matched Z-Score
Head	2.379	-	-	-	-
Arms	0.839	-	-	-	-
Legs	1.257	-	-	-	-
Trunk	0.975	-	-	-	-
Ribs	0.647	-	-	-	-
Pelvis	1.199	-	-	-	-
Spine	1.159	-	-	-	-
Total	1.199	107	0.9	113	1.7

Measured Date	Age (years)	1 BMD (g/cm²)	Change vs Previous (%/yr)	Change vs Previous (%)
12/12/2005	61.6	1.211	2.8	1.0
08/10/2005	61.3	1.199	-	-

COMMENTS:

Image not for diagnosis

Printed: 02/27/2006 9:54:18 AM (8.80) Rev 0 L3-Pelvis 62.4 0.000 1.00
4.80x13.00 13.8%Fat= 38.2%
0.80x0.80 0.00-0.00
Filename: 7rd88f93.dfx
Scan Mode: THOR 0.08 mmsec

1 -Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for Total Body Total)
2 -NHANES (ages 20-30) : DXA (ages 20-40) Total Body Reference Population (v1.02)
3 -Matched for Age, Weight (Females 25-100 kg), Ethnic

GE Medical Systems
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DF+14681

Appendix G.

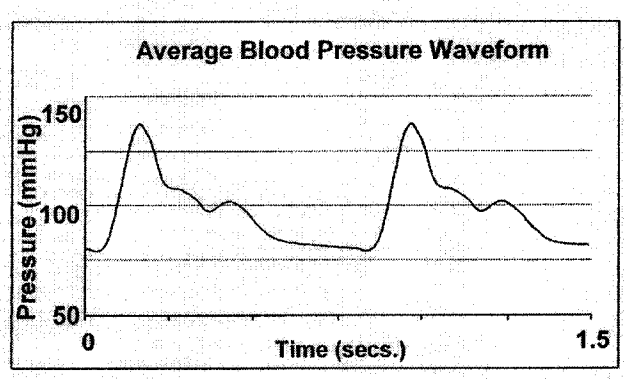
PCA Profile Report

HDI/*PulseWave*™ CR-2000

Research CardioVascular Profile Report

Research Subject ID:
Protocol 1743
Research Subject Name:
DOE, JOHN M

Date: 23 SEPT 1999
Time: 14:35
Age: 34 years
Gender: Male
Height: 71 in
Weight: 189 lbs.
BSArea: 2.06 sq. meters
Body Mass Index: 26.4



PARAMETER	RESEARCH SUBJECT VALUE
SYSTOLIC BLOOD PRESSURE (mmHg)	136
DIASTOLIC BLOOD PRESSURE (mmHg)	79
MEAN ARTERIAL BLOOD PRESSURE (mmHg)	102
PULSE PRESSURE (mmHg)	57
PULSE RATE (beats/min)	72
ESTIMATED CARDIAC EJECTION TIME (msec)	293
ESTIMATED STROKE VOLUME (ml/beat)	87
ESTIMATED STROKE VOLUME INDEX (ml/beat/m^2)	42
ESTIMATED CARDIAC OUTPUT (L/min)	6.3
ESTIMATED CARDIAC INDEX (L/min/m^2)	3.1
LARGE ARTERY ELASTICITY INDEX (ml/mmHg x 10) (Capacitive Arterial Compliance)	14.9
SMALL ARTERY ELASTICITY INDEX (ml/mmHg x 100) (Oscillatory or Reflective Arterial Compliance)	11.1
SYSTEMIC VASCULAR RESISTANCE (dyne•sec•cm^{-5})	1226
TOTAL VASCULAR IMPEDANCE (dyne•sec•cm^{-5})	111

Eagan, MN 55121 +1-651-687-9999 Toll-Free: 1-888-*PulseWave* (785-7392)

Form: 00017-001 (Rev. A / 08.Oct.99) *"For Research Purposes Only"*

Appendix H.

CRP Elisa Instructions

CRP ELISA

This kit is designed for the determination of C-Reactive Protein in serum, plasma, stool and urine.

For Research Use Only. Not For Use In Diagnostic Procedures.

Catalog Number:	**30-9710s**
Size:	**96 Wells**
Version:	**27.09.2005 – ALPCO 12/19/05**

ALPCO Diagnostics

26 Keewaydin Drive Unit G • Salem, NH 03079
Phone: (800) 592-5726 • Fax: (603) 898-6854
www.alpco.com • Email: web@alpco.com

1. INTENDED USE

This assay is a sandwich Enzyme Immuno Assay intended for the quantitative determination of **C-reactive Protein** in plasma, serum, stool and urine. For research use only. Not for use in diagnostic procedures.

2. CLINICAL RELEVANCE

C-reactive Protein (CRP) is mainly formed in hepatocytes. The synthesis rate is determined by the influence of cytokines involved in inflammatory processes. The biological half-life is estimated to be 13-16 hours.

A connection between inflammatory reactions and cardiovascular diseases such as arteriosclerosis and latent or chronically persisting infections has been described in recent studies. The **CRP** concentrations of healthy persons are under 5 µg/ml. **CRP** belongs to the acute phase proteins and will be released within 24 hours after inflammatory process started (fever, pneumonia, myocardial infarction, etc.). **CRP** proved itself as a marker for inflammation.

Indications

- Risk factor for myocardial infarction or stroke
- Prognosis factor for infarct patients
- Inflammatory reactions

3. PRINCIPLE OF THE TEST

This Enzyme Immunoassay is a sandwich assay for the determination of CRP in serum, plasma, urine and stool samples. The wells of the microtiter plate are coated with polyclonal antibodies directed against C-reactive Protein. In a first incubation step, the CRP in the samples is bound to the coated polyclonal rabbit antibodies (in excess). To remove all unbound substances, a washing step is carried out.

In a second incubation step, a Peroxidase-labeled CRP (PO-Antibody, polyclonal, rabbit-anti-CRP) antibody is added. After another washing step, to remove all unbound substances, the solid phase is incubated with the substrate, Tetramethylbenzidine (TMB). An acidic stopping solution is then added. The color converts to yellow. The intensity of the yellow color is directly proportional to the concentration of CRP in the sample. A dose

response curve of the absorbance (at 450 nm) unit vs. concentration is generated. CRP, present in the patient samples, is determined directly from this calibration curve.

The combination of two specific antibodies in the CRP ELISA drastically reduces the possibility of false-negatives results and offers a secure diagnostic system to the user.

4. MATERIAL SUPPLIED

The reagents of one kit are sufficient for 96 determinations.

Each test kit contains:

Catalog No.	Kit Components	Quantity
K 9710sMTP	one holder with precoated strips	96
K 9710sWP	ELISA wash buffer concentrate 10x	1 x 100 ml
K 9710sK	POD antibody, (rabbit-anti-CRP, Peroxidase-labeled), prediluted	1 x 150 µl
K 9710sST	Calibrators, ready to use (0; 1.9; 5.6; 16.7; 50; 150 ng/m l)	6 x 1 ml
K 9710sKO	Control, ready-to-use	1 x 1 ml
K 9710sVP	Dilution buffer, ready to use	2 x 100 ml
K 9710sTMB	TMB substrate (Tetramethylbenzidine), ready to use	1 x 15 ml
K 9710sAC	ELISA stop solution, ready to use	1 x 7 ml

The CRP calibrators were standardized against WHO standard 470.

5. MATERIAL REQUIRED BUT NOT SUPPLIED

- Distilled or deionized water
- Laboratory Balance
- Sealing film to cover microtiter plate
- Horizontal microtiter plate shaker
- Precision pipettes calibrated to deliver 10-1000 µl and disposable tips
- A multi-channel dispenser or repeating dispenser
- Centrifuge capable of 3000 x g
- Absorbent paper
- Vortex-Mixer
- Microplate reader 450 nm

6.PREPARATION AND STORAGE OF REAGENTS

- To run the assay more than one time, make sure that the reagents are carefully stored at 2-8°C. Prepare just the appropriate amount necessary for the assay.
- Reagents with a volume of less than 100uL shold be centrifuged before use to avoid loss of volume.
- The ELISA **wash buffer concentrate** should be diluted with distilled water **1:10** before use (add 450 ml distilled water to 50 ml ELISA wash buffer concentrate). Crystals may be formed due to high salt concentration. The crystals have to be dissolved **before dilution of the buffer concentrate** using a water bath (37°C). The buffer concentrates are stable at 2-8°C up to the expiry date stated on the label. Diluted solutions could be stored at 2-8°C for 1 month.
- The **POD labeled antibody** has to be diluted **1:100** in ELISA wash buffer (100 µl POD antibody and 10 ml ELISA wash buffer). The antibody is stable at 2 -4 °C up to the expiry date stated the label.

  Diluted antibody solution is not stable and can not be stored.

7. PRECAUTIONS

- For research use only. Not for use in diagnostic procedures.
- The calibrators and controls contain human source material which was tested and found to be non-reactive to HBsAg, anti-HIV-1/2. Since no method can offer complete assurance that hepatitis B virus, HIV-1/2, HCV or other infectious agents are absent, these reagents should be handled as if potentially infectious.
- The stop solution consists of diluted sulfuric acid, a strong acid. Although diluted, it still must be handled with care. It can cause burns and should be handled with gloves, eye protection, and appropriate protective clothing. Any spill should be wiped up immediately with copious quantities of water. Do not breathe vapor and avoid inhalation.
- Reagents should not be used beyond the expiration date stated on kit label.

8. SPECIMEN COLLECTION AND PREPARATION

Serum, plasma

Collection and storage of serum: Collect sufficient blood (at least 1 ml) by venipuncture into a tube or a plastic syringe, avoid hemolysis, centrifuge for 15 minutes at 1,000 x g and 4°C and collect the serum.

Collection and storage of plasma: Collect sufficient blood (at least 1 ml) by venipuncture into an EDTA venipuncture tube or a plastic syringe, centrifuge for 15 minutes at 1,000 x g and 4°C within 10 minutes after blood collection and separate the plasma from the cells.

Serum and plasma samples have to be diluted 1:100 or 1:500 before performing the assay.

Add **10 µl** serum /plasma to **990 µl** dilution buffer, mix well. (1:100)
Use the dilution factor (100 or 500) to calculate the CRP concentration read off the calibration curve.

Patient's samples with elevated CRP concentrations must be diluted 1:4000 – 1:8000. Samples of other patient collectives must be diluted according to the expected CRP concentration. The corresponding dilution factor must be used for calculation of the CRP concentration.

Feces

The test can be performed on either fresh or frozen stool samples. The samples should be refrigerated and can be stored at 2-8°C for 2 days. If the test cannot be performed within this period the specimen should be stored at –20°C or colder.

Add a stool sample of about **100 mg** (size of a pea, please note the exact weight for the calculation) to **5 ml** of the ELISA wash buffer and homogenize very thoroughly for 15 seconds on a Vortex-mixer. Centrifuge the suspension for 10 min at 3000 rpm. 1 ml of the supernatant is put into an Eppendorf tube and centrifuged once more at 13,000 rpm for 2 min. This supernatant can be stored at -20°C for about 1 month. 100 µl of this supernatant is used in the assay.

ALPCO recommends the use of Roche Diagnostics / Mannheim sample preparation tubes, article No. 745804, for sample preparation.

Urine

Urine samples have to be diluted 1:5 with dilution buffer.

9. ASSAY PROCEDURE

Procedural notes

- Do not mix different lot numbers of any kit component within the same assay.
- The quality control guidelines should be observed.
- Incubation time, incubation temperature and pipetting volumes of the different components are defined by the producer. Any variations of the test procedure, that are not coordinated with the producer, may influence the test results.
- Carry out the assay with the actual manual delivered with the kit.

Test procedure

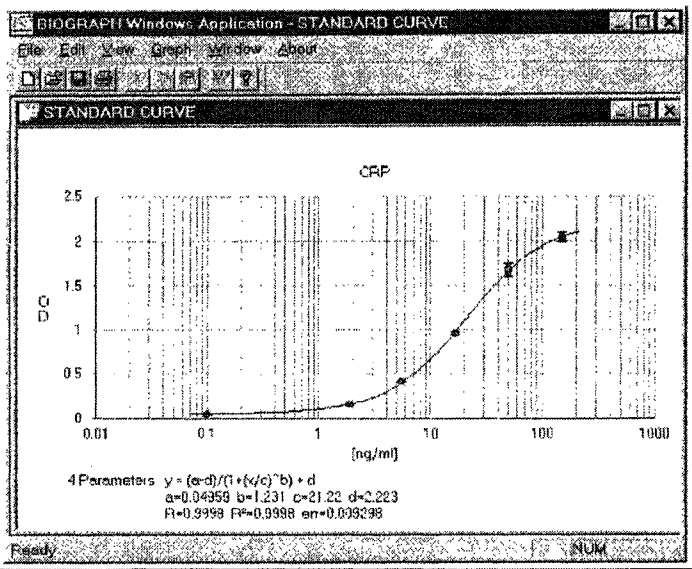
The precoated microtiter strips have to be washed **5 x with 250 µl** ELISA wash buffer before use. Bring all reagents to room temperature. Mix reagents well before use. Avoid direct sun light during all incubation steps. Covering the microtitre plate during the different incubation steps is recommended. Carrying out the tests in duplicate is also recommended.

1. Add **100 µl** of calibrator, controls or samples (in duplicate) into their respective wells. eg: 0 calibrator into A1 and A2, 1.9 calibrator B1 and B2 and so on for each calibrator, then control into G1 and G2 and samples into the remain wells starting with H1 and H2, then A3 and A4, B3 and B4, and so on.
2. Incubate for **1 hour,** shaking on a horizontal mixer, at room temperature.
3. Aspirate and wash the wells **5 x with 250 µl** ELISA wash buffer.
4. Add **100 µl** pre-diluted Peroxidase-labeled CRP antibody.
5. Incubate for **1 hour,** shaking on a horizontal mixer, at room temperature.
6. Decant the content of the plate and wash the wells **5 x with 250µl** ELISA wash buffer.
7. Add **100 µl** TMB substrate solution into each well.
8. Incubate for **5 - 10 minutes** at room temperature in the dark.
9. Add **50 µl** stop solution into each well and mix shortly.
10. Measure the extinction of the samples at **450 nm** directly after adding the stop solution.

10. RESULTS

A calibration curve is constructed from the standards. Commercially available software can be used as well as graph paper. Results of the samples are read from this calibration curve.
THE CALIBRATION CURVE IS NOT LINEAR, therefore a spline- or 4PL algorhythm is recommended.

Typical calibration curve



Concentration [ng/ml]	150	50	16.7	5.6	1.9	0
OD mean value	1.901	1.813	1.258	0.622	0.256	0.045

These data are for demonstration only and cannot be used instead of data obtained from the actual assay.

Fecal

To calculate the CRP concentration of fecal specimen see the following example:

weight:	80 mg (1ml stool = 1g) = 0.08 ml
dilution step 1:	5 ml / 0.08 ml = 62.5
dilution factor:	62.5

Multiply the results with the calculated dilution factor (in this case 62.5) to get the CRP concentration of the stool samples. **Please note:** the dilution factor depends on the weight of the used fecal specimen.

Serum, plasma

The value read of the calibration curve has to be multiplied by **100** or **500** repectively to get the CRP concentration in serum/plasma samples.

If samples were diluted 1:4000 or 1:8000, the estimated values must be multiplied by 4000 or 8000 respectively.

Urine

The measured CRP concentration has to be multiplied by a factor of **5** to get the actual concentration of the samples.

11. LIMITATIONS

Samples with CRP levels greater than the highest calibrator, should be diluted and re-assayed.

12. QUALITY CONTROL

ALPCO recommends commercial control samples for internal quality control.

Control samples or serum pools should be analyzed with each run of calibrators and patient samples. Results, generated from the analysis of control samples, should be evaluated for acceptability using appropriate statistical methods. The results for the patient samples may not be valid, if within the same assay one or more values of the quality control sample are outside the acceptable limits.

Expected values

Preliminary normal ranges:

Stool specimen	<1.12 ng/ml
Urine samples	<6 ng/ml
Serum/plasma:	
Adults/children	<0.068 – 8.2 mg/ l
New borns/umbilical cord	<0.6 mg/l
Infants 4th day up to 1 month	<1.6 mg/l
Pregnant women, at date of delivery	<47 mg/l

(According to L. Thomas; Labor und Diagnose)

These normal ranges should be used as a guideline only. It is recommended that each laboratory establishes an own expected range for its patient population.

13. PERFORMANCE CHARACTERISTICS

Precision and reproducibility

The precision (intra-assay variation) of the CRP ELISA test was calculated from 20 replicate determinations on each one of the samples.

Intra-Assay CV n= 20

Sample	CRP Mean value [ng/ml]	Intra-Assay CV [%]
1	23.3	6
2	99.4	5.5

The total precision (inter-assay variation) of the CRP
ELISA test was calculated from data on 2 samples obtained in 15 different assays by three technicians on two different lots of reagents over a period of three months.

Inter-Assay CV n= 15

Sample	CRP Mean value [ng/ml]	Intra-Assay CV [%]
1	22.1	11.6
2	90.4	13.8

11

Sensitivity

n=20

Sample	CRP Mean value [OD]	Standard variation	Detection limit [ng/ml]
1	0.053	0.007	0.124

Cross reactivity

Alpha-1-Antitrypsin	0 %
Lysozym	0 %
Albumin	0 %
Other acute phase proteins	0 %

14. REFERENCES

1. Koenig W et al. (2004) Circulation 109: 1349-1353
2. Pearson TA et al. (2003) Circulation 107: 645-651
3. Ridker P et al. (2000) N Eng J Med 342: 836-843

15. GENERAL NOTES ON THE TEST AND TEST PROCEDURE

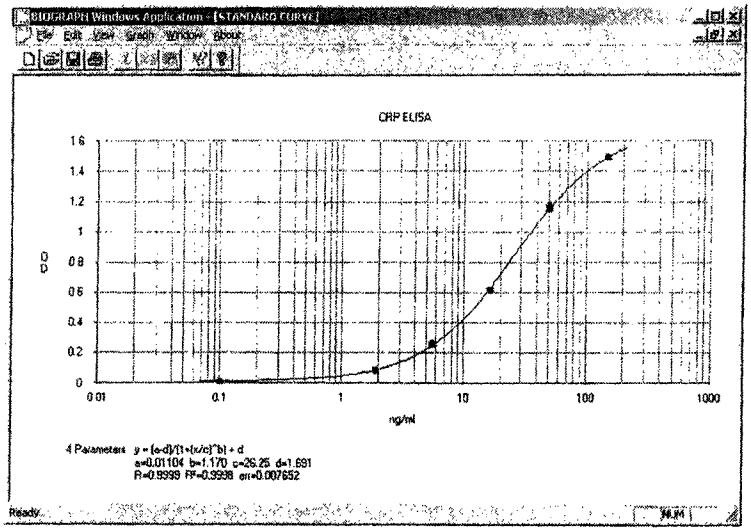
- This assay was produced and put on the market according to the IVD guidelines of 98/79/EC.
- The test components which are made of human serum are tested for HVB and HIV and found to be negative. However, since no test method can offer complete assurance that infectious agents are absent, these reagents should be handled as recommended for any potentially infectious human serum or blood specimen. The normal precautions for laboratory working should be observed.
- Reagents of the test package contain sodium azide as a bactericide. Contact with skin or mucous membranes has to be avoided.
- All reagents in the test package are to be used for research use only. Not for use in diagnostic procedures.
- The reagents should not be used after the date of expiry (see label on the test package).
- Single components with different lot numbers should not be mixed or exchanged.
- The guidelines for medical laboratories should be observed.
- Incubation time, incubation temperature and pipetting volumes of the different components have been defined by the producer. Any alterations of the test procedure, that are not coordinated with the producer, may influence the results of the test.

K 9710s Quality Control Protocol

C-reactive Protein (CRP)

Lot: K9710s-070329

Kontrolle Ch. – B./ Control lot: 0611-019 17.8 ng/ml (14.5 – 27.8 ng/ml)



Standard-Ch. – B./ calibrator lot: 0611 - 018

STD	OD1	OD2	mean OD	CV (%)	Conc. [ng/ml]
1	1.488	1.501	1.494	0.6	150
2	1.149	1.176	1.162	1.6	50
3	0.629	0.615	0.622	1.6	16.7
4	0.249	0.267	0.258	4.8	5.6
5	0.086	0.086	0.086	0.6	1.9
6	0.010	0.009	0.009	6.7	0

For Production:

For quality assurance: 29/03/2007

PRODUKT SPEZIFIKATION

CRP Kontrolle / CRP control

Artikelnr. / Catalog no.: K 9710sKO

Matrix: Phosphatpuffer / Phosphatebuffer

Sicherheitshinweis / Safety advice: Enthält < 0,1% Thimerosal / contains < 0,1% Thimerosal

Inhalt / Content: 1 ml

Bereich / range: 14.5 - 27.8 ng/ml

Der angegebene Kontollbereich ist mit den Reagenzien des Testkit CRP ELISA Artikelnr. K9710s ermittelt worden.
Der Einsatz anderer Messysteme oder Reagenzien kann zu abweichenden Ergebnissen führen.
The given range was measured with reagents of the CRP ELISA kit catalogno. K9710 s.
The use of other reagents or systems of measurements could give deviate results.

Lagerung / Store at: 2 - 8 °C .

Ch.-B. / Lot: 0611 - 019

Verwendbar bis / Expiry date: 24.11.08

Appendix I.

Data

	subject	group	agepre	htpre	htprem	wtpre	wtpost
1	15	C	34.20	168.00	1.68	97.00	97.10
2	19	C	24.00	162.00	1.62	66.50	65.70
3	33	C	48.30	169.00	1.69	56.40	55.20
4	34	C	47.90	174.00	1.74	71.20	69.60
5	35	C	35.70	168.00	1.68	58.20	58.80
6	37	C	21.50	155.00	1.55	60.40	56.80
7	38	C	45.90	156.00	1.56	62.20	63.30
8	40	C	22.10	162.50	1.63	67.80	69.80
9	41	C	45.20	160.00	1.60	58.70	60.30
10	42	C	47.70	170.50	1.71	71.40	70.70
11	43	C	32.80	177.00	1.70	67.50	67.00
12	1	T	33.00	166.00	1.66	66.30	62.40
13	2	T	24.00	157.00	1.57	53.10	53.00
14	3	T	19.00	160.00	1.60	66.20	67.40
15	4	T	23.00	170.00	1.70	64.50	64.80
16	5	T	25.00	164.00	1.64	67.10	67.40
17	10	T	33.00	166.50	1.67	106.00	107.60
18	11	T	33.00	162.50	1.63	56.50	57.80
19	13	T	26.00	167.30	1.67	70.30	73.00
20	14	T	23.00	164.00	1.64	57.20	57.50
21	16	T	22.00	177.00	1.77	112.70	110.50
22	17	T	39.00	170.00	1.70	103.10	105.10
23	21	T	27.00	164.50	1.65	69.60	67.40
24	22	T	47.10	169.50	1.70	98.60	97.50
25	23	T	47.30	170.50	1.71	66.90	66.80
26	24	T	46.50	166.00	1.66	57.10	57.20
27	27	T	45.20	159.50	1.60	51.10	51.10
28	29	T	46.10	165.40	1.65	84.40	80.30
29	30	T	21.00	168.00	1.68	59.70	58.60
30	31	T	39.40	157.50	1.58	54.30	53.90
31	32	T	44.40	176.50	1.77	77.90	77.00
32	36	T	33.30	167.50	1.68	117.40	117.90

	bmipre	bmipost	bsapre	bsapost	hrpre	hrpost	pppre
1	34.30	34.60	2.06	2.06	73.60	62.30	53.00
2	25.30	25.30	1.71	1.69	61.60	59.60	47.30
3	19.70	19.80	1.64	1.61	49.60	48.30	48.30
4	23.50	23.70	1.85	1.82	70.30	72.00	48.30
5	20.60	20.80	1.66	1.67	74.30	76.00	50.60
6	25.10	23.60	1.59	1.55	49.00	47.60	50.60
7	25.60	26.00	1.62	1.63	64.90	62.30	42.00
8	25.70	25.80	1.73	1.76	49.30	47.00	47.30
9	22.90	23.60	1.61	1.63	71.30	70.30	48.00
10	24.60	24.50	1.83	1.82	55.30	53.30	51.60
11	21.50	21.40	1.78	1.78	60.00	50.00	43.60
12	24.06	22.90	1.74	1.69	67.60	39.00	60.60
13	21.50	21.50	1.52	1.52	52.60	44.60	48.30
14	25.80	26.30	1.69	1.70	66.30	65.00	54.60
15	22.30	22.20	1.75	1.76	73.60	67.00	43.60
16	24.90	25.10	1.73	1.74	61.00	62.00	51.30
17	38.20	38.60	2.13	2.14	63.00	62.30	43.00
18	21.30	21.90	1.60	1.61	54.30	61.60	46.60
19	25.10	26.10	1.79	1.82	55.60	56.00	57.00
20	21.30	21.40	1.62	1.62	69.30	74.00	46.60
21	35.90	35.30	2.28	2.26	56.60	69.30	50.00
22	35.60	36.40	2.13	2.15	82.60	81.00	53.00
23	25.70	24.60	1.76	1.75	84.00	62.00	50.60
24	34.30	33.50	2.09	2.09	68.00	64.30	49.00
25	23.00	22.70	1.78	1.79	68.60	74.30	58.60
26	20.70	21.30	1.63	1.62	77.30	72.30	46.30
27	20.10	20.10	1.51	1.51	71.60	68.00	43.00
28	30.90	29.90	1.92	1.87	59.60	58.30	53.30
29	21.20	20.80	1.68	1.66	62.30	58.30	44.60
30	21.90	22.30	1.54	1.52	75.60	83.30	39.60
31	25.00	24.70	1.95	1.94	64.00	64.60	48.30
32	41.80	41.80	2.23	2.24	60.30	82.60	59.00

	pppost	sbppre	dbppre	sbppost	dbppost	hyptpre	hyptpost
1	51.00	130.60	77.60	123.00	72.00	1.00	.00
2	47.00	124.60	77.30	112.00	65.00	.00	.00
3	46.00	109.00	60.60	111.60	65.60	.00	.00
4	47.00	123.30	75.00	116.60	69.60	.00	.00
5	47.30	119.30	68.80	111.00	63.60	.00	.00
6	46.60	113.30	62.60	110.30	63.60	.00	.00
7	43.30	103.30	61.30	107.60	64.30	.00	.00
8	43.00	114.00	66.60	106.30	63.30	.00	.00
9	45.60	137.00	89.00	130.60	85.00	1.00	1.00
10	50.00	113.30	61.60	108.60	58.60	.00	.00
11	41.00	109.30	65.60	112.30	71.30	.00	.00
12	42.60	111.00	50.30	93.00	50.30	.00	.00
13	42.00	117.00	68.60	99.30	57.30	.00	.00
14	53.00	123.30	68.60	118.30	65.30	.00	.00
15	48.00	106.00	62.30	107.30	59.30	.00	.00
16	52.50	108.00	56.60	110.00	57.50	.00	.00
17	43.30	116.30	73.30	117.00	73.60	.00	.00
18	44.60	106.30	59.60	100.60	56.00	.00	.00
19	58.60	113.60	56.60	113.00	54.30	.00	.00
20	49.00	115.30	68.60	116.60	67.60	.00	.00
21	52.60	117.30	67.30	118.30	65.60	.00	.00
22	65.00	131.60	78.60	156.60	91.60	1.00	1.00
23	43.60	132.30	81.60	115.60	72.00	1.00	.00
24	54.60	117.60	68.60	132.60	78.00	.00	1.00
25	51.60	144.60	86.00	128.30	76.60	1.00	.00
26	43.30	118.30	72.00	111.00	67.60	.00	.00
27	46.00	103.60	60.60	106.00	60.00	.00	.00
28	57.00	128.30	75.00	127.00	70.00	.00	.00
29	41.60	108.60	64.00	104.00	62.30	.00	.00
30	52.00	117.60	78.00	129.60	77.60	.00	.00
31	49.00	119.30	71.00	119.60	70.60	.00	.00
32	50.60	141.00	82.00	117.60	67.00	1.00	.00

	bmdpre	bmdpost	tissgpre	tissgpos	fatgpre	fatgpost	leangpre
1	1.20	1.21	92944.00	93131.00	47313.00	47344.00	45632.00
2	1.15	1.17	63072.00	62112.00	27611.00	27400.00	35461.00
3	1.22	1.19	54137.00	52395.00	11741.00	11032.00	42396.00
4	1.12	1.12	67489.00	66039.00	30463.00	29682.00	37027.00
5	1.29	1.28	54329.00	55684.00	15710.00	17322.00	38619.00
6	1.14	1.14	57437.00	54228.00	18330.00	15420.00	39107.00
7	1.09	1.09	58617.00	60295.00	26271.00	26813.00	32346.00
8	1.17	1.15	64976.00	66160.00	27090.00	28298.00	37886.00
9	1.20	1.20	55489.00	57082.00	20064.00	20539.00	35424.00
10	1.21	1.20	67929.00	66835.00	26918.00	27065.00	41011.00
11	1.16	1.15	64888.00	64712.00	19663.00	18970.00	45225.00
12	1.23	1.22	62584.00	58755.00	27479.00	24734.00	35105.00
13	1.15	1.18	50454.00	50248.00	15039.00	14773.00	35415.00
14	1.24	1.21	63118.00	63900.00	21974.00	24154.00	41144.00
15	1.24	1.23	60901.00	61303.00	20497.00	19982.00	40404.00
16	1.25	1.24	64031.00	64080.00	22560.00	23696.00	41471.00
17	1.31	1.31	101914.0	103748.0	52655.00	53617.00	49258.00
18	1.12	1.13	53682.00	54684.00	17460.00	18025.00	36222.00
19	1.15	1.16	66920.00	69448.00	29452.00	31912.00	37468.00
20	1.19	1.17	54286.00	54443.00	18019.00	18430.00	36267.00
21	1.38	1.36	108551.0	106342.0	44632.00	46487.00	63919.00
22	1.26	1.33	99358.00	101629.0	47453.00	46200.00	51905.00
23	1.17	1.17	65804.00	64269.00	26174.00	21318.00	39630.00
24	1.33	1.34	95573.00	93715.00	47263.00	45475.00	48310.00
25	1.27	1.27	63544.00	63430.00	16388.00	15422.00	47156.00
26	1.15	1.15	53700.00	54053.00	18573.00	18939.00	35127.00
27	1.14	1.14	48283.00	48555.00	12226.00	13308.00	36057.00
28	1.30	1.30	80007.00	76089.00	37996.00	34408.00	42011.00
29	1.10	1.08	56968.00	56049.00	16055.00	14678.00	40914.00
30	1.20	1.21	51122.00	50911.00	17704.00	17378.00	33418.00
31	1.18	1.20	74413.00	73835.00	23938.00	20808.00	50475.00
32	1.25	1.28	113249.0	114145.0	58561.00	57080.00	54688.00

	leangpos	bmcpre	bmcpost	lgfatpre	lgfatpos	lgtispre	lgtispos
1	45787.00	2889.00	2905.00	52.60	51.30	36695.00	33513.00
2	34713.00	2520.00	2608.00	46.50	45.60	23392.00	22914.00
3	41363.00	2568.00	2514.00	23.30	21.40	19213.00	17852.00
4	36357.00	2571.00	2574.00	50.60	50.20	26560.00	25786.00
5	38361.00	2781.00	2854.00	35.10	36.00	19521.00	20193.00
6	38808.00	2160.00	2225.00	34.00	30.80	19662.00	18212.00
7	33482.00	2297.00	2201.00	51.10	52.50	23238.00	23785.00
8	37862.00	2790.00	2814.00	40.70	42.10	22093.00	21726.00
9	36543.00	2583.00	2557.00	35.80	35.50	18896.00	19501.00
10	39770.00	2750.00	2756.00	40.70	40.20	22147.00	21259.00
11	45743.00	2788.00	2759.00	29.00	28.40	21777.00	21969.00
12	34021.00	2725.00	2754.00	44.30	42.00	23238.00	21300.00
13	35475.00	2287.00	2264.00	32.70	32.50	18821.00	19677.00
14	39745.00	2596.10	2720.60	39.10	40.60	23830.00	24006.00
15	41321.00	2799.00	2767.00	36.50	35.10	21597.00	22030.00
16	40384.00	2680.00	2725.00	41.20	43.60	23370.00	23852.00
17	50130.00	2567.00	2552.00	49.20	50.10	37913.00	38296.00
18	36659.00	2250.00	2282.00	36.70	36.80	19616.00	20043.00
19	37536.00	2570.00	2782.00	46.70	45.10	23444.00	25127.00
20	36013.00	2416.00	2482.00	36.70	37.90	19761.00	19775.00
21	59855.00	3125.00	3335.00	33.70	33.90	32189.00	29229.00
22	55429.00	2834.00	2658.00	46.00	43.50	32293.00	35343.00
23	42951.00	2903.00	2694.00	40.90	36.10	22529.00	23245.00
24	48240.00	3184.00	3037.00	48.20	48.10	34012.00	30427.00
25	48009.00	3123.00	3089.00	31.50	29.20	22610.00	22400.00
26	35114.00	2498.00	2440.00	42.00	43.30	19158.00	19954.00
27	35247.00	2122.00	2171.00	27.10	28.80	15326.00	15266.00
28	41681.00	3179.00	3104.00	43.00	43.10	27122.00	24880.00
29	41371.00	2256.00	2304.00	33.90	32.40	23255.00	23046.00
30	33533.00	2385.00	2317.00	35.90	35.70	17054.00	17438.00
31	53027.00	2861.00	2826.00	36.90	33.60	28694.00	28273.00
32	57064.00	2882.00	2565.00	49.60	48.40	41395.00	42020.00

	lgfatgpr	lgfatgpo	lglengpr	lglengpo	lgbmcpre	lgbmcpos	bfpre
1	19903.00	17753.00	16792.00	15760.00	1177.00	1103.00	49.40
2	11317.00	10894.00	12074.00	12020.00	957.00	977.00	42.10
3	4698.00	4020.00	14515.00	13832.00	965.00	918.00	20.70
4	13950.00	13434.00	12609.00	12352.00	1008.00	996.00	43.50
5	7223.00	7652.00	12298.00	12541.00	1085.00	1091.00	27.50
6	6978.00	5875.00	12684.00	12338.00	858.00	863.00	30.80
7	12274.00	12910.00	10964.00	10875.00	803.00	814.00	43.10
8	9367.00	9544.00	12726.00	12183.00	933.00	926.00	40.00
9	7098.00	7251.00	11799.00	12249.00	940.00	939.00	34.60
10	9416.00	8935.00	12731.00	12324.00	981.00	979.00	38.10
11	6617.00	6546.00	15160.00	15423.00	1034.00	1043.00	29.10
12	10750.00	9366.00	12488.00	11934.00	1025.00	1003.00	42.10
13	6421.00	6655.00	12400.00	13022.00	800.00	811.00	28.50
14	9665.00	10101.00	14165.00	13905.00	892.60	891.70	33.40
15	8253.00	8099.00	13344.00	13932.00	1022.00	1015.00	32.20
16	10025.00	10815.00	13345.00	13037.00	946.00	964.00	33.80
17	19234.00	19758.00	18679.00	18538.00	1168.00	1135.00	50.40
18	7495.00	7681.00	12122.00	12363.00	832.00	837.00	31.20
19	11399.00	11777.00	12045.00	13350.00	952.00	987.00	42.40
20	7566.00	7838.00	12194.00	11937.00	872.00	888.00	31.80
21	11312.00	10386.00	20876.00	18843.00	1394.00	1389.00	40.00
22	15398.00	15858.00	16895.00	19484.00	1146.00	1140.00	46.40
23	9585.00	8721.00	12944.00	14524.00	917.00	901.00	38.10
24	17001.00	15228.00	17011.00	15199.00	1242.00	1214.00	47.90
25	7452.00	6824.00	15159.00	15576.00	1030.00	999.00	24.60
26	8432.00	9047.00	10726.00	10907.00	926.00	925.00	33.00
27	4364.00	4618.00	10962.00	10648.00	759.00	767.00	24.30
28	12109.00	11189.00	15013.00	13690.00	1064.00	1059.00	45.70
29	8177.00	7747.00	15078.00	15299.00	893.00	899.00	27.10
30	6411.00	6512.00	10644.00	10927.00	807.00	795.00	33.10
31	10953.00	9849.00	17741.00	18424.00	1016.00	1038.00	31.00
32	21135.00	20909.00	20261.00	21111.00	1203.00	1184.00	50.40

	bfpost	c1pre1	c1pre2	c1pre3	c1preavg	c1post1	c1post2
1	49.30	13.40	14.00	13.60	13.67	16.50	15.00
2	42.30	17.50	13.60	16.40	15.83	18.50	18.90
3	20.10	15.60	13.80	18.30	15.90	17.40	15.60
4	43.30	16.90	12.20	14.40	14.50	9.80	13.90
5	29.60	14.10	12.70	12.90	13.23	12.70	14.80
6	27.30	17.30	15.10	17.10	16.50	23.00	24.10
7	42.90	20.20	17.40	17.20	18.27	15.40	16.30
8	41.00	20.20	26.40	23.90	23.50	26.50	28.00
9	34.40	14.50	12.00	12.00	12.83	17.40	14.50
10	38.90	14.80	12.60	13.30	13.57	20.10	13.30
11	28.10	17.60	18.30	20.00	18.63	22.40	28.50
12	40.20	22.00	10.80	14.60	15.80	25.40	25.20
13	28.10	20.40	20.30	11.90	17.53	26.60	23.20
14	36.30	13.40	13.70	14.00	13.70	14.20	18.40
15	31.20	15.00	18.40	19.90	17.77	16.20	15.10
16	35.50	15.20	12.50	18.10	15.27	13.60	11.90
17	50.40	23.00	17.50	20.60	20.37	27.20	14.00
18	31.60	25.20	22.60	25.30	24.37	24.10	26.60
19	44.20	14.90	13.70	14.60	14.40	19.40	18.60
20	32.40	17.20	15.50	16.60	16.43	13.20	19.80
21	42.40	20.50	19.20	20.60	20.10	25.10	21.50
22	44.30	12.20	13.80	13.90	13.30	8.90	11.60
23	31.80	14.50	12.10	10.30	12.30	23.10	21.30
24	47.00	16.60	14.20	14.90	15.23	15.10	14.10
25	23.20	10.40	12.40	13.10	11.97	20.40	17.40
26	33.50	13.50	10.90	14.50	12.97	12.70	12.30
27	26.20	14.50	12.60	12.60	13.23	13.60	18.00
28	43.40	16.70	11.70	15.90	14.77	13.40	14.50
29	25.20	19.00	18.10	18.70	18.60	16.80	16.60
30	32.60	13.20	16.00	12.90	14.03	9.60	8.60
31	27.10	16.00	19.20	18.10	17.77	18.40	17.30
32	48.90	14.40	16.10	11.70	14.07	11.20	16.10

	c1post3	c1postav	c2pre1	c2pre2	c2pre3	c2preavg	c2post1
1	16.60	16.03	6.00	4.40	7.10	5.83	13.80
2	15.30	17.57	7.90	5.80	8.30	7.33	6.90
3	17.90	16.97	10.30	11.70	10.90	10.97	9.90
4	13.30	12.33	4.50	5.70	4.80	5.00	6.90
5	14.90	14.13	5.80	5.30	6.00	5.70	5.40
6	25.10	24.07	8.10	9.80	11.10	9.67	9.60
7	16.10	15.93	7.50	6.90	8.10	7.50	5.50
8	21.10	25.20	7.50	7.50	8.20	7.73	9.30
9	14.80	15.57	3.70	3.80	3.60	3.70	5.10
10	16.70	16.70	12.50	12.90	13.60	13.00	13.60
11	23.00	24.63	15.00	15.30	11.30	13.87	9.20
12	34.80	28.47	10.00	9.10	12.10	10.40	11.20
13	19.40	23.07	8.50	6.10	5.40	6.67	7.20
14	15.20	15.93	11.50	7.70	12.40	10.53	9.60
15	15.80	15.70	7.50	6.90	8.70	7.70	7.60
16	.	12.75	10.70	7.60	12.10	10.13	8.20
17	28.10	23.10	14.30	9.50	10.10	11.30	10.70
18	23.00	24.57	7.10	8.20	5.50	6.93	10.30
19	19.00	19.00	12.10	7.40	7.40	8.97	7.00
20	15.10	16.03	6.80	5.20	5.40	5.80	4.90
21	21.60	22.73	9.60	10.60	14.70	11.63	10.10
22	10.60	10.37	4.00	4.10	6.50	4.87	3.80
23	19.10	21.17	5.60	4.20	3.80	4.53	10.30
24	12.00	13.73	9.80	9.60	10.60	10.00	10.50
25	13.80	17.20	4.50	5.10	7.20	5.60	6.80
26	15.00	13.33	4.50	4.10	3.70	4.10	5.50
27	12.60	14.73	13.00	13.90	10.70	12.53	12.00
28	9.90	12.60	7.70	5.60	4.90	6.07	5.10
29	20.10	17.83	5.30	5.70	5.40	5.47	6.10
30	7.70	8.63	3.20	5.60	3.30	4.03	2.10
31	19.70	18.47	10.00	4.60	6.90	7.17	12.10
32	13.00	13.43	7.70	5.80	6.60	6.70	5.10

	c2post2	c2post3	c2postav	svrpre	svrpost	tvipre	tvipost
1	12.30	12.80	12.97	1193.60	1152.30	126.00	118.00
2	6.60	8.30	7.27	1400.30	1280.60	127.60	117.60
3	11.80	9.90	10.53	1415.60	1503.30	149.00	145.60
4	4.30	4.80	5.33	1404.60	1261.30	121.00	136.60
5	5.40	6.30	5.70	1244.00	1135.30	126.00	117.50
6	9.40	8.90	9.30	1333.30	1318.60	151.00	114.00
7	8.10	8.10	7.23	1213.30	1246.00	106.60	121.00
8	9.10	9.20	9.20	1304.60	1240.00	110.00	110.00
9	4.40	3.70	4.40	1820.00	1609.30	139.00	116.00
10	14.40	15.10	14.37	1253.00	1131.30	153.30	131.60
11	8.50	8.10	8.60	1092.60	1253.60	103.30	98.30
12	11.70	12.00	11.63	897.00	884.60	229.00	129.00
13	8.60	8.00	7.93	1383.30	1307.30	145.30	125.30
14	9.20	9.50	9.43	1111.60	1156.30	133.00	127.30
15	7.40	8.30	7.77	1031.60	1038.30	92.30	118.00
16	6.70		7.45	2273.60	977.50	136.00	143.50
17	7.10	10.80	9.53	1099.00	1100.60	94.00	91.60
18	8.40	11.50	10.07	1179.30	991.60	95.30	85.00
19	7.60	5.50	6.70	1089.30	1005.00	141.30	104.30
20	5.60	4.80	5.10	1171.00	1174.30	108.00	107.00
21	11.90	9.90	10.63	975.30	839.60	107.00	80.00
22	4.40	4.70	4.30	1239.60	1421.60	116.60	149.30
23	12.30	10.00	10.87	1367.00	1140.60	124.00	93.60
24	8.00	6.70	8.40	1054.30	1343.30	111.60	123.30
25	6.30	9.40	7.50	1520.60	1262.30	156.60	101.30
26	4.20	5.20	4.97	1460.60	1312.00	127.00	129.60
27	11.20	16.30	13.17	1229.00	1277.30	127.30	132.30
28	4.80	4.40	4.77	1336.00	1202.30	143.00	168.00
29	5.60	6.70	6.13	1185.30	1148.30	104.60	121.00
30	2.90	2.70	2.57	1568.30	1829.60	121.00	176.60
31	9.80	8.60	10.17	1190.30	1171.00	112.00	104.30
32	6.00	4.20	5.10	1180.60	934.00	131.60	115.60

	cprpre	crppost	hfpre	hepre	abdpre	addpre	lppre
1	7.70	9.89	59.66	90.91	51.14	59.66	136.36
2	.27	.06	51.14	51.14	28.41	39.77	72.73
3	.42	.75	56.82	73.86	45.45	56.82	104.55
4	1.02	1.10	39.77	59.66	39.77	45.45	104.55
5	1.12	1.04	48.30	62.50	36.93	48.30	81.82
6	.07	.22	56.82	90.91	45.45	62.50	127.27
7	1.30	.88	48.30	79.55	39.77	51.14	109.09
8	.75	.45	62.50	85.23	48.30	59.66	113.64
9	.98	1.67	45.45	73.86	39.77	51.14	81.82
10	.65	.37	48.30	65.34	34.09	51.14	81.82
11	.52	.10	51.14	62.50	34.09	51.14	100.00
12	1.02	4.70	39.77	56.82	45.45	45.45	81.82
13	.45	.56	39.77	56.82	28.41	34.09	81.82
14	.52	1.29	39.77	42.61	31.25	36.93	127.27
15	4.60	8.40	39.77	71.02	36.93	56.82	109.09
16	1.40	1.59	56.82	68.18	42.61	53.98	100.00
17	2.70	6.20	51.14	62.50	45.45	56.82	100.00
18	.18	1.42	51.14	65.34	39.77	42.61	100.00
19	4.78	3.14	48.30	73.86	39.77	51.14	100.00
20	.20	.80	59.66	65.34	39.77	51.14	104.55
21	.62	1.56	59.66	85.23	48.30	62.50	136.36
22	3.48	3.49	45.45	107.95	39.77	56.82	100.00
23	1.18	.56	62.50	62.50	36.93	51.14	109.09
24	.71	1.49	45.45	65.34	36.93	48.30	90.91
25	.11	.07	53.98	65.34	39.77	51.14	118.18
26	.93	1.09	36.93	65.34	36.93	39.77	100.00
27	.37	.38	31.25	56.82	34.09	39.77	90.91
28	15.40	4.78	45.45	79.55	51.14	53.98	131.82
29	.56	.45	56.82	62.50	39.77	56.82	100.00
30	.68	.40	48.30	48.30	39.77	36.93	90.91
31	.98	.25	51.14	76.70	31.25	45.45	113.64
32	6.60	10.60	62.50	76.70	48.30	62.50	168.18

	shinpre	calfpre	hfmid	hemid	abdmid	addmid	lpmid
1	18.18	70.45	.	.	.	.	.
2	21.82	40.91	.	.	.	.	.
3	20.45	50.00	.	.	.	.	.
4	20.45	45.45	.	.	.	.	.
5	19.32	34.09	.	.	.	.	.
6	25.00	54.55	.	.	.	.	.
7	18.18	34.09	.	.	.	.	.
8	20.45	50.00	.	.	.	.	.
9	11.36	31.82	.	.	.	.	.
10	13.64	43.18	.	.	.	.	.
11	27.27	54.55	.	.	.	.	.
12	12.50	40.91	48.30	62.50	36.93	48.30	100.00
13	9.09	45.45	65.34	68.18	48.30	48.30	118.18
14	18.18	36.36	68.18	48.30	45.45	62.50	154.55
15	11.36	47.73	65.34	88.07	45.45	59.66	122.73
16	13.64	40.91	62.50	68.18	45.45	56.82	136.36
17	15.91	54.55	62.50	73.86	51.14	68.18	118.18
18	17.05	50.00	62.50	79.55	45.45	56.82	118.18
19	11.36	38.64	59.66	82.39	48.30	56.82	109.09
20	17.05	56.82	79.55	79.55	51.14	53.98	172.73
21	27.27	72.73	79.55	125.00	68.18	90.91	163.64
22	18.18	59.09	62.50	102.27	39.77	68.18	109.09
23	18.18	59.09	93.75	79.55	51.14	71.02	131.82
24	15.91	50.00	56.82	68.18	39.77	51.14	131.82
25	27.27	59.09	90.91	96.59	53.98	65.34	145.45
26	18.18	59.09	48.30	76.70	45.45	51.14	104.55
27	14.77	31.82	56.82	65.34	45.45	51.14	90.91
28	20.45	56.82	71.02	79.55	56.82	62.50	127.27
29	15.91	45.45	76.70	88.07	51.14	68.18	131.82
30	22.73	38.64	65.34	48.30	42.61	53.98	113.64
31	27.27	54.55	68.18	99.43	48.30	59.66	131.82
32	25.00	86.36	71.02	96.59	53.98	62.50	186.36

	shinmid	calfmid	hfpost	hepost	abdpost	addpost	lppost
1	.	.	85.23	116.48	62.50	73.86	136.36
2	.	.	73.86	68.18	36.93	42.61	109.09
3	.	.	53.98	73.86	45.45	45.45	118.18
4	.	.	48.30	73.86	39.77	53.98	113.64
5	.	.	48.30	73.86	34.09	45.45	109.09
6	.	.	51.14	68.18	45.45	56.82	104.55
7	.	.	56.82	65.34	42.61	48.30	109.09
8	.	.	65.34	90.91	53.98	62.50	136.36
9	.	.	45.45	56.82	42.61	53.98	81.82
10	.	.	51.14	73.86	42.61	56.82	95.45
11	.	.	48.30	68.18	36.93	45.45	109.09
12	22.73	45.45	65.34	79.55	48.30	62.50	113.64
13	20.45	63.64	88.07	85.23	68.18	68.18	118.18
14	20.45	43.18	65.34	82.39	42.61	56.82	204.55
15	20.45	61.36	102.27	107.95	62.50	71.02	122.73
16	20.45	54.55	82.39	85.23	59.66	71.02	186.36
17	20.45	86.36	79.55	110.80	59.66	82.39	131.82
18	22.73	59.09	79.55	82.39	53.98	56.82	131.82
19	20.45	68.18	82.39	88.07	59.66	65.34	109.09
20	22.73	68.18	107.95	107.95	79.55	79.55	163.64
21	23.86	122.73	117.70	119.40	90.91	118.00	213.64
22	22.73	68.18	102.27	120.00	68.18	85.23	131.82
23	20.45	84.09	117.20	107.95	59.66	73.86	145.45
24	22.73	81.82	76.70	90.91	48.30	56.82	113.64
25	22.73	88.64	99.43	99.43	62.50	65.34	140.91
26	20.45	56.82	51.14	71.02	42.61	51.14	118.18
27	19.32	54.55	65.34	76.70	45.45	48.30	95.45
28	23.86	81.82	85.23	90.91	56.82	59.66	131.82
29	27.27	77.27	79.55	85.23	51.14	62.50	163.64
30	23.86	52.27	85.23	85.23	53.98	62.50	127.27
31	23.86	81.82	79.55	116.48	62.50	85.23	140.91
32	27.27	100.00	82.39	107.95	68.18	68.18	231.82

	shinpost	calfpost	sessions	load1hf	load1he	load1hab	load1had
1	22.73	104.55	.	.	.	.	.
2	22.73	56.82	.	.	.	.	.
3	23.64	68.18	.	.	.	.	.
4	21.59	59.09	.	.	.	.	.
5	22.73	38.64	.	.	.	.	.
6	18.18	59.09	.	.	.	.	.
7	18.18	40.91	.	.	.	.	.
8	22.73	68.18	.	.	.	.	.
9	11.36	45.45	.	.	.	.	.
10	19.32	38.64	.	.	.	.	.
11	20.45	63.64	.	.	.	.	.
12	28.41	65.91	34.00	5500.00	7999.90	5999.90	5999.90
13	22.73	72.73	26.00	4000.00	5818.10	2909.00	3272.70
14	27.27	61.36	30.00	3500.00	3818.10	2545.40	3181.80
15	29.86	100.00	28.00	4500.00	8181.80	4090.90	6545.40
16	22.73	72.73	26.00	5818.10	6909.00	4363.60	5454.50
17	29.55	104.55	30.00	6999.90	8500.00	5999.90	7999.90
18	26.14	72.73	30.00	6999.90	8999.90	5500.00	5999.90
19	20.45	95.45	29.00	6500.00	9999.90	5500.00	6999.90
20	25.00	90.91	32.00	7272.70	8181.80	5000.00	6363.60
21	36.36	145.45	31.00	6545.40	9818.10	5318.10	6954.50
22	27.27	90.91	30.00	3818.10	9545.40	3500.00	5090.90
23	22.73	104.55	32.00	6954.50	6954.50	4254.50	5727.20
24	25.00	95.45	34.00	7090.90	10636.30	5909.00	7681.80
25	25.00	100.00	35.00	8181.80	9818.10	6000.00	7636.30
26	21.59	65.91	33.00	4545.40	8181.80	4545.40	5000.00
27	20.45	65.91	30.00	2909.00	5818.10	3272.70	4000.00
28	22.73	86.36	32.00	4363.60	8000.00	5090.90	5454.50
29	32.95	86.36	33.00	7272.70	7727.20	5000.00	7272.70
30	22.73	72.73	31.00	5318.10	5318.10	4500.00	4090.90
31	26.14	86.36	34.00	7636.00	11454.40	4363.60	6545.20
32	27.27	122.73	28.00	6181.80	7636.30	4727.20	6181.80

	load1lp	load1sh	load1cal	load2hf	load2he	load2hab	load2had
1	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.
4	.	.	.	.	.	.	.
5	.	.	.	.	.	.	.
6	.	.	.	.	.	.	.
7	.	.	.	.	.	.	.
8	.	.	.	.	.	.	.
9	.	.	.	.	.	.	.
10	.	.	.	.	.	.	.
11	.	.	.	.	.	.	.
12	16800.00	2640.00	8639.90	8272.70	10818.10	6363.60	8272.70
13	12218.10	1396.30	6981.80	7363.60	7772.70	5318.10	5318.10
14	16800.00	2443.60	4887.20	9500.00	6500.00	5999.90	8500.00
15	18249.50	1936.60	8247.20	9818.10	13090.90	6545.40	8727.20
16	14836.30	2094.50	6283.60	5409.00	6045.40	3818.10	5090.90
17	20399.90	3359.90	11760.00	7727.20	9090.90	6363.60	8636.30
18	20399.90	3599.90	10560.00	6545.40	8000.00	4727.20	5818.10
19	20399.90	2399.90	8160.00	7272.70	10454.50	5909.00	7272.70
20	19636.30	3272.70	10909.00	12000.00	12000.00	7636.30	8181.80
21	23563.60	4712.70	12567.20	12000.00	19090.90	10363.60	13636.30
22	12981.80	2443.60	7941.80	9272.70	15272.70	6000.00	10363.60
23	18654.50	3141.80	10210.90	10800.00	9000.00	5727.20	8181.80
24	22690.90	3970.90	12480.00	7999.90	9500.00	5500.00	6999.90
25	26181.80	6283.60	13614.50	14772.70	15954.50	8863.60	10636.30
26	16363.60	3490.90	4909.00	5909.00	9545.40	5454.50	6363.60
27	13963.60	2269.00	4887.20	7272.70	8181.80	5454.50	6363.60
28	20072.70	3141.80	8727.20	10909.00	12000.00	8727.20	9272.70
29	18545.40	3054.50	8727.20	9545.40	10909.00	6363.60	8636.30
30	15709.00	3927.20	5890.90	9818.10	8727.20	6545.40	8181.80
31	26181.60	5236.00	12567.20	9499.60	13999.90	6499.90	7999.90
32	25309.00	3840.00	13265.40	5454.50	7363.20	4090.80	4636.30

	load2lp	load2sh	load2cal	tvolpre	tvolpost	totalvol	percchan
1	.	.	.	.	.	.	.
2	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.
4	.	.	.	.	.	.	.
5	.	.	.	.	.	.	.
6	.	.	.	.	.	.	.
7	.	.	.	.	.	.	.
8	.	.	.	.	.	.	.
9	.	.	.	.	.	.	.
10	.	.	.	.	.	.	.
11	.	.	.	.	.	.	.
12	25963.60	6109.00	12218.10	53579.60	78017.80	131597.4	45.61
13	19636.30	3534.50	9818.10	36596.00	58761.40	95357.40	60.57
14	32400.00	4320.00	9119.90	37176.10	76339.80	113515.9	105.35
15	27490.20	4581.80	14138.10	51751.40	84391.70	136143.1	63.07
16	18327.20	2749.00	7330.90	45759.60	48770.50	94530.10	6.58
17	21818.10	3927.20	16581.80	65019.50	74145.10	139164.6	14.04
18	18327.20	3490.90	9076.30	62059.50	55985.10	118044.6	-9.79
19	20727.20	3927.20	13090.90	59959.60	68654.20	128613.8	14.50
20	39272.70	5236.30	15709.00	60636.10	100036.1	160672.2	64.98
21	36654.50	5498.10	28276.30	69479.60	125519.7	194999.3	80.66
22	24872.70	5236.30	15709.00	45321.60	86727.00	132048.6	91.36
23	22581.80	3534.50	14530.90	55897.90	74356.20	18458.30	33.02
24	27600.00	4799.90	17279.90	70459.80	79679.60	150139.4	13.09
25	35454.50	5672.70	22123.60	77716.10	113477.9	191194.0	46.02
26	19636.30	3927.20	10909.00	47036.10	61745.00	108781.1	31.27
27	17454.50	3709.00	10472.70	37119.60	58908.80	96028.40	58.70
28	28800.00	5498.10	18850.90	54850.70	94057.90	148908.6	71.48
29	22581.80	4712.70	13352.70	57599.70	76101.50	133701.2	32.12
30	26181.80	5498.10	12043.60	44754.20	76996.00	121750.2	72.04
31	27599.90	5039.90	17279.90	73984.00	87919.00	161903.0	18.84
32	20945.40	3141.80	11520.00	67141.50	57152.00	124293.5	-14.88

	agerank	hrabscha	hrpercch	ppabscha	pppercha	sbpabsch	sbpperch
1	1.00	-11.30	-15.35	-2.00	-3.77	-7.60	-5.82
2	.00	-2.00	-3.25	-.30	-.63	-12.60	-10.11
3	1.00	-1.30	-2.62	-2.30	-4.76	2.60	2.39
4	1.00	1.70	2.42	-1.30	-2.69	-6.70	-5.43
5	1.00	1.70	2.29	-3.30	-6.52	-8.30	-6.96
6	.00	-1.40	-2.86	-4.00	-7.91	-3.00	-2.65
7	1.00	-2.60	-4.01	1.30	3.10	4.30	4.16
8	.00	-2.30	-4.67	-4.30	-9.09	-7.70	-6.75
9	1.00	-1.00	-1.40	-2.40	-5.00	-6.40	-4.67
10	1.00	-2.00	-3.62	-1.60	-3.10	-4.70	-4.15
11	.00	-10.00	-16.67	-2.60	-5.96	3.00	2.74
12	.00	-28.60	-42.31	-18.00	-29.70	-18.00	-16.22
13	.00	-8.00	-15.21	-6.30	-13.04	-17.70	-15.13
14	.00	-1.30	-1.96	-1.60	-2.93	-5.00	-4.06
15	.00	-6.60	-8.97	4.40	10.09	1.30	1.23
16	.00	1.00	1.64	1.20	2.34	2.00	1.85
17	.00	-.70	-1.11	.30	.70	.70	.60
18	.00	7.30	13.44	-2.00	-4.29	-5.70	-5.36
19	.00	.40	.72	1.60	2.81	-.60	-.53
20	.00	4.70	6.78	2.40	5.15	1.30	1.13
21	.00	12.70	22.44	2.60	5.20	1.00	.85
22	1.00	-1.60	-1.94	12.00	22.64	25.00	19.00
23	33.02	-22.00	-26.19	-7.00	-13.83	-16.70	-12.62
24	1.00	-3.70	-5.44	5.60	11.43	15.00	12.76
25	1.00	5.70	8.31	-7.00	-11.95	-16.30	-11.27
26	1.00	-5.00	-6.47	-3.00	-6.48	-7.30	-6.17
27	1.00	-3.60	-5.03	3.00	6.98	2.40	2.32
28	1.00	-1.30	-2.18	3.70	6.94	-1.30	-1.01
29	.00	-4.00	-6.42	-3.00	-6.73	-4.60	-4.24
30	1.00	7.70	10.19	12.40	31.31	12.00	10.20
31	1.00	.60	.94	.70	1.45	.30	.25
32	.00	22.30	36.98	-8.40	-14.24	-23.40	-16.60

	dpbabsch	dbpperch	c1absoch	c1percha	c2absoch	c2percha	svrabsoc
1	-5.60	-7.22	2.37	17.32	7.13	122.29	-41.30
2	-12.30	-15.91	1.73	10.95	-.07	-.91	-119.70
3	5.00	8.25	1.07	6.71	-.43	-3.95	87.70
4	-5.40	-7.20	-2.17	-14.94	.33	6.67	-143.30
5	-5.20	-7.56	.90	6.80	.00	.00	-108.70
6	1.00	1.60	7.57	45.86	-.37	-3.79	-14.70
7	3.00	4.89	-2.33	-12.77	-.27	-3.56	32.70
8	-3.30	-4.95	1.70	7.23	1.47	18.97	-64.60
9	-4.00	-4.49	2.73	21.30	.70	18.92	-210.70
10	-3.00	-4.87	3.13	23.10	1.37	10.51	-121.70
11	5.70	8.69	6.00	32.20	-5.27	-37.98	161.00
12	.00	.00	12.67	80.17	1.23	11.86	-12.40
13	-11.30	-16.47	5.53	31.56	1.27	19.00	-76.00
14	-3.30	-4.81	2.23	16.30	-1.10	-10.44	44.70
15	-3.00	-4.82	-2.07	-11.63	.07	.87	6.70
16	.90	1.59	-2.52	-16.48	-2.68	-26.48	-1296.10
17	.30	.41	2.73	13.42	-1.77	-15.63	1.60
18	-3.60	-6.04	.20	.82	3.13	45.19	-187.70
19	-2.30	-4.06	4.60	31.94	-2.27	-25.28	-84.30
20	-1.00	-1.46	-.40	-2.43	-.70	-12.07	3.30
21	-1.70	-2.53	2.63	13.10	-1.00	-8.60	-135.70
22	13.00	16.54	-2.93	-22.06	-.57	-11.64	182.00
23	-9.60	-11.76	8.87	72.09	6.33	139.71	-226.40
24	9.40	13.70	-1.50	-9.85	-1.60	-16.00	289.00
25	-9.40	-10.93	5.23	43.73	1.90	33.93	-258.30
26	-4.40	-6.11	.37	2.83	.87	21.14	-148.60
27	-.60	-.99	1.50	11.34	.63	5.05	48.30
28	-5.00	-6.67	-2.17	-14.67	-1.30	-21.43	-133.70
29	-1.70	-2.66	-.77	-4.12	.67	12.20	-37.00
30	-.40	-.51	-5.40	-38.48	-1.47	-36.36	261.30
31	-.40	-.56	.70	3.94	3.00	41.86	-19.30
32	-15.00	-18.29	-.63	-4.50	-1.60	-23.88	-246.60

	svrperch	tviabsch	tviperch	crpabsoc	crpperch	hfabscha	hfpercch
1	-3.46	-8.00	-6.35	2.19	28.44	25.57	42.86
2	-8.55	-10.00	-7.84	-.21	-78.89	22.73	44.44
3	6.20	-3.40	-2.28	.33	78.57	-2.84	-5.00
4	-10.20	15.60	12.89	.08	7.84	8.52	21.43
5	-8.74	-8.50	-6.75	-.08	-7.14	.00	.00
6	-1.10	-37.00	-24.50	.15	197.30	-5.68	-10.00
7	2.70	14.40	13.51	-.42	-32.31	8.52	17.65
8	-4.95	.00	.00	-.30	-40.00	2.84	4.55
9	-11.58	-23.00	-16.55	.69	70.41	.00	.00
10	-9.71	-21.70	-14.16	-.28	-43.08	2.84	5.88
11	14.74	-5.00	-4.84	-.42	-80.77	-2.84	-5.56
12	-1.38	-100.00	-43.67	3.68	360.78	25.57	64.29
13	-5.49	-20.00	-13.76	.11	24.44	48.30	121.43
14	4.02	-5.70	-4.29	.77	148.08	25.57	64.29
15	.65	25.70	27.84	3.80	82.61	62.50	157.14
16	-57.01	7.50	5.51	.19	13.57	25.57	45.00
17	.15	-2.40	-2.55	3.50	129.63	28.41	55.56
18	-15.92	-10.30	-10.81	1.24	688.89	28.41	55.56
19	-7.74	-37.00	-26.19	-1.64	-34.31	34.09	70.59
20	.28	-1.00	-.93	.60	300.00	48.30	80.95
21	-13.91	-27.00	-25.23	.94	151.61	58.04	97.29
22	14.68	32.70	28.04	.01	.29	56.82	125.00
23	-16.56	-30.40	-24.52	-.62	-52.54	54.70	87.52
24	27.41	11.70	10.48	.78	109.86	31.25	68.75
25	-16.99	-55.30	-35.31	-.04	-36.36	45.45	84.21
26	-10.17	2.60	2.05	.16	17.20	14.20	38.46
27	3.93	5.00	3.93	.01	2.70	34.09	109.09
28	-10.01	25.00	17.48	-10.62	-68.96	39.77	87.50
29	-3.12	16.40	15.68	-.11	-19.64	22.73	40.00
30	16.66	55.60	45.95	-.28	-41.18	36.93	76.47
31	-1.62	-7.70	-6.88	-.73	-74.49	28.41	55.56
32	-20.89	-16.00	-12.16	4.00	60.61	19.89	31.82

	heabsch	hepercch	abdabsch	abdpercc	addabsch	addperch	lpabscha
1	25.57	28.13	11.36	22.22	14.20	23.81	.00
2	17.05	33.33	8.52	30.00	2.84	7.14	36.36
3	.00	.00	.00	.00	-11.36	-20.00	13.64
4	14.20	23.81	.00	.00	8.52	18.75	9.09
5	11.36	18.18	-2.84	-7.69	-2.84	-5.88	27.27
6	-22.73	-25.00	.00	.00	-5.68	-9.09	-22.73
7	-14.20	-17.86	2.84	7.14	-2.84	-5.56	.00
8	5.68	6.67	5.68	11.76	2.84	4.76	22.73
9	-17.05	-23.08	2.84	7.14	2.84	5.56	.00
10	8.52	13.04	8.52	25.00	5.68	11.11	13.64
11	5.68	9.09	2.84	8.33	-5.68	-11.11	9.09
12	22.73	40.00	2.84	6.25	17.05	37.50	31.82
13	28.41	50.00	39.77	140.00	34.09	100.00	36.36
14	39.77	93.33	11.36	36.36	19.89	53.85	77.27
15	36.93	52.00	25.57	69.23	14.20	25.00	13.64
16	17.05	25.00	17.05	40.00	17.05	31.58	86.36
17	48.30	77.27	14.20	31.25	25.57	45.00	31.82
18	17.05	26.09	14.20	35.71	14.20	33.33	31.82
19	14.20	19.23	19.89	50.00	14.20	27.78	9.09
20	42.61	65.22	39.77	100.00	28.41	55.56	59.09
21	34.17	40.10	42.61	88.24	55.50	88.80	77.27
22	12.05	11.16	28.41	71.43	28.41	50.00	31.82
23	45.45	72.73	22.73	61.54	22.73	44.44	36.36
24	25.57	39.13	11.36	30.77	8.52	17.65	22.73
25	34.09	52.17	22.73	57.14	14.20	27.78	22.73
26	5.68	8.70	5.68	15.38	11.36	28.57	18.18
27	19.89	35.00	11.36	33.33	8.52	21.43	4.55
28	11.36	14.29	5.68	11.11	5.68	10.53	.00
29	22.73	36.36	11.36	28.57	5.68	10.00	63.64
30	36.93	76.47	14.20	35.71	25.57	69.23	36.36
31	39.77	51.85	31.25	100.00	39.77	87.50	27.27
32	31.25	40.74	19.89	41.18	5.68	9.09	63.64

	lgpercch	shinabsc	shinperc	calfabsc	calfperc
1	.00	4.55	25.00	34.09	48.39
2	50.00	.91	4.17	15.91	38.89
3	13.04	3.18	15.56	18.18	36.36
4	8.70	1.14	5.56	13.64	30.00
5	33.33	3.41	17.65	4.55	13.33
6	-17.86	-6.82	-27.27	4.55	8.33
7	.00	.00	.00	6.82	20.00
8	20.00	2.27	11.11	18.18	36.36
9	.00	.00	.00	13.64	42.86
10	16.67	5.68	41.67	-4.55	-10.53
11	9.09	-6.82	-25.00	9.09	16.67
12	38.89	15.91	127.27	25.00	61.11
13	44.44	13.64	150.00	27.27	60.00
14	60.71	9.09	50.00	25.00	68.75
15	12.50	18.50	162.80	52.27	109.52
16	86.36	9.09	66.67	31.82	77.78
17	31.82	13.64	85.71	50.00	91.67
18	31.82	9.09	53.33	22.73	45.45
19	9.09	9.09	80.00	56.82	147.06
20	56.52	7.95	46.67	34.09	60.00
21	56.67	9.09	33.33	72.73	100.00
22	31.82	9.09	50.00	31.82	53.85
23	33.33	4.55	25.00	45.45	76.92
24	25.00	9.09	57.14	45.45	90.91
25	19.23	-2.27	-8.33	40.91	69.23
26	18.18	3.41	18.75	6.82	11.54
27	5.00	5.68	38.46	34.09	107.14
28	.00	2.27	11.11	29.55	52.00
29	63.64	17.05	107.14	40.91	90.00
30	40.00	.00	.00	34.09	88.24
31	24.00	-1.14	-4.17	31.82	58.33
32	37.84	2.27	9.09	36.36	42.11

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

TRIALS	Dependent Variable
1	C1PREAVG
2	C1POSTAV

Between-Subjects Factors

		N
GROUP	C	11
	T	21

Descriptive Statistics

	GROUP	Mean	Std. Deviation	N
C1PREAVG	C	16.0394	3.16055	11
	T	15.9032	3.11021	21
	Total	15.9500	3.07693	32
C1POSTAV	C	18.1030	4.43392	11
	T	17.2786	5.07643	21
	Total	17.5620	4.80895	32

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
TRIALS	Sphericity Assumed	42.688	1	42.688	5.761	.023
	Greenhouse-Geisser	42.688	1.000	42.688	5.761	.023
	Huynh-Feldt	42.688	1.000	42.688	5.761	.023
	Lower-bound	42.688	1.000	42.688	5.761	.023
TRIALS * GROUP	Sphericity Assumed	1.710	1	1.710	.231	.634
	Greenhouse-Geisser	1.710	1.000	1.710	.231	.634
	Huynh-Feldt	1.710	1.000	1.710	.231	.634
	Lower-bound	1.710	1.000	1.710	.231	.634
Error(TRIALS)	Sphericity Assumed	222.277	30	7.409		
	Greenhouse-Geisser	222.277	30.000	7.409		
	Huynh-Feldt	222.277	30.000	7.409		
	Lower-bound	222.277	30.000	7.409		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	16359.651	1	16359.651	626.741	.000
GROUP	3.331	1	3.331	.128	.723
Error	783.082	30	26.103		

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

TRIALS	Dependent Variable
1	C2PREAVG
2	C2POSTAV

Between-Subjects Factors

		N
GROUP	C	11
	T	21

Descriptive Statistics

	GROUP	Mean	Std. Deviation	N
C2PREAVG	C	8.2091	3.29781	11
	T	7.6730	2.67382	21
	Total	7.8573	2.86140	32
C2POSTAV	C	8.6273	3.11879	11
	T	7.8183	2.76909	21
	Total	8.0964	2.87004	32

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
TRIALS	Sphericity Assumed	1.146	1	1.146	.391	.537
	Greenhouse-Geisser	1.146	1.000	1.146	.391	.537
	Huynh-Feldt	1.146	1.000	1.146	.391	.537
	Lower-bound	1.146	1.000	1.146	.391	.537
TRIALS * GROUP	Sphericity Assumed	.269	1	.269	.092	.764
	Greenhouse-Geisser	.269	1.000	.269	.092	.764
	Huynh-Feldt	.269	1.000	.269	.092	.764
	Lower-bound	.269	1.000	.269	.092	.764
Error(TRIALS)	Sphericity Assumed	87.990	30	2.933		
	Greenhouse-Geisser	87.990	30.000	2.933		
	Huynh-Feldt	87.990	30.000	2.933		
	Lower-bound	87.990	30.000	2.933		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	3772.071	1	3772.071	273.089	.000
GROUP	6.530	1	6.530	.473	.497
Error	414.378	30	13.813		

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

TRIALS	Dependent Variable
1	CPRPRE
2	CRPPOST

Between-Subjects Factors

		N
GROUP	C	11
	T	21

Descriptive Statistics

	GROUP	Mean	Std. Deviation	N
CPRPRE	C	1.3458	2.14060	11
	T	2.2605	3.50286	21
	Total	1.9461	3.09663	32
CRPPOST	C	1.5025	2.82488	11
	T	2.5343	2.89271	21
	Total	2.1796	2.86717	32

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
TRIALS	Sphericity Assumed	.669	1	.669	.222	.641
	Greenhouse-Geisser	.669	1.000	.669	.222	.641
	Huynh-Feldt	.669	1.000	.669	.222	.641
	Lower-bound	.669	1.000	.669	.222	.641
TRIALS * GROUP	Sphericity Assumed	.050	1	.050	.016	.899
	Greenhouse-Geisser	.050	1.000	.050	.016	.899
	Huynh-Feldt	.050	1.000	.050	.016	.899
	Lower-bound	.050	1.000	.050	.016	.899
Error(TRIALS)	Sphericity Assumed	90.455	30	3.015		
	Greenhouse-Geisser	90.455	30.000	3.015		
	Huynh-Feldt	90.455	30.000	3.015		
	Lower-bound	90.455	30.000	3.015		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	210.845	1	210.845	14.122	.001
GROUP	13.675	1	13.675	.916	.346
Error	447.923	30	14.931		