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# Effect of body fat on substrate utilization during aerobic exercise

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# Effect of Body Fat on Substrate Utilization During Aerobic Exercise

by

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***Effect of Body Fat on Substrate Oxidation During Aerobic Exercise***

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**ABSTRACT: PURPOSE:** The purpose of this project was to determine the exercise intensity relative to ventilatory threshold (VT) that utilized the greatest absolute amount of fat in both recreationally fit-low body fat and lower fit-high body fat males. **METHODS:** Sixteen apparently healthy males, lower fit-high body fat (lofit-hifat) (27.1 ± 5.0%) (n = 8) and recreationally fit-low body fat (recfit-lofat) (10.5 ± 2.3%) (n = 8), completed an exercise test on a cycle ergometer to determine $VO_2$ at VT ($VO_2$vt) and $VO_2$peak. On a separate occasion, within two weeks of the first session, the subjects completed a cycle test consisting of three, five-minute stages at intensities corresponding to 70, 85, and 100% of their VT. **RESULTS:** No significant group differences were found in maximal heart rates, or absolute $VO_2$peak (L/min) and $VO_{2VT}$ (L/min). However relative $VO_2$peak (ml/kg/min and ml/kg FFM/min) and $VO_{2VT}$ (ml/kg/min and ml/kg FFM/min) were significantly higher in the recfit-lofat group. Maximal absolute fat oxidation occurred at 70% of VT in the lofit-hifat males and decreased with increasing intensity, whereas there was no significant difference between exercise intensities within the recfit-lofat group. Absolute fat oxidation was significantly higher in the recfit-lofat group at 85% of VT (1.80 ± 1.2 vs. 2.51 ± 0.9 kcals/min) and 100% of VT (1.54 ± 1.2 vs. 2.35 ± 1.3 kcals/min). Fat oxidation relative to FFM was significantly higher in the recfit-lofat group at each intensity [(70% of VT) 0.036. ± 0.01 vs. 0.044 ± 0.01, (85% of VT) 0.023 ± 0.02 vs. 0.041 ± 0.02, and (100% of VT) 0.020 ± 0.02 vs. 0.038 ± 0.02 kcals/kg LBM/min]. **CONCLUSIONS:** Exercising at 70% of VT results in the greatest absolute amount of fat oxidation in lower fit-high fat males, whereas in higher fit-low fat males fat oxidation does not significantly change as exercise intensity increases from 70 to 100% of VT (53% of $VO_2$peak). These data suggest that lower fit-high body fat males will optimize fat oxidation at low intensity (70% of VT, ~ 40% $VO_2$peak, and RPE = very light). As individuals become more fit with lower body fat, they are able to maintain higher rates of fat oxidation over a wide range of moderate exercise intensities.

**KEY WORDS:** Fat utilization, sedentary, overweight, ventilatory threshold, exercise intensity

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# Chapter One

# INTRODUCTION

## Introduction

Regular aerobic exercise brings multiple benefits to individuals of all ages and fitness levels. One very well known benefit of regular aerobic exercise is improved body composition. In order to decrease body fat, a well-planned exercise prescription is essential. An appropriate intensity of physical exercise is one of the necessary components of any exercise prescription (American College of Sports Medicine (ACSM), 2000). Intensity levels can be prescribed using one or more of many possible parameters including the ratings of perceived exertion (RPE), resting metabolic equivalents (MET), speed, exercise machine setting, kilocalories per hour, heart rate, percent of $VO_2max$, or as a percent of ventilatory threshold (VT). The exercise intensity level, along with duration of exercise will determine how much energy will be used during the exercise session and what combination of substrates (fats and carbohydrates) will be used to fuel the exercise. During exercise there are two major sources of energy; carbohydrate from muscle glycogen and blood glucose, and fat from plasma fatty acids and intramuscular triglycerides. Protein does not significantly contribute to energy when exercising (Coyle, 1995). Substrate utilization during exercise is dependent not only on intensity and duration, but also on gender, nutritional state, age, and training level. This study will focus on finding the optimal exercise intensity level relative to VT in sedentary males that utilizes the greatest amount of fat as the fuel source. Relating intensity level to the individual's VT is most appropriate due to the variability of individual's fitness levels. Ventilatory threshold is the point where ventilation increases non-linearly to compensate for the accumulation of lactate in the blood. Lactate starts to accumulate in the blood when there is an increase lactic acid production and/or decreased lactic acid removal. Just below this point is the maximum intensity of exercise that an individual can sustain for a long period of time (McArdle, 1996). An individual's VT can change with training. To improve VT, training must occur at a level above VT, even if only for a few seconds at a time. Therefore it is essential that individuals know where that point is.

As an individual's fitness level improves several physiological adaptations occur. One adaptation that usually occurs, however also depends on other factors, is a decrease in body fat (McArdle, 1996). Body fatness is a result of activity level, diet, genetics, psychological factors, diseases, drug use, or other factors. Overweight individuals often try to lower their percent body fat by increasing their activity level.

**Problem**

The NIH (National Institutes of Health) reported that in 1998 55% of the U.S. adult population (97 million individuals) were overweight or obese. Being overweight increases ones risk of, and is associated with increased problems from, hypertension, lipid disorders, type II diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and other respiratory problems, and certain cancers (ACSM, 2000). Total costs from obesity related problems are estimated at approximately $100 billion per year (NIH, 1998).

Lifestyle habits such as diet and sedentary behavior contribute to excess body fat. Becoming more active and increasing daily energy expenditure helps to decrease excess body fat while maintaining lean body mass (ACSM, 2000). However, adhering to exercise programs has proved to be a difficult challenge for many individuals to overcome. Thus, designing appropriate and comprehensive exercise programs is imperative. To optimize fat utilization, knowing the optimal intensity may encourage better adherence and results.

**Research Questions**

Is there an optimal intensity of exercise, relative to ventilatory threshold, at which fat is most rapidly oxidized in males with a body fat greater than 18%? Is this point the same in males with a healthy body fat percent?

**Significance**

The significance of this study is to help individuals and health professionals chose an intensity level that is optimal for that individual to most rapidly metabolize fat during exercise. These findings could help individuals decrease total body fat and therefore improve their health and decrease costs associated with obesity and excess body fat.

**Rationale**

The rationale for this study is that there has been little research done to find the optimal intensity for fat utilization when exercising taking into account energy expenditure and substrate utilization. It is already well known that as exercise intensity increases, energy expenditure increases and the proportion of energy from fat metabolization decreases. What is not well known is the intensity relative to ventilatory threshold that offers the greatest absolute fat utilization. This research will be useful in better understanding the relationship between intensity of exercise relative to the stable set point of ventilatory threshold and absolute amounts of fat consumed.

**Null Hypothesis**

There will be no significant difference in substrate utilization at different levels of exercise intensities relative to the subjects' ventilatory threshold in sedentary males aged 18 to 30 years with > 18% body fat.

**Research Hypothesis**

There will be a specific exercise intensity relative to the ventilatory threshold that metabolizes the greatest rate of fat in sedentary males aged 18 to 30 years with > 18% body fat.

**Limitations**

***Indirect methods of testing:*** Indirect calorimetry was used in the form of open-circuit spirometry to estimated gas exchange and therefore substrate utilization.

***Instrumentation:*** There is an inherent error associated with the use of all instrumentation. To minimize errors the testers were trained and the equipment was carefully calibrated.

**Delimitations**

***Mode:*** The mode of exercise was limited to cycling.

***Subjects:*** The number of subjects was limited to twelve and they consisted only of apparently healthy sedentary males aged 18 to 30 years, with a body fat percent > 18. Subjects were limited to members of health clubs in Missoula Montana, including the University of Montana.

**Definition of Terms**

***Energy Expenditure:*** The amount of energy (kilocalories) per minute metabolized by the body to perform an activity.

***Intensity:*** The level of difficulty relative to the individual's ventilatory threshold.

***Sedentary:*** Not meeting the Surgeon Generals guidelines for physical activity of at least 30 minutes per day of moderate activity on most days of the week.

***Respiratory Gas-Exchange Ratio (RER):*** The ratio of carbon dioxide produced to oxygen consumed, indicating substrate utilization where an RER = 1.0 represents 100% carbohydrate metabolism and RER = .7 represents 100% fat metabolism.

***Substrate Utilization:*** The combination of fuels metabolized by the body to perform an activity.

***Ventilatory Threshold (VT):*** The first sustained rise in $Ve/VO_2$ (minute ventilation of oxygen consumed) without a rise in $Ve/VCO_2$ (minute ventilation of carbon dioxide expired).

***$VO_2$ max:*** Maximal oxygen uptake, represented by a plateau in $VO_2$, RER is at or above 1.1, heart rate plateaus, and / or RPE $\geq$ 19.

# Chapter Two

# REVIEW OF LITERATURE

## Substrate Utilization and Body Composition Differences

Body composition in a two-part model is the proportion of fat mass (FM) to fat free mass (FFM). As an individual's body mass increases, usually both FM and FFM increase, however the proportion may change. FFM is metabolically more active than FM; therefore as one increases FFM, both basal metabolic rate and energy expenditure during activity is increased.

Keim, Belko, and Barbieri (1996) studied 26 males and 26 females to see the effects of different body fat percentages on energy expenditure and substrate oxidation when exercising. Keim et al. tested their subjects on a cycle ergometer for four stages of five minutes each at 60 rpm with intensities set at 30, 60, 90, and 120 watts with five-minute rest periods in between each stage. The significant differences they found were that body fat percentage did not affect total caloric expenditure at submaximal levels. However, men with lower body fat percentages (9 to 15%) as opposed to higher body fat percentages (20 to 25 %) had greater percent of energy production from fat oxidation when exercising at 40 to 60 % of $VO_2max$. After adjusting for fat free mass, there were no differences in energy expenditure (EE) or fat oxidation between the women with different percentages of body fat. There were also no differences in EE in the men after adjusting for fat free mass; however, absolute fat oxidation rate was higher in the lean men.

Steffan, Elliott, Miller, and Fernhall (1999) studied substrate utilization in twenty sedentary-obese and fifteen normal-weight women. They found greater absolute fat oxidation at 50% of $VO_2$max than at 75% of $VO_2$max (133 kJ compared to 96 kJ) when exercising on a treadmill for fifteen minutes in both groups. Also, both the sedentary-obese women and the normal-weight women were similar in substrate utilization when exercising at the same intensity relative to $VO_2$max.

Studies investigating subjects with different body compositions often find similar effects on substrate utilization during exercise.

**Substrate Utilization at Different Exercise Intensities**

It is well known that, as intensity of exercise increases, the amount of energy required also increases. Furthermore, it is well established that as exercise intensity increases relative carbohydrate utilization increases and relative fat utilization decreases. However, finding the optimal intensity for absolute fat utilization has yet to be proclaimed.

Romijn et al. (1993) studied five trained cyclists at three different intensities: 25% and 65% of $VO_2$max for 120 minutes and 85% of $VO_2$max for 30 minutes on a cycle ergometer to see the effects on substrate utilization. After 30 minutes on the cycle ergometer there was no difference in absolute fat oxidation between 25% and 85% of $VO_2$max. However at 65% of $VO_2$max the rate of fat oxidation was significantly higher.

In 1996 Treuth, Hunter, and Williams studied eight females exercising at either a low intensity (50% $VO_2$max) or high intensity (100% $VO_2$max) to evaluate the effects of these exercise intensities on substrate oxidation and post exercise energy expenditure for the subsequent 23 hours. The subjects all cycled for 70 minutes: 5 minute warm-up, 60 minutes at 50% of $VO_2$max, and a 5-minute cool-down, or 2-minute intervals at 100% of $VO_2$max with 2-minute recoveries. They found no significant difference in relative substrate oxidation between the two groups during the 23 hours post exercise. During exercise, the high intensity group had a significantly higher RER. For the 24-hour period, the total energy expenditure was 160 kcals higher in the high intensity group: ~100 kcal increase in resting metabolic rate and ~ 60 kcal increase during exercise.

Astorino (2000) tested nine moderately trained women on a treadmill at six different workloads over two days. The subjects worked at 25, 40, 55, 65, 75, and 85% or their $VO_2max$ for 15 minutes each separated by five-minutes of recovery. Astorino found that energy from fat was highest at 75% $VO_2max$ which was very close to their ventilatory threshold of 76% ± 7.41% of $VO_2max$.

Intensity studies suggest that maximal fat utilization occurs around 65 to 75% of $VO_2max$, which may be close to the tested individual's ventilatory threshold.

**Substrate Utilization and Nutritional Status**

It is a common belief that nutritional status will influence substrate utilization during exercise. This is a complex problem. Variable include proportions of macronutrients, amount of energy consumed, and the timing of when the food was consumed in relation to the exercise session.

Maughan et al. (1978) studied the effects of different diets on substrate utilization during low intensity exercise. They tested four healthy males on a cycle ergometer for one hour at 50% of $VO_2max$ three separate times after following three different diets; 1) mixed (15% protein, 41% fat, and 44% carbohydrate (CHO)), 2) low CHO (26% protein, 69% fat, and 5% CHO), and 3) high CHO (12% protein, 36% fat, and 52% CHO). During exercise they found average fat utilization to be lowest (~29%) after the lowest fat diet (high CHO) and highest (~64%) after consuming the diet when fat was the highest (low CHO).

Knapik et al. (1988) looked at the effects of fasting on CHO and fat metabolism. Male soldiers (n = 8) were tested twice on a cycle ergometer at 45% of $VO_2$max until exhaustion at two to three hours. After four days on a mixed diet (12% protein, 34% fat, and 53% CHO) the subjects fasted for 14 hours before the exercise test and on a separate time they fasted for three and a half days prior to the exercise test. They found that the longer fast resulted in significantly greater reliance on fat oxidation during exercise.

In 1995 Schneiter et al. studied six men and eight women to evaluate the effects of nutritional state on substrate utilization during exercise. The subjects were tested on a treadmill at an incline of 10% and speed of 5 km/hr for 45 minutes on two separate occasions: 1) in the fed state (1 ½ hours after meal) and 2) after an overnight fast. They found that exercising in the fed state increased carbohydrate oxidation to ~96% and only ~4% of energy expenditure from fat was utilized whereas when exercising in the fasted state ~35% of the energy expenditure was from fat.

Horowitz, Mora-Rodriguez, Byerley, and Coyle (1997) studied six active males to see the effects on fat oxidation during exercise after carbohydrate ingestion. The subjects were tested on a cycle ergometer for 60 minutes at ~44% of $VO_2$max on four separate times; 1) after a 12 hour fast, 2) one hour after ingesting glucose (~60 g), 3) one hour after ingesting fructose, and 4) one hour after ingesting glucose and having an intravenous infusion of 20% triglycerides. The researchers found that the rate of energy expenditure was similar in all trials. However, the proportion of energy derived from fat oxidation was quite low in the glucose trial (~34%), slightly higher in both the fructose and the triglycerides trials (~37%), and it was the highest when subjects had been fasting (~48%).

In 1999 Bergman and Brooks studied seven trained and seven untrained men to see the effects of training and nutritional status on substrate utilization. The subjects were exercise tested four times, on a cycle ergometer at 70 rpm for two hours each at 22 and 40% of $VO_2$max, for 1-½ hours at 59% of $VO_2$max, and for 45 minutes at 75% of $VO_2$max for the trained group and for the untrained group, 30 minutes at 75% of $VO_2$max. They concluded that food intake significantly increased RER when exercising at intensities up to 59% of $VO_2$max. At an intensity of 75% of $VO_2$max, training or food did not affect RER.

Most studies agree that fat utilization is greatest in the fasted state with increased fasting related to increased fat metabolism. Additionally as substrate is increased in the diet, it will be increasingly utilized during physical activity.

**Substrate Utilization and Training Status**

With increasing aerobic fitness, several adaptations occur to the body affecting metabolism, cardiovascular and pulmonary function, and as well as other adaptations (McArdle et al., 1996). These adaptations to training affect substrate utilization by increasing the size and number of mitochondria, increasing the concentration of aerobic enzymes, increasing the size of the heart, stroke volume, and cardiac output, decreasing heart rate and blood pressure, increasing plasma volume and blood flow to active muscles, and increasing tidal volume and breathing frequency. These adaptations all ultimately have a positive effect on fat metabolism (McArdle et al., 1996).

Hurley et al. (1986) evaluated the effect of a 12-week training program on substrate utilization in nine sedentary males. The subjects cycled for six five-minute intervals separated by two minutes of rest at an intensity of 90 – 100% of $VO_2$max, three days per week and ran three days per week for 40 minutes at 75% of $VO_2$max. Hurley et al. found that this training program resulted in a 65% increase in energy derived from fat over pre-training values.

Klein, Coyle, and Wolfe (1994) tested trained male endurance runners (n = 5) and untrained healthy men (n = 5) at low intensity exercise, 20 ml/kg/min, which was approximately 28% of $VO_2$max for the trained males and 43% of $VO_2$max for the untrained males. The subjects walked on a treadmill for four hours. The RER for the trained men averaged .79, whereas for the untrained men it was .83. Klein et al. showed that the runners used more energy from fat than the untrained men at these similar absolute workloads.

In 1995 Green and Dawson evaluated the differences in substrate utilization between trained male cyclists (n = 10) and untrained men (n = 9). The subjects were tested on a cycle ergometer at 90 rpm, starting at 90 watts and increasing 44 watts every four minutes for five to six stages, until they reached approximately 85% of $VO_2$max. Their findings included significantly lower RER at all power outputs in the trained vs. untrained groups and therefore more fat metabolized during exercise.

Sial, Coggan, Hickner, and Klein (1998) studied elderly men (n = 3) and women (n = 3) on a 16-week endurance-training program consisting of cycling at 70 to 85% of $VO_2$max for 30 minutes, three days per week, working up to 45 minutes five times per week. They found that the training program increased fat oxidation (~34% increase) in the elderly subjects during exercise to levels comparable to untrained young adults.

Additional results from the previously described research of Bergman and Brooks (1999), suggest that RER was lower in the trained men only at exercise intensities ≤ 40% of $VO_2max$. At an intensity of 75% of $VO_2max$ training level did not affect RER.

Friedlander et al. (1999) looked at the effects of a 10-week cycle ergometer training program on 19 sedentary males to study the training effects on fat oxidation. Subjects exercised for one hour five times per week. They started at 50% of $VO_2max$ and gradually increased to 75% of $VO_2max$ throughout the program. Friedlander et al. did not see any effects from their training program; fat oxidation was the same before and after the training program.

The success of training programs depends on how the variables of mode, frequency, intensity, duration, and progression are combined and how intensity is determined. Other factors also contribute to the success of the program. These include diet, quantity and quality of rest, and psychological wellbeing. Varying results from studies could be due to any number of factors.

# Chapter Three

# METHODOLOGY

## Setting

All testing was completed at the University of Montana, Missoula in the Human Performance Laboratory room 121 McGill Hall.

## Subjects

Twelve apparently healthy sedentary male subjects aged 18 to 30 years with a body fat > 18% were tested. The subjects had an interest in decreasing their body fat percent. They were recruited from Missoula, Montana. All procedures were explained in detail to each subject prior to all testing. The subjects then filled out a PAR-Q (Canadian Society for Exercise Physiology *P*hysical *A*ctivity *R*eadiness *Q*uestionnaire) and read and signed an informed consent form approved by the Internal Review Board at the University of Montana.

## Descriptive Data

Prior to testing on the cycle ergometer the following descriptive measures were obtained; age, height (cm), body weight (kilograms) using a calibrated digital scale model PS6600T (Befour Inc., Cedarburg, WI), resting heart rate using a Polar® (Port Washington, New York) heart rate monitor. Residual lung volume was measured in a seated position using the helium dilution method (Collins Modular Lung Analyzer, Greensboro, NC). Body composition was calculated using the hydrostatic (underwater) weighing technique with adjustments made for residual lung volume and gastrointestinal (GI) gas. Body density (Db) was calculated using the average of three underwater weight values within 100 grams of each other, residual lung volume, and 100 grams of GI gas.

Density of the water was corrected for temperature. Body composition was estimated from body density using the Siri equation for white males ages 20 to 80 [(4.95 / Db) – 4.5] (Siri, 1961). Body mass index (BMI) was calculated from individual weight and height [kg / meters$^2$].

**Exercise Testing**

A Monark cycle ergometer, model 824E (Varberg, Sweeden) was used for the exercise testing. Two separate sessions were needed to complete the study. Each session took between 45 and 75 minutes to complete. Subjects were asked to refrain from exercise 15 hours prior to testing and to refrain from nicotine, caffeine, alcohol, and eating anything containing calories, 8 – 12 hours before each testing session.

**Session 1**

During the initial session all descriptive measurements were completed followed by a cycle ergometer test to determine ventilatory threshold (VT) and $VO_2$max. The subjects returned their 24-hour diet records from which they were asked to maintain their usual diet and record all caloric containing foods and beverages for the 24 hours prior to their eight-hour fast. Height, body weight, residual lung volume, and hydrostatic weighing measurements were then completed.

The cycle test began with a two to three minute warm up with no added resistance and a speed of 50 rpm, which was maintained throughout the test. After the warm-up period the resistance was increased every minute until the subject could no longer maintain 50 rpm. The first increase was to 74 watts and then 97 watts after which the resistance was increased by 18 watts each minute. RPE (rate of perceived exertion) was taken at the end of each minute using the 6 - 20 Borg scale (Borg, 1982). Heart rates

(HR) were monitored and recorded every minute using a Polar® heart rate monitor. An activity duration scale (DUR) was used to estimate the individuals expected duration at the given intensity. A Parvo Medics metabolic cart (Salt Lake City, Utah) was used to measure expired gases using 15-second averages during the tests. The metabolic cart was calibrated before each test with known concentrations of $CO_2$ and $O_2$ and a three-liter syringe was used to calibrate flow rate. The $VO_2max$ exercise test was terminated at volatile fatigue, but subjects were encouraged to continue as long as possible. $VO_2max$ was determined by reaching two of the following criteria: a plateau in $VO_2$, RER at or above 1.1, heart rate plateau, or RPE $\geq$ 19. After the test was completed the subjects were allowed to cool down at a lower intensity.

**Determination of Ventilatory Threshold**

Ventilatory Threshold (VT) values were determined as previously described by Gaskill et al (Gaskill, Ruby, and Walker et al., 2001), using a combination of three methods to reduce error: 1) the ventilatory equivalent method, that intensity of physical exercise that stimulates an increase in $Ve/VO_2$ without an increase in $Ve/VCO_2$ (Shimizu et al., 1991); 2) the excess carbon dioxide method, that exercise intensity that stimulates an increase in excess $CO_2$ production (Anderson and Rhodes, 1989); 3) the V-slope method, that exercise intensity where a transition between $VCO_2$ and $VO_2$ occur (Beaver, Wasserman, and Whipp, 1986). Two researchers assessed the data and needed to agree on VT or the data were eliminated from analysis. A regression equation was developed to determine the watts that corresponded with 70, 85, 100, and 115% each individual's VT.

**Session 2**

The second exercise testing session took place within 14 days after the initial session. It included a 20-minute cycle test with four stages of increasing intensity of five minutes duration each. Prior to the cycle test the subjects sat on the cycle for five minutes to measure resting $VO_2$. Then the subjects were allowed to warm up at 50 watts for five minutes. After the warm-up the intensity of the stages were set at the wattage that corresponded to 70, 85, 100, and 115% of the subject's VT. At each stage RPE, HR, DUR (activity duration scale), and RER were recorded. RER was averaged in the last two minutes of each stage so substrate utilization could be estimated (Frayn, 1983). Milligrams per minute of fat and CHO were estimated for each stage and averaged across the group. Data were also calculated as μmol/kg/min.

**Research Design and Statistical Procedures**

An independent student's t-test was used to evaluate significant differences in substrate utilization at different exercise intensities relative to VT. A two-way (intensity x body composition) repeated measures ANOVA (analysis of variances) was used to compare fat utilization across exercise intensities with the SuperANOVA statistical package (Abacus Inc, Berkeley, CA). Significance level was set at $p = .05$.

# Chapter Four

## MANUSCRIPT

### INTRODUCTION

In 1998 the NIH (National Institutes of Health) reported that 97 million adult Americans (55% of the U.S. adult population) were overweight or obese (1). Being overweight increases ones risk of, and is associated with, increased problems from hypertension, lipid disorders, type II diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and other respiratory problems, and certain cancers (2). Total costs from obesity related problems are estimated at approximately $100 billion per year (1). Body fatness is a result of activity level, diet, genetics, psychological factors, diseases, drug use, or other factors. Becoming more active and increasing daily energy expenditure helps to decrease excess body fat while maintaining fat free mass (2). However, exercise adherence is a major obstacle for many individuals to overcome. If the exercise intensity for maximal fat oxidation is determined, it may enhance fat loss while improving exercise program adherence.

It is well known that as exercise intensity increases, energy expenditure increases and the proportion of energy from fat metabolism decreases. There appears to be aerobic exercise intensities that optimize the oxidation of fat (kcal fat/min) (4,5,6,7,8). Studies to evaluate optimal intensities of exercise to maximize fat oxidation have generally reported intensity as a percentage of $VO_2$peak. While useful for research purposes, most individuals interested in exercise for weight reduction do not know their $VO_2$peak or their VT. In addition, the large variation in $VO_2$, RPE and Respiratory Exchange Rate (RER) values at similar percentages of $VO_2$peak across sedentary individuals suggests that the metabolic response of these individuals is not uniform (9). In contrast, very similar, and predictable, values for $VO_2$, RPE and RER at the VT in sedentary individuals have been reported (9,10). These similar values suggest that VT represents an intensity of exercise that is more stable between individuals.

Ventilatory threshold is defined as the first sustained rise in $Ve/VO_2$ (minute ventilation of oxygen consumed) without a rise in $Ve/VCO_2$ (minute ventilation of carbon dioxide expired). This threshold occurs partly as a result of lactate accumulation in the blood resulting in increased bicarbonate buffering and the related rise in venous $CO_2$ and subsequent increases in minute ventilation. Adjusting exercise intensity levels relative to an individual's VT is the most appropriate method to set exercise intensity as the variability in individual fitness levels is accounted for by this method. An intensity of exercise just below VT is the maximum intensity of exercise that an individual can sustain for a long period of time (11).

To date, little is known about the intensity of exercise, relative to ventilatory threshold, that offers the greatest absolute fat oxidation. Of additional interest is the question of fat oxidation and those populations most at risk from obesity related diseases and how they may differ from normal weight-recreationally fit individuals and high fit individuals. The purpose of this study was to investigate variations in fat oxidation in low fit-high body fat (lofit-hifat) and recreationally fit-low body fat (recfit-lofat) males at exercise intensities relative to VT.

## METHODOLOGY

### *Subjects*

Sixteen apparently healthy male subjects participated in this study. The subjects were divided into two groups based on their body composition and aerobic fitness. Lower fit-high body fat (lofit-hifat) males (n = 8) consisted of those with a body fat percent between 21 and 37% (27.1 ± 5.0) and $VO_2$ at VT ($VO_2vt$) less than 20 ml/kg/min. Recreationally fit-low body fat (recfit-lofat) males (n = 8) consisted of those with a body fat percent between 7 and 13% (10.5 ± 2.3) and $VO_2vt$ greater than 30 ml/kg/min. All procedures were explained in detail to each subject prior to all testing. The subjects then filled out a PAR-Q (Canadian Society for Exercise Physiology *P*hysical *A*ctivity *R*eadiness *Q*uestionnaire) to screen for potential contraindications to exercise and read and signed an informed consent form approved by the Internal Review Board at the University of Montana.

### *Descriptive Characteristics of Subjects*

Prior to testing on the cycle ergometer the following descriptive measures were obtained; age, height (cm), body weight (kilograms) using a calibrated digital scale model PS6600T (Befour Inc., Cedarburg, WI), and resting heart rate using a Polar® heart rate monitor (Port Washington, New York). Residual lung volume was measured in a seated position using the helium dilution method (Collins Modular Lung Analyzer, Greensboro, NC). Hydrostatic (underwater) weight was measured on an electronic scale (Exertech, Dresbach, MN). Body density (Db) was calculated using the average of three underwater weight values within 100 grams of each other and corrected for residual lung volume, 100 grams of GI gas, and water density. Body composition was estimated from body density using the Siri equation for white males (12).

***Exercise Testing***

A Monark cycle ergometer, model 824E (Varberg, Sweeden) was used for the exercise testing. Two separate sessions were needed to complete the study. Each session took between 45 and 75 minutes to complete. The first session included a graded exercise test to determine $VO_2$peak and $VO_2$vt. The second session consisted of cycling exercise at 70, 85, and 100% of VT determined during the prior visit. Subjects were asked to refrain from exercise 15 hours prior to testing and to refrain from nicotine, caffeine, alcohol, and eating anything containing calories, 8 – 12 hours before each testing session.

***Session 1***

During the initial session all descriptive measurements were completed followed by a cycle ergometer test to determine $VO_2$vt and $VO_2$peak. Upon arrival at the lab subjects returned their diet records. During the 24-hour diet-recording period they were asked to maintain their usual diet and record all caloric containing foods and beverages for the 24 hours prior to their 12-hour fast. Height, body weight, residual lung volume, and hydrostatic weighing measurements were completed prior to exercise testing. The $VO_2$peak cycle test began with a two to three min warm-up at 50 watts. After the warm-up period the subjects were required to maintain 50 rpm and the resistance was increased every minute. The test was terminated when the subject could no longer maintain 50 rpm. Protocol was constant for all subjects with an increase at one minute to 74 watts and at two minutes to 97 watts, after which the resistance was increased by 18 watts each minute. Ratings of perceived exertion was taken at the end of each minute using the 6 - 20 Borg scale (13). Heart rates (HR) were monitored and recorded every minute using a Polar® heart rate monitor. A Parvo Medics metabolic cart (Salt Lake City, Utah) was used to measure expired gases using 15-second averages during the tests. The metabolic cart was calibrated before each test with known concentrations of $CO_2$ and $O_2$ and a three-liter syringe was used to calibrate flow rate. The $VO_2$peak exercise test was terminated at volitional exhaustion. $VO_2$peak was determined by reaching two of the following criteria: a plateau in $VO_2$, RER at or above 1.1, heart rate plateau, or RPE $\geq$ 19. After the test was completed the subjects were allowed to recover at a lower intensity.

***Determination of Ventilatory Threshold***

Ventilatory Threshold values were determined as previously described by Gaskill et al (14), using a combination of three methods to reduce error: 1) the ventilatory equivalent method: the intensity of physical exercise that stimulates an increase in $Ve/VO_2$ without an increase in $Ve/VCO_2$ (15); 2) the excess carbon dioxide method: the exercise intensity that stimulates an increase in excess $CO_2$ production (16); 3) the V-slope method: the exercise intensity where a transition between $VCO_2$ and $VO_2$ occur (17). Two researchers independently assessed the data and needed to agree on VT or the data were eliminated from analysis. The VT data was used to develop a regression equation to determine the watts and $VO_2$ values that corresponded with 70, 85, and 100% each individual's VT.

***Session 2***

The second exercise testing session took place within 14 days after the initial session. It included a 15-minute cycle test with three stages of increasing intensity of five minutes duration each. Prior to the cycle test the subjects sat on the cycle for five minutes to measure resting $VO_2$. Then the subjects were allowed to warm up at 50 watts for five minutes. After the warm-up the intensity of the stages were set at the workload corresponding to 70, 85, and 100% of the subject's VT as previously determined. At each stage $VO_2$, $VCO_2$, RPE, and HR were continuously recorded. $VO_2$ and $VCO_2$ were averaged during the last two minutes of each stage for the calculation of substrate oxidation (18). Milligrams per minute of fat and CHO were estimated for each stage.

***Research Design and Statistical Procedures***

An independent student's t-test was used to evaluate significant between group differences in descriptive data. A mixed–design, two-way (intensity x group) repeated measures analysis of variances (ANOVA) was used to compare fat oxidation across exercise intensities between the two groups. Analysis was made using the SuperANOVA statistical package (Abacus Inc, Berkeley, CA). Significance level was set at $p \leq 0.05$.

## RESULTS

***Descriptive Characteristics of Subjects***

The descriptive characteristics of the two groups are listed in Table 1. The groups were separated apriori by body fat and activity level with the lofit-hifat group being sedentary with >21% body fat (27.1 ± 5.0%) and the recfit-lofat group being moderately active with <13% body fat (10.5 ± 2.3%). There were no significant differences in age or height between the lofit-hifat and recfit-lofat groups. The lofit-hifat group had significantly greater total body mass, fat free mass, fat mass, percent body fat, and BMI. Absolute $VO_2$ at VT (L/min) was not significantly different between the two groups, however when expressed relative to total body mass (ml/kg/min) and fat free mass (ml/kg FFM/min), VT was significantly greater in the recfit-lofat group. Percent of $VO_2$peak at 70 and 85% of VT was not significantly different between the two groups. At 100% of VT the recfit-lofat group was working at a lower percent of $VO_2$peak than was the lofit-hifat group.

***Physiological Responses of Exercise at Intensities Relative to Ventilatory Threshold and Maximal Exercise***

Table 2 lists the physical responses to exercise at 70, 85, and 100% of VT and maximal exercise. In Figure 1, power output at each intensity relative to VT, is shown expressed in watts. Watts were not significantly different between groups at 70%, but were significantly higher in recfit-lofat group at 85 and 100% of VT. When expressed relative to body mass and lean body mass, the recfit-lofat group had a significantly higher power output at each intensity. $VO_2$ in L/min, ml/kg/min, and ml/kg FFM/min were all significantly higher in the recfit-lofat group at each intensity relative to VT. However there were no significant differences in heart rates at any of the intensities (Figure 2). RPE was significantly higher in the recfit-lofat group at 70% of VT but not different at 85 or 100% (Figure 3). There were no significant differences in $VO_2$peak (L/min) or maximal heart rate between groups. However, maximal power and $VO_2$peak, when expressed in units/kg body mass and units/kg FFM, were all significantly higher in the recfit-lofat group.

***Substrate Oxidation During Exercise***

Table 3 lists substrate oxidation at 70, 85, and 100% of VT. Figures 5 and 6 show kcals/kg FFM/min of fat and kcals/min of fat respectfully, for the two groups at each exercise intensity. In the recfit-lofat group fat oxidation, when expressed as kcals/kg FFM/min of fat or as total kcals of fat remained the same across all three exercise intensity levels while fat oxidation decreased with increasing intensity in the lofit-hifat group. When fat and carbohydrate (CHO) oxidation were expressed relative to kg body mass and kg FFM, both were significantly different between groups at each level of intensity with the lofit-hifat group using less carbohydrate and less fat per minute. When expressed in absolute values there were no significant differences between groups in CHO oxidation at 85 and 100% of VT, whereas at 70% of VT CHO oxidation was significantly higher in the recfit-lofat group. Absolute fat oxidation was significantly higher in the recfit-lofat group at 85 and 100% of VT but there was no difference between groups at 70% of VT. Total kilocalories were significantly higher in the recfit-lofat group at each of the three intensities in absolute values and when expressed relative to total body mass and lean body mass.

## DISCUSSION

The purpose of this study was to investigate variations in fat oxidation in lofit-hifat and recfit-lofat males at exercise intensities relative to VT.

Activity level plays a crucial role in body composition. Body composition plays a crucial role in health and disease risk. With a large percent of the U.S. population overweight or obese, exercise prescriptions that are designed specifically to meet the individual's goals are in great demand. To increase the individual's success at weight loss, the health professional needs to consider many factors for the exercise prescription, most importantly the individuals current fitness level, likes and dislikes, schedule, and fitness goals. Mode, frequency, and duration are generally straightforward when designing the prescription, whereas exercise intensity and more importantly the progression of the exercise intensity are more variable. The American College of Sports Medicine's (ACSM) general guidelines for intensity are 50 to 85% of $VO_2$peak and for lower fit individuals as low as 40% of $VO_2$peak (19). These percentages are generally estimated using the HR reserve formal. However, data from studies that have evaluated VT and RPE have shown that moderate exercise (RPE=12) is closely associated with VT in nearly all individuals, but is highly variable as a percentage of $VO_2$peak. Thus, the prescription of exercise intensity without consideration of VT may not result in the desired outcome and often result in the client receiving a prescription that is either too low to keep the client's interest or occasionally well above VT resulting in high RPE values and leading to failure of the program. If the goal of the exercise program is to decrease body fat, recommending the exercise intensity as a percent of $VO_2$peak, may not be the optimal method to prescribe an intensity that will maximize fat oxidation.

Results from the current study clearly show that there is a difference in the patterns of fat oxidation between lofit-hifat individuals when compared to recfit-lofat individuals. Maximal fat oxidation in the lofit-hifat group occurred at 70% of VT (38.8% of $VO_2$peak) and then decreased as the intensity was increased to 85 and 100% of VT. In contrast, for the recfit-lofat group there was no difference in total fat oxidation across the three exercise intensity modes. These results suggest that individuals who are over weight and sedentary will metabolize fat at the greatest rate at low intensities of exercise, but as fitness improves and body fat is reduced they can maintain similar rates of absolute fat oxidation across a wider range of exercise intensities.

Ventilatory threshold in the lofit-hifat group was at 58.4% of $VO_2$peak and for the recfit-lofat group averaged 52.6% of $VO_2$peak. If exercise intensity was set via self-selection for 'moderate' exercise, or if the general guidelines from ACSM were used, one would expect exercise for the lofit-hifat group to be self-selected at 58% of HR reserve (VT, RPE=12) or prescribed at 50% of HR reserve. Both of these intensity levels would be above the optimal intensity for fat metabolism in this group.

This study used 5-minute steady state exercise to evaluate substrate oxidation. While this is only a snapshot of a longer duration workout, Achten et al (2002) has shown that this is a valid method and that below VT; steady state is quickly reached and is maintained for extended periods (20).

Keim et al (1996) compared men and women with different levels of body fatness while exercising on a cycle ergometer at 60 rpm for five-minute stages at 30, 60, 90, and 120 watts (5). With increasing intensity the leaner men's fat oxidation rate increased, while the fatter men's fat oxidation rate decreased. They concluded that the differences in substrate oxidation were independent of physical fitness since the subjects were matched for maximal aerobic capacity, but not for VT values. In contrast, Kanaley et al (2001) showed that obese women, when exercising on a treadmill at 70% of $VO_2$peak for 30 minutes and adjusted for differences in fat free mass, used significantly more fat than non-obese women (21). This study did not correct for fitness of the individuals. In a third study Steffan et al (1999) looked at substrate use during exercise in normal-weight women and obese women and found no differences in substrate use at the same relative intensities but also did not evaluate the role of aerobic fitness (8). The current study separated individuals by both aerobic fitness level using VT, and by body fatness.

We found that maximal fat oxidation occurred at 70% of VT and as intensity increased, fat oxidation decreased significantly in the lofit-hifat group whereas in the recfit-lofat group fat oxidation was maintained as exercise intensity increased. The benefit of understanding this for low-fit, overweight individuals is that at 70% of VT (RPE=9, very light), individuals will be able to continue their exercise for a longer duration and therefore have both a higher total energy output from the exercise session and maximize their oxidation of fat both overall and per unit of time. If fat oxidation, as well as increasing total caloric expenditure, is necessary to decrease body fat, then exercise prescriptions need to include intensity guidelines that yield maximal fat oxidation and encourage increased total caloric output. As fitness improves, individuals will be able to increase exercise intensities closer to VT, an intensity that most individuals can maintain for 30-45 minutes, and still maintain fat oxidation while increasing the rate to total caloric expenditure.

In summary we have concluded that males with excess body fat and low fitness levels need to begin an exercise program close to 70% of their VT to yield maximal fat oxidation. Males with a healthy body fat percent can work at higher levels and will still maintain fat oxidation. Future research should compare individuals with similar fitness levels and different body fat levels. Female subjects should also be evaluated with similar research.

## CONCLUSIONS

The findings of this study indicate that exercising at 70% of ventilatory threshold utilizes the greatest absolute amount of fat in lofit-hifat males whereas in recfit-lofat males, fat oxidation does not significantly change as exercise intensity increases up to VT (53% of $VO_2$peak). Therefore health professionals prescribing exercise intensities for fat loss need to measure the individual's VT, recommend beginning the exercise program at 70% of VT, and gradually increase the intensity level with time as fitness improves. Weight loss program, at least in lofit-hifat males should focus on low intensity (easy) aerobic exercise maintained for longer durations.

TABLE 1 **Physical Characteristics of Subjects.** (mean ± SD)

| | **lofit-hifat** | **recfit-lofat** |
|---|---|---|
| AGE (years) | 24 ± 4.6 | 23.6 ± 2.4 |
| HEIGHT (cm) | 179.8 ± 3.7 | 177.3 ± 8.0 |
| BODY MASS INDEX (BMI) | 32.7 ± 8.8 | 21.7 ± 1.5* |
| BODY MASS (kg) | 105.2 ± 25.3 | 68.4 ± 9.6* |
| BODY FAT (%) | 27.1 ± 5.0 | 10.5 ± 2.3* |
| FAT MASS (kg) | 29.3 ± 13.0 | 7.2 ± 2.2* |
| FAT FREE MASS (kg) | 76.0 ± 13.0 | 61.4 ± 8.3* |
| VT (L/min) | 1.96 ± 0.27 | 2.11 ± 0.40 |
| VT (ml/kg/min) | 19.18 ± 3.4 | 30.82 ± 3.6* |
| VT (ml/FFM/min) | 26.08 ± 3.3 | 34.41 ± 4.6* |
| $VO_2$MAX (L/min) | 3.39 ± 0.52 | 4.00 ± 0.66 |
| $VO_2$MAX (ml/kg/min) | 33.13 ± 6.7 | 58.60 ± 5.8* |
| $VO_2$MAX (ml/FFM/min) | 45.02 ± 7.0 | 65.37 ± 7.4* |
| % $VO_2$MAX @ 100% VT | 58.3 ± 5.1 | 52.6 ± 3.8* |
| HEART RATE MAX | 183.63 ± 11.6 | 182.88 ± 3.8 |

FFM = fat free mass in kilograms
VT = ventilatory threshold
* Significantly different from lofit-hifat group ($p \leq 0.05$)

TABLE 2 **Physiological Responses at Intensities Relative to Ventilatory Threshold.** (mean ± SD)

| | 70% VT | | 85% VT | | 100% VT | |
|---|---|---|---|---|---|---|
| | lofit-hifat | recfit-lofat | lofit-hifat | recfit-lofat | lofit-hifat | recfit-lofat |
| POWER OUTPUT (W) | 85.95 ± 20.6 | 91.87 ± 21.6 | 104.80 ± 28.7 | 115.31 ± 25.3* | 127.16 ± 33.3 | 135.64 ± 31.4* |
| POWER OUTPUT (W/kg) | 0.85 ± 0.26 | 1.34 ± 0.18* | 1.04 ± 0.36 | 1.68 ± 0.23* | 1.26 ± 0.42 | 1.98 ± 0.29* |
| POWER OUTPUT (W/LBM) | 1.16 ± 0.32 | 1.49 ± 0.22* | 1.42 ± 0.45 | 1.88 ± 0.27* | 1.72 ± 0.53 | 2.21 ± 0.35* |
| $VO_2$ (L/min) | 1.39 ± 0.22 | 1.55 ± 0.27* | 1.64 ± 0.27 | 1.89 ± 0.36* | 1.94 ± 0.30 | 2.17 ± 0.44* |
| $VO_2$ (ml/kg/min) | 13.47 ± 2.1 | 22.66 ± 2.3* | 15.98 ± 3.0 | 27.65 ± 2.8* | 18.99 ± 3.8 | 31.60 ± 3.7* |
| $VO_2$ (ml/kg LBM/min) | 18.36 ± 2.1 | 25.29 ± 3.0* | 21.72 ± 3.0 | 30.86 ± 3.7* | 25.80 ± 3.8 | 35.27 ± 4.8* |
| HEART RATE | 104.28 ± 11.1 | 103.59 ± 10.7 | 114.21 ± 14.1 | 115.75 ± 8.9 | 122.59 ± 20.2 | 126.36 ± 9.2 |
| RPE | 8.75 ± 1.6 | 10.25 ± 1.8* | 11.13 ± 1.8 | 11.75 ± 1.6 | 13.50 ± 2.3 | 13.38 ± 0.92 |
| ACTUAL % VT | 70.79 ± 0.07 | 73.64 ± 0.03 | 83.24 ± 0.04 | 89.83 ± 0.02* | 98.67 ± 0.03 | 102.5 ± 0.03* |

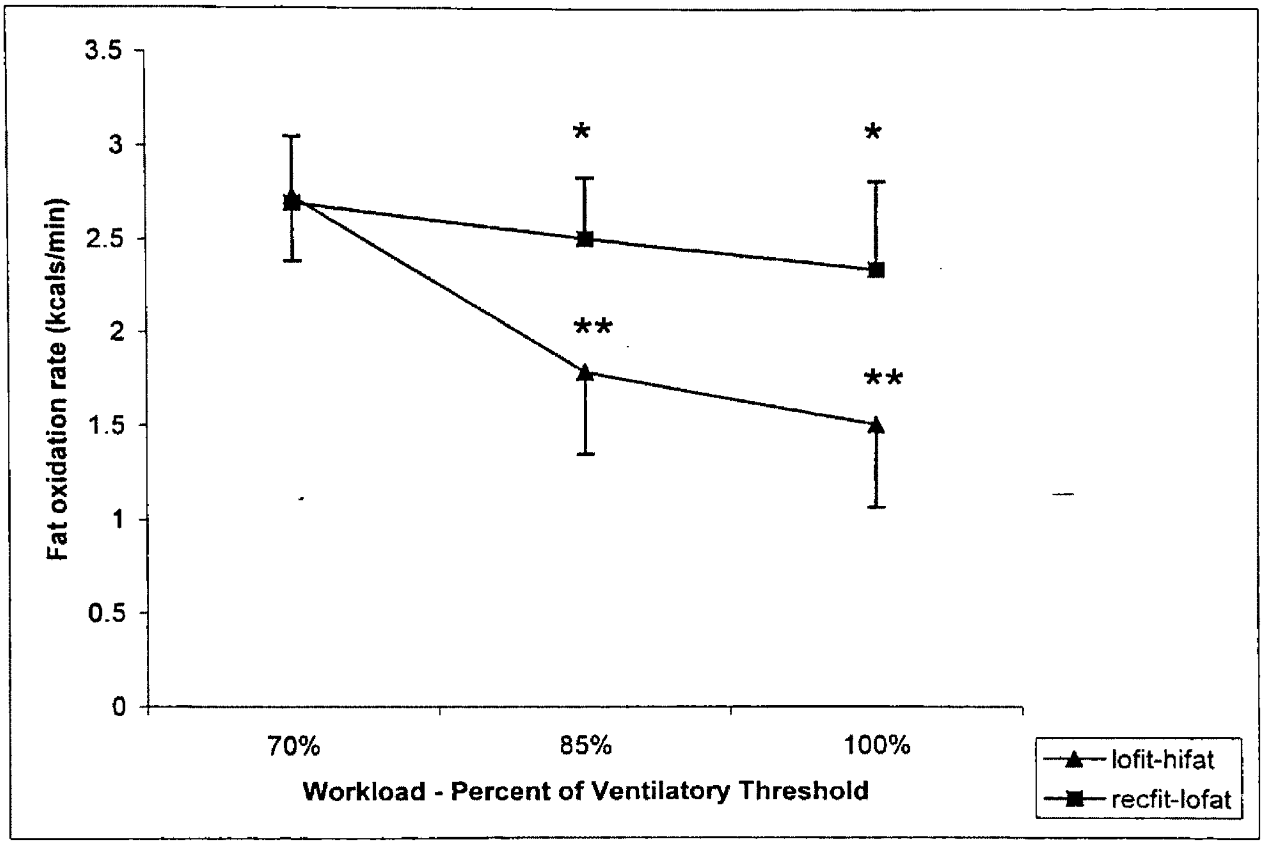
W = watts
FFM = fat free mass in kilograms
RPE = ratings of perceived exertion
VT = ventilatory threshold
* Significantly different from lofit-hifat group ($p \leq 0.05$)

TABLE 3 **Substrate Utilization at Intensities Relative to Ventilatory Threshold.** (mean ± SD)

| | 70% VT | | 85% VT | | 100% VT | |
|---|---|---|---|---|---|---|
| | lofit-hifat | recfit-lofat | lofit-hifat | recfit-lofat | lofit-hifat | recfit-lofat |
| Respiratory Exchange Ratio (RER) | 0.876 ± 0.04 | 0.890 ± 0.03 | 0.933 ± 0.04 | 0.916 ± 0.03 | 0.951 ± 0.04* | 0.933 ± 0.03* |
| Percent Carbohydrates (CHO) | 59.38% | 64.10% | 77.79% | 72.82% | 83.94% | 77.91% |
| Percent FAT | 40.77% | 35.90% | 22.33% | 27.08% | 16.06% | 22.09% |
| CHO kcal/min | 3.99 ± 0.7* | 4.82 ± 1.0* | 6.27 ± 1.1 | 6.75 ± 1.4 | 8.05 ± 1.4 | 8.29 ± 1.6 |
| CHO kcal/kg/min | 0.039 ± 0.01* | 0.071 ± 0.01* | 0.062 ± 0.02* | 0.099 ± 0.01* | 0.080 ± 0.02* | 0.121 ± 0.02* |
| CHO kcal/kg FFM/min | 0.053 ± 0.01* | 0.079 ± 0.02* | 0.084 ± 0.02* | 0.110 ± 0.01* | 0.108 ± 0.02* | 0.135 ± 0.02* |
| FAT kcal/min | 2.74 ± 1.0 | 2.70 ± 1.0 | 1.80 ± 1.2* | 2.51 ± 0.9* | 1.54 ± 1.2 * | 2.35 ± 1.3* |
| FAT kcal/kg/min | 0.026 ± 0.01* | 0.039 ± 0.01* | 0.017 ± 0.01* | 0.037 ± 0.01* | 0.014 ± 0.01* | 0.034 ± 0.02* |
| FAT kcal/kg FFM/min | 0.036 ± 0.01* | 0.044 ± 0.01* | 0.023 ± 0.02* | 0.041 ± 0.02* | 0.020 ± 0.02* | 0.038 ± 0.02* |
| TOTAL kcal/min | 6.72 ± 1.0* | 7.52 ± 1.3* | 8.06 ± 1.3* | 9.27 ± 1.8* | 9.59 ± 1.5* | 10.64 ± 2.1* |
| TOTAL kcal/kg/min | 0.065 ± 0.01* | 0.110 ± 0.01* | 0.079 ± 0.02* | 0.135 ± 0.01* | 0.094 ± 0.02* | 0.155 ± 0.02* |
| TOTAL kcal/kg FFM/min | 0.089 ± 0.01* | 0.123 ± 0.02* | 0.107 ± 0.02* | 0.151 ± 0.02* | 0.127 ± 0.02* | 0.173 ± 0.02* |

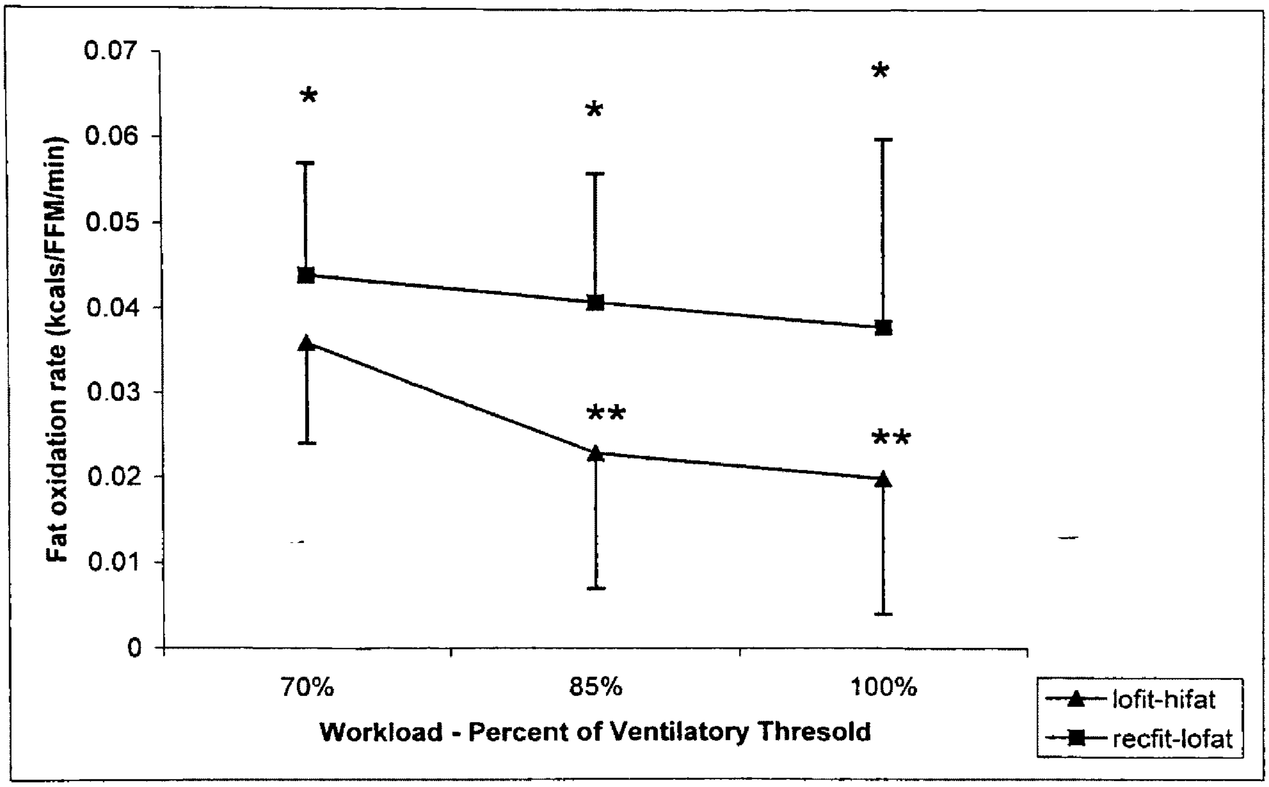
kcal = kilocalories FFM = fat free mass in kilograms * Significantly different from lofit-hifat group ($p < 0.05$)

FIGURE 1 Absolute Fat Oxidation Rate at Intensities Relative to Ventilatory Threshold.




Error bars denote SD.
* Significantly different from lofit-hifat group ($p \leq 0.05$).
** Significantly different from 70% of VT ($p \leq 0.05$).
Values are mean ± SD.

FIGURE 2 Relative Fat Oxidation Rate at Intensities Relative to Ventilatory Threshold.




FFM = fat free mass in kilograms
Error bars denote SD.
* Significantly different from lofit-hifat group ($p \leq 0.05$).
** Significantly different from 70% of VT ($p \leq 0.05$).
Values are mean ± SD.

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## Appendix I: Data Sheets and Forms

For Internal
Use Only

RECEIVED
Form RA-108
(Rev. 7/00)
NOV 3 0 2001
UNIVERSITY OF MONTANA
VICE PRESIDENT FOR RESEARCH

The University of Montana #171-01
INSTITUTIONAL REVIEW BOARD (IRB)
**CHECKLIST**

Submit one completed copy of this Checklist, including any required attachments, for each course involving human subjects. The IRB meets monthly to evaluate proposals, and approval is granted for one academic year. See *IRB Guidelines and Procedures* for details.

Project Director:__Lori Looper________________Dept.:_HHP_______Phone:_543-0689

Signature: ____________________ Date:__11-29-01_____

Co-Director(s):__Steven Gaskill, Ph.D._______Dept.:__HHP______________Phone:__243-4268

Project Title:_Effect of Eatness on Substrate Utilization________________________

Project Description:__*Cycle exercise at different exercise intensities relative to ventilatory threshold to determine the optimal intensity for maximal fat utilization.*______________________

All investigators on this project must complete the NIH self-study course on protection of human research subjects. Certification: I/We have completed the course - (Use additional page if necessary)

| Signature | Date | Signature | Date |
|---|---|---|---|
| [signature] | 11-29-01 | | |
| [signature] | 11/29/01 | | |
| | | | |

**Students Only:**

Faculty Supervisor:_Steven E. Gaskill, Ph.D__Dept.:____HHP___________Phone:_243-4268

Signature: ____________________

(My signature confirms that I have read the IRB Checklist and attachments and agree that it accurately represents the planned research and that I will supervise this research project.)

For IRB Use Only

**IRB Determination:**

____ Approved Exemption from Review

____ Approved by Administrative Review

_X_ Full IRB Determination:

____ Approved
_X_ Conditional Approval (see attached memo)
____ Resubmit Proposal (see attached memo)
____ Disapproved (see attached memo)

Signature IRB Chair: ____________________ Date: 12/12/01

(over)

SUBJECT INFORMATION AND CONSENT FORM

UNIVERSITY OF MONTANA
Department of Health and Human Performance
Human Performance Laboratory

TITLE: Effect of Body Fat on Substrate Utilization During Aerobic Exercise

| | | |
|---|---|---|
| STUDY DIRECTORS: | Lori Looper | University of Montana, McGill Hall, (406) 543-0689 |
| | Steven Gaskill, Ph.D. | University of Montana, McGill Hall, (406) 243-4268 |
| | Brent Ruby, Ph.D. | University of Montana, McGill Hall, (406) 243-2117 |

SPECIAL INSTRUCTIONS TO THE POTENTIAL SUBJECT:

♦ This consent form may contain words that are new to you. Please ask the person who gave you this form any questions you may have about it.

PURPOSE OF THE RESEARCH STUDY:

♦ You are being asked to participate in a research study to examine the effects of different intensities of exercise on fat utilization.

♦ You have been chosen because you are between the ages of 18 and 30 years, male, healthy, have >18% body fat, and are sedentary.

♦ The purpose of this study is to determine the exercise intensity that maximizes fat utilization.

PROCEDURES:

- If you agree to participate in this study you will be asked visit the Human Performance Laboratory in McGill Hall on the University of Montana Campus twice for about 1 hour each visit.

Visit one:

- Informed Consent Form will be reviewed and signed and questions will be answered.
- Measurements to be made include:
    - Body weight in a bathing suit.
    - Height
    - Residual lung volume using the helium dilution technique. This requires breathing 4 deep breaths in and out of a bag containing oxygen and helium. There is no associated pain or discomfort though a few individual have reported becoming slightly light headed for a few seconds following the technique.
    - Hydrostatic (underwater) weighing technique. This requires total immersion in a warm tank (similar to a hot tub) and holding ones breath for about 4 seconds underwater after exhaling as much air as possible. Body fat will be calculated from the results of the hydrostatic weighing. If body fat is less than 18% then the subject will not continue testing and will be disqualified from the study.
    - Increasing intensity cycle ergometer (stationary bicycle) test to maximal volatile fatigue to measure $VO_2max$. This involves riding on a stationary bicycle while the resistance is gradually increased until the subject can no longer continue. Normal test length is about 15 minutes. Expired gases will be collected and analyzed during the test. The subject must have a mouthpiece in his mouth during the test and must wear a noseclip. Heart rate values will be obtained using a Polar® heart rate monitor placed around the subject's chest. This test requires a maximal effort and will cause the subject some discomfort. Most subjects recover very rapidly and generally are uncomfortable only during the final 2-3 minutes of the test. Subjects are likely to experience shortness of breath, tired muscles, lightheadedness and fatigue.

Visit two:

- Submaximal cycle exercise test. The exercise test will again be on a stationary bike and will consist of five, five-minute stages (warm up, 70, 85, 100, and 115% ventilatory threshold). These intensities are generally quite easy until the final five-minute stage, which is generally rated as moderately hard. The subject will again have a mouthpiece in his mouth so that the researchers can collect expired air. Heart rate values will be obtained using a Polar® heart rate monitor placed around the subject's chest. The subjects must maintain a specific 50 rev/min (moderate) pedaling cadence throughout the test. During this test the subjects may experience shortness of breath, tired muscles, lightheadedness and fatigue.

BENEFITS:

♦ Your participation in this study will provide you with personal fitness information you may find useful when choosing training intensities.

RISKS / DISCOMFORTS:

♦ Mild discomfort (muscle soreness, shortness of breath) may occur during and/or after exercise sessions.

♦ During any time when exercising if abnormal signs or symptoms occur the test will be terminated.

♦ Abnormal signs or symptoms may include: heart rate or blood pressure that does not increase appropriately with increasing intensity, extreme shortness of breath, dizziness, lightheadedness, or pain/discomfort in the chest, jaw, arm, shoulder, or upper back.

♦ Every effort will be made to minimize possible problems by the preliminary evaluation and constant surveillance during exercise testing.

♦ Guidelines set by the American College of Sports Medicine will be followed to determine when a test should be stopped.

COMPENSATION FOR INJURY:

♦ Although we believe that the risk of taking part in this study is minimal, the following liability statement is required in all University of Montana consent forms. "*In the event that you are injured as a result of this research you should individually seek appropriate medical treatment. If the injury is caused by the negligence of the University or any of its employees, you may be entitled to reimbursement or compensation pursuant to the Comprehensive State Insurance Plan established by the Department of Administration under the authority of M.C.A., Title 2, Chapter 9. In the event of a claim for such injury, further information may be obtained from the University's Claims representative or University Legal Counsel.* (Reviewed by University Legal Counsel, July 6, 1993)

CONFIDENTIALITY:

♦ Your identification will be kept confidential.

♦ Your records will be kept private and will not be released without your consent except as required by law.

♦ If the results of this study are written in a journal or presented at a meeting, your name will not be used.

♦ Only the researcher and her faculty supervisor will have access to the files.

♦ All data, identified only by an ID#, will be stored in our laboratory.

♦ Your signed consent form and information sheet will be stored in a locked office separate from the data.

VOLUNTARY PARTICIPATION / WITHDRAWAL:

♦ Your decision to participate in this research study is entirely voluntary.

♦ You may withdraw from participation at any time and for any reason.

♦ You may be asked to discontinue participation in this study if you fail to follow the instructions of the study director or if the study director believes it is in the best interest of your health and welfare.

QUESTIONS:

♦ If you have any questions concerning this research study please contact Lori Looper at 543-6089 or Steven Gaskill at 243-4268, University of Montana Department of Health and Human Performance.

♦ If you have any questions regarding your rights as a research subject, you may contact the Institutional Review Board through the Research Office at the University of Montana at (406) 243-6670.

☐ I am willing to have photos of me taken during the testing. I understand that my name will not be used on the photos or in any reports generated from this research.

☐ I do not want photos taken during this testing.

SUBJECT'S STATEMENT OF CONSENT:

♦ I have read the above description of this research study. I have been informed of the risks and benefits— involved and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions may be directed to a member of the research team. I voluntarily agree to participate in this study. I understand I will receive a copy of this consent form.

Subject's Signature ________________________ Today's Date: ____________

Printed Subject's Name: ________________ ID# ________ Phone: ____________

Address: ______________________________________________

Date Approved by UM IRB 12/27/01
Approval Expires on 12/11/02
_______________ IRB Chair

11 Point IRB Summary

1. The purpose of this study is to determine the exercise intensity at which an individual metabolizes fat at their highest rate. This study is being done to assist health professionals and the general population to choose an exercise intensity that will utilize their stored body fat to fuel the activity and to therefore promote a healthy body composition.

2. The subjects used in this research study will be sedentary males, between the ages of 18 and 30 years, with a body fat percent greater than 18%, and have no apparent health problems that will limit their ability to perform these bouts of exercise testing.

3. Subjects will be recruited from the University of Montana.

4. The testing will take place in the Human Performance Laboratory, room 121 McGill Hall.

5. The subjects will be asked to perform two exercise tests on two separate days on a cycle ergometer. The first session will also include body weight, height, measuring the subjects' residual lung volume using the helium dilution technique, and estimating body composition using the hydrostatic (underwater) weighing technique. If body fat is not greater than 18% then the subject will not continue testing. The first exercise test will be a $VO_2$ max test until volatile fatigue is reached. The second exercise session will consist of five, five-minute stages (warm up, 70, 85, 100, and 115%). The subjects must maintain a specific speed throughout both tests. The subjects will need to wear headgear to hold a mouthpiece that will be used to collect their expired gases. Heart rate values will be obtained using a Polar® heart rate monitor placed around the subject's chest.

6. This research will benefit the subjects, health professionals, and the general public when choosing an exercise intensity. The data from this study should help determine optimal ranges of exercise intensities to promote body fat loss.

7. Minimal physical risk and discomfort exist with all physical exercise. This population should be able to tolerate the levels of intensities required for the testing.

8. Physical signs and symptoms will be monitored during the testing. If any abnormal signs or symptoms are seen, the test will be terminated. Abnormal signs or symptoms include abnormal heart rate, extreme shortness of breath, dizziness, lightheadedness, or unusual pain/discomfort anywhere but especially in the chest, jaw, arm, shoulder, or upper back. The test will be stopped at any time at the request of the subject.

9. Each subject will have an ID number that will be used on his data sheets. Only the consent form will have both the subject's name and ID number. The data sheets will be kept in a separate location than the consent form. Only the study directors will have access to all the forms.

10. Please see attached subject information consent form.

11. Not applicable

Physical Activity Readiness
Questionnaire PAR-Q
(revised 1994)

# PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

| YES | NO | | |
|---|---|---|---|
| ☐ | ☐ | 1. | Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor? |
| ☐ | ☐ | 2. | Do you feel pain in your chest when you do physical activity? |
| ☐ | ☐ | 3. | In the past month, have you had chest pain when you were not doing physical activity? |
| ☐ | ☐ | 4. | Do you lose your balance because of dizziness or do you ever lose consciousness? |
| ☐ | ☐ | 5. | Do you have a bone or joint problem that could be made worse by a change in your physical activity? |
| ☐ | ☐ | 6. | Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition? |
| ☐ | ☐ | 7. | Do you know of any other reason why you should not do physical activity? |

If you answered

## YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

## NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active—begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal—this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever—wait until you feel better; or
- if you are or may be pregnant—talk to your doctor before you start becoming more active.

**Please note:** If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

**You are encouraged to copy the PAR-Q but only if you use the entire form**

*NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.*

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME ______________________________

SIGNATURE ______________________________ DATE ______________________________

SIGNATURE OF PARENT ______________________________ WITNESS ______________________________
or GUARDIAN (for participants under the age of majority)



Supported by: Health Canada Sante Canada

# LOOKING FOR SUBJECTS

To be a part of a research study in the
Health & Human Performance Department
University of Montana

Subjects must be: males between age 18 and 30
> 18% body fat
Not participating in regular aerobic exercise

Testing will take place on two separate occasions in the human performance lab in McGill Hall

Testing consists of: $VO_2$max cycle ergometer test (10 – 15-minutes)
Five stage cycle ergometer test (25 – 30 minutes)
Underwater weighing for body composition
Lung volume test

PLEASE LEAVE YOUR NAME & NUMBER FOR MORE INFORMATION

| NAME | PHONE NUMBER |
|---|---|
| | |
| | |
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| | |
| | |

For more information please call Lori @ 543-0689 or leave your name and number and she will call you

UNIVERSITY OF MONTANA
Department of Health and Human Performance
Human Performance Laboratory

## Effect of Body Fat on Substrate Utilization During Aerobic Exercise

The purpose of this research study is to find the exercise intensity that utilizes the greatest amount of fat.

You have been selected to participate in this research study because you are a healthy sedentary male with a body fat >18% and are between the age of 18 and 30 years.

The studies consists of two sessions that need to be completed in the morning and within two weeks of each other:

1) $VO_2$ max test on a cycle ergometer
underwater weighing
residual lung volume
height and weight
paper work (60 to 90 minutes)

2) Cycle test (approximately 30 minutes)

Both testing sessions will take place in the Human Performance Laboratory Room 121 McGill Hall (straight ahead through the main entrance second door on right)

Please do not eat or drink anything except water at least 8 hours prior to your appointments.
Please do not ingest any caffeine, alcohol, or nicotine 15 hours prior to your appointments.

Date & Time of First Appointment*: ________________________________

* Please bring comfortable exercise clothes & cycling shoes, swim trunks, and a towel
* Please bring 24-hour diet record

Date & Time of Second Appointment*: ________________________________

* Please bring comfortable exercise clothes and cycling shoes
* Please bring 24-hour diet record

If you have any questions or need to change your appointment please call Lori Looper at 543-0689 or Steve Gaskill at 243-4268.

UNIVERSITY OF MONTANA
Department of Health & Human Performance
Human Performance Laboratory

## Effect of Body Fat on Substrate Utilization During Aerobic Exercise

## 24-Hour Diet Record for Subject ID# ____________

Please record all caloric containing foods and beverages for the 24 hours prior to your 12-hour fast. Please include the most accurate quantity by measuring, counting, or including the weight of the item. Also include the time you consumed the items and any other helpful information.

| TIME | FOOD OR BEVERAGE DESCRIPTION | QUANTITY | OTHER |
|---|---|---|---|
| | | | |
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SUBJECT DATA FORM

UNIVERSITY OF MONTANA
Department of Health & Human Performance
Human Performance Laboratory

**Effect of Body Fat on Substrate Utilization During Aerobic Exercise**

Subject ID #: __________ Consent Form Signed: ________ PAR-Q Signed: _________

Session 1 – Date: ________ Time: ________ Session 2 – Date: _______ Time: ________

24-Hour Diet Record Completed For Session 1: __________ For Session 2: __________

Activity Level Less Than Surgeon General's Guidelines: _________________________

**DESCRIPTIVE SUBJECT INFORMATION**

| | | | |
|---|---|---|---|
| Date of Birth | | Weight | |
| Age | | Height | |
| BMI | | Average Underwater Weight | |
| Resting Heart Rate | | Fat Mass | |
| Maximal Heart Rate | | Fat Free Mass | |
| Residual Lung Volume | | Body Fat Percent | |
| Lung Bag Volume | | % Helium Initial | |
| Room Temp | | % Helium Final | |
| Water Temp | | Barometric Pressure | |

**2ND SESSION RESISTANCE PROTOCOL**

| INTENSITY | WATTS | WEIGHTS | PLATES |
|---|---|---|---|
| 70 % | | | |
| 85 % | | | |
| 100 % | | | |
| 115 % | | | |

**SESSION 1**

**$VO_2$ MAX TEST**

SUBJECT ID # ___________

| MINUTE / STAGE | WATTS | KG | RPE | DUR | HR | RER | $VO_2$ ML/KG/M | $VO_2$ L / MIN |
|---|---|---|---|---|---|---|---|---|
| WARM UP | 49 | 1 | | | | | | |
| WARM UP | 49 | 1 | | | | | | |
| 1 | 49 | 1 | | | | | | |
| 2 | 74 | 1.5 | | | | | | |
| 3 | 97 | 1.97 | | | | | | |
| 4 | 114 | 2.33 | | | | | | |
| 5 | 132 | 2.69 | | | | | | |
| 6 | 150 | 3.05 | | | | | | |
| 7 | 168 | 3.42 | | | | | | |
| 8 | 185 | 3.78 | | | | | | |
| 9 | 203 | 4.15 | | | | | | |
| 10 | 222 | 4.52 | | | | | | |
| 11 | 240 | 4.89 | | | | | | |
| 12 | 258 | 5.26 | | | | | | |
| 13 | 276 | 5.63 | | | | | | |
| 14 | 294 | 6.00 | | | | | | |
| 15 | 312 | 6.37 | | | | | | |

## SESSION 2

SUBJECT ID # ____________

| MIN | STAGE | WATTS | KG | RPE | DUR | EXP HR | ACT HR | EXP VO2 | $VO_2$ ML/KG/M | $VO_2$ L / MIN | RER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | REST | ____ | ____ | ____ | ____ | | | | | | |
| 0 | REST | ____ | ____ | ____ | ____ | | | | | | |
| 0 | REST | ____ | ____ | ____ | ____ | | | | | | |
| 0 | REST | ____ | ____ | ____ | ____ | | | | | | |
| 0 | REST | ____ | ____ | ____ | ____ | | | | | | |
| 0 | WARM | | | | | | | | | | |
| 0 | WARM | | | | | | | | | | |
| 0 | WARM | | | | | | | | | | |
| 0 | WARM | | | | | | | | | | |
| 0 | WARM | | | | | | | | | | |
| 1 | 70% | | | | | | | | | | |
| 2 | 70% | | | | | | | | | | |
| 3 | 70% | | | | | | | | | | |
| 4 | 70% | | | | | | | | | | |
| 5 | 70% | | | | | | | | | | |
| 6 | 85% | | | | | | | | | | |
| 7 | 85% | | | | | | | | | | |
| 8 | 85% | | | | | | | | | | |
| 9 | 85% | | | | | | | | | | |
| 10 | 85% | | | | | | | | | | |
| 11 | 100% | | | | | | | | | | |
| 12 | 100% | | | | | | | | | | |
| 13 | 100% | | | | | | | | | | |
| 14 | 100% | | | | | | | | | | |
| 15 | 100% | | | | | | | | | | |
| 16 | 115% | | | | | | | | | | |
| 17 | 115% | | | | | | | | | | |
| 18 | 115 % | | | | | | | | | | |
| 19 | 115% | | | | | | | | | | |
| 20 | 115% | | | | | | | | | | |
| 21 | COOL | | | | | | | | | | |
| 22 | COOL | | | | | | | | | | |
| 23 | COOL | | | | | | | | | | |

# *ACTIVITY DURATION SCALE*

| | COULD MAINTAIN FOR: |
|---|---|
| 1 | < 1 MIN |
| 2 | 1 – 5 MIN |
| 3 | 5 – 10 MIN |
| 4 | 10 – 30 MIN |
| 5 | 30 – 60 MIN |
| 6 | 1 – 2 HOURS |
| 7 | 2 – 4 HOURS |
| 8 | > 4 HOURS |

SUBJECT RESULT FORM

UNIVERSITY OF MONTANA
Department of Health and Human Performance
Human Performance Laboratory

## Effect of Body Fat on Substrate Utilization During Aerobic Exercise

Subjects name: ________________________________ Date: ________________

Thank you for participating in this research study.
If you have any questions please call Lori Looper at 543-0689 or Steve Gaskill at 243-4268.

HERE ARE YOUR RESULTS:

**Body Weight:** ___________ kg ____________ pounds

**Height:** ________________ cm ____________ inches

**Residual Lung Volume:** _____________________ Expected Value_____________

**Body Fat Percent:** _________________________ Ideal Values______________

**Max Watts for Cycle:** _________________________

**Max Heart Rate:** _____________________________

**$VO_2$max:**

_________L/min _________ ml / kg / min    Normal Values _________ml/kg/min

**Ventilatory Threshold:**

______________L / min ______________ml / kg / min __________ % of $VO_2$max

Normal Values ______________ml / kg / min ______________ % of $VO_2$max

**Your Optimal Intensity For Fat Utilization:**

Heart Rate: _____________ RPE: ______________ Watts: _________________

**Recommended Aerobic Exercise Program:**

Mode: ______________ Frequency: ______________ Duration: _____________

_________________________________________________________________

## Appendix II: Statistical Data

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .562 | .562 | .041 | .8416 |
| Residual | 14 | 189.875 | 13.562 | | |

Dependent: Age

**Means Table**
**Effect: Group**
**Dependent: Age**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 24.000 | 4.598 | 1.626 |
| lean | 8 | 23.625 | 2.446 | .865 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 25.000 | 25.000 | .636 | .4385 |
| Residual | 14 | 550.278 | 39.306 | | |

Dependent: Height

**Means Table**
**Effect: Group**
**Dependent: Height**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 179.837 | 3.737 | 1.321 |
| lean | 8 | 177.338 | 8.040 | 2.843 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 5416.960 | 5416.960 | 14.735 | .0018 |
| Residual | 14 | 5146.839 | 367.631 | | |

Dependent: MASS-KG

**Means Table**
**Effect: Group**
**Dependent: MASS-KG**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 105.213 | 25.345 | 8.961 |
| lean | 8 | 68.413 | 9.639 | 3.408 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .111 | .111 | 72.032 | .0001 |
| Residual | 14 | .021 | .002 | | |

Dependent: Body Fat

**Means Table**
**Effect: Group**
**Dependent: Body Fat**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | .271 | .050 | .018 |
| lean | 8 | .105 | .023 | .008 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 488.963 | 488.963 | 12.223 | .0036 |
| Residual | 14 | 560.056 | 40.004 | | |

Dependent: BMI

**Means Table**
**Effect: Group**
**Dependent: BMI**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 32.715 | 8.813 | 3.116 |
| lean | 8 | 21.659 | 1.528 | .540 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 1955.627 | 1955.627 | 22.588 | .0003 |
| Residual | 14 | 1212.120 | 86.580 | | |

Dependent: FM_KG

**Means Table**
**Effect: Group**
**Dependent: FM_KG**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 29.349 | 12.979 | 4.589 |
| lean | 8 | 7.238 | 2.167 | .766 |

Type III Sums of Squares

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 860.249 | 860.249 | 7.215 | .0177 |
| Residual | 14 | 1669.331 | 119.238 | | |

Dependent: LBM_KG

**Means Table**
**Effect: Group**
**Dependent: LBM_KG**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 76.036 | 13.032 | 4.608 |
| lean | 8 | 61.371 | 8.285 | 2.929 |

Type III Sums of Squares

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 16320.062 | 16320.062 | 15.994 | .0013 |
| Residual | 14 | 14285.375 | 1020.384 | | |

Dependent: WATTS_MAX

**Means Table**
**Effect: Group**
**Dependent: WATTS_MAX**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 246.750 | 25.342 | 8.960 |
| lean | 8 | 310.625 | 37.397 | 13.222 |

Type III Sums of Squares

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 2.250 | 2.250 | .030 | .8646 |
| Residual | 14 | 1044.750 | 74.625 | | |

Dependent: HR_MAX

**Means Table**
**Effect: Group**
**Dependent: HR_MAX**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 183.625 | 11.624 | 4.110 |
| lean | 8 | 182.875 | 3.758 | 1.329 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 2594.374 | 2594.374 | 66.618 | .0001 |
| Residual | 14 | 545.216 | 38.944 | | |

Dependent: VO2_MAX (ml/kg/min)

**Means Table**
**Effect: Group**
**Dependent: VO2_MAX (ml/kg/min)**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 33.131 | 6.672 | 2.359 |
| lean | 8 | 58.599 | 5.777 | 2.043 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 1.519 | 1.519 | 4.350 | .0558 |
| Residual | 14 | 4.888 | .349 | | |

Dependent: VO2_MAX (L)

**Means Table**
**Effect: Group**
**Dependent: VO2_MAX (L)**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 3.385 | .520 | .184 |
| lean | 8 | 4.001 | .654 | .231 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 1657.101 | 1657.101 | 32.175 | .0001 |
| Residual | 14 | 721.036 | 51.503 | | |

Dependent: VO2_MAX/LBM

**Means Table**
**Effect: Group**
**Dependent: VO2_MAX/LBM**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 45.019 | 6.949 | 2.457 |
| lean | 8 | 65.372 | 7.397 | 2.615 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .084 | .084 | .728 | .4078 |
| Residual | 14 | 1.617 | .115 | | |

Dependent: VT (L)

**Means Table**
**Effect: Group**
**Dependent: VT (L)**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 1.964 | .267 | .094 |
| lean | 8 | 2.109 | .400 | .141 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 541.609 | 541.609 | 44.548 | .0001 |
| Residual | 14 | 170.212 | 12.158 | | |

Dependent: VT (ml/kg)

**Means Table**
**Effect: Group**
**Dependent: VT (ml/kg)**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 19.184 | 3.417 | 1.208 |
| lean | 8 | 30.820 | 3.555 | 1.257 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 277.306 | 277.306 | 17.337 | .0010 |
| Residual | 14 | 223.926 | 15.995 | | |

Dependent: VT (ml/ LBM)

**Means Table**
**Effect: Group**
**Dependent: VT (ml/ LBM)**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 26.084 | 3.303 | 1.168 |
| lean | 8 | 34.410 | 4.591 | 1.623 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .013 | .013 | 6.566 | .0226 |
| Residual | 14 | .028 | .002 | | |

Dependent: VT % of MAX

**Means Table**
**Effect: Group**
**Dependent: VT % of MAX**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | .583 | .051 | .018 |
| lean | 8 | .526 | .038 | .013 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .002 | .002 | 1.268 | .2791 |
| Residual | 14 | .027 | .002 | | |

Dependent: %Max@70%VT

**Means Table**
**Effect: Group**
**Dependent: %Max@70%VT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | .412 | .050 | .018 |
| lean | 8 | .388 | .037 | .013 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .001 | .001 | .390 | .5424 |
| Residual | 14 | .024 | .002 | | |

Dependent: %Max@85%VT

**Means Table**
**Effect: Group**
**Dependent: %Max@85%VT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | .485 | .045 | .016 |
| lean | 8 | .473 | .036 | .013 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 18.371 | 18.371 | 64.172 | .0001 |
| Residual | 14 | 4.008 | .286 | | |

Dependent: MAX WATTS/KG

**Means Table**
**Effect: Group**
**Dependent: MAX WATTS/KG**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 2.439 | .500 | .177 |
| lean | 8 | 4.582 | .568 | .201 |

**Type III Sums of Squares**

| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 12.873 | 12.873 | 33.552 | .0001 |
| Residual | 14 | 5.371 | .384 | | |

Dependent: MAX WATTS/LBM

**Means Table**
**Effect: Group**
**Dependent: MAX WATTS/LBM**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| fat | 8 | 3.316 | .558 | .197 |
| lean | 8 | 5.110 | .675 | .239 |

**Type III Sums of Squares**

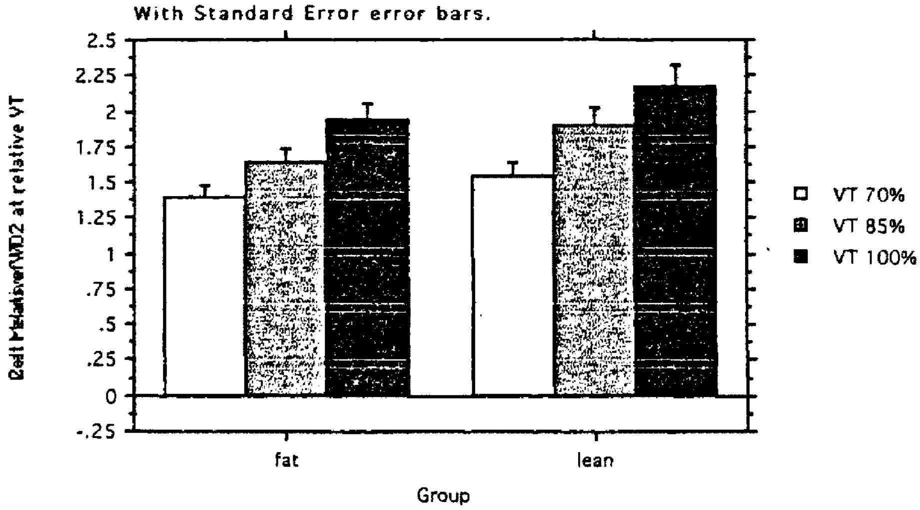
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .539 | .539 | 1.873 | .1927 |
| Subject(Group) | 14 | 4.030 | .288 | | |
| VO2 at relative VT | 2 | 2.741 | 1.370 | 144.037 | .0001 |
| VO2 at relative VT * Group | 2 | .018 | .009 | .961 | .3946 |
| VO2 at relative VT * Subject(... | 28 | .266 | .010 | | |

Dependent: VO2 at relative VTVO2 at relative VT

**Means Table**
**Effect: VO2 at relative VT * Group**
**Dependent: VO2 at relative VT**
**VO2 at relative VT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 1.389 | .221 | .078 |
| VT 70%, lean | 8 | 1.548 | .272 | .096 |
| VT 85%, fat | 8 | 1.641 | .272 | .096 |
| VT 85%, lean | 8 | 1.894 | .361 | .127 |
| VT 100%, fat | 8 | 1.942 | .300 | .106 |
| VT 100%, lean | 8 | 2.166 | .443 | .157 |

**Interaction Bar Chart**
**Effect: VO2 at relative VT * Group**
**Dependent: VO2 at relative VT**
**VO2 at relative VT**
**With Standard Error error bars.**



Comparison 1
Effect: VO2 at relative VT * Group
Dependent: VO2 at relative VT
VO2 at relative VT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .102 |
| Mean Square | .102 |
| F-Value | 10.691 |
| P-Value | .0029 |

Comparison 2
Effect: VO2 at relative VT * Group
Dependent: VO2 at relative VT
VO2 at relative VT

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .256 |
| Mean Square | .256 |
| F-Value | 26.914 |
| P-Value | .0001 |

Comparison 3
Effect: VO2 at relative VT * Group
Dependent: VO2 at relative VT
VO2 at relative VT

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .200 |
| Mean Square | .200 |
| F-Value | 20.990 |
| P-Value | .0001 |

Type III Sums of Squares

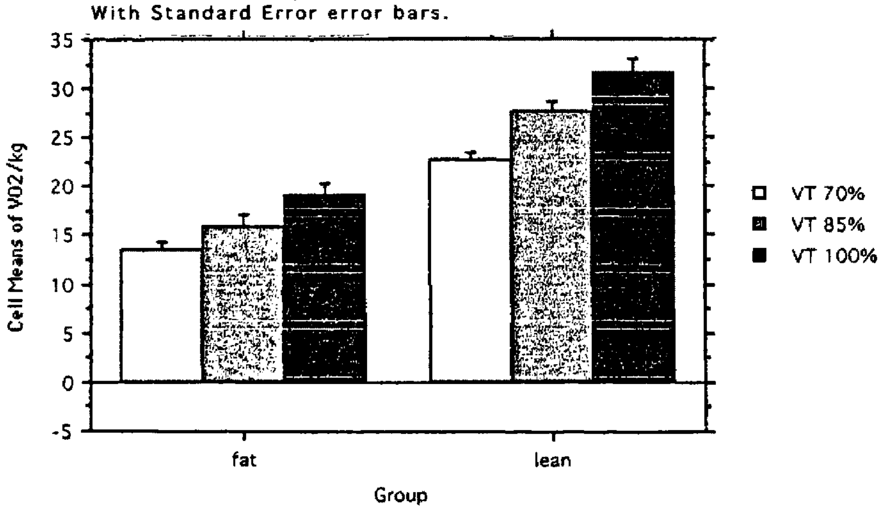
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 1492.506 | 1492.506 | 58.676 | .0001 |
| Subject(Group) | 14 | 356.112 | 25.437 | | |
| VO2/kg | 2 | 418.597 | 209.299 | 182.449 | .0001 |
| VO2/kg * Group | 2 | 24.981 | 12.491 | 10.888 | .0003 |
| VO2/kg * Subject(Group) | 28 | 32.121 | 1.147 | | |

Dependent: VO2/kg

Means Table
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 13.471 | 2.122 | .750 |
| VT 70%, lean | 8 | 22.655 | 2.318 | .820 |
| VT 85%, fat | 8 | 15.976 | 3.029 | 1.071 |
| VT 85%, lean | 8 | 27.648 | 2.847 | 1.007 |
| VT 100%, fat | 8 | 18.994 | 3.795 | 1.342 |
| VT 100%, lean | 8 | 31.596 | 3.728 | 1.318 |

Interaction Bar Chart
Effect: VO2/kg * Group
Dependent: VO2/kg
With Standard Error error bars.



Comparison 1
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 337.361 |
| Mean Square | 337.361 |
| F-Value | 294.082 |
| P-Value | .0001 |

Comparison 2
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 544.950 |
| Mean Square | 544.950 |
| F-Value | 475.041 |
| P-Value | .0001 |

Comparison 3
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 635.176 |
| Mean Square | 635.176 |
| F-Value | 553.693 |
| P-Value | .0001 |

Comparison 4
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 25.102 |
| Mean Square | 25.102 |
| F-Value | 21.882 |
| P-Value | .0001 |

Comparison 5
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 122.019 |
| Mean Square | 122.019 |
| F-Value | 106.366 |
| P-Value | .0001 |

Comparison 6
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 99.740 |
| Mean Square | 99.740 |
| F-Value | 86.945 |
| P-Value | .0001 |

Comparison 7
Effect: VO2/kg * Group
Dependent: VO2/kg

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 319.749 |
| Mean Square | 319.749 |
| F-Value | 278.730 |
| P-Value | .0001 |

**Type III Sums of Squares**

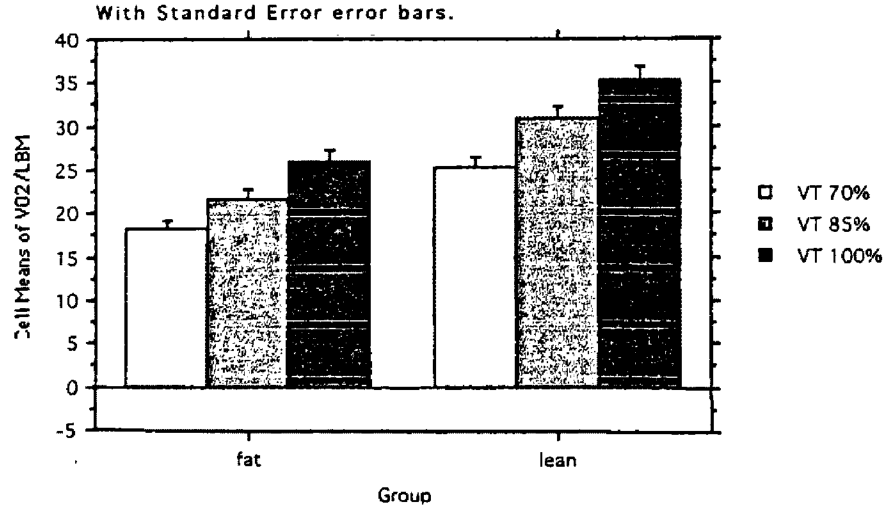
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 869.207 | 869.207 | 25.884 | .0002 |
| Subject(Group) | 14 | 470.127 | 33.580 | | |
| VO2/LBM | 2 | 606.892 | 303.446 | 181.499 | .0001 |
| VO2/LBM * Group | 2 | 15.332 | 7.666 | 4.585 | .0189 |
| VO2/LBM * Subject(Group) | 28 | 46.813 | 1.672 | | |

Dependent: VO2/LBM

**Means Table**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 18.363 | 2.078 | .735 |
| VT 70%, lean | 8 | 25.287 | 3.036 | 1.073 |
| VT 85%, fat | 8 | 21.724 | 3.049 | 1.078 |
| VT 85%, lean | 8 | 30.859 | 3.712 | 1.313 |
| VT 100%, fat | 8 | 25.798 | 3.822 | 1.351 |
| VT 100%, lean | 8 | 35.271 | 4.757 | 1.682 |

Interaction Bar Chart
Effect: VO2/LBM * Group
Dependent: VO2/LBM
With Standard Error error bars.



**Comparison 1**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 191.779 |
| Mean Square | 191.779 |
| F-Value | 114.708 |
| P-Value | .0001 |

**Comparison 2**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 333.809 |
| Mean Square | 333.809 |
| F-Value | 199.659 |
| P-Value | .0001 |

**Comparison 3**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 358.951 |
| Mean Square | 358.951 |
| F-Value | 214.698 |
| P-Value | .0001 |

**Comparison 4**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 45.182 |
| Mean Square | 45.182 |
| F-Value | 27.024 |
| P-Value | .0001 |

**Comparison 5**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 221.087 |
| Mean Square | 221.087 |
| F-Value | 132.238 |
| P-Value | .0001 |

**Comparison 6**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 124.183 |
| Mean Square | 124.183 |
| F-Value | 74.277 |
| P-Value | .0001 |

**Comparison 7**
**Effect: VO2/LBM * Group**
**Dependent: VO2/LBM**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 398.664 |
| Mean Square | 398.664 |
| F-Value | 238.451 |
| P-Value | .0001 |

Type III Sums of Squares

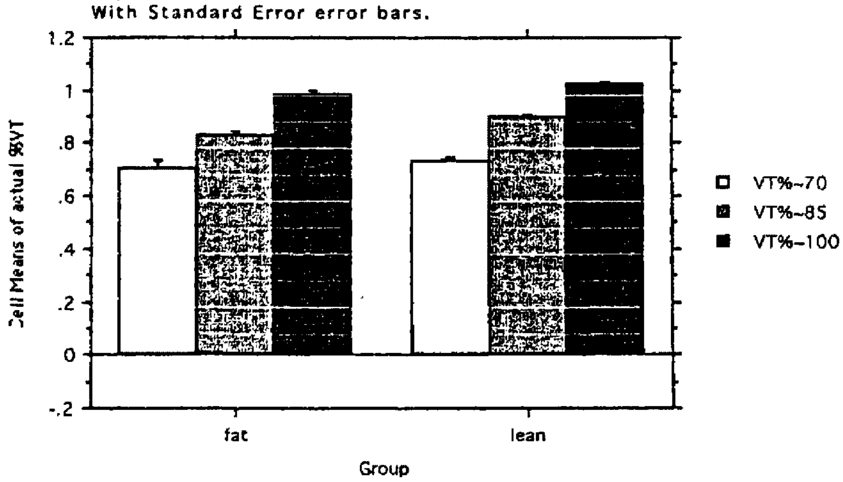
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .023 | .023 | 9.351 | .0085 |
| Subject(Group) | 14 | .035 | .003 | | |
| Actual %VT | 2 | .644 | .322 | 293.194 | .0001 |
| Actual %VT * Group | 2 | .003 | .002 | 1.376 | .2693 |
| Actual %VT * Subject(Group) | 28 | .031 | .001 | | |

Dependent: actual %VT

Means Table
Effect: Actual %VT * Group
Dependent: actual %VT

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT%~70, fat | 8 | .708 | .068 | .024 |
| VT%~70, lean | 8 | .736 | .031 | .011 |
| VT%~85, fat | 8 | .832 | .038 | .013 |
| VT%~85, lean | 8 | .898 | .024 | .009 |
| VT%~100, fat | 8 | .987 | .035 | .012 |
| VT%~100, lean | 8 | 1.025 | .025 | .009 |

Interaction Bar Chart
Effect: Actual %VT * Group
Dependent: actual %VT
With Standard Error error bars.



Comparison 1
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~70, fat | 1.000 |
| VT%~70, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 2.949 |
| P-Value | .0969 |

Comparison 2
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~85, fat | 1.000 |
| VT%~85, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .017 |
| Mean Square | .017 |
| F-Value | 15.838 |
| P-Value | .0004 |

Comparison 3
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~100, fat | 1.000 |
| VT%~100, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .006 |
| Mean Square | .006 |
| F-Value | 5.344 |
| P-Value | .0284 |

Comparison 4
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~70, fat | 1.000 |
| VT%~85, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .062 |
| Mean Square | .062 |
| F-Value | 56.385 |
| P-Value | .0001 |

Comparison 5
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~70, fat | 1.000 |
| VT%~100, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .311 |
| Mean Square | .311 |
| F-Value | 283.099 |
| P-Value | .0001 |

Comparison 6
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~70, lean | 1.000 |
| VT%~85, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .105 |
| Mean Square | .105 |
| F-Value | 95.478 |
| P-Value | .0001 |

Comparison 7
Effect: Actual %VT * Group
Dependent: actual %VT

| | Cell Weight |
|---|---|
| VT%~70, lean | 1.000 |
| VT%~100, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .333 |
| Mean Square | .333 |
| F-Value | 303.448 |
| P-Value | .0001 |

Type III Sums of Squares

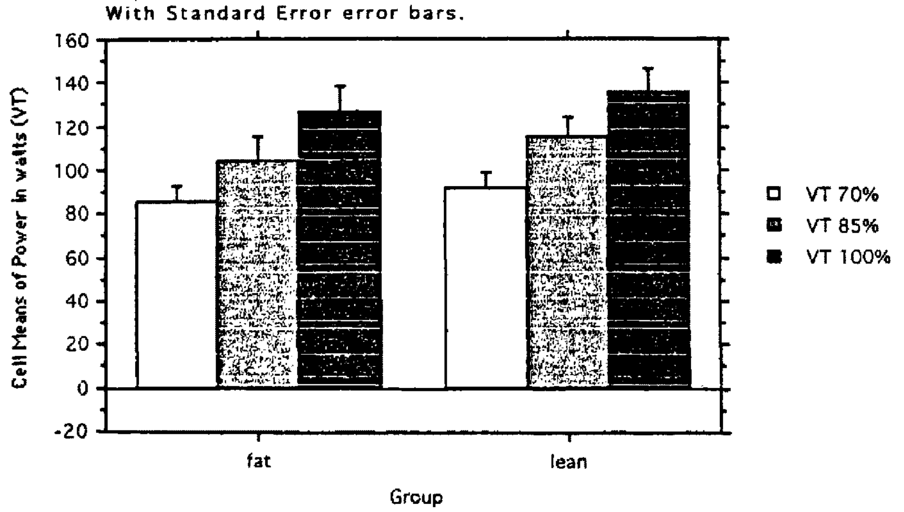
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 827.561 | 827.561 | .388 | .5433 |
| Subject(Group) | 14 | 29852.393 | 2132.314 | | |
| "Power in Watts (VT)" | 2 | 14443.980 | 7221.990 | 161.558 | .0001 |
| "Power in Watts (VT)" * Group | 2 | 42.329 | 21.164 | .473 | .6277 |
| "Power in Watts (VT)" * Subj... | 28 | 1251.658 | 44.702 | | |

Dependent: Power in watts (VT)

Means Table
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 85.950 | 20.574 | 7.274 |
| VT 70%, lean | 8 | 91.869 | 21.563 | 7.624 |
| VT 85%, fat | 8 | 104.798 | 28.680 | 10.140 |
| VT 85%, lean | 8 | 115.306 | 25.297 | 8.944 |
| VT 100%, fat | 8 | 127.157 | 33.305 | 11.775 |
| VT 100%, lean | 8 | 135.644 | 31.361 | 11.088 |

Interaction Bar Chart
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)
With Standard Error error bars.



Comparison 1
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 140.116 |
| Mean Square | 140.116 |
| F-Value | 3.134 |
| P-Value | .0875 |

Comparison 2
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 441.686 |
| Mean Square | 441.686 |
| F-Value | 9.881 |
| P-Value | .0039 |

Comparison 3
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 288.087 |
| Mean Square | 288.087 |
| F-Value | 6.445 |
| P-Value | .0170 |

Comparison 4
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1420.968 |
| Mean Square | 1420.968 |
| F-Value | 31.788 |
| P-Value | .0001 |

Comparison 5
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 6792.054 |
| Mean Square | 6792.054 |
| F-Value | 151.940 |
| P-Value | .0001 |

Comparison 6
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2197.266 |
| Mean Square | 2197.266 |
| F-Value | 49.154 |
| P-Value | .0001 |

Comparison 7
Effect: Power in Watts (VT) * Group
Dependent: Power in watts (VT)

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 7665.003 |
| Mean Square | 7665.003 |
| F-Value | 171.469 |
| P-Value | .0001 |

Type III Sums of Squares

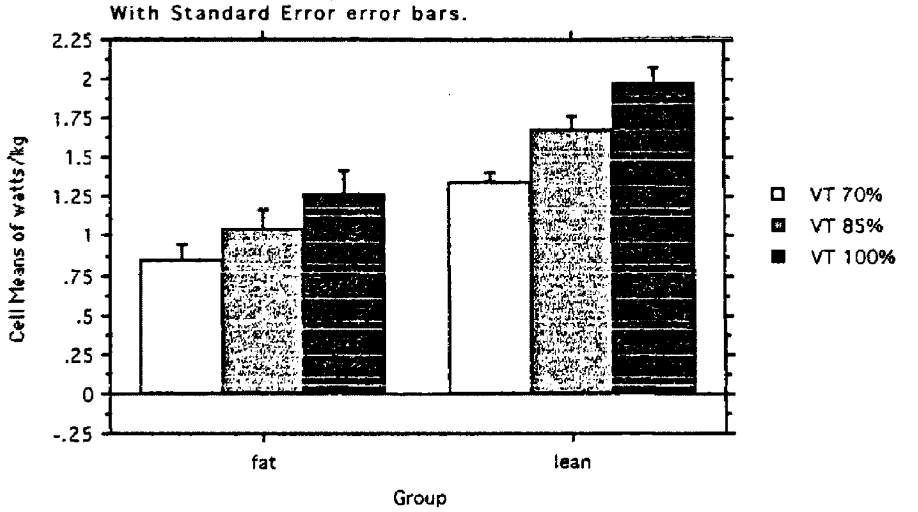
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 4.503 | 4.503 | 17.281 | .0010 |
| Subject(Group) | 14 | 3.648 | .261 | | |
| watts/kg | 2 | 2.221 | 1.111 | 171.837 | .0001 |
| watts/kg * Group | 2 | .107 | .054 | 8.304 | .0015 |
| watts/kg * Subject(Group) | 28 | .181 | .006 | | |

Dependent: watts/kg

Means Table
Effect: watts/kg * Group
Dependent: watts/kg

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .850 | .262 | .093 |
| VT 70%, lean | 8 | 1.336 | .180 | .064 |
| VT 85%, fat | 8 | 1.042 | .360 | .127 |
| VT 85%, lean | 8 | 1.681 | .226 | .080 |
| VT 100%, fat | 8 | 1.264 | .423 | .150 |
| VT 100%, lean | 8 | 1.977 | .293 | .104 |

Interaction Bar Chart
Effect: watts/kg * Group
Dependent: watts/kg
With Standard Error error bars.



**Comparison 1**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .944 |
| Mean Square | .944 |
| F-Value | 146.102 |
| P-Value | .0001 |

**Comparison 2**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.632 |
| Mean Square | 1.632 |
| F-Value | 252.537 |
| P-Value | .0001 |

**Comparison 3**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.034 |
| Mean Square | 2.034 |
| F-Value | 314.670 |
| P-Value | .0001 |

**Comparison 4**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .147 |
| Mean Square | .147 |
| F-Value | 22.802 |
| P-Value | .0001 |

**Comparison 5**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .683 |
| Mean Square | .683 |
| F-Value | 105.720 |
| P-Value | .0001 |

**Comparison 6**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .476 |
| Mean Square | .476 |
| F-Value | 73.605 |
| P-Value | .0001 |

**Comparison 7**
**Effect: watts/kg * Group**
**Dependent: watts/kg**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.641 |
| Mean Square | 1.641 |
| F-Value | 253.884 |
| P-Value | .0001 |

**Type III Sums of Squares**

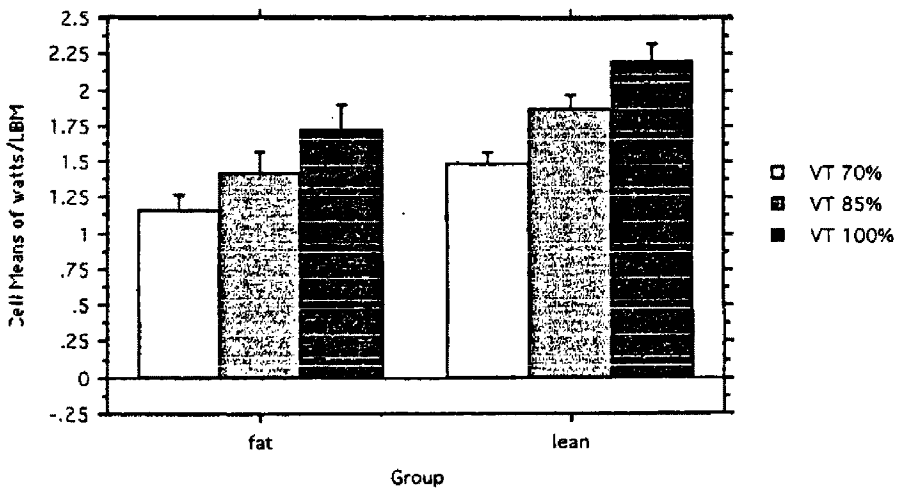
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 2.192 | 2.192 | 5.590 | .0330 |
| Subject(Group) | 14 | 5.490 | .392 | | |
| watts/LBM | 2 | 3.258 | 1.629 | 163.876 | .0001 |
| watts/LBM * Group | 2 | .052 | .026 | 2.598 | .0923 |
| watts/LBM * Subject(G... | 28 | .278 | .010 | | |

Dependent: watts/LBM

**Means Table**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 1.155 | .319 | .113 |
| VT 70%, lean | 8 | 1.491 | .219 | .077 |
| VT 85%, fat | 8 | 1.416 | .450 | .159 |
| VT 85%, lean | 8 | 1.875 | .269 | .095 |
| VT 100%, fat | 8 | 1.718 | .529 | .187 |
| VT 100%, lean | 8 | 2.205 | .346 | .122 |

Interaction Bar Chart
Effect: watts/LBM * Group
Dependent: watts/LBM
With Standard Error error bars.



**Comparison 1**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .452 |
| Mean Square | .452 |
| F-Value | 45.435 |
| P-Value | .0001 |

**Comparison 2**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .843 |
| Mean Square | .843 |
| F-Value | 84.802 |
| P-Value | .0001 |

**Comparison 3**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .949 |
| Mean Square | .949 |
| F-Value | 95.459 |
| P-Value | .0001 |

**Comparison 4**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .272 |
| Mean Square | .272 |
| F-Value | 27.383 |
| P-Value | .0001 |

**Comparison 5**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.266 |
| Mean Square | 1.266 |
| F-Value | 127.381 |
| P-Value | .0001 |

**Comparison 6**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .590 |
| Mean Square | .590 |
| F-Value | 59.307 |
| P-Value | .0001 |

**Comparison 7**
**Effect: watts/LBM * Group**
**Dependent: watts/LBM**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.038 |
| Mean Square | 2.038 |
| F-Value | 204.950 |
| P-Value | .0001 |

**Type III Sums of Squares**

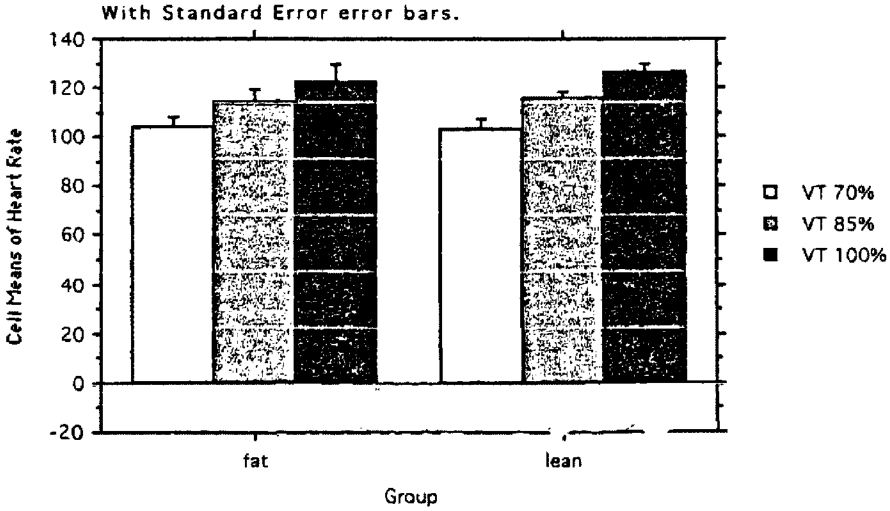
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 28.521 | 28.521 | .063 | .8048 |
| Subject(Group) | 14 | 6293.365 | 449.526 | | |
| HR | 2 | 3382.824 | 1691.412 | 61.356 | .0001 |
| HR * Group | 2 | 39.828 | 19.914 | .722 | .4944 |
| HR * Subject(Group) | 28 | 771.875 | 27.567 | | |

Dependent: Heart Rate

**Means Table**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 104.275 | 11.119 | 3.931 |
| VT 70%, lean | 8 | 103.587 | 10.702 | 3.784 |
| VT 85%, fat | 8 | 114.212 | 14.149 | 5.002 |
| VT 85%, lean | 8 | 115.750 | 8.920 | 3.154 |
| VT 100%, fat | 8 | 122.588 | 20.181 | 7.135 |
| VT 100%, lean | 8 | 126.363 | 9.171 | 3.243 |

**Interaction Bar Chart**
**Effect: HR * Group**
**Dependent: Heart Rate**
**With Standard Error error bars.**



**Comparison 1**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.891 |
| Mean Square | 1.891 |
| F-Value | .069 |
| P-Value | .7953 |

**Comparison 2**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 9.456 |
| Mean Square | 9.456 |
| F-Value | .343 |
| P-Value | .5628 |

**Comparison 3**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 57.002 |
| Mean Square | 57.002 |
| F-Value | 2.068 |
| P-Value | .1615 |

**Comparison 4**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 395.016 |
| Mean Square | 395.016 |
| F-Value | 14.329 |
| P-Value | .0007 |

**Comparison 5**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1341.391 |
| Mean Square | 1341.391 |
| F-Value | 48.659 |
| P-Value | .0001 |

**Comparison 6**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 591.706 |
| Mean Square | 591.706 |
| F-Value | 21.464 |
| P-Value | .0001 |

**Comparison 7**
**Effect: HR * Group**
**Dependent: Heart Rate**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2074.802 |
| Mean Square | 2074.802 |
| F-Value | 75.264 |
| P-Value | .0001 |

**Type III Sums of Squares**

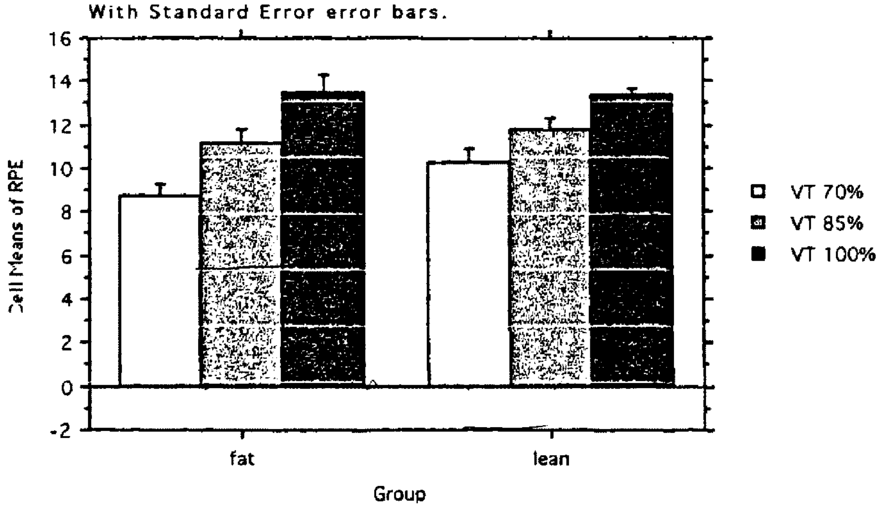
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 5.333 | 5.333 | .705 | .4152 |
| Subject(Group) | 14 | 105.917 | 7.565 | | |
| RPE | 2 | 124.042 | 62.021 | 100.187 | .0001 |
| RPE * Group | 2 | 5.292 | 2.646 | 4.274 | .0240 |
| RPE * Subject(Group) | 28 | 17.333 | .619 | | |

Dependent: RPE

**Means Table**
**Effect: RPE * Group**
**Dependent: RPE**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 8.750 | 1.581 | .559 |
| VT 70%, lean | 8 | 10.250 | 1.753 | .620 |
| VT 85%, fat | 8 | 11.125 | 1.808 | .639 |
| VT 85%, lean | 8 | 11.750 | 1.581 | .559 |
| VT 100%, fat | 8 | 13.500 | 2.330 | .824 |
| VT 100%, lean | 8 | 13.375 | .916 | .324 |

Interaction Bar Chart
Effect: RPE * Group
Dependent: RPE
With Standard Error error bars.



Comparison 1
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 9.000 |
| Mean Square | 9.000 |
| F-Value | 14.538 |
| P-Value | .0007 |

Comparison 2
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.563 |
| Mean Square | 1.563 |
| F-Value | 2.524 |
| P-Value | .1234 |

Comparison 3
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .063 |
| Mean Square | .063 |
| F-Value | .101 |
| P-Value | .7530 |

Comparison 4
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 22.563 |
| Mean Square | 22.563 |
| F-Value | 36.447 |
| P-Value | .0001 |

Comparison 5
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 90.250 |
| Mean Square | 90.250 |
| F-Value | 145.788 |
| P-Value | .0001 |

Comparison 6
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 9.000 |
| Mean Square | 9.000 |
| F-Value | 14.538 |
| P-Value | .0007 |

Comparison 7
Effect: RPE * Group
Dependent: RPE

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 39.062 |
| Mean Square | 39.062 |
| F-Value | 63.101 |
| P-Value | .0001 |

**Type III Sums of Squares**

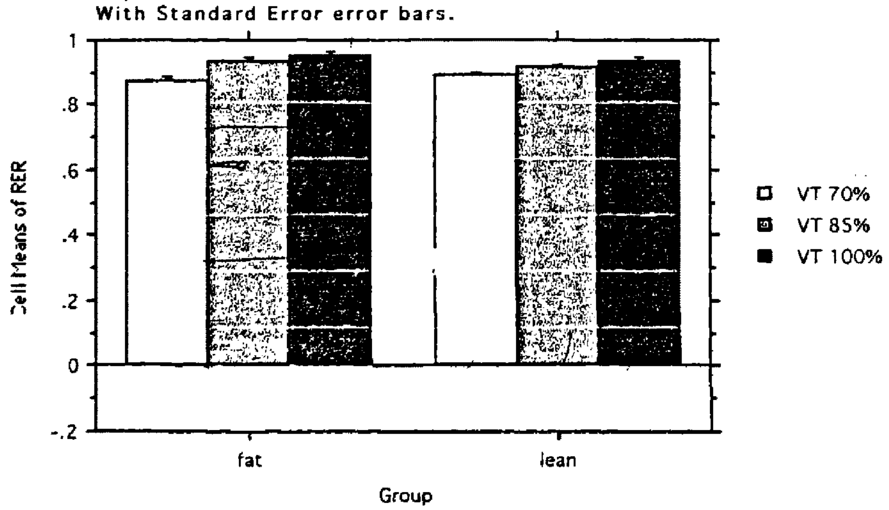
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .001 | .001 | .193 | .6675 |
| Subject(Group) | 14 | .043 | .003 | | |
| RER | 2 | .030 | .015 | 50.011 | .0001 |
| RER * Group | 2 | .003 | .001 | 4.574 | .0191 |
| RER * Subject(Group) | 28 | .008 | 2.954E-4 | | |

Dependent: RER

**Means Table**
**Effect: RER * Group**
**Dependent: RER**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .876 | .035 | .012 |
| VT 70%, lean | 8 | .890 | .029 | .010 |
| VT 85%, fat | 8 | .933 | .044 | .016 |
| VT 85%, lean | 8 | .916 | .025 | .009 |
| VT 100%, fat | 8 | .951 | .040 | .014 |
| VT 100%, lean | 8 | .933 | .034 | .012 |

Interaction Bar Chart
Effect: RER * Group
Dependent: RER
With Standard Error error bars.



Comparison 1
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 2.734 |
| P-Value | .1094 |

Comparison 2
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 4.102 |
| P-Value | .0525 |

Comparison 3
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 4.311 |
| P-Value | .0472 |

Comparison 4
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .013 |
| Mean Square | .013 |
| F-Value | 44.891 |
| P-Value | .0001 |

Comparison 5
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .023 |
| Mean Square | .023 |
| F-Value | 76.450 |
| P-Value | .0001 |

Comparison 6
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 9.128 |
| P-Value | .0053 |

Comparison 7
Effect: RER * Group
Dependent: RER

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .007 |
| Mean Square | .007 |
| F-Value | 25.140 |
| P-Value | .0001 |

**Type III Sums of Squares**

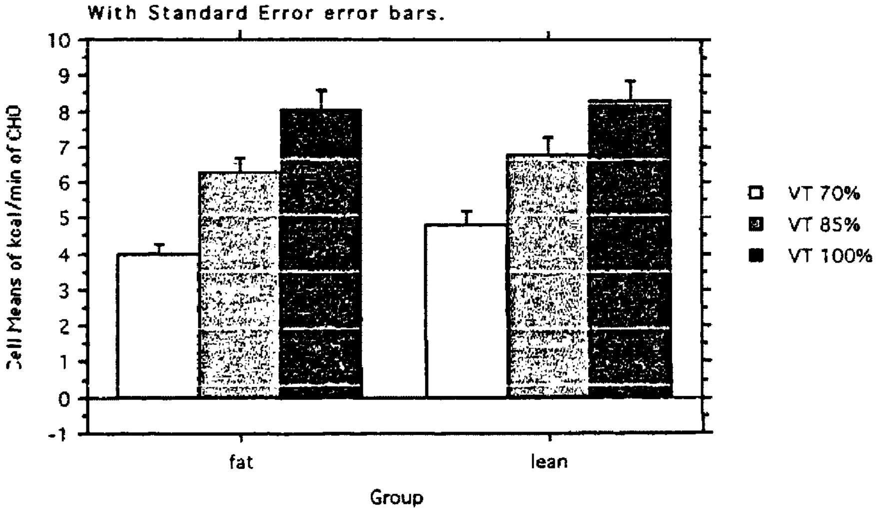
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 3.264 | 3.264 | .991 | .3364 |
| Subject(Group) | 14 | 46.118 | 3.294 | | |
| kcal of CHO | 2 | 114.170 | 57.085 | 92.961 | .0001 |
| kcal of CHO * Group | 2 | .720 | .360 | .587 | .5629 |
| kcal of CHO * Subject(Group) | 28 | 17.194 | .614 | | |

Dependent: kcal/min of CHO

**Means Table**
**Effect: kcal of CHO * Group**
**Dependent: kcal/min of CHO**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 3.985 | .701 | .248 |
| VT 70%, lean | 8 | 4.823 | .998 | .353 |
| VT 85%, fat | 8 | 6.265 | 1.075 | .380 |
| VT 85%, lean | 8 | 6.751 | 1.378 | .487 |
| VT 100%, fat | 8 | 8.053 | 1.433 | .507 |
| VT 100%, lean | 8 | 8.294 | 1.565 | .553 |

Interaction Bar Chart
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO
With Standard Error error bars.



Comparison 1
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.808 |
| Mean Square | 2.808 |
| F-Value | 4.573 |
| P-Value | .0413 |

Comparison 2
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .944 |
| Mean Square | .944 |
| F-Value | 1.538 |
| P-Value | .2253 |

Comparison 3
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .232 |
| Mean Square | .232 |
| F-Value | .378 |
| P-Value | .5437 |

Comparison 4
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 20.799 |
| Mean Square | 20.799 |
| F-Value | 33.871 |
| P-Value | .0001 |

Comparison 5
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 66.185 |
| Mean Square | 66.185 |
| F-Value | 107.781 |
| P-Value | .0001 |

Comparison 6
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 14.873 |
| Mean Square | 14.873 |
| F-Value | 24.220 |
| P-Value | .0001 |

Comparison 7
Effect: kcal of CHO * Group
Dependent: kcal/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 48.183 |
| Mean Square | 48.183 |
| F-Value | 78.465 |
| P-Value | .0001 |

Type III Sums of Squares

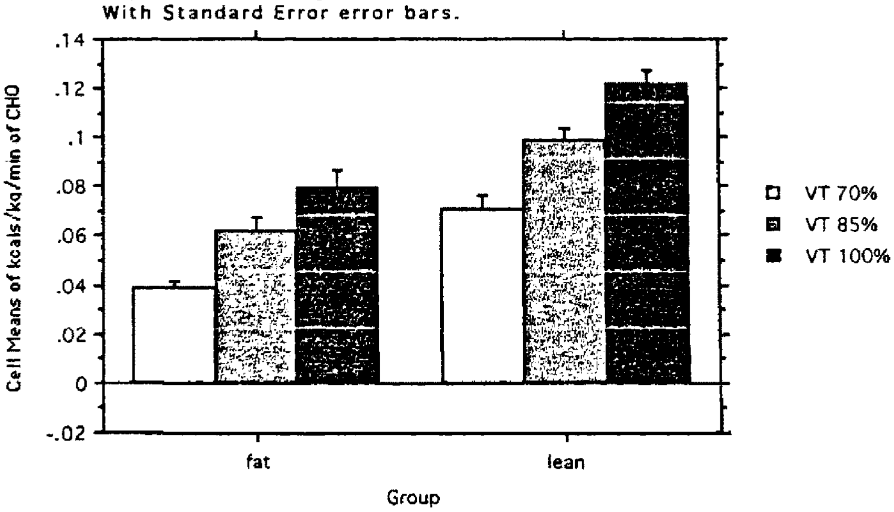
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .016 | .016 | 31.613 | .0001 |
| Subject(Group) | 14 | .007 | .001 | | |
| kcals/kg/min of CHO | 2 | .017 | .008 | 100.561 | .0001 |
| kcals/kg/min of CHO * Group | 2 | 1.758E-4 | 8.788E-5 | 1.060 | .3598 |
| kcals/kg/min of CHO * Subject(... | 28 | .002 | 8.288E-5 | | |

Dependent: kcals/kg/min of CHO

Means Table
Effect: kcals/kg/min of CHO * Group
Dependent: kcals/kg/min of CHO

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .039 | .008 | .003 |
| VT 70%, lean | 8 | .071 | .014 | .005 |
| VT 85%, fat | 8 | .062 | .016 | .006 |
| VT 85%, lean | 8 | .099 | .013 | .004 |
| VT 100%, fat | 8 | .080 | .021 | .007 |
| VT 100%, lean | 8 | .121 | .017 | .006 |

Interaction Bar Chart
Effect: kcals/kg/min of CHO * Group
Dependent: kcals/kg/min of CHO
With Standard Error error bars.



**Comparison 1**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .004 |
| Mean Square | .004 |
| F-Value | 50.466 |
| P-Value | .0001 |

**Comparison 2**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .005 |
| Mean Square | .005 |
| F-Value | 65.330 |
| P-Value | .0001 |

**Comparison 3**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .007 |
| Mean Square | .007 |
| F-Value | 83.954 |
| P-Value | .0001 |

**Comparison 4**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .002 |
| Mean Square | .002 |
| F-Value | 25.488 |
| P-Value | .0001 |

**Comparison 5**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .007 |
| Mean Square | .007 |
| F-Value | 80.635 |
| P-Value | .0001 |

**Comparison 6**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 36.328 |
| P-Value | .0001 |

**Comparison 7**
**Effect: kcals/kg/min of CHO * Group**
**Dependent: kcals/kg/min of CHO**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .010 |
| Mean Square | .010 |
| F-Value | 121.847 |
| P-Value | .0001 |

Type III Sums of Squares

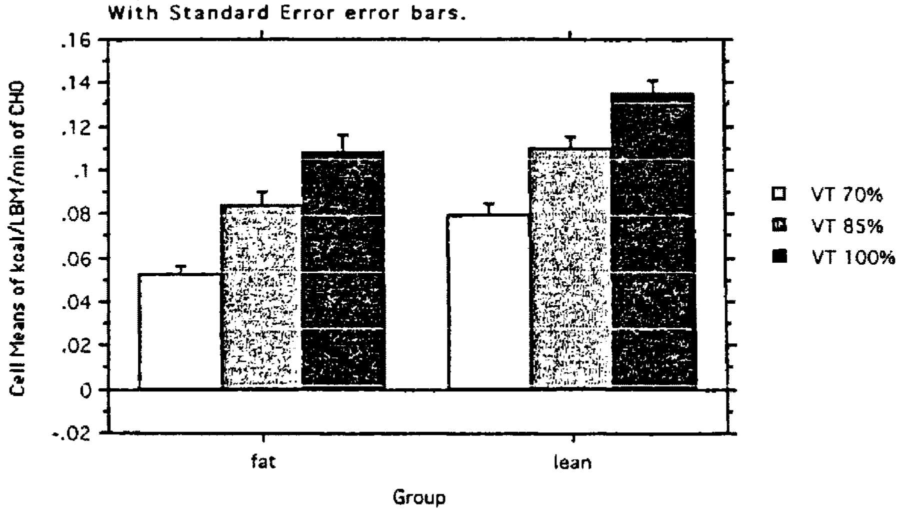
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .008 | .008 | 14.281 | .0020 |
| Subject(Group) | 14 | .008 | .001 | | |
| kcal/LBM of CHO | 2 | .025 | .012 | 104.853 | .0001 |
| kcal/LBM of CHO * Group | 2 | 2.921E-6 | 1.461E-6 | .012 | .9877 |
| kcal/LBM of CHO * Subject(Group) | 28 | .003 | 1.176E-4 | | |

Dependent: kcal/LBM/min of CHO

Means Table
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .053 | .009 | .003 |
| VT 70%, lean | 8 | .079 | .016 | .006 |
| VT 85%, fat | 8 | .084 | .017 | .006 |
| VT 85%, lean | 8 | .110 | .014 | .005 |
| VT 100%, fat | 8 | .108 | .023 | .008 |
| VT 100%, lean | 8 | .135 | .017 | .006 |

Interaction Bar Chart
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO
With Standard Error error bars.



Comparison 1
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 23.608 |
| P-Value | .0001 |

Comparison 2
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 23.106 |
| P-Value | .0001 |

Comparison 3
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 25.206 |
| P-Value | .0001 |

Comparison 4
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .004 |
| Mean Square | .004 |
| F-Value | 32.311 |
| P-Value | .0001 |

Comparison 5
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .012 |
| Mean Square | .012 |
| F-Value | 102.806 |
| P-Value | .0001 |

Comparison 6
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .004 |
| Mean Square | .004 |
| F-Value | 31.723 |
| P-Value | .0001 |

Comparison 7
Effect: kcal/LBM of CHO * Group
Dependent: kcal/LBM/min of CHO

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .012 |
| Mean Square | .012 |
| F-Value | 106.112 |
| P-Value | .0001 |

**Type III Sums of Squares**

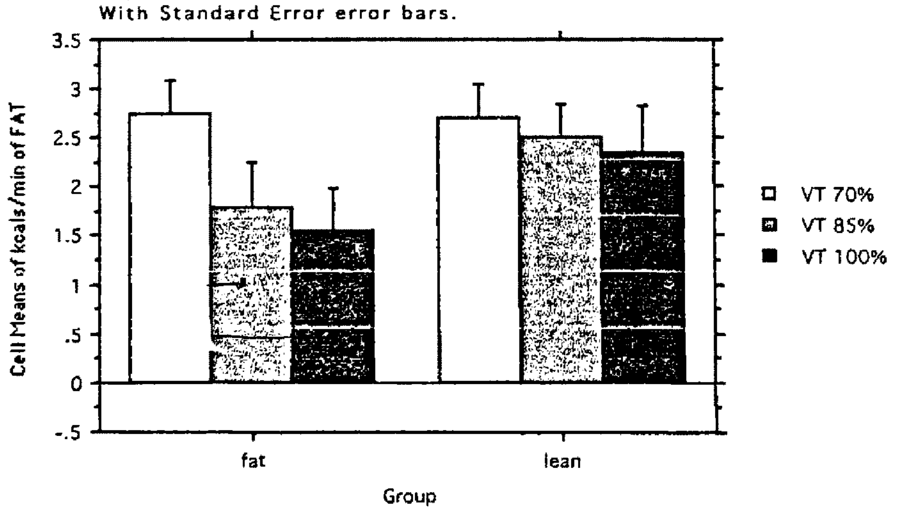
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 2.966 | 2.966 | .845 | .3736 |
| Subject(Group) | 14 | 49.156 | 3.511 | | |
| Category 16 | 2 | 5.097 | 2.549 | 14.409 | .0001 |
| Category 16 * Group | 2 | 1.723 | .861 | 4.870 | .0153 |
| Category 16 * Subject(Group) | 28 | 4.953 | .177 | | |

Dependent: kcals/min of FAT

**Means Table**
**Effect: Category 16 * Group**
**Dependent: kcals/min of FAT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 2.735 | .991 | .350 |
| VT 70%, lean | 8 | 2.699 | .999 | .353 |
| VT 85%, fat | 8 | 1.795 | 1.248 | .441 |
| VT 85%, lean | 8 | 2.514 | .919 | .325 |
| VT 100%, fat | 8 | 1.541 | 1.249 | .442 |
| VT 100%, lean | 8 | 2.349 | 1.336 | .472 |

Interaction Bar Chart
Effect: Category 16 * Group
Dependent: kcals/min of FAT
With Standard Error error bars.



Comparison 1
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .005 |
| Mean Square | .005 |
| F-Value | .030 |
| P-Value | .8644 |

Comparison 2
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.069 |
| Mean Square | 2.069 |
| F-Value | 11.699 |
| P-Value | .0019 |

Comparison 3
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.614 |
| Mean Square | 2.614 |
| F-Value | 14.780 |
| P-Value | .0006 |

Comparison 4
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 3.534 |
| Mean Square | 3.534 |
| F-Value | 19.977 |
| P-Value | .0001 |

Comparison 5
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 5.704 |
| Mean Square | 5.704 |
| F-Value | 32.250 |
| P-Value | .0001 |

Comparison 6
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .136 |
| Mean Square | .136 |
| F-Value | .769 |
| P-Value | .3880 |

Comparison 7
Effect: Category 16 * Group
Dependent: kcals/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .489 |
| Mean Square | .489 |
| F-Value | 2.763 |
| P-Value | .1076 |

**Type III Sums of Squares**

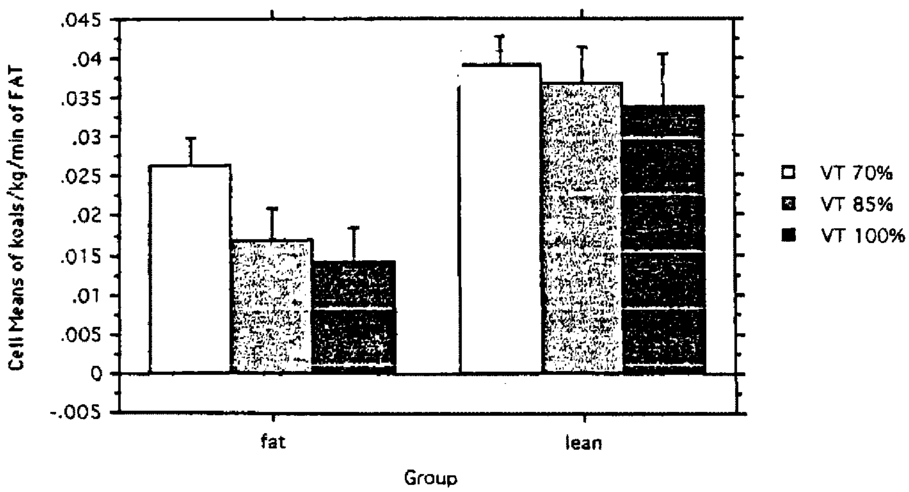
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .004 | .004 | 8.124 | .0128 |
| Subject(Group) | 14 | .006 | 4.474E-4 | | |
| kcals/kg/min of FAT | 2 | .001 | 3.101E-4 | 9.872 | .0006 |
| kcals/kg/min of FAT * Group | 2 | 1.403E-4 | 7.015E-5 | 2.233 | .1260 |
| kcals/kg/min of FAT * Subj... | 28 | .001 | 3.142E-5 | | |

Dependent: kcals/kg/min of FAT

**Means Table**
**Effect: kcals/kg/min of FAT * Group**
**Dependent: kcals/kg/min of FAT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .026 | .010 | .003 |
| VT 70%, lean | 8 | .039 | .011 | .004 |
| VT 85%, fat | 8 | .017 | .012 | .004 |
| VT 85%, lean | 8 | .037 | .013 | .005 |
| VT 100%, fat | 8 | .014 | .012 | .004 |
| VT 100%, lean | 8 | .034 | .019 | .007 |

Interaction Bar Chart
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT
With Standard Error error bars.



Comparison 1
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 20.118 |
| P-Value | .0001 |

Comparison 2
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .002 |
| Mean Square | .002 |
| F-Value | 50.631 |
| P-Value | .0001 |

Comparison 3
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .002 |
| Mean Square | .002 |
| F-Value | 49.412 |
| P-Value | .0001 |

Comparison 4
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 3.693E-4 |
| Mean Square | 3.693E-4 |
| F-Value | 11.755 |
| P-Value | .0019 |

Comparison 5
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 18.855 |
| P-Value | .0002 |

Comparison 6
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.002E-5 |
| Mean Square | 2.002E-5 |
| F-Value | .637 |
| P-Value | .4314 |

Comparison 7
Effect: kcals/kg/min of FAT * Group
Dependent: kcals/kg/min of FAT

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.016E-4 |
| Mean Square | 1.016E-4 |
| F-Value | 3.233 |
| P-Value | .0829 |

**Type III Sums of Squares**

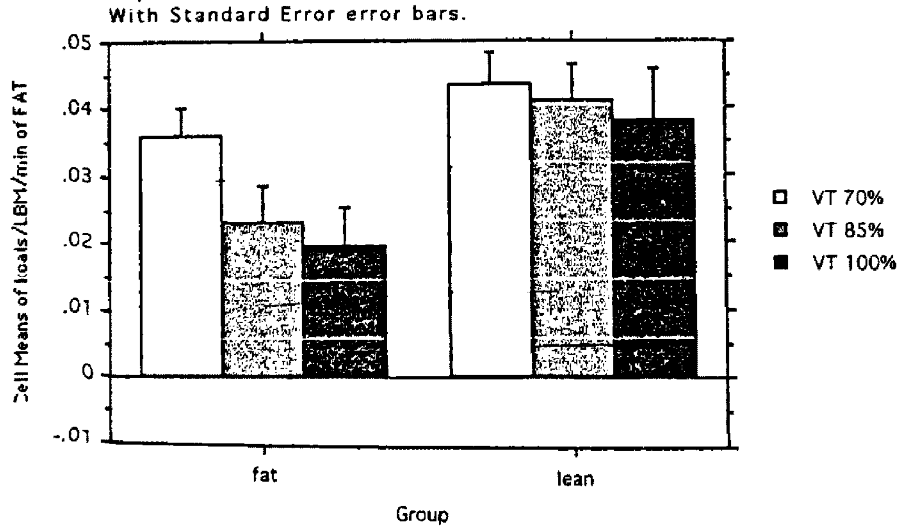
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .003 | .003 | 3.933 | .0673 |
| Subject(Group) | 14 | .009 | .001 | | |
| umol/kg/min of Fat | 2 | .001 | 4.993E-4 | 11.760 | .0002 |
| umol/kg/min of Fat * Group | 2 | 3.057E-4 | 1.529E-4 | 3.600 | .0406 |
| umol/kg/min of Fat * Subject... | 28 | .001 | 4.245E-5 | | |

Dependent: kcals/LBM/min of FAT

**Means Table**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .036 | .012 | .004 |
| VT 70%, lean | 8 | .044 | .013 | .005 |
| VT 85%, fat | 8 | .023 | .016 | .006 |
| VT 85%, lean | 8 | .041 | .015 | .005 |
| VT 100%, fat | 8 | .020 | .016 | .006 |
| VT 100%, lean | 8 | .038 | .022 | .008 |

**Interaction Bar Chart**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**
**With Standard Error error bars.**



**Comparison 1**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.351E-4 |
| Mean Square | 2.351E-4 |
| F-Value | 5.537 |
| P-Value | .0259 |

**Comparison 2**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 30.934 |
| P-Value | .0001 |

**Comparison 3**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 32.632 |
| P-Value | .0001 |

**Comparison 4**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 15.642 |
| P-Value | .0005 |

**Comparison 5**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 25.174 |
| P-Value | .0001 |

**Comparison 6**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.364E-5 |
| Mean Square | 2.364E-5 |
| F-Value | .557 |
| P-Value | .4617 |

**Comparison 7**
**Effect: umol/kg/min of Fat * Group**
**Dependent: kcals/LBM/min of FAT**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.167E-4 |
| Mean Square | 1.167E-4 |
| F-Value | 2.749 |
| P-Value | .1085 |

Comparison 1
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .005 |
| Mean Square | .005 |
| F-Value | 104.535 |
| P-Value | .0001 |

Comparison 2
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .008 |
| Mean Square | .008 |
| F-Value | 176.407 |
| P-Value | .0001 |

Comparison 3
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .008 |
| Mean Square | .008 |
| F-Value | 189.822 |
| P-Value | .0001 |

Comparison 4
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 29.077 |
| P-Value | .0001 |

Comparison 5
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .006 |
| Mean Square | .006 |
| F-Value | 134.878 |
| P-Value | .0001 |

Comparison 6
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 71.401 |
| P-Value | .0001 |

Comparison 7
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .010 |
| Mean Square | .010 |
| F-Value | 230.040 |
| P-Value | .0001 |

Type III Sums of Squares

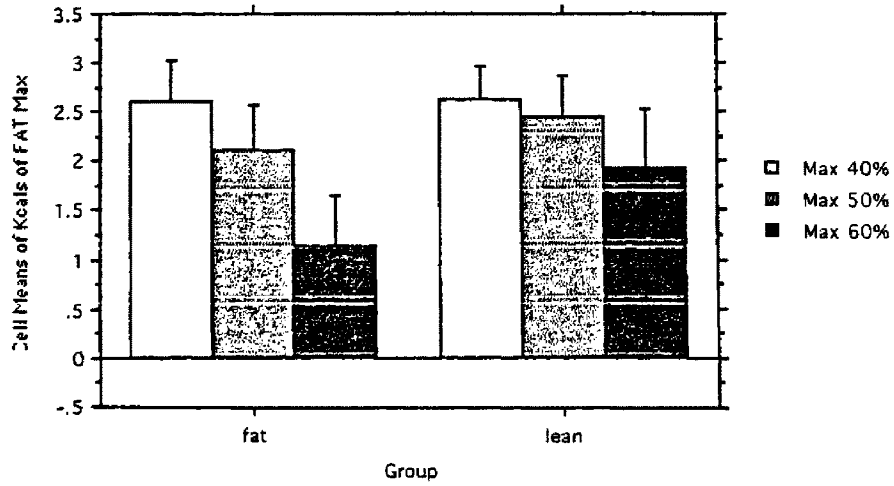
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 1.730 | 1.730 | .365 | .5557 |
| Subject(Group) | 14 | 66.442 | 4.746 | | |
| Kcals of FAT | 2 | 9.919 | 4.959 | 24.425 | .0001 |
| Kcals of FAT * Group | 2 | 1.231 | .616 | 3.032 | .0643 |
| Kcals of FAT * Subject(Group) | 28 | 5.685 | .203 | | |

Dependent: Kcals of FAT Max

Means Table
Effect: Kcals of FAT * Group
Dependent: Kcals of FAT Max

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| Max 40%, fat | 8 | 2.614 | 1.150 | .407 |
| Max 40%, lean | 8 | 2.625 | .951 | .336 |
| Max 50%, fat | 8 | 2.106 | 1.301 | .460 |
| Max 50%, lean | 8 | 2.443 | 1.213 | .429 |
| Max 60%, fat | 8 | 1.134 | 1.444 | .510 |
| Max 60%, lean | 8 | 1.926 | 1.682 | .595 |

Interaction Bar Chart
Effect: Kcals of FAT * Group
Dependent: Kcals of FAT Max
With Standard Error error bars.



**Comparison 1**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 40%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 4.577E-4 |
| Mean Square | 4.577E-4 |
| F-Value | .002 |
| P-Value | .9625 |

**Comparison 2**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 50%, fat | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .453 |
| Mean Square | .453 |
| F-Value | 2.232 |
| P-Value | .1464 |

**Comparison 3**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 60%, fat | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.508 |
| Mean Square | 2.508 |
| F-Value | 12.350 |
| P-Value | .0015 |

**Comparison 4**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 50%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.031 |
| Mean Square | 1.031 |
| F-Value | 5.077 |
| P-Value | .0323 |

**Comparison 5**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 60%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 8.760 |
| Mean Square | 8.760 |
| F-Value | 43.141 |
| P-Value | .0001 |

**Comparison 6**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .132 |
| Mean Square | .132 |
| F-Value | .651 |
| P-Value | .4265 |

**Comparison 7**
**Effect: Kcals of FAT * Group**
**Dependent: Kcals of FAT Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.953 |
| Mean Square | 1.953 |
| F-Value | 9.619 |
| P-Value | .0044 |

Type III Sums of Squares

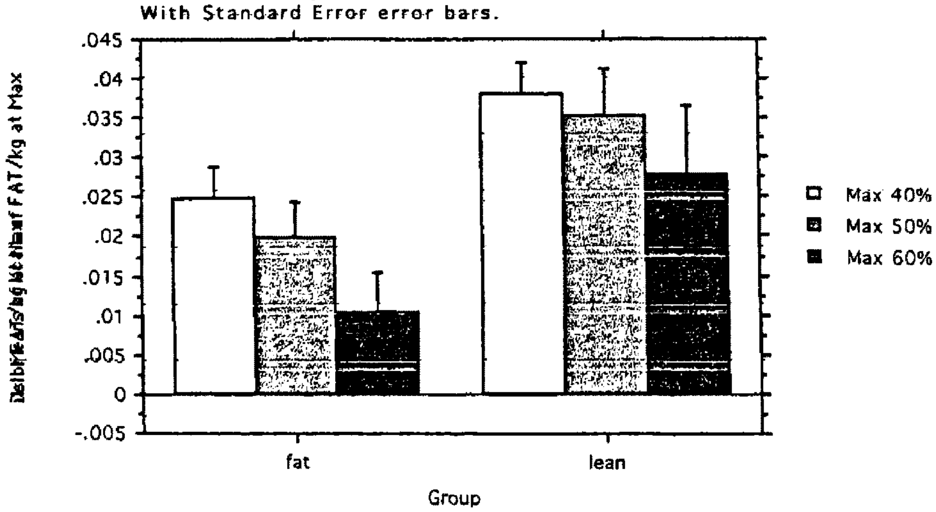
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .003 | .003 | 4.343 | .0560 |
| Subject(Group) | 14 | .009 | .001 | | |
| Kcals of FAT/kg at Max | 2 | .001 | .001 | 14.528 | .0001 |
| Kcals of FAT/kg at Max * Group | 2 | 3.649E-5 | 1.825E-5 | .407 | .6698 |
| Kcals of FAT/kg at Max * Subje... | 28 | .001 | 4.488E-5 | | |

Dependent: Kcals of FAT/kg at MaxKcals of FAT/kg at Max

Means Table
Effect: Kcals of FAT/kg at Max * Group
Dependent: Kcals of FAT/kg at Max
Kcals of FAT/kg at Max

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| Max 40%, fat | 8 | .025 | .011 | .004 |
| Max 40%, lean | 8 | .038 | .011 | .004 |
| Max 50%, fat | 8 | .020 | .012 | .004 |
| Max 50%, lean | 8 | .035 | .016 | .006 |
| Max 60%, fat | 8 | .010 | .014 | .005 |
| Max 60%, lean | 8 | .028 | .025 | .009 |

Interaction Bar Chart
Effect: Kcals of FAT/kg at Max * Group
Dependent: Kcals of FAT/kg at Max
Kcals of FAT/kg at Max
With Standard Error error bars.



**Comparison 1**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 40%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 15.334 |
| P-Value | .0005 |

**Comparison 2**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 50%, fat | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 21.249 |
| P-Value | .0001 |

**Comparison 3**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 60%, fat | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 26.930 |
| P-Value | .0001 |

**Comparison 4**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 50%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.019E-4 |
| Mean Square | 1.019E-4 |
| F-Value | 2.270 |
| P-Value | .1431 |

**Comparison 5**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 60%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 19.019 |
| P-Value | .0002 |

**Comparison 6**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.965E-5 |
| Mean Square | 2.965E-5 |
| F-Value | .661 |
| P-Value | .4232 |

**Comparison 7**
**Effect: Kcals of FAT/kg at Max * Group**
**Dependent: Kcals of FAT/kg at Max**
**Kcals of FAT/kg at Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 4.279E-4 |
| Mean Square | 4.279E-4 |
| F-Value | 9.533 |
| P-Value | .0045 |

**Type III Sums of Squares**

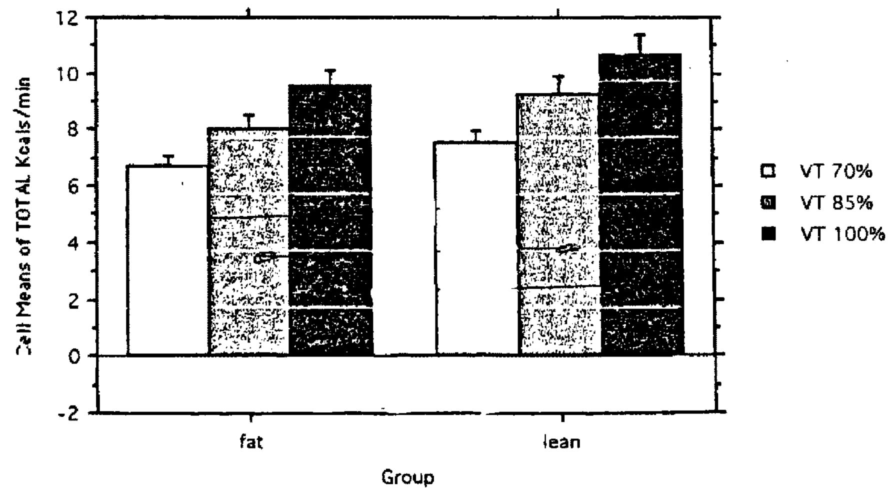
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 12.453 | 12.453 | 1.885 | .1913 |
| Subject(Group) | 14 | 92.463 | 6.604 | | |
| Total Kcals | 2 | 71.893 | 35.946 | 142.013 | .0001 |
| Total Kcals * Group | 2 | .331 | .166 | .654 | .5276 |
| Total Kcals * Subject(Group) | 28 | 7.087 | .253 | | |

Dependent: TOTAL Kcals/min

**Means Table**
**Effect: Total Kcals * Group**
**Dependent: TOTAL Kcals/min**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | 6.720 | 1.040 | .368 |
| VT 70%, lean | 8 | 7.522 | 1.305 | .462 |
| VT 85%, fat | 8 | 8.061 | 1.292 | .457 |
| VT 85%, lean | 8 | 9.266 | 1.755 | .620 |
| VT 100%, fat | 8 | 9.594 | 1.452 | .513 |
| VT 100%, lean | 8 | 10.643 | 2.140 | .757 |

**Interaction Bar Chart**
**Effect: Total Kcals * Group**
**Dependent: TOTAL Kcals/min**
**With Standard Error error bars.**



Comparison 1
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.571 |
| Mean Square | 2.571 |
| F-Value | 10.156 |
| P-Value | .0035 |

Comparison 2
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 5.809 |
| Mean Square | 5.809 |
| F-Value | 22.950 |
| P-Value | .0001 |

Comparison 3
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 100%, fat | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 4.404 |
| Mean Square | 4.404 |
| F-Value | 17.400 |
| P-Value | .0003 |

Comparison 4
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 7.187 |
| Mean Square | 7.187 |
| F-Value | 28.393 |
| P-Value | .0001 |

Comparison 5
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 33.028 |
| Mean Square | 33.028 |
| F-Value | 130.485 |
| P-Value | .0001 |

Comparison 6
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 12.164 |
| Mean Square | 12.164 |
| F-Value | 48.057 |
| P-Value | .0001 |

Comparison 7
Effect: Total Kcals * Group
Dependent: TOTAL Kcals/min

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 38.967 |
| Mean Square | 38.967 |
| F-Value | 153.946 |
| P-Value | .0001 |

Type III Sums of Squares

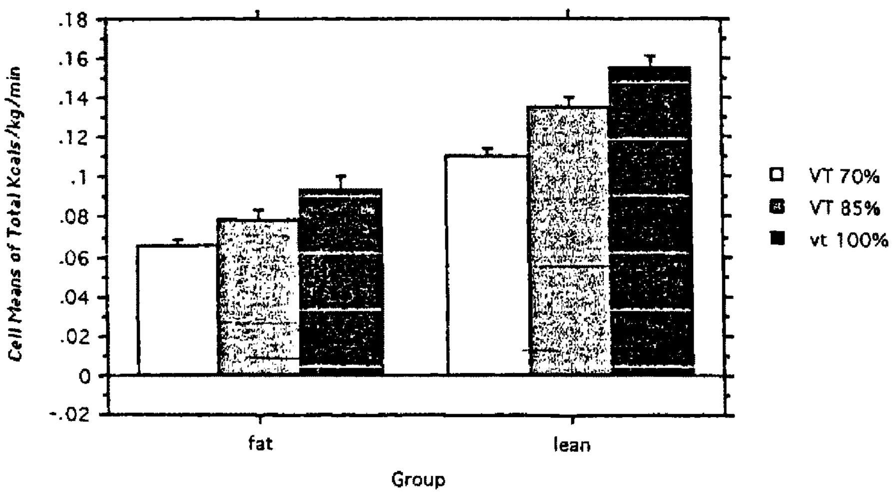
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .035 | .035 | 60.092 | .0001 |
| Subject(Group) | 14 | .008 | .001 | | |
| Total Kcals/kg/min | 2 | .011 | .005 | 180.103 | .0001 |
| Total Kcals/kg/min * Group | 2 | .001 | 2.893E-4 | 9.532 | .0007 |
| Total Kcals/kg/min * Sub... | 28 | .001 | 3.035E-5 | | |

Dependent: Total Kcals/kg/min

Means Table
Effect: Total Kcals/kg/min * Group
Dependent: Total Kcals/kg/min

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .065 | .010 | .004 |
| VT 70%, lean | 8 | .110 | .011 | .004 |
| VT 85%, fat | 8 | .079 | .015 | .005 |
| VT 85%, lean | 8 | .135 | .014 | .005 |
| vt 100%, fat | 8 | .094 | .019 | .007 |
| vt 100%, lean | 8 | .155 | .018 | .006 |

Interaction Bar Chart
Effect: Total Kcals/kg/min * Group
Dependent: Total Kcals/kg/min
With Standard Error error bars.



**Comparison 1**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 70%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .008 |
| Mean Square | .008 |
| F-Value | 265.767 |
| P-Value | .0001 |

**Comparison 2**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 85%, fat | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .013 |
| Mean Square | .013 |
| F-Value | 424.181 |
| P-Value | .0001 |

**Comparison 3**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| vt 100%, fat | 1.000 |
| vt 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .015 |
| Mean Square | .015 |
| F-Value | 496.958 |
| P-Value | .0001 |

**Comparison 4**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| VT 85%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 23.565 |
| P-Value | .0001 |

**Comparison 5**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 70%, fat | 1.000 |
| vt 100%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 108.595 |
| P-Value | .0001 |

**Comparison 6**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| VT 85%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .003 |
| Mean Square | .003 |
| F-Value | 83.680 |
| P-Value | .0001 |

**Comparison 7**
**Effect: Total Kcals/kg/min * Group**
**Dependent: Total Kcals/kg/min**

| | Cell Weight |
|---|---|
| VT 70%, lean | 1.000 |
| vt 100%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .008 |
| Mean Square | .008 |
| F-Value | 269.324 |
| P-Value | .0001 |

**Type III Sums of Squares**

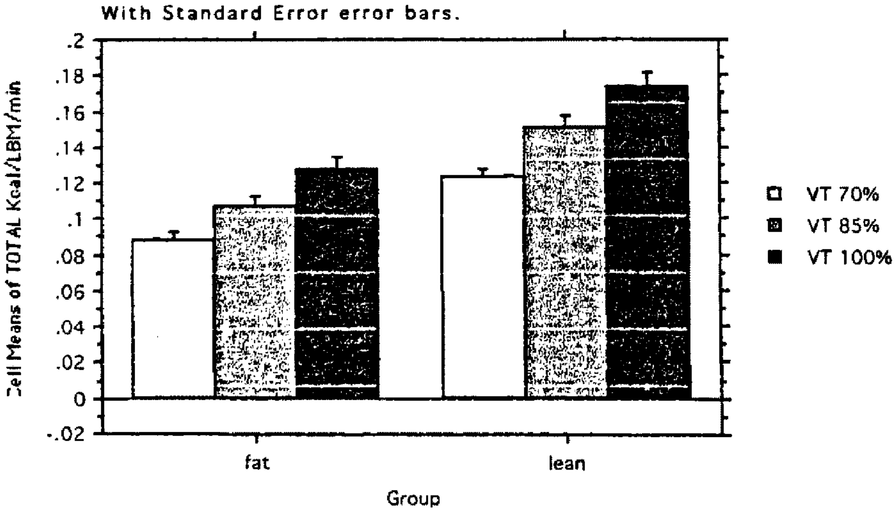
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .021 | .021 | 26.823 | .0001 |
| Subject(Group) | 14 | .011 | .001 | | |
| TOTAL Kcals/LBM/min | 2 | .016 | .008 | 179.370 | .0001 |
| TOTAL Kcals/LBM/min * Group | 2 | 3.279E-4 | 1.640E-4 | 3.703 | .0374 |
| TOTAL Kcals/LBM/min * Subjec... | 28 | .001 | 4.427E-5 | | |

Dependent: TOTAL Kcal/LBM/min

**Means Table**
**Effect: TOTAL Kcals/LBM/min * Group**
**Dependent: TOTAL Kcal/LBM/min**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| VT 70%, fat | 8 | .089 | .010 | .003 |
| VT 70%, lean | 8 | .123 | .015 | .005 |
| VT 85%, fat | 8 | .107 | .015 | .005 |
| VT 85%, lean | 8 | .151 | .018 | .006 |
| VT 100%, fat | 8 | .127 | .019 | .007 |
| VT 100%, lean | 8 | .173 | .023 | .008 |

Interaction Bar Chart
Effect: TOTAL Kcals/LBM/min * Group
Dependent: TOTAL Kcal/LBM/min
With Standard Error error bars.



**Type III Sums of Squares**

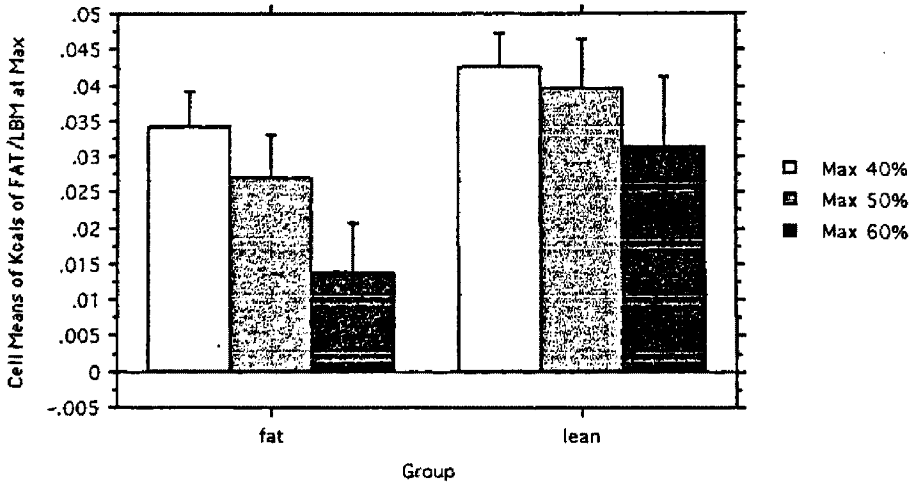
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | .002 | .002 | 2.052 | .1740 |
| Subject(Group) | 14 | .014 | .001 | | |
| Kcals of FAT/LBM at Max | 2 | .002 | .001 | 17.813 | .0001 |
| Kcals of FAT/LBM at Max * Group | 2 | 1.582E-4 | 7.912E-5 | 1.383 | .2675 |
| Kcals of FAT/LBM at Max * Subje... | 28 | .002 | 5.722E-5 | | |

Dependent: Kcals of FAT/LBM at Max

**Means Table**
**Effect: Kcals of FAT/LBM at Max * Group**
**Dependent: Kcals of FAT/LBM at Max**

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| Max 40%, fat | 8 | .034 | .014 | .005 |
| Max 40%, lean | 8 | .043 | .013 | .005 |
| Max 50%, fat | 8 | .027 | .016 | .006 |
| Max 50%, lean | 8 | .040 | .019 | .007 |
| Max 60%, fat | 8 | .014 | .019 | .007 |
| Max 60%, lean | 8 | .031 | .028 | .010 |

Interaction Bar Chart
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max
With Standard Error error bars.



Comparison 1
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 40%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 2.928E-4 |
| Mean Square | 2.928E-4 |
| F-Value | 5.118 |
| P-Value | .0316 |

Comparison 2
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 50%, fat | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 11.123 |
| P-Value | .0024 |

Comparison 3
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 60%, fat | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .001 |
| Mean Square | .001 |
| F-Value | 21.262 |
| P-Value | .0001 |

Comparison 4
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 50%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 1.924E-4 |
| Mean Square | 1.924E-4 |
| F-Value | 3.363 |
| P-Value | .0773 |

Comparison 5
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 60%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | .002 |
| Mean Square | .002 |
| F-Value | 28.104 |
| P-Value | .0001 |

Comparison 6
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 3.313E-5 |
| Mean Square | 3.313E-5 |
| F-Value | .579 |
| P-Value | .4530 |

Comparison 7
Effect: Kcals of FAT/LBM at Max * Group
Dependent: Kcals of FAT/LBM at Max

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 4.988E-4 |
| Mean Square | 4.988E-4 |
| F-Value | 8.717 |
| P-Value | .0063 |

Type III Sums of Squares

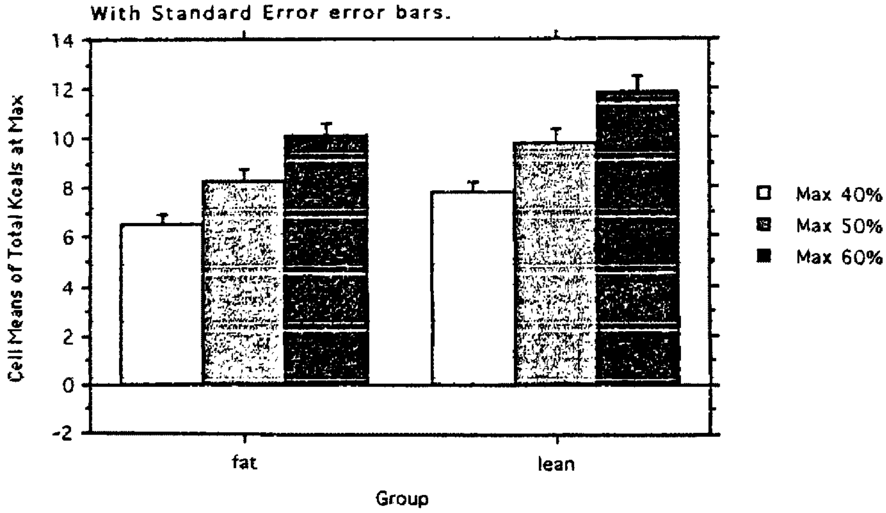
| Source | df | Sum of Squares | Mean Square | F-Value | P-Value |
|---|---|---|---|---|---|
| Group | 1 | 27.371 | 27.371 | 4.608 | .0498 |
| Subject(Group) | 14 | 83.166 | 5.940 | | |
| Total Kcals at Max | 2 | 115.068 | 57.534 | 678.720 | .0001 |
| Total Kcals at Max * Group | 2 | .605 | .302 | 3.568 | .0416 |
| Total Kcals at Max * Subjec... | 28 | 2.374 | .085 | | |

Dependent: Total Kcals at Max

Means Table
Effect: Total Kcals at Max * Group
Dependent: Total Kcals at Max

| | Count | Mean | Std. Dev. | Std. Error |
|---|---|---|---|---|
| Max 40%, fat | 8 | 6.555 | .987 | .349 |
| Max 40%, lean | 8 | 7.789 | 1.236 | .437 |
| Max 50%, fat | 8 | 8.294 | 1.240 | .438 |
| Max 50%, lean | 8 | 9.808 | 1.555 | .550 |
| Max 60%, fat | 8 | 10.073 | 1.494 | .528 |
| Max 60%, lean | 8 | 11.856 | 1.879 | .664 |

Interaction Bar Chart
Effect: Total Kcals at Max * Group
Dependent: Total Kcals at Max
With Standard Error error bars.



**Comparison 1**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 40%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 6.086 |
| Mean Square | 6.086 |
| F-Value | 71.791 |
| P-Value | .0001 |

**Comparison 2**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 50%, fat | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 9.169 |
| Mean Square | 9.169 |
| F-Value | 108.161 |
| P-Value | .0001 |

**Comparison 3**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 60%, fat | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 12.722 |
| Mean Square | 12.722 |
| F-Value | 150.079 |
| P-Value | .0001 |

**Comparison 4**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 50%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 12.093 |
| Mean Square | 12.093 |
| F-Value | 142.663 |
| P-Value | .0001 |

**Comparison 5**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 40%, fat | 1.000 |
| Max 60%, fat | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 49.492 |
| Mean Square | 49.492 |
| F-Value | 583.852 |
| P-Value | .0001 |

**Comparison 6**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 50%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 16.310 |
| Mean Square | 16.310 |
| F-Value | 192.412 |
| P-Value | .0001 |

**Comparison 7**
**Effect: Total Kcals at Max * Group**
**Dependent: Total Kcals at Max**

| | Cell Weight |
|---|---|
| Max 40%, lean | 1.000 |
| Max 60%, lean | -1.000 |

| | |
|---|---|
| df | 1 |
| Sum of Squares | 66.177 |
| Mean Square | 66.177 |
| F-Value | 780.687 |
| P-Value | .0001 |

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