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The overall hypothesis is that the decline in physical activity habits and resultant increase in body fat reduces exercise capacity and muscle mass in military women. These lifestyle changes worsen cardiovascular risk factors. Therefore, continued involvement in resistance and endurance exercise programs which increases or preserves fat-free mass, as well as enhances physical activity will prevent functional declines in military-eligible women. Although exercise is frequently recommended to enhance overall fitness, it is unclear as to whether endurance or resistance exercise is more effective in attenuating functional and cardiovascular declines in women. We will systematically compare the effects of **endurance** and **resistance** exercise on physical activity, cardiovascular fitness, and fat metabolism in military eligible women.

To accomplish this objective, women (18 to 35 yrs) will be randomized to a 6-month endurance training, resistance training or a control group. We will examine the following dependant variables: **1)** free-living physical activity using doubly labeled water and indirect calorimetry; **2)** body composition and body fat distribution using dual energy x-ray absorptiometry and computerized tomography, **3)** in-vivo fat oxidation from ^{13}C palmitate; and **4)** insulin sensitivity from hyperglycemic/euglycemic clamps. Our results will provide new information on the energetic and physiological effects of endurance and resistance training on energy metabolism, cardiovascular fitness, and fuel utilization in women.

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FOREWORD

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INTRODUCTION:

This proposal responds directly to the recommendations for research as outlined by the Institute of Medicine: **Recommendations for Research on the Health of Military Women**. Our proposal specifically addresses the request for research on the effectiveness of different types of physical training programs for women in the military.

Although physical activity is routinely prescribed for military-eligible women, a systematic examination of the effects of different modes of training on women's physiology and work performance has not been undertaken. Specifically, the decline in physical activity and loss of fat-free mass are significant predictors of decreased function and increased cardiovascular risk in military-eligible women. Thus, exercise interventions specifically designed to offset these deleterious changes in work performance, body composition and physical activity are important considerations. All military women initially experience the physical challenges of basic training and once through this experience, the new soldier experiences additional physical challenges that are directly influenced by other military-related activities including, deployment, natural aging, etc. Moreover, given the increased number of career military women retained in the services, strategies to achieve and maintain optimal fitness are of high priority.

Although exercise is recommended to military women, it is unclear as to which type of exercise is most effective in maintaining physical fitness and body composition in an effort to reduce cardiovascular risk and enhance physical function. This proposal will address several health benefits of endurance and resistance exercise in military eligible women in an effort to establish guidelines to maintain optimal cardiovascular and metabolic fitness in military-eligible women. **Results from this study will lay the scientific groundwork for the prescription of endurance and/or resistance exercise as the optimal mode of exercise to maintain physical fitness, work performance and reduce cardiovascular risk in military eligible women.**

The overall hypothesis is that the decline in physical activity habits and resultant increase in body fat reduces exercise capacity and muscle mass in military women. These lifestyle changes worsen metabolic and cardiovascular risk factors. Therefore, continued involvement in resistance and endurance exercise programs which increases or preserves fat-free mass will prevent functional declines in military-eligible women. Although exercise is frequently recommended to enhance overall fitness, it is unclear as to whether endurance or resistance exercise is more effective in attenuating functional and cardiovascular declines in women. We will systematically compare the effects of **endurance** and **resistance** exercise on physical activity, cardiovascular fitness, and fat metabolism in military eligible women. The results of this study will lay the groundwork for appropriate exercise prescriptions to reduce cardiovascular and metabolic risk and enhance physical function in military-eligible women.

1. AIMS AND HYPOTHESES:

AIM #1: **To determine the effects of endurance exercise and resistance training on free-living physical activity and cardiovascular fitness in military-eligible women.**

AIM #2: **To determine the effects of endurance training and resistance training on body composition and body fat distribution.**

AIM #3: To determine the effects of low intensity endurance vs resistance training on in-vivo fat metabolism and insulin sensitivity.

2. BACKGROUND AND SIGNIFICANCE

Although increased physical activity is recommended to women, it is unknown as to the type of exercise that is most effective in attenuating functional declines and improving metabolic fitness. We will directly compare the effects of **endurance** and **resistance** training on: 1) free-living physical activity and cardiovascular fitness, 2) body composition and body fat distribution; fat metabolism, and insulin sensitivity in military-eligible women.

(2a) Exercise and Energy Expenditure.

One important reason to prescribe exercise is to increase daily energy expenditure and physical activity to maintain proper levels of body weight and composition. The influence of different types of exercise to achieve this goal has not been systematically examined in women.

Are endurance and resistance exercise effective interventions to increase resting and physical activity-related energy expenditure? A compelling goal of physical training programs is to increase physical activity and energy expenditure. It is presently unknown whether training programs accomplish this goal as physical activity levels outside of the exercise program could not be accurately measured. This proposal will provide new information on the impact of endurance and resistance exercise programs on resting and physical-activity related energy expenditure.

Resting metabolic rate is the largest component of daily energy expenditure in humans (1). A low resting metabolic rate is a significant predictor for body weight gain (2), which may partially explain increases in body weight in women. We have also found the women have a lower resting metabolic rate per kilogram of fat-free mass (3). Collectively, these findings underscore the importance of exercise interventions that would increase resting energy expenditure in women in an effort to offset increases in body weight over time.

It is encouraging to noted that both endurance and resistance training has been found to increase resting metabolic rate in women (1). However, its effects on free-living physical activity is of greater interest with respect to regulation of energy balance. Changes in physical activity constitute a large proportion of variation in daily energy expenditure. Moreover, low levels of physical activity is a significant predictor of an increase in body weight over time (4).

We recently performed a study to examine the effects of endurance exercise on free-living energy expenditure outside of the exercise program. We found that women actually reduced their free-living physical activity during non-exercising time in response to endurance training (5). This physiological adaptation is counter-productive to the goals of the military which strive to increase daily energy expenditure through physical exercise. It is possible that the intense level of the exercise program (85% of VO_2 max) may have contributed to this finding. This study raises new questions regarding the optimal exercise mode to enhance free-living physical activity in women. **This proposal will provide new information on the effects of endurance exercise on free-living physical activity by administration of doubly labeled water and the subsequent measurement of free-living physical activity.**

Much interest has recently focused on resistance training as an intervention to enhance muscular strength, restore physical function and reduce cardiovascular risk (6). The impact of resistance training, however, on physical and metabolic function has received less attention than endurance training, particularly in women. Resistance training is an effective stimulus to increase muscular strength and fat-free mass in untrained adults (6). The anabolic nature of resistance training may reverse declines in resting metabolic rate by increasing fat-free mass (7,8). We have no information, however, on the effects of resistance training on free-living physical activity in women. Resistance training may enhance free-living physical activity by several mechanisms: 1) an increase in protein synthesis (9); 2) an increase in sympathetic nervous system (8) and 3) increased levels of fat-free mass. In this study, we will provide new information on the effects of endurance exercise and resistance training as therapeutic interventions to increase free-living physical activity and maintain muscle mass in military-eligible women.

(2b) Exercise, Intra-abdominal Fat and Insulin Sensitivity

What are the effects of endurance and resistance exercise on body fat distribution and insulin sensitivity? We have included in the proposal an examination of the effects of exercise on the metabolic risk factors of insulin and fat metabolism. The rationale for their inclusion is twofold: 1) changes in physical activity and body composition in response to training positively influence these variables and 2) the insulin resistance syndrome is an independent risk factor for cardiovascular (10). It is only recently, however, that the role of exercise to reduce intra-abdominal fat has been examined, and to our knowledge, no information is available in women.

Schwartz et al (11) found that a six month endurance training induced a preferential loss of fat from the abdominal region. Despite the relatively small changes in body weight (<2 kg) and body composition, impressive (>20%) decrements were found in intra-abdominal fat. These changes were associated with improved lipid lipoprotein profiles. Tonino (12) demonstrated an increase in insulin sensitivity with the euglycemic clamp technique in men following an aerobic exercise training program which did not substantially affect body composition. Houmard et al (13) exercise trained 13 middle-aged men, but found that a reduction in central body fat, as measured from the waist circumference, was not related to an improvement in insulin sensitivity. Alternatively, Kirwan et al (14) noted that regular exercise was effective in reducing hyperinsulinemia and improving insulin sensitivity and that these changes were related to the reduction in the waist circumference. Khort et al (15) showed that a higher waist circumference was related to a lower rate of glucose disposal in men. Unfortunately, no systematic investigation of the effects of exercise on insulin sensitivity and body fat distribution has been undertaken in women.

Most studies have focused on endurance training, whereas less attention has been directed towards the effects of resistance training on intra-abdominal body fat and insulin sensitivity. However, because isometric contractions produce insulin-like effects on glucose uptake in skeletal muscle (16) and muscle mass serves as the principal site of glucose disposal, resistance training could be an important intervention to enhance insulin action in women. Recent reports provide support for this hypothesis. Ross and Rissanen (17) found that the combination of energy restriction (1000 kcal/day) and either resistance or aerobic exercise induced significant reductions in intra-abdominal fat. This was a surprising finding given the fact that the direct energy cost of the endurance exercise program was substantially higher than the resistance training program. This finding suggests that changes in the other components of total daily energy expenditure (resting metabolic rate or physical activity) may have occurred that significantly increased the total daily energy expenditure of the resistance training program.

Several investigators examined changes in insulin sensitivity in response to resistance training. For example, insulin responses to an oral glucose challenge were found to be lower in younger individuals after resistance training (18), and in some cases glucose tolerance was improved similarly in endurance and resistance training (19). Miller et al (20) showed that 16 weeks of strength training improved the insulin response to glucose ingestion in young males, which they attributed to an increased muscle mass. Data from our laboratory showed that strength training increased nonoxidative glucose metabolism by 45% in men (21). To our knowledge, no studies have directly compared the effects of endurance vs resistance training on changes in intra-abdominal body fat and associated changes in glucose metabolism in women.

(2c) Exercise and Fat Metabolism.

What are the effects of endurance and resistance exercise on fat oxidation? We feel is it is important to include a measure of fat oxidation in the present study to help explain the mechanisms related to changes in insulin sensitivity. It is reasonable to hypothesize that the loss of intra-abdominal body with exercise training programs will be associated with improvement in insulin sensitivity. This is based on the fact that adipose tissue in the visceral region is highly sensitive to lipolytic stimuli, particularly in those regions drained by the portal circulation (22). As a consequence, increased fat oxidation as a result of exercise would reduce the delivery of free-fatty acids to the liver, thereby reducing gluconeogenesis and stimulating hepatic insulin clearance. This would lead to lower circulating concentrations of insulin and increased insulin sensitivity (23). However, the optimal exercise mode to maximize loss of intra-abdominal fat and improve insulin action has not been clearly established.

The majority of knowledge regarding the effects of exercise on fat oxidation has been primarily derived from endurance training studies and from measurements of circulating concentrations of substrates considered to be representative of lipolytic action (24,25). More recently, we have used in-vivo techniques to quantify fat metabolism in humans. We showed that endurance training increased levels of fat oxidation in healthy women (26). However, less information is available regarding the effects of resistance training on fat oxidation in younger women. Pratley et al (8) showed that 16 weeks of resistance training increased plasma levels of norepinephrine in men, but no changes were noted in fat oxidation. Melby et al (27) showed that resistance exercise elevated postexercise metabolic rate and fat oxidation 15-hr after exercise completion. They suggested that resistance exercise may be beneficial in weight control because of the direct energy cost of the activity, the residual elevation of postexercise VO_2 and the greater post-exercise fat oxidation. Work from our laboratory shows that fat-free mass is an important regulator of the rate of appearance of fatty acids into circulation and fat oxidation in women (28,29). Thus, resistance training may elevate the level of fat oxidation by increasing the metabolic demand for fatty acids by increasing skeletal muscle mass as well as the level of daily energy expenditure and physical activity. This study will provide new insight into the effects of endurance and resistance training on insulin sensitivity and fat oxidation in military-eligible women.

Collectively, this will be the first proposal to systematically examine the effects of endurance and resistance training on a comprehensive battery of cardiovascular and metabolic risk factors in military-eligible women.

3. WORK ACCOMPLISHED:

Intervention Studies

We examined the effects of exercise training on changes in total daily energy expenditure and physical activity. We subjected women to 8 weeks of intense endurance training in which resting metabolic rate, body composition and norepinephrine kinetics were measured (30,31). We found that resting metabolic rate increased by 10% (150 kcal/d), without significant changes in body composition. These results suggest that endurance training increases resting energy needs in women. These results prompted further studies with doubly labeled water to examine the effects of exercise on daily physical activity, the true determinant of energy balance. **These studies document our ability to carry out and retain women in exercise intervention studies.**

We used doubly labeled water to assess the effects of exercise on free-living energy expenditure (5). We found that individuals became more inactive during their non-exercising time in response to a high intensity endurance exercise. We found that endurance training resulted in a 62% reduction in the energy expenditure of physical activity outside of the exercise program (571 ± 383 to 340 ± 452 kcal/d). The results underscore the importance of using doubly labeled water to determine the effects of endurance or resistance exercise on daily energy expenditure in women. **This study documents our ability to use doubly labeled water methodology in exercise intervention studies and raises new questions regarding the type of exercise that is most efficient in increasing physical activity in military-eligible women.**

Fat Metabolism:

In a series of studies, the effects of endurance training on fat oxidation in women were assessed. Free fatty acid appearance rate and fat oxidation were determined from ^{14}C palmitate infusions and indirect calorimetry (26). In response to endurance training, free fatty acid appearance did not change, but fat oxidation increased (200 ± 12 vs 244 ± 16 $\mu mol \cdot min^{-1}$; $P<0.01$). These results support the notion that endurance training increases fat oxidation in the basal state. Furthermore, individuals who increased total daily energy expenditure and physical activity, also showed higher levels of fat oxidation ($r=0.55$; $P<0.05$). **These findings led us to propose to test the hypothesis that significant increases in total daily energy expenditure and physical activity (by endurance or resistance exercise) will enhance fat oxidation, promote loss of intra-abdominal fat and increase insulin sensitivity in military-eligible women.**

Resistance Training:

We examined relationships of resting metabolic rate to cardiovascular disease risk in middle-aged women characterized as resistance trained, aerobic trained or untrained (33). Resting metabolic rate, after normalization for differences in fat-free mass, was 7% higher in aerobic and resistance trained women compared to untrained women. Both aerobic and resistance trained individuals were expending approximately 200 kcal/d more at rest when compared to untrained individuals. These results suggest that resistance and aerobic training can serve as suitable interventions to offset the decline in resting metabolic rate in military women. **We now propose a resistance training study in which daily energy expenditure can be measured to assess it**

relation to enhanced functional capacity and cardiovascular risk factors in military eligible women.

The effects of resistance training, with and without weight loss, on endogenous insulin secretion and peripheral tissue glucose utilization was examined in postmenopausal women (34). Women trained three times per week for 16 weeks on resistance machines. Body composition was measured from dual-energy x-ray absorptiometry. Despite weight loss, fat-free mass was maintained in weight loss groups by concomitant resistance training. The endogenous insulin response decreased 24% with resistance training and 42% with resistance training and weight loss, with no change in glucose utilization. These results suggest that peripheral tissue sensitivity to endogenously secreted insulin improved to a greater extent with resistance training and weight loss rather than resistance training alone. However, resistance training increased insulin sensitivity in both groups. These results suggest that increased adiposity and glucose intolerance associated with the post-menopausal state could be prevented with resistance training and weight loss. **We now propose to study the mechanism of the increase in insulin sensitivity in military-eligible women by examining in-vivo fatty acid utilization and oxidation.**

Significance of Proposed Work. The adaptive responses of military-eligible women to endurance and resistance training has been an understudied area of research. The combined used of doubly labeled water methodology, multicompartment models of body composition, and substrate measures of insulin sensitivity and fat oxidation will provide new information on the effects of resistance and endurance exercise to cardiovascular and metabolic risk factors. Our preliminary data demonstrates our ability to successfully conduct exercise studies in women, perform sophisticated measured of energy expenditure and substrate metabolism. **Results from this study will lay the scientific groundwork for the prescription of resistance and endurance exercise to enhance cardiovascular and metabolic fitness in military eligible women.**

BODY OF THE REPORT:

Subject Selection: We will recruit 104 military eligible, non-pregnant women (18 to 35 yrs) over 4 years. The recruiting goal of 104 individuals takes into account a 20% dropout rate with the goal of having 28 volunteers complete the interventions (endurance, resistance and control). Volunteers will be screened by telephone to ensure that they meet study inclusion criteria and are free of exclusionary criteria. Eligible subjects will be scheduled for a screening visit at which time the study will be explained in detail and a written informed consent will be obtained. A fasting blood profile, a urinalysis, fasting and two hour postprandial glucose and a resting EKG will be obtained.

Criteria for subject inclusion will be: premenopausal and age between 18 to 35 years, a body mass index between 18 and 25 kg/m^2. Exclusion criteria include a history or evidence on physical examination or testing of the following: 1) diabetes; 2) orthopedic limitations or history of pathologic fractures, 3) hypertension (>160/90 mmHg; 4) use of prescription or over the counter medications which could affect glucose metabolism (including insulin and oral hypoglycemic agents), 5) smoking.

Experimental Design. Volunteers will be randomly assigned to a 6-month **endurance, resistance training or control group**. All subjects will be weight stabilized and given dietary advice to consume a diet containing at least 250g of carbohydrate per day prior to testing. Diets will not be changed throughout the program. All tests will be performed during the follicular phase of the menstrual cycle. The testing sequence is described below:

Testing Sequence.

1. Recruiting: Telephone screen and advertising

2. Screening visit (1 day)

(a) Physical exam and history

(b) Graded exercise test

3. Dietary Instruction, Body Weight Stabilization (2 weeks)

(a) Two weeks of dietary instruction for body weight stabilization and adequate carbohydrate intake. Perform test of VO_2 max test during this period to avoid interference of vigorous exercise with other metabolic tests.

4. Overnight Visit to the University of Vermont (1 day)

(a) Administration of Baseline Doubly Labeled Water (afternoon of admission)

(b) Computerized Tomography Scan (afternoon of admission)

(c) Resting Metabolic Rate

(d) Dual Energy x-ray Absorptiometry Scan

(e) Fatty Acid Kinetics

(f) Perform Insulin Clamp

5. Return visit (10 days later)

(a) Urine collections of doubly labeled water

6. Random assignment to Endurance, Resistance or Control group

7. Tests During Exercise Programs

(a) Re-assessment of strength to maintain exercise prescription

8. 6 month Post-testing Period:

(a) Testing sequence is identical as described in 3, 4 and 5 (testing conducted at least 48 h after last exercise session)

METHODS

The **METHODS** section is subdivided into the following categories:
(1) Endurance Training, Resistance Training and Control Group;
(2) Energy Expenditure;
(3) Body Composition and Body Fat Distribution;
(4) Insulin Sensitivity
(5) Fat Metabolism

(1) INTERVENTIONS:

(a) Endurance Training Program

All endurance exercise sessions will be preceded by a 10 min warm-up which will consist of stretching of the major muscle groups and slow walking on a treadmill. The women will exercise three times per week using the Racquets Edge Health and Fitness Center. The training sessions will consist of an individually prescribed duration and intensity. To monitor adherence to prescribed training plan, volunteers will wear the heart rate monitor (Polar Accurex, Polar Electronics Inc.) during each training session. A warm-down will be performed after the treadmill session and will consist of flexibility exercises. Data of individuals will be considered in the statistical analysis who attend at least 80% of all exercise sessions.

The women will be taught to monitor their heart rates. The duration of the exercise will be begin at ~ 20 minutes walk/jogging. By the end of the exercise program, individuals will be jogging approximately 45 to 55 minutes (Table 1). By the end of 6 months of endurance training, volunteers will be expending approximately 600-800 kcal per session, or an additional increase of 2400 to 3200 kcal per week generated by the direct energy cost of the exercise. The quantity of expenditure will be substantial but realistic to perform when an adequate adaptation period is built into the study. Dr. Dvorak (a fellow in Dr. Poehlman's laboratory) and hired personal trainers will supervise the exercise program.

Duration of exercise	Week 1	Week 2	Week 3	Week 4
25'	70%	75%	80%	85%
	Week 5	**Week 6**	**Week 7**	**Week 8**
30'	75%	80%	85%	90%
	Week 9	**Week 10**	**Week 11**	**Week 12**
35'	75%	80%	85%	90%
	Week 13	**Week 14**	**Week 15**	**Week 16**
40'	75%	80%	85%	90%
	Week 17	**Week 18**	**Week 19**	**Week 20**
45'	80%	85%	90%	
	Week 21	**Week 22**	**Week 23**	
50'	80%	85%	90%	
	Week 24	**Week 25**	**Week 26**	
55'	80%	85%	90%	

Table 1. Endurance exercise training program (70% represents the percentage of HR_{max} obtained during the peak oxygen consumption test)

(b) Resistance Training Program

The resistance training program is designed to stimulate optimal gains in muscular size and strength over the 6-month training period. Women will train on three non-consecutive days during the week (e.g., Mon, Wed, Fri). Variation in training will enhance the quality of the exercise stimulus by improving the adherence to the training program and reducing the potential boredom often associated with the use of a redundant resistance training protocol.

Women will be individually instructed in the performance of each exercise and allowed to practice the exercise and strength testing protocol several times prior to initial testing and the start of the training program. Prior to strength testing, two resistance training sessions will be conducted so that women can become familiar with the equipment and proper exercise techniques.

Each training session will include a warm-up of low intensity cycling for 5 min, followed by a 10 min of static stretching of all the major muscle groups used in training. Each exercise session will be individually monitored for optimal progression. The resistance program will consist of the following exercises: 1) Leg press, 2) Bench Press; 3) Leg Extensions; 4) Military Press; 5) Lat Pull Downs; 6) Hamstring Curls; 7) Seated Rows; 8) Triceps Extensions and 9) Biceps Curls. The exercises will provide for a total body resistance training program for all of the major muscle groups of the body. Cybex weight training equipment (located in the Racquets Edge Health and Fitness Center) will be used.

The basic prescription is to perform three sets of ten repetitions for individual lift, with sixty seconds breaks between the sets. In addition, volunteers should exercise to the failure during the last set, more specifically, they should be able to perform at least six but no more than 12 repetitions. When they reach the level of performance so that they can reach 12 repetitions during the last set, the resistance will be increased for the next training session. This will ensure the necessary level of overload for each training session.

Because of the need for test specificity, 1 RM evaluations of certain exercises used in the training program will provide the most direct evaluation of the training gains made over the 6-month period. The 1-RM is defined as the maximum amount of resistance that can be moved through the full range of motion of an exercise for no more than one repetition. To determine the 1 RM, each subject will initially perform 3 to 5 repetitions with the lightest weight possible to be sure proper technique is used. The investigator will then select a weight and ask the subject to perform the lift. Following 3 to 4 minutes of rest, the next heaviest weight will be selected and the attempt will be repeated until the subject cannot complete the full lift. In each case, the investigator will attempt to determine the 1 RM with 6 to 7 trials to prevent localized muscle fatigue. Training will be at approximately 80% of 1 RM. The same number of trials, time between trials and order of exercises will be used before and after training for the 1-RM test. Tests will be administered prior to the start of the training program and twice per month for the first two months (because of the anticipated rapid increase in strength) and once per month thereafter. The following exercise will be evaluated for 1 RM's: leg press, leg extension, bench press, military press, lat pull downs and seated rows.

(c) Control Group

The attention control group will meet as frequently in a group as the exercise intervention groups at the University of Vermont. They will be strongly encouraged to maintain their current level of physical activity and not to engage in any form of endurance or resistance exercise. They will receive similar dietary instruction and social support as the exercise intervention groups. They will participate in all testing and weight stabilization. Following the completion of the study, these women will be provide personalized exercise prescriptions for endurance and resistance training programs.

(2) ENERGY EXPENDITURE

(a) Doubly labeled water (DLW).

To determine the effects of endurance and resistance training on **changes** in daily energy expenditure and physical activity, energy expenditure will be measured during a 10-day period using DLW methodology (32). A baseline urine (10 ml) will be collected and a mixed dose of DLW will be orally administered the afternoon before the first test visit. The doses will be approximately 0.24g of $H_2{}^{18}O$ and 0.22g of ^2H_2O per kg of estimated total body water. The dose described has been selected to achieve initial and final enrichments that translate, by propagation of error analysis to a theoretical uncertainty in carbon dioxide production rates arising from analytical error of less than 5% (32).

Two urine samples will be collected on the morning after dosing, and another two will be collected on a return visit 10 days later. Samples will be analyzed in triplicate for $H_2{}^{18}O$ and ^2H_2O enrichments by isotope ratio mass spectrometry at the Biomedical Mass Spectrometry Facility in the

Department of Medicine at the University of Vermont using the CO_2 equilibration technique (36), and the off-line zinc reduction method (37). Total daily energy expenditure will be calculated from doubly labeled water data using equation A6 of Schoeller et al (38). **This technique will provide new information on whether physical activity levels (outside of the exercise programs) change in response to the endurance and resistance exercise programs.**

(b) Resting Metabolic Rate (RMR).

RMR will be assessed after an overnight fast in which volunteers will stay overnight. RMR will be measured for each subject by indirect calorimetry for 45 min, using the ventilated hood technique (39). Energy expenditure will be calculated from the equation of Weir (40). The intraclass correlation and coefficient of variation (CV) for RMR determined using test-retest in 17 volunteers is 0.90 and 4.3%, respectively. **This measurement provides information on whether resting energy requirements change in response to endurance and resistance exercise.**

(c) Physical Activity Energy Expenditure.

The energy expenditure of physical activity will be derived by subtracting RMR, and an estimate for the thermic effect of a meal from total daily energy expenditure (32). A fixed constant of 10% of daily energy expenditure for the thermic response to feeding will be assumed (41). We have chosen not to directly measure the thermic effect of a meal because: 1) its contribution to total daily energy expenditure is small (10% of total daily energy expenditure) (42) and 2) postprandial measurements are long (4 to 6 hr) and of questionable reproducibility (43) and 3) the measurement of postprandial energy expenditure would significantly increase the time commitment for the women. **The change in the level of physical activity is a primary outcome variable because of its large contribution to daily energy expenditure and its relationship to changes in body composition.**

(d) Maximal Aerobic Power (VO_2 max).

VO_2 max will be assessed by a progressive and continuous test to exhaustion on a treadmill. VO_2 max will be considered to have been achieved if two of the following criteria are met: 1) a plateauing of VO_2 when the increase in oxygen consumption during the last minute of the VO_2 max test is <200 ml; 2) a respiratory exchange ratio greater than 1.1; or 3) a heart rate at or above the age-related predicted maximum (220 - age, yr). Test-retest conditions (within 1 week) for VO_2 max for 20 volunteers have yielded an intraclass correlation of 0.94. If these criteria are not met, we will request that the volunteer perform another test of VO_2max. VO_2 max will be assessed every two months to take into account the increases in maximal aerobic power so that exercise prescriptions can be re-evaluated to maintain the desired exercise intensity.

(d) Estimated energy intake.

Self-recorded energy intake will be measured for seven days during the doubly labeled water measurement period. Briefly, volunteers will be provided with record sheets and dietary scales including procedures for reporting intake, estimation of portions, and describing food combinations. The energy content from food diaries will provide a more accurate estimate of food quotient necessary in the calculation from doubly labeled water.

(3) BODY COMPOSITION AND BODY FAT DISTRIBUTION

(a) Dual Energy x-ray Absorptiometry (DEXA)

DEXA uses the exponential attenuation due to absorption by body tissues of photons emitted at two energy levels (40 and 70 keV) to resolve body weight into bone mineral, and lean and fat soft tissue masses. The subject will lie supine on a padded table. All metal objects will be removed. The total dose for a scan is less than 1mSv. A total body scan takes about 30 minutes and provides estimates of the following: bone mineral densities (BMD, g/cm^2), soft-tissue attenuations ratios (Rst-values), fat and lean tissue weights (g), and percent body fat for 9 body regions, as well as total body fat weight, %body fat, fat-free mass and total body mineral weight. The reproducibility for body fat is 1.7% in test-retest conditions in six females. **This technique provides information on whether fat mass, fat-free mass and bone density changes in response to endurance and resistance exercise.**

(b) Computerized tomography (CT).

CT scans are performed on a Siemens Somatom DRH scanner (Erlangen, FRG) using the procedures of Sjostrom et al (44). Briefly, women are examined in the supine position with both arms stretched above their head and single 5 mm, 2 second scans are taken at the abdomen at the level of the umbilicus and the mid-thigh level halfway between the greater trochanter and superior aspect of the patella and greater trochanter. Based on our evaluation of mean attenuation and intersection of adipose muscle tissues of over 400 cross-sections of intra-abdominal adipose tissue, a range of -190 to -30 Hounsfield units (HU) are used to measure cross-sectional area of adipose tissue and 30-80 HU for muscle tissue. Intra-abdominal and subcutaneous fat areas (expressed in cm^2) are measured using an automated computer program which outlines fat with the HU range selected. The coefficient of variation for repeat cross-section analysis of scans among 40 women is less than 2% for adipose tissue. **The technique will provide information on whether the quantity of visceral fat changes in response to resistance and endurance exercise.**

(3) INSULIN SENSITIVITY

The hyperinsulinemic/euglycemic clamp will be used to measure sensitivity to insulin (23). Women will have an intravenous catheter placed in a large antecubital vein for infusion (20% dextrose) and another placed in a retrograde fashion into a dorsal vein with the hand kept in a warming box at 70^{0}C to arterialize venous effluent. Blood samples are drawn from the dorsal hand vein for glucose and insulin determination (every 5 min). Plasma glucose levels are measured (Beckman Instruments, Fullerton, CA) and the rate of glucose infusion adjusted every 5 minutes to maintain the desired level of glycemia. Insulin concentrations will be measured by radioimmunoassay in all samples from an individual (baseline, and post-intervention) in a single assay to minimize interassay variation.

The amount of glucose utilized is an index of insulin sensitivity. **This technique will provide new information on changes in insulin sensitivity in response to endurance and resistance exercise in military-eligible women.**

(4) FAT METABOLISM

i. ^{13}C-palmitate kinetics:

Basal rates of lipolysis and whole body fat oxidation will be assessed as previously described (26). Briefly, a non-primed constant infusion of [1-^{13}C]palmitic acid will be administered for 120 min in the post-absorptive state with simultaneous measurement of resting metabolic rate with indirect calorimetry. Samples for determination of the enrichment of the specific activity of palmitic acid will be taken prior to and at 90, 100, 110, and 120 min after the start of the infusion.

The calculations will be made using the following equations:

i. T he rate of appearance of palmitic acid (R_{aP}) with the following formula:

$$R_{aP}\,(\mu mol/kg/min) = IR\,/\,IE$$

where, **IR** is the infusion rate of tracer (µmol/kg/min) and **IE** is the enrichment of substrate in plasma at isotopic equilibrium.

ii. The rate of appearance of free fatty acids (R_{aFFA}) with the following formula:

$$R_{aFFA}\,(\mu mol/kg/min) = R_{aP}\,(C_{FFA}/C_P)$$

where, C_{FFA} is a concentration of free fatty acids in the blood measured by colorometric assay using kit from Biochemical Diagnostics (Brentwood, NY) and C_P is the concentration of plasma palmitate measured by gas chromatography-mass spectrometry.

iii. The rate of oxidative disposal (FFA_{ox}) of serum fatty acids will be measured by indirect calorimetry. The rate of fat oxidation (FAT_{ox}) is obtained by dividing fat oxidation calculated with indirect calorimetry by 860 (molecular weight of a typical triglyceride), and multiplying it times three (three fatty acids per mole of triglyceride).

iv. The rate of non-oxidative disposal (FFA_{NOX}) of serum fatty acids (extracellular recycling of fatty acids by the following formula:

$$FFA_{NOX} = R_{aFFA} - FFA_{OX}$$

The coefficient of variation for test-retest measurements is 13% and the intra-class correlation is 0.95 for ten older individuals tested two weeks apart. **This technique will provide information on changes in fatty acid appearance and fat oxidation in response to endurance and resistance exercise programs in military eligible women.**

(5) SAMPLE SIZE CALCULATIONS and DATA ANALYSIS

(1) Sample Size Calculations

We have calculated sample sizes based on hypothesized changes within the endurance and resistance treatment conditions. We present power calculations for hypothesized changes in two variables: 1) total daily energy expenditure and 2) insulin sensitivity. Our sample size calculations are for an alpha level of 0.05 with 80% power. Our recruiting and sample size goals were finally based on the changes anticipated with insulin sensitivity because of the larger sample size required.

We hypothesized that the total daily energy expenditure will be increased by 360 kcal/d for both endurance and resistance training with a standard deviation of 200 kcal/d in women. This increase takes into account the 10% increase in resting metabolic rate (160 kcal/d) (30) and the hypothesized increase of 200 kcal/d in free-living physical activity. We anticipate that endurance exercise will increase physical activity during non-exercising time because: 1) the loss of fat mass will reduce the burden of carrying extra weight and 2) daily physical activities will be performed at a lower percentage of VO_2max. We anticipate that resistance training will increase fat-free mass by 2-3 kg. Data from our laboratory shows that for each 1 kg increase in fat-free mass, resting metabolic rate increases by approximately 50 kcal/d (42). This would translate into a 150-160 increase in resting metabolic rate per day. Again, given the increase in fat-free mass, we anticipate that women will be more physically active and expend approximately 200 kcal/d more per day in their non-exercising time. Thus, we hypothesize that total daily energy expenditure will be increased by an extra 360 kcal/d with a standard deviation of 200 kcal/d (32).

We have also performed power analyses on changes in insulin sensitivity. We estimated that setting the power at 0.80 and a significance level at 0.05, in order to detect a difference in glucose utilization 0.4 mg/kg fat free-mass/min. This preliminary data from our laboratory is based on 0.8 mg/kg fat-free mass change in glucose utilization in 10 endurance trained individuals who trained for 6 months and a 0.4 mg/kg fat-free mass change in 12 older individuals who lost 4 kg after 6 months and with a standard deviation of 1.1 and 1.3 mg, respectively. We will need 85 subjects or 28 women per group (resistance, endurance and control). With a 20% dropout rate, we will need to recruit 104 women over the four year grant period. Because the sample size calculations for this variable yielded the greatest number of subjects to be recruited, we have based our recruiting and sample size calculations on the change in insulin sensitivity.

(b) Statistical Analysis

Analysis: A repeated measures analysis of variance will be used to detect changes with time within the treatment condition and among groups (endurance vs resistance vs control). The repeated measures factor will be the repeated tests during the exercise programs.

This analysis will provide information on whether total daily energy expenditure, resting metabolic rate, physical activity, fat metabolism and intra-abdominal body fat and insulin sensitivity change in response to and among treatment conditions. Changes in the dependent variables will be analyzed on an absolute as well as relative (%) basis.

RESULTS:

To date we have screened via telephone over 300 women for the study. From those, 97 volunteers met inclusion and exclusion criteria and were invited for the screening visit at the Clinical Research Center (CRC). To date, 71 women were invited for the first overnight visit at the CRC. Their physical characteristics are presented in Table 1. Body composition descriptors, resting metabolic rate, and insulin sensitivity values are presented in Table 2 (complete "raw" data are presented in enclosed Appendix 1). There were no statistically significant differences among the groups at the baseline, except for the difference between the Groups 2 and 3 in insulin sensitivity (M-value, Table 2).

Group ⟶	**1** (Endurance)		**2** (Resistance)		**3** (Control)	
	Pre (n = 25)	**Post (n = 11)**	**Pre (n = 27)**	**Post (n = 11)**	**Pre (n = 19)**	**Post (n = 17)**
Age (yr.)	29 ± 4	n/a	28 ± 4	n/a	28 ± 5	n/a
Weight (kg)	60 ± 6	60 ± 5	57 ± 6	59 ± 6	60 ± 8	60 ± 9
Body mass index (kg/m^2)	23 ± 2	23 ± 2	21 ± 2	22 ± 3	22 ± 2	22 ± 2
Peak VO_2 (L/min)	2.4 ± 0.5	2.7 ± 0.5*	2.1 ± 0.3	2.2 ± 0.2	2.3 ± 0.4	2.3 ± 0.4

Table 1. Physical characteristics of volunteers pre- and post-intervention, values are presented as mean ± standard deviation. (* denotes a significant difference pre- vs. post-intervention, $P < 0.05$)

Starting in February 1997, volunteers began exercising at the Racquets Edge Health and Fitness Club using the exercise prescription described previously. To date, we have introduced 25 volunteers into the endurance training group, 27 to the resistance training group, and 19 to the control group. So far, 11 members of the endurance-training group, 11 of the resistance-training group, and 17 from the control group have completed the intervention period and undergone the second overnight visit. Available pre- and post-intervention data are presented in Tables 1 and 2 and in enclosed spreadsheet (Appendix 1).

Although our sample size is still small, we conducted some exploratory statistical analyses, mainly to assess the success of our exercise training interventions. We found a significant time by group interaction effect in peak oxygen consumption ($P < 0.01$) among the groups. Post-hoc analysis revealed that women in Group 1 significantly increased their peak oxygen consumption (by 13.2%, $P < 0.01$), with no changes observed in Groups 2 and 3, thus supporting a successful effect of our endurance training intervention. Furthermore, we observed a ~ 35% increase in strength (measured by 1-repetition maximum test) in Group 2, with no changes in Groups 1 and 3, thus supporting the anticipated effect of resistance training intervention (data not presented in table form).

We found no changes in body weight, body mass index, fat mass, and body fat percentage following the intervention period. However, there was a significant group by time interaction effect in fat-free mass ($P < 0.01$). Post-hoc analysis showed a significant increase in the fat-free mass of Group 2 (1.45 kg, $P < 0.01$), as compared to a non-significant increase in

Groups 1 and a decrease in Group 3. This finding, together with an observed gain in maximum strength, further supports the effectiveness of our resistance training intervention.

Group ⟶	1 (Endurance)		2 (Resistance)		3 (Control)	
	Pre (n = 25)	**Post (n = 11)**	**Pre (n = 27)**	**Post (n = 11)**	**Pre (n = 19)**	**Post (n = 17)**
Fat mass (kg)	16 ± 6	16 ± 4	16 ± 4	16 ± 5	16 ± 6	17 ± 6
Fat-free mass (kg)	40 ± 4	41 ± 4	39 ± 3	40 ± 2*	41 ± 4	40 ± 4
Body fat percentage	29 ± 7	28 ± 6	28 ± 5	28 ± 6	28 ± 7	28 ± 7
Resting metabolic rate (kcal/d)	1396 ± 124	1401 ± 155	1331 ± 125	1452 ± 142*	1359 ± 138	1389 ± 165
M-value (mg/h)	417 ± 108	503 ± 123*	359 ± 85	388 ± 92	476† ± 140	460 ± 135

Table 2. Body composition, resting metabolic rate and insulin sensitivity variables pre – and post intervention, values are presented as mean ± standard deviation. (* denotes a significant difference pre- vs. post-intervention, † denotes a significant difference among the groups at the baseline, $P < 0.05$)

Individual data for resting metabolic rate pre- and post-intervention are presented in Table 2. There was no significant difference among the groups at baseline. However, we found a significant group by time interaction effect ($P < 0.05$) following the intervention. We observed a significant increase (121 kcal/d, $P < 0.01$) in Group 2, whereas no significant changes were observed in Groups 1 and 3. Furthermore, we examined the effects of our intervention on insulin sensitivity. There was a significant difference among the groups at the baseline, with Group 3 being more sensitive than Group 2 ($P < 0.05$); however, there were no differences between Group 1 and 2 or Groups 1 and 3. Following the intervention, we observed a significant time by group interaction effect ($P < 0.01$). When examining the differences within the groups, we found a significant increase in insulin sensitivity in Group 1 (by 21%, $P < 0.01$), but no significant changes in Groups 2 and 3.

Results for total daily energy expenditure (doubly labeled water), fat oxidation (^{13}C-palmitic acid), and visceral fatness are only partially available at this time, because of the labor-intensive nature of analyses involved. Furthermore, to reduce "intra-assay" variance, we analyze the pre- and post-intervention samples together. At the time of preparation of this report we continuously analyze the first batch of samples (i.e., for volunteers who finished intervention prior to October 1998). We anticipate having these results available by December 1998. Data available at this point are presented in Appendix 1.

DISCUSSION:

We conclude that our randomization procedure has been successful, as there were not any statistically significant differences among the groups at pre-testing in any of the physical characteristic variables. Moreover, we continue to be successful in recruitment of volunteers. The training proceeds as planned, without any major problems. To date, the dropout rate is ~35 % (25 volunteers), which is slightly higher than we have anticipated (20%). The major reason for dropouts has been non-compliance with the training protocol (18 volunteers). That is, the volunteers' participation in the training was below an acceptable level (80%), typically due to conflicts with their other commitments. Furthermore, four volunteers dropped out because of an injury (knee pains, ankle pains). This is to be expected, because only previously sedentary women are accepted for participation. Some of the other reasons included relocation (one volunteer), refusal to return for post-testing (one volunteer), and pregnancy (one volunteer). To decrease our dropout rate, we have adopted a strategy of very detailed discussions with each prospective volunteer (by two different members of our team) during the initial contact over the phone as well as during the screening visit. On both occasions, we thoroughly describe and stress the time commitment necessary for their successful participation in the study. This approach has proven successful, during the last six to eight months we have observed a substantially lower dropout rate.

The analysis of the pre- and post-intervention data supported the anticipated effect of our exercise training interventions. The increases in peak oxygen consumption as well as maximum strength and fat-free mass are in accordance with the results of similar exercise intervention studies. We feel that it is premature to discuss any other results, because the available sample size is still quite low; however, we can see some interesting trends emerging with respect to the effects of exercise training on resting metabolic rate and insulin sensitivity.

RECOMMENDATIONS:

We do not have any recommendations at this time.

CONCLUSIONS:

We are very pleased with the progress of the study. We were able to recruit a substantial cohort of young women and the composition of all three groups follow the inclusion criteria as outlined above. Moreover, absence of significant difference among the groups at the pre-testing in age, weight, body mass index and peak oxygen consumption indicates that our randomization procedure works as anticipated. We have been receiving positive feedback from volunteers in the exercise training groups. Furthermore, the analysis of pre- versus post-exercise intervention data has shown that our exercise training intervention induced the anticipated effects with respect to peak oxygen consumption, maximum strength, and fat-free mass. Overall, we conclude that every aspect of the study proceeds as proposed in our original application and that we will complete the project in the anticipated time.

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APPENDIX 1

LAST NAME	FIRST NAME	Age	group	Start	Situtation	Pre Date	Post Date	height1	weight1	BMI1	height2	weight2
Abell	Susan	29	1	7/23/97	dropout			166.0	67.7	24.6		
Ahearn	Erin	25	2	2/23/98	done-paid	2/13/98	9/18/98	174.8	68.2	22.3	174.0	73.0
Alberts	Heather	24	2	5/28/97	dropout			169.9	55.5	19.2		
Blaiklock	Jennifer	33	3	5/19/97	done-paid	5/8/97	12/11/97	162.0	52.5	20.0	161.6	52.9
Boe	Mary Beth	27	2	5/9/97	done-paid	4/28/97	12/18/97	166.2	55.9	20.2	166.2	55.8
Bognar	Janina	22	3	6/9/97	done-paid	5/29/97	12/19/97	163.0	55.0	20.7	163.0	55.3
Boucher	Ann	31	3	3/20/97	done-paid	4/10/97	9/19/97	152.0	50.0	21.6	152.0	49.5
Boyd	Kristen	26	2	6/18/97	done-paid	5/21/97	12/14/98	163.6	59.3	22.2	164.0	60.0
Brennan	Kasara	21	3	2/17/97	dropout			171.4	57.5	19.6		
Bragg	Denise	33	1	2/23/98	done-paid	2/6/98	10/14/98	156.8	61.3	24.9	156.8	62.2
Brice	Whitney	30	1	2/26/97	done-paid	2/7/97	10/17/97	166.0	65.0	23.6	166.0	64.9
Brigham	Heidi	28	2	5/28/97	dropout			170.2	59.9	20.7		
Brochu	Kara	34	2	6/30/97	done-paid	6/20/97	12/23/97	151.0	58.2	25.5	151.0	60.7
Brown	Anna	34	2	3/10/97	done-paid	2/28/97	9/15/97	173.2	58.1	19.4	172.8	60.9
Brown	Kimball	33	1	4/8/98	done-paid	3/26/98	10/15/98	166.6	66.3	23.9	167.0	67.7
Bruce	Jennifer	23	2	3/21/97	dropout			163.6	52.3	19.5		
Brulatour	Maria	27	2	12/19/97	done-paid	12/4/97	6/25/98	171.4	47.2	16.1	171.4	52.4
Caldwell	Paige	31	2	3/10/97	dropout			177.8	83.0	26.3		
Camp	Karen	33	1	July '98	in-training			162.6	53.5	20.2		
Carlson	Kristin	29	3	5/12/97	done-paid	5/2/97	4/9/98	168.0	54.0	19.1	168.0	56.8
Casale	Leanne	25	1	3/3/97	done-paid			165.4	63.9	23.4		
Cass	Wendy	26	3	2/27/97	done-paid			165.0	54.1	19.9	164.4	51.2
Chase	Lynette	33	3	8/11/97	done-paid			154.6	50.4	21.1	158.2	49.3
Chicoine	Kim	31	1	5/18/97	dropout			171.6	59.3	20.1		
Chiu	Cynthia	20	3	3/31/97	done-paid	3/21/97	12/30/97	156.3	58.3	23.9	156.4	59.2
Companion	Amy	24	2	4/20/98	in-training			163.2	66.7	25.0		
Cruise	Linda	33	1		drop-out			162.4	62.9	23.8		
Cutter	Susan	23	2	3/3/97	done-paid	2/18/97	8/12/97	156.6	53.0	21.6	156.0	56.7
Descoteaux	Maureen	33	1	5/19/97	dropout			176.6	81.5	26.1		
Erdmann	Lisa	29	2	2/16/98	done-paid	2/3/98	8/10/97	166.8	59.5	21.4	166.8	62.4
Gagne	Havalah	24	3	1/10/97	done-paid	8/26/97	3/6/98	162.4	56.7	21.5	161.6	53.4
Gallo	Michelle	22	1	10/6/97	done-paid	9/23/97	4/24/98	159.0	55.2	21.8	159.0	55.4
Gear	Amy	31	2		dropout			149.2	40.2	18.1		
Geelmuyden	Jenifer	27	2		dropout			151.4	46.2	20.2		
Grennon	Gertrude	24	1	4/9/97	done-paid	3/28/97	10/24/97	161.2	56.6	21.8	161.2	57.1
Hanson	Sara	25	1	2/17/97	dropout			164.0	67.2	25.0		

Johnson	Mitzi	26	1	6/13/97	dropout			167.0	59.7	21.4		
Joy	Dierdra	33	1	10/1/97	done-paid	9/18/97	5/20/97	163.0	55.4	20.9	163.0	57.4
Krcmar	Chantal	24	1	5/1/98	in-training			172.0	57.6	19.5		
Ladd	Donna	28	2	6/23/97	dropout			162.4	60.4	22.9		
Llauger	Giannina	23	1	2/24/97	done-paid	2/11/97	10/7/97	163.4	54.0	20.2	163.4	53.4
MacLachlan	Catherine	26	2	6/16/97	done-paid	6/4/97	12/8/98	158.6	58.8	23.4	158.6	59.4
Marland	Dawn	34	1	6/1/97	dropout			164.4	60.0	22.2		
Mason	Carol Lee	35	3	6/16/97	done-paid	6/5/97	12/22/98	174.5	63.6	20.9	175.0	66.0
Matthews	Stacey	27	2	9/25/98	dropout			174.4	73.8	24.3		
McKenny	Heather	29	3	4/25/97	done-paid	4/15/97	11/25/97	168.0	59.8	21.2	168.0	59.3
Mills	Jennifer	26	1	3/3/97	done-paid	2/19/97	9/12/97	157.0	51.7	21.0	157.2	54.2
Moirano	Kimberley	35	1	5/30/97	done-paid	5/20/97	12/5/97	163.8	66.3	24.7	163.8	65.4
Moreno	Joan	32	1	6/16/97	dropout			162.8	58.6	22.1		
Morgan	Lynne	26	2	4/10/98	done-paid	4/1/98	10/21/98	154.8	50.3	21.0	154.8	52.8
Nieves	Yanaris	23	2	2/24/97	dropout			167.2	56.1	20.1		
Olmstead	Jennifer	28	3	3/17/97	done-paid	3/6/97	11/11/97	175.0	78.0	25.5	175.0	74.4
Padnos	Rebecca	33	1	6/20/97	dropout			159.4	57.2	22.5		
Previs	Lisa	25	1	5/7/97	done-paid	4/24/97	11/21/97	155.6	60.8	25.1	155.0	60.5
Quick	Denise	34	2	3/12/97	dropout			164.8	57.9	21.3		
Randall	Erin	22	3	8/1/97	done-paid	7/23/97	3/9/98	172.4	70.1	23.6	172.4	73.0
Record	Norma	28	2	8/3/98	in-training			161.0	54.4	21.0		
Roddy	Margaret	33	3	3/28/97	done-paid	3/18/97	1/6/98	172.6	69.4	23.3	172.0	77.2
Ruesink	Adreana	26	1	3/23/97	done-paid	3/12/97	10/1/97	172.2	66.4	22.4	172.8	64.4
Sarabia	Paige	24	2	7/14/97	dropout			168.4	57.4	20.2		
Scolin	Lynda	29	3	6/23/97	done-paid	6/13/97	12/23/98	159.4	61.5	24.2	159.4	64.0
Scribner	Shirley	28	1	1/21/98	dropout			170.4	63.0	21.7		
Shannon	Joan	33	2	8/24/98	in-training			180.0	70.2	21.7		
Siegel	Amy	29	1	6/9/97	dropout			155.0	53.2	22.1		
Smith	Christina	33	3	6/16/97	done-paid	6/6/97	1/13/98	166.8	62.2	22.4	166.8	61.3
Teague	Jennifer	25	2	3/29/97	done-paid	3/19/97	10/10/97	163.0	53.2	20.0	163.0	53.5
Vieira	Aimee	27	3	11/1/98	in-training			175.4	64.4	20.9		
Watson	Rebecca	32	2	2/17/97	dropout			164.6	54.7	20.2		
Wyss	Vanessa	23	3	6/30/97	done-paid	6/19/97	1/29/98	154.4	56.0	23.5	154.4	56.5
Yezerski	Ann	26	3	2/21/97	done-paid	2/10/97	9/4/97	167.6	62.1	22.1	167.6	66.3
Zarrillo	Nicole	27	2	5/10/98	in-training	4/30/98		174.2	67.0	22.1		

Tis_Fa1	Tis_Fa2	Regn % fat	Regn % fat2	F_mass1	F_mass2	FF_m1	FF_m2	LTM trunk	LTM trunk	LTM arms	LTM arms2	LTM legs
37.4		35.9		23.99		40.09		18.46		4.40		14.58
36.2	40.90	34.8	39.2	23.66	28.81	41.65	41.71	20.26	19.48	4.26	4.51	15.10
29.5		28.2		15.68		37.44		16.65		4.47		14.08
24.6	25.5	23.4	24.3	12.24	12.70	37.53	37.03	17.45	18.02	4.33	3.70	13.37
28.7	23.3	27.3	22.2	15.39	12.40	38.19	40.75	18.04	4.58	4.46	4.58	13.27
22.4	22.8	21.4	21.8	11.68	11.96	40.44	40.55	18.74	20.31	4.40	3.97	14.47
27.6	27.0	26.4	25.8	13.13	12.74	34.48	34.48	15.98	17.57	3.76	3.48	11.88
32.3	28.0	30.9	26.8	18.31	16.07	38.43	41.33	18.02	20.29	4.74	4.66	12.81
15.1		14.4		8.24		46.37		20.86		4.91		17.91
33.8	34.2	32.4	32.8	19.75	20.65	38.73	39.77	19.56	20.75	3.81	3.62	12.74
25.6	25.8	24.5	24.7	15.88	16.19	46.09	46.45	21.47	23.23	4.87	4.70	16.67
33.0		31.6		18.92		38.44		17.98		4.43		14.04
30.1	32.4	28.8	31.0	16.59	18.84	38.46	39.32	19.18	18.86	4.17	4.53	13.05
22.7	26.5	21.6	25.2	12.63	15.47	42.98	42.84	19.69	18.93	4.92	5.24	15.64
31.0		29.6		19.30		42.93		20.87		4.24		15.46
19.6		18.7		9.74		39.88		20.08		4.14		12.60
20.4	23.3	20.4	22.2	9.43	11.58	34.52	38.10	17.47	18.84	3.27	3.97	11.14
38.5		36.9		29.80		47.55		23.24		5.34		16.28
22.7		21.7		11.62		39.59		19.74		4.56		12.73
28.8	29.7	27.6	28.5	14.86	16.09	36.80	38.08	17.17	19.25	4.08	3.85	13.33
30.6		29.3		17.81		40.35		19.36		4.63		13.36
22.9	23.0	21.7	21.8	11.68	11.10	39.40	37.19	19.22	18.07	4.21	3.79	12.73
23.6	23.8	22.6	22.8	11.17	11.21	36.17	35.83	17.51	18.69	3.89	3.38	12.29
27.8		26.5		15.57		40.35		18.97		4.33		14.96
26.9	27.5	25.8	26.3	14.71	15.21	39.92	40.09	18.70	19.45	4.32	4.28	14.07
31.3		30.1		19.80		43.46		20.57		5.06		15.94
36.1		34.6		21.76		38.52		19.53		4.39		12.63
29.2	31.8	28.0	31.8	14.47	17.09	35.14	36.70	17.41	18.25	3.64	4.31	11.80
39.5		38.1		31.37		48.09		25.00		5.76		14.80
31.5	29.7		28.5	17.88	17.13	38.88	40.64	19.43	18.39	4.41	4.99	12.57
21.2	18.0	20.2	17.1	11.08	9.20	41.25	42.06	19.46	21.11	4.27	3.96	14.81
27.5	24.8	26.4	23.7	14.16	13.11	37.29	39.82	18.98	19.61	3.70	4.08	11.75
20.8		19.8		7.92		30.19		15.42		2.77		9.41
34.7		33.2		14.97		28.22		14.70		2.85		8.28
31.4	29.9	30.1	28.5	17.13	15.96	37.36	37.50	18.13	18.03	4.28	3.67	12.34
34.1		32.7		21.77		42.09		19.86		4.64		15.32

20.1		19.3		11.46		45.54		21.88		4.44		21.88
16.2	19.1	15.4	18.1	8.56	10.55	44.29	44.70	20.90	21.26	4.95	4.96	15.24
22.3		21.3		12.33		42.92		20.26		4.61		15.61
29.7		28.4		16.85		39.90		18.56		5.17		13.67
31.5	26.1	30.1	24.9	6.50	13.13	35.15	37.17	17.21	19.96	3.93	3.62	11.22
27.9	27.6	26.7	26.3	15.86	15.52	41.06	40.79	19.73	20.41	4.38	4.38	14.25
33.1		32.0		18.94		38.24		19.42		4.16		12.42
26.9	27.1	25.6	25.9	16.15	17.22	43.88	46.26	20.44	22.77	5.02	5.06	15.65
31.4		30.1		21.91		47.78		22.74		5.08		17.09
23.6	21.8	22.4	20.6	13.45	12.32	43.47	44.25	22.41	21.66	4.38	5.24	13.26
24.5	24.7	23.5	23.6	12.34	12.74	37.99	38.88	18.30	19.12	4.33	4.27	12.72
37.8	36.1	36.3	34.6	24.03	22.69	39.51	40.13	19.10	20.11	4.98	4.58	13.00
34.7		33.3		19.41		36.53		17.79		4.05		12.18
36.3		34.8		17.73		31.18		16.04		3.16		10.28
25.6		24.5		13.85		40.15		18.88		4.56		14.01
44.3	41.4	42.7	39.8	33.49	29.25	42.10	41.39	19.44	19.25	5.27	4.88	15.45
27.6		26.4		14.77		38.75		18.93		4.23		12.81
37.0	35.2	35.6	33.7	21.69	19.64	36.86	36.22	17.93	17.84	4.22	3.83	12.34
29.9		28.6		16.99		39.83		18.65		4.24		14.30
32.8	35.3	31.4	33.8	21.40	24.09	43.86	44.23	21.10	21.33	5.08	4.74	15.24
30.5		29.1		15.61		35.62		17.78		3.73		12.09
33.8	39.1	32.4	37.5	23.97	28.43	46.88	44.28	21.72	21.37	5.69	5.05	16.62
24.0	19.5	22.9	18.6	15.05	11.80	47.77	48.64	22.96	21.79	4.90	5.37	16.97
33.6	N/A	32.3		18.41	N/A	36.43		18.05		4.01		12.15
38.8	39.0	37.5	37.7	22.77	23.73	35.93	37.10	17.39	18.14	3.99	3.98	12.72
33.8		32.3		20.17		39.55		19.25		3.97		13.71
32.3		30.8		21.76		45.70		22.81		4.64		13.31
27.8		26.7		13.94		36.11		17.52		3.94		12.22
17.8	19.7	16.9	19.7	10.41	12.20	48.11	46.77	13.22	22.29	5.56	5.25	16.35
21.4	19.6	20.4	18.7	10.56	9.86	38.80	40.44	18.86	20.16	3.83	4.11	13.49
23.6		22.5		12.41		40.17		19.19		4.33		13.87
29.6	27.1	28.4	25.9	15.83	13.86	37.60	37.21	17.26	17.39	4.74	4.60	13.21
30.6	35.0	29.2	33.4	18.78	21.84	42.65	40.58	20.28	20.17	5.49	4.94	14.28
31.2		29.9		19.81		43.57		20.42		5.25		15.80

LTM legs2	FM_tr	FM_tr2	FM_arms	FM arms2	FM legs	FM legs2	FM_per	FM per.2	VO2_l1	VO2_l2	V02_kg1	VO2_kg2
	9.60		2.34		10.14		12.47	0.00	1800		26.59	
15.81	9.49	11.57	1.63	2.64	10.75	12.81	12.38	15.45	2042	2381	29.90	30.76
	5.26		1.22		7.73		8.95	0.00	1540		27.80	
13.04	3.82	4.21	0.96	0.95	5.98	6.11	6.94	7.06	2010	2065	38.80	39.71
14.54	6.08	5.05	1.89	1.06	6.18	5.27	8.07	6.33	1960	2197	35.10	38.90
13.67	4.62	4.93	0.77	0.71	5.24	5.23	6.01	5.93	2010	2167	36.55	38.90
10.87	6.04	6.52	1.43	1.11	4.66	4.14	6.10	5.25	2140	2020	42.80	40.80
13.44	7.89	6.99	1.94	1.56	7.04	6.22	8.98	7.78	1920	2155	32.38	36.40
	2.34		0.61		4.30		4.91	0.00	3102		53.95	
12.63	9.84	11.02	1.98	1.87	6.60	6.44	8.58	8.31	1833	2185	29.90	34.30
15.93	6.18	6.94	1.45	1.39	6.74	6.58	8.19	7.97	2882	3135	44.34	48.30
	6.46		2.35		8.34		10.69	0.00	2870		47.91	
13.89	7.52	8.45	0.99	1.32	6.85	7.82	7.85	9.15	2400	2383	41.24	39.20
15.89	3.53	4.49	1.26		6.27	6.34	7.53	6.34	2074		35.70	
	8.58		1.61		7.86		9.47		2433	2810	36.70	41.50
	3.85		0.90		4.14		5.05	0.00	2693		51.49	
12.57	3.49	4.26	0.46	0.82	4.39	5.24	4.85	6.06	1663	1864	35.24	35.70
	14.30		3.43		10.46		13.89	0.00	3079		37.10	
	4.44		0.95		5.12		6.07		1882		35.50	
13.17	4.25	5.25	1.47	1.06	7.70	8.08	9.17	9.14	1940	1995	35.93	35.00
	8.36		1.98		6.23		8.21		2371		37.00	
12.28	4.95	4.66	1.23	1.04	4.48	4.34	5.71	5.38	2537	n/a	46.90	
11.40	4.69	5.31	1.38	1.00	4.32	4.09	5.70	5.09	1820	1879	36.11	38.20
	5.74		1.26		7.17		8.43	0.00	2400		40.47	
13.72	6.75	6.93	1.03	1.04	5.75	5.97	6.78	7.01	2775	2522	47.60	42.60
	7.72		1.76		9.00		10.76		2319		34.40	
	9.99		1.56		8.66		10.22		2132		33.90	
11.97	6.38	6.70	1.14	1.62	6.62	7.35	7.77	8.97	2282	2111	42.10	37.90
	15.96		3.82		9.99		13.81	0.00	2280		27.98	
13.98	8.66	7.79	2.06	2.14	6.09	6.09	8.14	8.23	1860		31.80	
14.37	4.00	3.30	0.90	0.74	5.12	4.19	6.02	4.93	2500	2686	44.10	50.30
13.10	6.49	5.59	1.24	1.15	5.30	5.25	6.53	6.40	1967	2764	36.50	49.90
	4.25		0.82		2.25		3.06	0.00	1885		46.88	
	7.60		1.60		4.54		6.14	0.00	1779		38.50	
13.31	7.23	6.50	1.62	1.42	6.82	6.68	8.44	8.10	2406	2954	42.51	51.10
	8.88		2.41		8.98		11.39	0.00	3051		45.40	

	4.38		0.84		5.71		6.54	0.00	3170		53.10	
15.71	3.08	3.99	0.79	0.86	3.70	4.61	4.50	5.47	2554	2910	46.10	50.70
	4.23		4.61		5.86		10.46		2678		46.50	
	6.65		1.66		7.23		8.89	0.00	1880		31.13	
11.64	6.50	5.42	1.39	1.06	6.73	5.43	8.11	6.50	1831	1858	33.90	34.80
13.35	6.91	7.30	1.90	1.78	5.94	5.41	7.84	7.19	2190	2287	37.24	38.70
	8.51		1.58		7.66		9.24	0.00	1710		28.50	
15.88	6.43	6.79	1.49	1.55	6.92	7.41	8.41	8.97	2870	2653	45.10	40.20
	9.42		1.81		9.18		10.99	0.00	2413		32.70	
14.41	6.71	5.35	0.96	1.24	4.71	4.76	5.67	6.00	3047	2450	50.20	41.34
12.84	5.75	5.46	1.07	1.31	4.55	4.94	5.62	6.25	2265	2417	43.80	43.70
13.16	10.03	9.54	3.36	2.47	8.97	8.90	12.33	11.38	2330	2439	35.14	37.29
	9.48		1.73		6.86		8.59	0.00	1980		33.79	
	7.32		1.44		7.42		8.86		1630		32.40	
	5.06		1.35		6.12		7.48	0.00	2017		35.95	
15.38	13.73	11.61	4.04	2.91	13.80	12.96	17.83	15.88	2870	2701	36.70	36.30
	6.30		2.02		5.36		7.38	0.00	2180		38.11	
12.48	9.38	8.56	2.52	2.05	8.22	7.67	10.74	9.72	2500	2704	41.12	44.70
	6.36		2.37		6.96		9.33	0.00	2577		44.51	
16.11	6.76	9.83	2.29	2.28	8.87	10.30	11.15	12.58	2940	2949	41.94	40.40
	5.53		1.09		7.38		8.47					
15.17	10.45	13.59	2.76	2.98	9.12	10.13	11.88	13.10	2138	2316	30.80	30.00
18.68	5.94	4.07	1.10	0.83	6.59	5.61	7.69	6.44	3466	3787	52.20	58.90
	8.14		1.63		7.31		8.94	0.00	1930		33.62	
13.33	9.43	10.21	2.77	2.31	9.26	9.89	12.04	12.20	1710	1616	27.80	25.10
	9.58		1.98		7.25		9.23		2220		35.80	
	8.54		1.41		9.91		11.33		2513		35.80	
	6.16		1.28		5.42		6.70	0.00	2290		43.05	
16.21	4.26	5.10	0.89	1.00	4.32	5.03	5.20	6.03	2494	2482	43.05	38.90
13.53	3.95	3.98	0.85	0.83	4.72	4.20	5.57	5.03	2389	2359	44.90	44.10
									3158		49.04	
	5.10		1.12		5.13		6.25	0.00	2210		40.40	
12.79	6.73	6.00	1.51	1.27	6.43	5.53	7.94	6.80	2020	2459	36.90	43.6
12.99	8.66	10.68	1.91	2.33	7.05	7.55	8.96	9.87	2186	2025	35.20	30.50
	6.93		2.68		8.61		11.29		2626		39.20	

max hr	max hr2	max RQ	max RQ2	VO2	VO2-2	VCO2	VCO2_2	RMR_1	RMR_2	RQ	RQ2	M_abs1
180		1.05		206.0		176.0		1420.0		0.85		642.9
187	185	1.09	1.09	219.0	261.0	201.0	221.0	1530.0	1780	0.92	0.81	339.4
192		1.15		207.0		166.0		1400.0		0.80		341.6
180	179	1.13	1.08	183.0	147.0	166.0	134.0	1270.0	1020.0	0.91	0.92	365.4
182	183	1.22	1.22	185.0	206.0	158.0	175.0	1270.0	1420.0	0.86	0.85	325.9
211	212	1.13	1.10	194.0	188.0	160.0	158.0	1320.0	1290.0	0.82	0.84	344.3
200	206	1.13	1.10	176.0	171.0	147.0	159.0	1200.0	1190.0	0.83	0.93	503.3
200	199	1.16	1.16	179.0	196.0	151.0	165.0	1220.0	1340.0	0.85	0.84	305.7
206		1.13		236.0		191.0		1610.0		0.81		505.9
183		1.15		203.0	198.0	174.0	171.0	1400.0	1370.0	0.85	0.86	326.5
188	179	1.14	1.20	235.0	231.0	181.0	188.0	1580.0	1570.0	0.77	0.82	451.3
193		1.14		225.0		191.0		1540.0		0.85		377.0
201		1.15		170.0	185.0	152.0	165.0	1180.0	1280.0	0.89	0.90	395.4
195	not ava.	1.21	not avail.	223.0	228.0	185.0	189.0	1530.0	1560.0	0.83	0.83	522.7
not avail.	173	1.16	1.16	213.0		176.0		1450.0		0.83		309.4
193		1.22		164.0		146.0		1130.0		0.89		328.1
201	196	1.16	1.09	177.0	208.0	152.0	184.0	1220.0	1440.0	0.85	0.89	310.0
180		1.15		222.0		193.0		1540.0		0.87		298.7
197		1.11		202.0		165.0		1370.0		0.82		279.4
208	188	1.09	1.22	184.0	222.0	150.0	177.0	1250.0	1510.0	0.82	0.79	592.4
212		1.12		196.0		160.0		1330.0		0.82		191.4
190		1.17		217.0	211.0	166.0	176.0	1460.0	1440.0	0.77	0.84	353.3
191	177	1.12	1.22	150.0	174.0	132.0	160.0	1030.0	1210.0	0.88	0.92	336.1
184		1.13		196.0		168.0		1350.0		0.86		375.9
196	193	1.16	1.13	187.0	193.0	165.0	163.0	1290.0	1320.0	0.88	0.84	458.9
191		1.11		234.0		194.0		1600.0		0.83		480.0
183		1.08		216.0		184.0		1490.0		0.85		297.4
210	199	1.12	1.10	191.0	213.0	156.0	179.0	1300.0	1460.0	0.82	0.84	458.1
173		1.19		244.0		220.0		1700.0		0.90		610.4
197		1.08		206.0	213.0	173.0	187.0	1410.0	1480.0	0.84	0.88	283.7
190	191	1.18	1.16	202.0	210.0	166.0	176.0	1380.0	1440.0	0.82	0.84	530.9
196	196	1.18	1.17	177.0	211.0	157.0	182.0	1230.0	1450.0	0.88	0.86	246.1
188		1.19		142.0		123.0		970.0		0.87		379.4
213		1.04		161.0		136.0		1115.0		0.85		219.0
197	197	1.13	1.11	195.0	195.0	165.0	171.0	1340.0	1350.0	0.85	0.87	482.0
190		1.20		181.0		166.0		1260.0		0.92		66.9

195		1.14		203.0		164.0		1380.0		0.81		481.0
201	200	1.15	1.11	199.0	193.0	167.0	159.0	1365.0	1320.0	0.84	0.83	489.0
187		1.12		192.0		159.0		1310.0		0.83		514.3
184		1.09		188.0		161.0		1290.0		0.85		378.0
193		1.22		181.0	169.0	151.0	146.0	1230.0	1160.0	0.84	0.87	303.4
192	192	1.15	1.15	201.0	209.0	163.0	172.0	1360.0	1442.0	0.81	0.82	411.9
171		1.21		187.0		171.0		1300.0		0.91		414.4
170	168	1.15	1.09	217.0	227.0	188.0	182.0	1500.0	1540.0	0.86	0.80	445.6
201		1.16		231.0		211.0		1610.0		0.91		805.0
190		1.13		216.0	226.0	181.0	184.0	1480.0	1540.0	0.84	0.82	519.7
200	200	1.12	1.19	210.0	194.0	176.0	158.0	1440.0	1320.0	0.84	0.81	615.7
186	188	1.15	1.05	227.0	246.0	186.0	221.0	1550.0	1720.0	0.82	0.90	444.6
190		1.12		201.0		177.0		1390.0		0.88		326.4
190		1.16										219.3
182		1.19		189.0		159.0		1290.0		0.85		494.7
188	185	1.19	1.12	195.0	210.0	176.0	184.0	1360.0	1450.0	0.91	0.88	572.9
190		1.10		209.0		165.0		1410.0		0.79		372.7
191	190	1.07	1.16	189.0	192.0	169.0	166.0	1310.0	1320.0	0.90	0.87	463.4
190		1.16		210.0		180.0		1450.0		0.86		537.7
181		1.08		227.0	234.0	183.0	191.0	1540.0	1600.0	0.80	0.82	367.4
				197.0		155.0		1340.0		0.79		358.1
200	170	1.19	1.15	233.0	249.0	192.0	195.0	1596.0	1680.0	0.82	0.78	727.3
188	179	1.16	1.18	222.0	208.0	180.0	176.0	1510.0	1430.0	0.81	0.84	454.7
222		1.18		204.0		173.0		1400.0		0.85		325.9
187	167	1.12	1.02	189.0	206.0	167.0	169.0	1310.0	1400.0	0.89	0.83	256.1
196		1.13		197.0		176.0		1385.0		0.89		321.4
189		1.18		216.0		182.0		1480.0		0.85		485.8
183		1.10		189.0		157.0		1290.0		0.83		329.0
189	192	1.25	1.22	206.0	193.0	176.0	167.0	1420.0	1330.0	0.85	0.87	727.0
199	193	1.12	1.09	189.0	191.0	158.0	167.0	1290.0	1320.0	0.84	0.88	376.4
196		1.14										573.0
205		1.22		176.0		159.0		1220.0		0.91		469.9
190		1.07	1.08	189.0	189.0	160.0	166.0	1300.0	1300.0	0.85	0.88	363.0
191	188	1.12	1.05	207.0	200.0	159.0	164.0	1390.0	1360.0	0.77	0.82	395.7
190		1.16		267.0		220.0		1830.0		0.82		353.1

M_abs2	M_FFM1	M_FFM2	Chol_1	Trig_1	HDL_1	LDL_1	Ch_HDL1	ins_0	ins_120	glu_0	glu_120	L2sc_1
	16.04		158	58	64		2.47	5.6	50.5	99	102	n/a
500.3	8.15									77	72	13233
	9.12		251	236	63	141	3.98	7.4	64.9	73	77	
442.9	9.74	11.96	199	49	73	16	2.73	5.0	13.0	82	78	n/a
423.0	8.53	10.38	172	134	48	97	3.58	8.5	46.7	72	69	n/a
385.5	8.51	9.51	157	107	43	93	3.65	11.0	94.0	79	81	4207
504.0	14.60	14.62	176	81				5.0	11.0	70	51	n/a
374.6	7.95	9.06	193	174	41	117	4.71	7.0	25.6			n/a
	10.91		137	115				5.0	38.0	77	90	n/a
408.0	8.43	10.26	173	136	67	79	2.58	8.6	42.7	85	99	19509
436.7	9.79	9.40	159	93				5.0	63.0	78	89	n/a
	9.81		217	117	65	129	3.34	5.0	8.5	80	76	n/a
425.9	10.28	10.83	163	68	52	97	3.13	5.0	43.1	76	101	11943
482.0	12.16	11.25	157	63				6.0	53.0	82	79	n/a
454.3	7.21		230	153	111	88	2.07	10.1	71.0	79	111	15518
	8.23		118	79				8.0	37.0	75	73	n/a
305.4	8.98	8.01	182	87	62	103	2.94	5.5	55.5	75	134	4524
	6.28		196	47				7.0	41.0	85	76	n/a
	7.06		196	87	77	102	2.55	10.0	47.6	77	133	
583.5	16.10	15.33	167	117	47	97	3.55	6.3	16.0	82	87	n/a
	4.74		167	119				0.0	65.0	82	79	n/a
n/a	8.97	#VALUE!	165	91				7.0	18.0	83	64	n/a
316.3	9.29	8.83	167	126	34	108	4.91	5.3	21.3	89	77	n/a
	9.31		144	82	52	76	2.77	8.7	19.1	76	73	n/a
452.5	11.50	11.29	165	111				7.0	39.0	87	71	n/a
	11.05		201	144	56	116	3.59	8.8	84.5	85	125	n/a
	7.72		198	105	37	140	5.35	8.5	113.8			17743
329.7	13.04	8.98	189	188				10.0		85	88	n/a
	12.69		228	138	53	147	4.30	13.2	26.8	94	79	n/a
325.0	7.30	8.00	178	121	69	85	2.58	10.8	62.3	85	85	11869
456.8	12.87	10.86	133	62	50	71	2.66	5.0	31.9	83	104	4807
287.1	6.60	7.21	177	71	52	111	3.40	5.0	61.0	76	114	7904
	12.57		153	52	66	77	2.32	5.0	8.3	70	57	9131
			204	88	60	126	3.40	5.8	25.8	89	103	12612
550.7	12.90	14.68	184	106				7.1	59.4	87	104	n/a
	1.59		206	105				5.0	27.0	74	62	n/a

	10.56		155	45	61	85	2.54			76	67	n/a
550.3	11.04	12.31	166	61	59	95	2.81	5.0	41.8	80	102	4958
	11.98		245	73	52	178	4.71	7.8	30.0	84	74	3988
	9.47		146	76	49	82	2.98	5.0	8.0	84	79	7572
406.0	8.63	10.92	153	110				9.0	23.0	80	88	n/a
358.7	10.03	8.80	162	71	71	77	2.28	5.0	13.0	64	87	13222
	10.84		141	53				12.2	96.9	80	124	11677
574.3	10.15	12.41	167	61	66	89	2.53	5.0	13.0	82	64	7872
	16.85		128	30	60	62	2.13	12.9	29.5	84	91	10725
536.6	11.95	12.13	184	108				6.0	14.0	79	66	n/a
660.1	16.21	16.98	209	97				5.0	18.0	77	74	n/a
670.3	11.25	16.70	222	132	74	122	3.00	6.2	27.2	85	75	19182
	8.94		232	70	52	166	4.46	5.8	74.6	87	125	12944
219.4	7.04		228	117	69	136	3.30	8.7	64.8	86	98	10060
	12.32		183	81				6.0	51.0	81	96	n/a
516.0	13.61	12.47	174	111				12.0	45.0	82	76	n/a
	9.62		191	65	45	133	4.24	5.4	14.3	83	58	10955
459.7	12.57	12.69	157	123				6.1	21.5	80	86	n/a
	13.50		158	64				5.0	18.0	68	74	n/a
error	8.38	error	156	113	48	85	3.25	5.0	21.8	82	103	15136
	10.05							9.9	45.4	80	67	
577.7	15.51	13.05	180	83				12.0	22.0	87	75	n/a
645.4	9.52	13.27	165	33				5.0	40.0	73	78	n/a
	8.95							7.7	101.4	90	98	10572
240.0	7.13	6.47	292	75	77	200	3.79	6.4	58.0	92	111	17852
	8.13		191	68	55	122	3.47	5.8	80.1	81	112	15903
	10.63							5.0	32.1	79	78	
	9.11		206	173	58	113	3.55	10.1	77.3	84	102	8460
720.0	15.11	15.39	194	121				5.0	17.0	86	69	5315
519.0	9.70	12.83	179	73				5.0	11.3	90	51	n/a
										72	69	
	11.70	#DIV/0!	151	59				5.0	33.0	81	72	n/a
340.3	9.65	9.15	184	81	39	129	4.72	6.0	37.0			9462
252.4	9.28	6.22	188	98				9.0	71.0	79	76	n/a
	8.10		231	95	67	145	3.45	10.3	32.0	80	68	13606

L2sc_2	L2vis_1	L2vis_2	L4sc_1	L4sc_2	L4vis_1	L4vis_2	RTatt_1	RTatt_2	LTatt_1	LTatt_2	Avatt_1	Avatt_2
n/a	n/a	n/a	n/a	n/a	n/a	n/a	47.9	n/a	48.9	n/a	48.40	#DIV/0!
18061	1944	2297	30197	37348	2536	3351	48.3	49.7	47.7	48.8	48.57	49.25
			8458		3474		47.0	n/a	47.9	n/a	47.45	n/a
6493	n/a	1735	7809	12631	1438	3149	45.0	49.2	45.4	49.7	46.53	49.45
5279	n/a	2175	12936	12935	2883	2834	50.5	52.8	51.4	52.9	51.57	52.85
5440	3795	3140	5440	12841	3140	3069	50.8	n/a	50.1	n/a	50.45	n/a
11919	n/a	3155	14767	18821	3793	4074	49.8	51.3	51.3	49.4	50.80	50.35
9760	n/a	4051	18499	16102	3979	4205	48.2	50.8	48.1	50.9	49.03	50.85
n/a	n/a	n/a	2727	n/a	2023	n/a	48.8	n/a	50.1	n/a	49.45	n/a
	8590		34578		5791		49.8		49.5		49.65	#DIV/0!
7342	n/a	4712	17093	17340	3853	5078	n/a	51.5	n/a	49.5	n/a	50.50
n/a	n/a	n/a	14333	n/a	2693	n/a	47.8	n/a	50.3	n/a	49.05	#DIV/0!
13876	3742	4509	22231	26000	3232	4426	46.9	52.5	47.6	51.1	49.00	51.80
6884	n/a	3232	10042	12909	3248	4635	50.1	50.3	48.0	51.4	49.47	50.85
	2506		24221		4174		47.6		48.3		47.95	#DIV/0!
n/a	n/a	n/a	8221	n/a	1895	n/a					#DIV/0!	#DIV/0!
	1486		7575		2092		47.2	51.0	47.1	50.2	48.43	50.60
n/a	n/a	n/a	35004	n/a	6033	n/a	45.7	n/a	46.6	n/a	46.15	n/a
											#DIV/0!	#DIV/0!
5457	n/a	1436	5306	n/a	3203	n/a	46.7	49.6	45.9	49.2	47.40	49.40
15777	n/a	7282	n/a	28180	n/a	6539	n/a	51.2	n/a	52.7	n/a	51.95
6520	n/a	2220	13150	11976	3929	3488	49.8	50.6	49.1	49.7	49.83	50.15
7792	n/a	3272	16136	13993	4288	4342	51.8	51.2	51.1	50.8	51.37	51.00
n/a	n/a	n/a	10032	n/a	4467	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11815	n/a	3219	n/a	21447	n/a	3439	n/a	50.8	n/a	50.0	n/a	50.40
	n/a		27896		4451						#DIV/0!	#DIV/0!
n/a	2360	n/a	21360	n/a	2811	n/a	50.1	n/a	50.2	n/a	50.15	n/a
7884	n/a	3438	n/a	17942	n/a	3091	n/a		n/a		n/a	#DIV/0!
n/a	n/a	n/a	36987	n/a	8387	n/a	44.3	n/a	43.9	n/a	44.10	n/a
	5291		22683		7993		52.3		51.6		51.95	#DIV/0!
3847	1779	1616	13065	8812	2400	2116	51.1	n/a	51.0	n/a	51.05	n/a
7484	4852	3416	19810	20239	4416	4666	52.5		49.8		51.15	#DIV/0!
n/a	3397	n/a	17414	n/a	3979	n/a	49.8	n/a	50.1	n/a	49.95	n/a
n/a	5037	n/a	23255	n/a	3062	n/a	51.2	n/a	50.6	n/a	50.90	n/a
12292	n/a	3587	n/a	20720	n/a	3224	n/a	51.8	n/a	51.9	n/a	51.80
n/a	n/a	n/a	16170	n/a	4071	n/a	n/a	n/a	n/a	n/a	n/a	n/a

	n/a		9490		2078		47.2		46.2		46.70	#DIV/0!
5102	2061	3415	9809	8433	3558	3845	51.7	49.9	51.4	49.8	51.00	49.85
	1591		8120		3188		51.1		49.2		50.15	#DIV/0!
n/a	3233	n/a	23822	n/a	4366	n/a	48.0	n/a	46.3	n/a	47.15	n/a
7601	n/a	3061	14324	16507	2294	2478	50.9	54.0	49.1	53.4	51.33	53.70
13678	3651	4219	27723	25320	2931	2572	50.1	50.7	50.6	50.0	50.47	50.35
n/a	7726	n/a	24784	n/a	6522	n/a	44.6	n/a	44.0	n/a	44.30	n/a
9642	4260	5854	12513	13401	5060	5558	46.2		45.0		45.60	#DIV/0!
n/a	5794	n/a	25894	n/a	5071	n/a	46.6	n/a	46.6	n/a	46.60	n/a
10623	n/a	3391	13871	21091	2851	1907	47.3	48.9	46.4	49.4	47.53	49.15
11508	n/a	2915	12756	19587	2397	3365	50.2	52.8	51.4	52.7	51.47	52.75
14936	5417	4563	34014	29311	6173	4566	44.7	52.4	43.8	50.1	46.97	51.25
	6342		17753		6708		48.4		47.4		47.90	#DIV/0!
	2133		20270		4316		53.0		52.4		52.70	#DIV/0!
n/a	n/a	n/a	11766	n/a	1658	n/a	48.5	n/a	48.9	n/a	48.70	n/a
17521	n/a	4344	n/a	40379	n/a	3628	n/a	49.8	n/a	49.8	n/a	49.80
n/a	5125	n/a	24819	n/a	3002	n/a	46.9	n/a	47.3	n/a	47.10	n/a
12698	n/a	4425	27934	26067	4581	5332	44.4	52.6	43.2	50.6	46.73	51.60
n/a	n/a	n/a	21250	n/a	3104	n/a	46.7	n/a	47.1	n/a	46.90	n/a
18210	2694	4099		26343		4442	44.8	45.6	47.0	45.7	45.80	45.65
											#DIV/0!	#DIV/0!
18482	n/a	6848	17056	36109	4862	7300	43.9	48.4	44.8	45.7	45.70	47.05
3822	n/a	2104	15832	11728	3909	2599		50.9		49.9	50.90	50.40
n/a	4697	n/a	15822	n/a	5280	n/a	47.8	n/a	45.5	n/a	46.65	n/a
17978	4542	6105	29532	29838	4707	5420	48.3	49.3	48.7	49.0	48.77	49.15
n/a	4763	n/a	22778	n/a	4968	n/a	49.4	n/a	49.3	n/a	49.35	n/a
											#DIV/0!	#DIV/0!
n/a	3493	n/a	17685	n/a	5192	n/a	49.5	n/a	51.7	n/a	50.60	n/a
6710	3237	4549	9813	11847	2128	2079	45.8	49.1	44.7	47.7	46.53	48.40
5465	n/a	2602	6684	9081	887	1784		51.3		49.3	51.30	50.30
	n/a		12703		2985		49.4		50.2		49.80	#DIV/0!
9280	4944	4500	18400	16672	4389	4503	48.4	52.0	49.6	51.6	50.00	51.80
20561	n/a	6172	18675	36236	2181	5093		52.2	53.0	55.9	52.60	54.05
	1497										#DIV/0!	#DIV/0!

RTarea_1	RTarea_2	LTarea_1	LTarea_2	RTsc_1	RTsc_2	LTsc_1	LTsc_2	TEE_1	TEE_2	$^{13}C_0\_1$	$^{13}C_0\_2$	$^{13}C_1\_1$
9789	n/a	10888	n/a	11297	n/a	11859	n/a	2460		8.26		84.88
10200	11583	9865	11678	12548	17591	11980	18194					
9209	n/a	8969	n/a	16779	n/a	16818	n/a	2679		9.08		84.06
11472	9969	10636	9305	12223	9286	11543	9213	2614	2122			
11009	11553	10471	10991	9448	5963	9273	5778	3185	3024			
11782	n/a	11772	n/a	7145	n/a	6891	n/a	2770	2630			
10952	11379	10717	11022	6627	7949	6653	8040	2675		8.66	9.49	82.85
10464	11035	10192	10624	10419	6340	10567	6562					
13329	n/a	13162	n/a	6397	n/a	6417	n/a	3856				
11292		10728		11798		12801						
n/a	14021	n/a	13129	n/a	8186	n/a	8195	2491	2863	12.65	12.63	79.80
10785	n/a	10532	n/a	12757	n/a	12722	n/a					
15243	15076	13827	13616	12059	11735	12257	11531	2325	2587			
9785	10621	9295	10498	6626	8757	6687	9004	2310	2362	8.62	9.51	82.24
11161		11477		10624		10525						
										7.82		84.55
7139	9352	7232	9481	4704	6714	4598	6674					
11582	n/a	11174	n/a	18407	n/a	18811	n/a	2372				
9200	7961	8452	7592	12745	9235	12840	9931					
n/a	12106	n/a	11707	n/a	7642	n/a	7139	2835				
12009	11659	10757	10412	7877	6013	8174	6042	2681	2620	9.62		80.97
10564	10737	10143	10040	5147	7247	5716	7870					
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2114		7.21		83.69
n/a	11993	n/a	11537	n/a	9697	n/a	9144					
10820	n/a	10030	n/a	14129	n/a	14333	n/a					
n/a		n/a		n/a	12196	n/a	12431	2142	2120	10.84	8.15	83.02
10938	n/a	10330	n/a	17706	n/a	16558	n/a	3211				
10646		10808		7707		7487						
12774	n/a	12525	n/a	8470	n/a	8021	n/a					
11333		11142		8757	9211	9269	9601					
9555	n/a	9708	n/a	5955	n/a	5259	n/a	2325				
7336	n/a	7441	n/a	6081	n/a	6161	n/a	1643		6.51		86.36
n/a	10045	n/a	10178	n/a	8000	n/a	7793					
n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2933		10.04		89.10

12579		13371		8067		8274						
12865	13159	12607	12902	5823	5880	5090	5468					
12251		12104		6486		6725						
11763	n/a	11631	n/a	10282	n/a	10077	n/a					
9005	9516	8751	9057	13115	8294	12459	8174	2047	2356	10.05	9.29	83.26
12698	13569	12749	14083	11313	8610	12471	8775					
9673	n/a	10014	n/a	11817	n/a	11736	n/a					
12195		12516		8537	11631	8837	11664					
13128	n/a	14444	n/a	11282	n/a	10991	n/a					
13284	13190	12534	12689	7586	6985	7624	7335	3003	3036			
10910	10395	11013	10215	5990	5990	5955	5955		3655	8.85	6.68	84.02
10633	10842	9918	10196	12108	10261	12515	11182					
10437		9294		7136		7477						
8662		7935		9053		9099						
10673	n/a	10941	n/a	8041	n/a	8548	n/a	1904				
n/a	10247	n/a	10487	n/a	15841	n/a	15879	2191	2477			
12066	n/a	10840	n/a	9135	n/a	9903	n/a					
9043	9655	10092	10734	16157	9647	15872	10199	2871				
10370	n/a	10286	n/a	14143	n/a	14022	n/a	3127		9.67		82.50
11543	11564	12649	12375	14350	11272	14136	11787					
13356	13102	12511	12239	14028	11740	13841	11214					
	13887		13266		7064		7770	2843		12.41	18.85	86.70
9006	n/a	8799	n/a	9761	n/a	9631	n/a	2218				
9783	9827	9628	9614	12654	13603	12537	13255					
11371	n/a	11522	n/a	9914	n/a	9904	n/a					
11440	n/a	11959	n/a	10222	n/a	10355	n/a					
16354	14929	15919	14589	7298	6928	7122	6499					
	12208		11826		6530		6238	2772		6.44		85.20
12006		12098		9109		8471		2337		9.60		81.55
11987	11166	11624	10946	8522	6893	8616	6567					
11158	9833	11528	10537	8844	8116	8585	8341	2132	2169	10.02	8.16	88.35

$^{13}C_1$_2	$^{13}C_1 + ^{18}O_1$_1	$^{13}C_1 + ^{18}O_1$_2
	6.86	
	6.86	
84.53	8.49	5.97
85.11	7.55	2.26
81.24	9.14	9.25
	7.64	
	9.42	
	9.11	
84.02	6.14	7.82
	7.13	
	0.86	

81.56	6.68	9.15
84.32	7.14	9.02
	7.83	
73.77	0.90	7.39
	8.36	
	8.86	
82.90	1.63	8.94