RELATIONSHIP BETWEEN FASTING SERUM LEPTIN LEVELS AND MARKERS OF BONE, FAT AND HEALTH IN SEDENTARY WOMEN

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Abstract

Leptin, a hormone secreted by adipose tissue, is used to measure energy stores, which in turns helps in the regulation of metabolism. Obese individuals tend to have higher leptin levels, partially because of their increased stores of adipose tissue. In addition to fat mass, leptin levels continue to be evaluated for its relationships with other variables related to health and obesity. The purpose of this investigation was to compare baseline leptin levels to other markers of health, metabolism and bone in sedentary obese women. Participants underwent a baseline testing session prior to starting a diet and exercise program. The testing included DEXA body composition, body mass, resting blood pressure and heart rates, resting energy expenditure (REE), fasting blood samples to analyze for various metabolic markers, and a maximal graded exercise test on the treadmill. Data was analyzed by Pearson product bivariate correlational analysis and is reported as the mean ± SD along with the correlation coefficient. Baseline leptin levels (91.4 ± 73.9 ng/mL) were positively correlated with body weight (202.7±37.5 lbs, r=0.40), BMI (34.5±5.9, r=0.39) waist circumference (39.0±5.2 in, r=0.36), FM (37.3±9.6 kg, r=0.33), FFM (46.3±4.2 kg, r=0.18), percent body fat (48.1±5.3%, r=0.30), resting HR (74±10 bpm, r=0.14), REE (1615.9±266.7 kcal/d, r=0.29), insulin (11.3±19.3 IU/mL, r=0.38), alkaline phosphatase (76.4±25.1 IU/L, r=0.16), BMA (1778.9±157.2 cm^2, r=0.16), and body cell mass (28.2±6.2 kg, r=0.31). Leptin was negatively correlated with maximal METs during the graded exercise test (5.9±1.3, r= -0.13). Leptin was not significantly correlated with age (44.0±12.2 yrs, r=-0.08), height (64.3±2.7 in, r=0.06), resting SBP (124.6±14.3 mm/hg, r=0.04), resting DBP (81.3±9.0 mm/hg, r=0.00) serum triglycerides (139.0±87.3 mg/dL, r=-0.02), total cholesterol (197.1±40.1 mg/dL, r=0.02), HDL (51.4±12.6 mg/dL, r=-0.06), LDL (117.5±34.0 mg/dL, r=0.05), CHL/HDL (3.9±1.0, r=0.01), uric acid (4.8±1.2 mg/dL, r=0.08), glucose (99.2±21.9 mg/dL, r=0.03), BUN (13.6±5.7 mg/dL, r=-0.04), creatinine (0.9±1.4 mg/dL, r=-0.06), BUN/Cre (16.3±4.9, r=-0.08), BMC (1792.0±276.1 g, r=0.12) or BMD (1.0±0.1 g/cm^2, r=0.05). Leptin levels show to be positively related to common health variables related to obesity and negatively correlated to fitness levels. It would be of interest to examine the leptin trends over time during a weight loss program for overweight or obese individuals.

Supported by Curves International, Waco, TX

Rationale

Leptin is a cytokine protein secreted from adipose tissue and has been positively associated with fat mass in both lean and obese individuals. In addition, leptin levels have been associated with other measures of bone and health. It has been positively associated with bone markers. One theory of the effect of leptin on bone formation is by inducing osteogenesis in bone tissue. Leptin has a large role in energy metabolism and is a strong sensor of energy balance in the body. Subtle changes in energy balance can have profound effects on leptin levels. For example, a decrease in weight of 10% can result in a 53% reduction in leptin levels. The opposite is also true in that an increase of 10% in body weight can result in a 300% increase in leptin levels. However, leptin can also inhibit appetite and increase energy expenditure. Leptin may also be up-regulated by insulin and glucocorticoids, which could be due to the relationship between serum levels and meal timing. The purpose of this study was to examine the relationship among fasting leptin and a number of markers of health, fitness, and body composition in a large cohort of sedentary and overweight women.

Experimental Design

Subjects

- 450 overweight and sedentary women (44±12 yr; 202±68 lbs; 37±7% body fat) participated in this study.
- Subjects were informed as to the experimental procedures and signed informed consent statements in adherence with the human subject guidelines of Texas A&M University.

Methods & Procedures

- Baseline testing sessions were conducted prior to the start of a diet and exercise program, which included:
  - DEXA Body Composition
  - Body Mass
  - Resting blood pressure and heart rate
  - REE
  - Fasting blood
  - Maximal GXT on the treadmill

Statistical Analysis

- Data were analyzed by Pearson product bivariate correlational analysis and is reported as the mean ± SD along with the correlation coefficient.

Results

- Baseline leptin levels (91.4 ± 73.9 ng/mL) were positively correlated with BW (202.7±37.5 lbs, r=0.40), BMI (34.5±5.9, r=0.39) waist circumference (39.0±5.2 in, r=0.36), FM (37.3±9.6 kg, r=0.33), FFM (46.3±4.2 kg, r=0.18), percent body fat (48.1±5.3%, r=0.30), resting HR (74±10 bpm, r=0.14), REE (1615.9±266.7 kcal/d, r=0.29), insulin (11.3±19.3 IU/mL, r=0.38), alkaline phosphatase (76.4±25.1 IU/L, r=0.16), BMA (1778.9±157.2 cm^2, r=0.16), and BCM (28.2±6.2 kg, r=0.31).
- Leptin was negatively correlated with maximal METs during the graded exercise test (5.9±1.3, r= -0.13).
- Leptin was not significantly correlated with age (44.0±12.2 yrs, r=-0.08), height (64.3±2.7 in, r=0.06), resting SBP (124.6±14.3 mm/hg, r=0.04), resting DBP (81.3±9.0 mm/hg, r=0.00) serum triglycerides (139.0±87.3 mg/dL, r=-0.02), total cholesterol (197.1±40.1 mg/dL, r=0.02), HDL (51.4±12.6 mg/dL, r=-0.06), LDL (117.5±34.0 mg/dL, r=0.05), CHL/HDL (3.9±1.0, r=0.01), uric acid (4.8±1.2 mg/dL, r=0.08), glucose (99.2±21.9 mg/dL, r=0.03), BUN (13.6±5.7 mg/dL, r=-0.04), creatinine (0.9±1.4 mg/dL, r=-0.06), BUN/Cre (16.3±4.9, r=-0.08), BMC (1792.0±276.1 g, r=0.12) or BMD (1.0±0.1 g/cm^2, r=0.05).

Conclusions

- Leptin levels were positively correlated to common health variables related to obesity and negatively correlated to fitness levels

Funding

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We would like to thank Terri Magrans-Courtney, Donovan Fogt, Jen Bunn, Chad Kirksick, Melyn Galbreath, Rui Li, Jean Gutierrez, and Mike Greenwood who assisted in data collection when the ESNL was located at Baylor University.

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Baseline Leptin Significant Correlations

Variable	Mean ± SD	Correlation Coefficient
Body Weight (lbs)	202 ± 37.5	0.40
BMI	34.5 ± 5.9	0.39
Waist Circumference (in)	39.0 ± 5.2	0.36
Fat Mass (kg)	37.3 ± 9.6	0.33
FFM (kg)	46.3 ± 4.2	0.18
Percent Body Fat (%)	48.1 ± 5.3	0.30
Resting Heart Rate (bpm)	74 ± 10	0.14
REE (kcal/d)	1615.9 ± 266.7	0.29
Insulin (IU/mL)	11.3 ± 19.3	0.39
Alkaline Phosphatase (IU/L)	76.4 ± 24.1	0.16
BMA (cm^2)	1778.9 ± 157.2	0.16
Body Cell Mass (kg)	28.2 ± 6.2	0.31
Maximal METs during GXT	5.9 ± 1.3	-0.13

Baseline Leptin Non-Significant Correlations

Variable	Mean ± SD	Correlation Coefficient
Age (yrs)	44.0 ± 12.2	-0.08
Height (in)	64.3 ± 2.7	0.06
Resting SBP (mm/hg)	124.6 ± 14.3	0.04
Resting DBP (mm/hg)	81.3 ± 9.0	0.00
Serum Triglycerides (mg/dL)	139.0 ± 87.3	-0.02
Total Cholesterol (mg/dL)	197.1 ± 40.1	0.02
HDL (mg/dL)	51.4 ± 12.6	-0.06
LDL (mg/dL)	117.5 ± 34.0	0.05
CHL/HDL	3.9 ± 1.0	0.01
Uric Acid (mg/dL)	4.8 ± 1.2	0.08
Glucose (mg/dL)	99.2 ± 21.9	0.03
BUN (mg/dL)	13.6 ± 5.7	-0.04
Creatinine (mg/dL)	0.9 ± 1.4	-0.06
BUN/Cre	16.3 ± 4.9	-0.08
BMC (g)	1792.0 ± 276.1	0.12
BMD (g/cm^2)	1.0 ± 0.1	0.05

EFFECTS OF EXERCISE, WEIGHT LOSS, AND DIET TYPE ON LEPTIN IN SEDENTARY WOMEN

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Abstract

Circulating levels of leptin are directly associated with the proportion of body fat and is a gauge of the body's energy reserves. Due to leptin being secreted by adipose tissue, obese individuals have been shown to have higher circulating levels. Weight loss, particularly fat loss, has been shown to reduce the circulating levels of this hormone, however, the influence of exercise and/or type of diet on levels of circulating leptin remains unclear. **PURPOSE**: To determine the effect of two different isocaloric diets, one high in carbohydrate, while the other high in protein, on circulating levels of leptin on previously sedentary obese women. **METHODS**: 308 sedentary women (44.0±12 yrs; 92.0±17 kg; 44±5 % fat) served as controls (C, n=24), participated in an exercise program (E, n=16), or performed the exercise program while maintaining a high carbohydrate (HC, n=110) or high protein diet (HP, n=158). Diets consisted of 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9-wks. Diets were 55% CHO, 15% P, and 30% F (HC) or 7-15% CHO, 55-63% P, and 30% F (HP). Exercise groups participated in a supervised fitness program (3-d/wk) that involved 30 min. of circuit-style resistance training interspersed with callisthenic exercises. Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks and were analyzed by MANOVA with repeated measures, one-way ANOVA, and Pearson product bivariate correlation analysis. Data are presented as means ± SD changes from baseline for the C, E, HC, and HP groups, respectively. **RESULTS**: Subjects in the HP group experienced significantly greater loss in body mass (-0.4±2.1; -0.9±2.5; -3.5±3.6; -4.4±3.5 kg, p=0.000); fat mass (-0.6±1.7; -1.1±2.1, -2.3±2.2; -3.4±2.7 kg, p=0.01); and leptin levels (-5+18; -11+22; -9+28; -22+36 ng/mL, p=0.000). Changes in waist circumference were greater in the E, HC, and HP groups (-0.1±1.3; -1.9±2.4; -1.0±3.6; -1.9±2.8 in, p=0.000). While time effects were observed, no significant differences were observed among groups in changes in uric acid, blood lipids (total CHL, LDL, HDL, TG), or resting energy expenditure (REE). Changes in leptin significantly and positively correlated with changes in body mass (r=0.36), fat mass (r=0.35), FFM (r=0.28), waist circumference (r=0.17), and REE (r=0.19) while negatively correlating with the glucose insulin ratio (r=-0.23). **CONCLUSION**: A HP diet during exercise training promotes more favorable changes in serum leptin and weight loss. Moreover, changes in leptin are correlated with indices of weight loss and REE.

Supported by Curves International, Waco, TX

Rationale

Leptin is a cytokine protein secreted from adipose tissue that has been positively associated with fat mass in both lean and obese individuals. Leptin has a large role in energy metabolism and is a strong sensor of energy balance in the body. Subtle changes in energy balance can have profound effects on leptin levels. For example, a decrease in weight of 10% can result in a 53% reduction in leptin levels while a 10% increase in body weight can result in a 300% increase in leptin levels. However, leptin can also inhibit appetite and increase energy expenditure. Leptin may also be up-regulated by insulin and glucocorticoids, which could be due to the relationship between serum levels and meal timing. Higher protein and carbohydrate diets have been reported to differentially affect weight loss. Theoretically, this may have differential affects on leptin levels. The purpose of this study was to determine the effect of two different isocaloric diets, one higher in carbohydrate and the other higher in protein, on circulating levels of leptin in sedentary obese women initiating an exercise and weight loss program.

Experimental Design

- Subjects were informed as to the experimental procedures and signed informed consent statements in adherence with the human subject guidelines of Texas A&M University.
- 308 sedentary women (44±12 yrs; 92±17 kg; 44±5 % fat) participated in this study.
- Subjects were assigned to a control group (C, n=24), exercise group (E, n=16), exercise and high carbohydrate diet group (HC, n=110), or an exercise and high protein diet group (HP, n=158).
- Diets involved consuming 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9-wks.
  - High carbohydrate diet (HC) consisted of 55% CHO, 15% PRO and 30% FAT
  - High protein diet (HP) consisted of 7-15% CHO, 55-63% PRO, and 30% FAT
- Subjects in the exercise groups participated in a supervised 30-min resistance circuit training program that was interspersed with callisthenic exercises and performed 3 days/week for the entire duration of the study.

Methods & Procedures

Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks.

Statistical Analysis

Data were analyzed by repeated measures MANOVA, one-way ANOVA, and Pearson product bivariate correlation analysis using SPSS for Windows version 18 software (Chicago, IL) and are presented as means ± SEM changes from baseline.

Results

- Subjects in the HP group experienced significantly greater loss in body mass (-0.4±2.1; -0.9±2.5; -3.5±3.6; -4.4±3.5 kg, p=0.000); fat mass (-0.6±1.7; -1.1±2.1, -2.3±2.2; -3.4±2.7 kg, p=0.01); and leptin levels (-5+18; -11+22; -9+28; -22+36 ng/mL, p=0.000).
- Changes in waist circumference were greater in the E, HC, and HP groups (-0.1±1.3; -1.9±2.4; -1.0±3.6; -1.9±2.8 in, p=0.000).
- While time effects were observed, no significant differences were observed among groups in changes in uric acid, blood lipids (total CHL, LDL, HDL, TG), or resting energy expenditure (REE).
- Changes in leptin significantly and positively correlated with changes in body mass (r=0.36), fat mass (r=0.35), FFM (r=0.28), waist circumference (r=0.17), and REE (r=0.19) while negatively correlating with the glucose insulin ratio (r=-0.23).

Conclusions

A HP diet during exercise training promotes more favorable changes in serum leptin and weight loss. Moreover, changes in leptin are correlated with indices of weight loss and REE.

Acknowledgements

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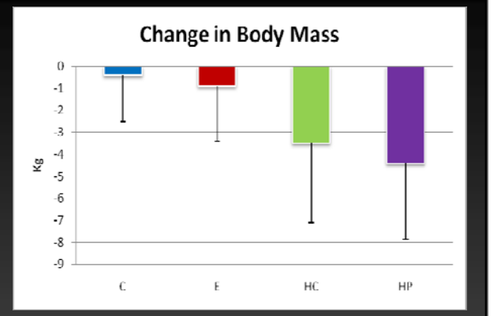

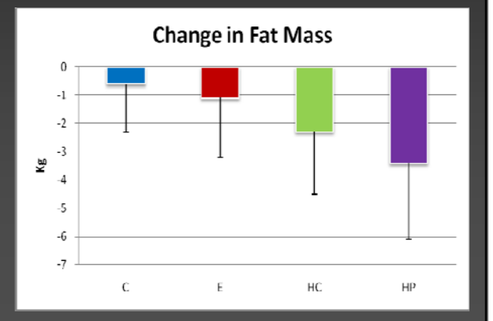

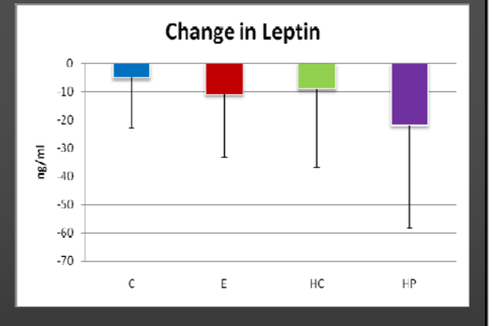

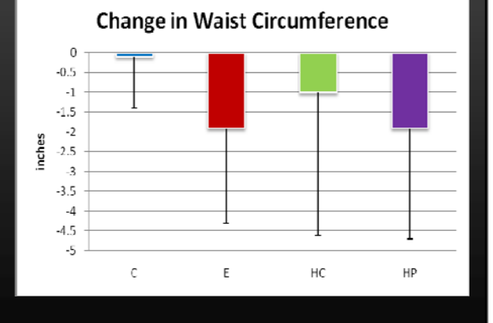

EFFECTS OF A HIGH PROTEIN DIET ON WEIGHT LOSS AND LEPTIN LEVELS IN SEDENTARY WOMEN WITH NORMAL AND ELEVATED LEPTIN

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Abstract

We have previously shown that a diet high in protein provides a greater reduction in leptin levels for individuals when combined with exercise. PURPOSE: The purpose of this study was to determine whether sedentary women with higher than normal leptin levels (> 30 ng/mL) experience greater benefits from an exercise and weight loss program. In addition, to determine whether macronutrient composition of isocaloric diets promote differential effects. METHODS: 208 sedentary women (44±12 yrs; 92±17 kg; 44±5 % fat) participated in an exercise program while maintaining a higher carbohydrate (HC, n=86) or high protein diet (HP, n=122). Diets consisted of 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks. Diets were 55% CHO, 15% P, and 30% F (HC) or 7-15% CHO, 55-63% P, and 30% F (HP). Exercise groups participated in a supervised fitness program (3-d/wk) that involved 30 min of circuit-style resistance training interspersed with callisthenic exercises. Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks. Subjects were stratified into normal fasting leptin levels (<30 ng/mL, n=56) or elevated leptin levels (>30 ng/mL, n=152), Data were analyzed by MANOVA and are presented as mean ± SD changes from baseline. RESULTS: Leptin levels in the NL group (20±5 ng/mL) were significantly lower than the HL group (98±60 ng/mL). Diet and training significantly decreases weight, fat mass, body fat, and leptin levels. Subjects in the HL/HP experienced greater reductions in leptin levels than remaining groups (HL/HP -33±40; NL/HP -1±12; HL/HC -12±35; NL/HC -0.3±8 ng/mL, p=0.053). Subjects in the HP group experienced greater weight loss (HP/NL -4.3±3.1; HP/HL –4.3±3.7; HC/NL -3.3±2.6; HC/HL -3.0±73.2 kg, p=0.03); fat loss (HP/NL -3.5±2.3; HP/HL -3.3±2.8; HC/NL -2.2±2.3; HC/HL -2.3±2.2 kg, p=0.005); and, tended to lose more body fat (HP/NL -2.1±2.1; HP/HL -1.8±2.0; HC/NL -1.3±2.7; HC/HL -1.5±1.7, p=0.11) with no significant differences between subjects with normal and elevated leptin. CONCLUSION: Adherence to a HP diet during a circuit-training program promoted greater reductions in weight and fat loss. Individuals following a HP diet with elevated leptin levels (>30 ng/mL) experienced the greatest reduction in leptin levels with no additive effects on weight or fat loss.

Supported by Curves International, Waco, TX

Rationale

Leptin is a cytokine protein secreted from adipose tissue that has been positively associated with fat mass in both lean and obese individuals. Leptin has a large role in energy metabolism and is a strong sensor of energy balance in the body. Subtle changes in energy balance can have profound effects on leptin levels. For example, a decrease in weight of 10% can result in a 53% reduction in leptin levels while a 10% increase in body weight can result in a 300% increase in leptin levels. However, leptin can also inhibit appetite and increase energy expenditure. Leptin may also be up-regulated by insulin and glucocorticoids, which could be due to the relationship between serum levels and meal timing.

We have previously reported that a diet high in protein provides a greater reduction in leptin levels for individuals when combined with exercise. If this is the case, individuals with higher than normal leptin levels prior to participation in an exercise and weight loss program may experience greater benefits from a high protein weight loss diet during an exercise program. The purpose of this study was to examine whether individuals with higher than normal leptin levels would benefit to a greater degree from a higher protein or higher carbohydrate diet plan when combined with a structured circuit style resistance training program compared to those with normal levels.

Experimental Design

- Subjects were informed as to the experimental procedures and signed informed consent statements in adherence with human subject guidelines.
- 208 sedentary obese women (44 ±12 yrs; 92 ± 17 kg; 44 ± 5 % body fat) participated in this study.
- Subjects maintained either a high protein (HP, n=122); or, a high carbohydrate diet (HC, n=86).
- The diets involved consuming 1,200 kcal/d for 1-wk and 1,600 kcal/d for the following 9 wks.
  - High carbohydrate diet (HC) consisted of 55% CHO, 15% PRO and 30% Fat
  - High protein diet (HP) consisted of 7-15% CHO, 55-63% PRO, and 30% FAT
- Subjects participated in a supervised 30-min resistance circuit training program that was interspersed with calisthenic exercises and performed 3-d per week for the entire duration of the study.
- Subjects were further stratified into normal fasting leptin levels (<30ng/ml, n = 56, [NL]) or elevated leptin levels (>30 ng/ml, n = 152, [HL]).

Methods & Procedures

Body mass, DEXA body composition, anthropometic measurements, resting blood pressures, and fasting blood samples were obtained at 0 and 10 weeks.

Statistical Analysis

Data were analyzed by MANOVA with repeated measures using SPSS for Windows version 17.0 software (Chicago, IL) and are presented as means ± SD % change from baseline for each group (NL, HL, HC, and HP) at week 10 of the study.

Results

- Leptin levels (20 ± 5 ng/ml) were significantly lower in the NL group compared to the HL group (98 ± 60 ng/ml).
- Subjects in the HL/HP experienced greater reductions in leptin levels than remaining groups (HL/HP -33±40; NL/HP -1±12; HL/HC -12±35; NL/HC -0.3±8 ng/mL, p=0.053).
- Subjects in the HP group experienced greater weight loss (HP/NL -4.3±3.1; HP/HL –4.3±3.7; HC/NL -3.3±2.6; HC/HL -3.0±7.32 kg, p=0.03); fat loss (HP/NL -3.5±2.3; HP/HL -3.3±2.8; HC/NL -2.2±2.3; HC/HL -2.3±2.2 kg, p=0.005); and, tended to lose more body fat (HP/NL -2.1±2.1; HP/HL -1.8±2.0; HC/NL -1.3±2.7; HC/HL -1.5±1.7, p=0.11) with no significant differences between subjects with normal and elevated leptin.

Conclusions

- Consuming a hypocaloric diet higher in protein while participating actively in a 10-wk circuit resistance training program may promote greater reductions in weight and fat loss.
- Individuals with elevated leptin levels (>30 ng/mL) may experienced a greater reduction in leptin levels while following a high protein diet with no additive effects on weight or fat loss.

Practical Application

Obese individuals with high leptin levels can benefit from a high protein diet when combined with an exercise regime which may help with issues of weight management and healthy living.

Acknowledgements

We would like to thank Terri Magrans-Courtney, Donovan Fogt, Jen Bunn, Chad Kerksick, Bill Campbell, Colin Wilborn, Melyn Galbreath, Rui Li, Jean Jitomir, and Mike Greenwood who assisted in data collection when the ESNL was located at Baylor University.

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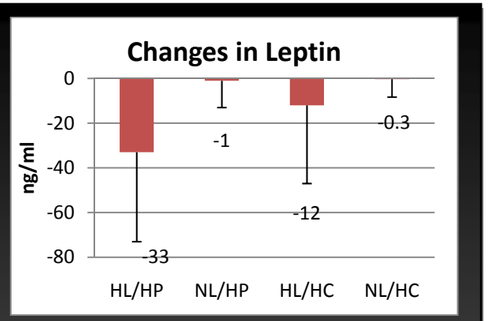

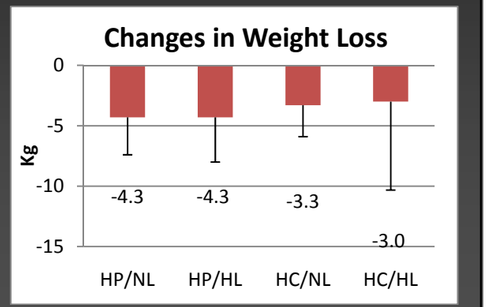

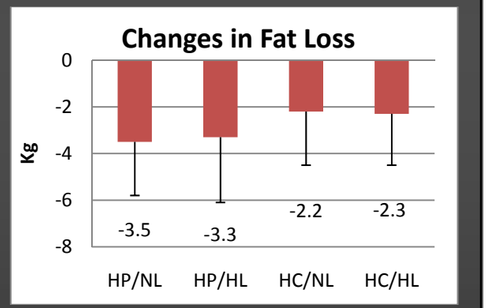

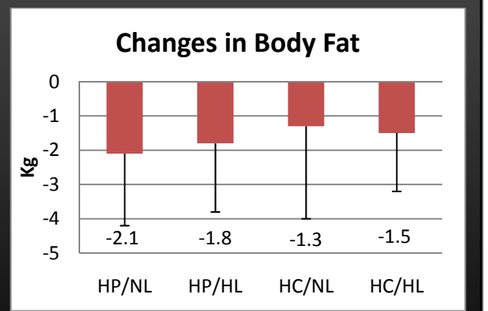

COMPARISON OF TWO DIFFERENT DIET PROGRAMS ON FASTING INSULIN LEVELS IN SEDENTARY OBESE WOMEN PARTICIPATING IN RESISTANCE TRAINING

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Exercise & Sport Nutrition Lab

Abstract

For years it was suggested that for weight loss, in addition to caloric restriction, fat intake should be reduced and carbohydrate intake increased. However, recent research has suggested macronutrient adjustments in diet may have substantial effects on weight loss and insulin sensitivity, particularly when a diet includes greater protein intake. Many health related benefits have been shown in the absence of weight loss. PURPOSE: To compare the effects of two different isocaloric diets, one higher in carbohydrate, the other higher in protein, on fasting insulin levels in previously sedentary obese women participating in a resistance training program. METHODS: 379 sedentary women (44.6±12.5 yrs; 90.1±16.0 kg; 31.2±2.0 % fat) served as controls (C, n=59), participated in an exercise program (E, n=18), or performed the exercise program while maintaining a higher carbohydrate (HC, n=136) or higher protein diet (HP, n=146). Diets consisted of 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks. Diets were 55% CHO, 15% P, and 30% F (HC) or 7-15% CHO, 55-63% P, and 30% F (HP). Exercise groups participated in a supervised fitness program (3-d/wk) that involved 30 min of circuit-style resistance training interspersed with callisthenic exercises. Fasting blood samples were taken at baseline and 10 wks to compare insulin levels in response to diets combined with exercise. Data were analyzed using MANOVA, univariate ANOVA, and one-way ANOVA. RESULTS: Subjects in the HP group experienced significantly greater changes over time in body weight (HP =-4.4 kg, HC=-2.6 kg, E=-1.1 kg and C=-2.2 kg, p=0.00), fat mass (HP=-3.4 kg, HC=-1.7 kg, E=-0.8 kg, C=-1.8 kg, p=0.00), and percent body fat (HP=-0.9, HC=-0.5, E=-0.3, C=-0.6, p=0.01). Lean tissue mass decreased slightly over time when calculated as a percent of total weight loss, with HP and HC groups having greater losses (HP=20.1 %, HC=22.3 %, E=17.3 % , C=17.9 %, p=0.01). There were no significant interactions seen between types of diet for insulin (p=0.69) or HOMA (p=0.54) levels. For insulin, there was no effect over time, however the HP group had lower levels than HC and C with mean differences of -4.0 mg/dL (p=0.00) and -9.1 mg/dL (p=0.00), respectively. A similar result was found for HOMA levels with the HP group having lower levels than HC and C with mean differences of -0.98 (p=0.01) and -2.48 (p=0.00), respectively. CONCLUSIONS: A diet higher in protein promotes greater losses in body weight, fat mass, and body fat percentage. Additionally, a diet higher in protein maintained lower insulin and HOMA levels compared to other groups. However, lean tissue mass decreased to a greater degree as well.

Supported by Curves International Inc., Waco, TX

Rationale

Decreasing calories and fat intake has been shown to have a beneficial effect on weight loss and markers of health in previously obese individuals. However, the macronutrient composition of a restricted calorie diet has gained more interest in recent years. Previous recommendations have included increasing carbohydrate intake with the reduction of calories and fat. However, recent evidence suggests that a diet high in protein may have significant effects on markers of health when compared to one high in carbohydrates.

Researchers in the Exercise & Sport Nutrition Laboratory have been conducting a number of studies to assess the safety and efficacy of the Curves fitness and weight loss program in women. Participants follow a high protein or high carbohydrate diet while participating in a a 30-minute hydraulic resistance circuit training program 3 days per week. The purpose of this study was to determine whether following a higher protein or higher carbohydrate diet while participating in an exercise program has differential effects on markers on insulin sensitivity in previously sedentary obese women.

Experimental Design

Subjects

- 379 sedentary women (44.6±12.5 yrs, 90.1±16.0 kg, 31.2±2.0 %fat) were informed as to the experimental procedures and randomly assigned to one of four groups (Control (C, n = 59), Exercise (E, n = 18), Exercise + High Carbohydrate Diet (HC, n = 136), Exercise + High Protein Diet (HP, n = 146))

Diet Protocol

- The diets involved consuming 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks.
  - The high carbohydrate diet (HC) consisted of 55% CHO, 15% protein, 30% fat; while the
  - High protein diet (HP) consisted of 7-15% CHO, 55-63% protein, 30% fat

Exercise Program

- Subjects participated in a supervised 30-min resistance circuit training program that was interspersed with calisthenic exercises and performed 3-d per week for the entire duration of the study.

Methods & Procedures

- Body mass, DEXA body composition, anthropometic measurements, and fasting blood samples were obtained at 0 and 10 weeks.

Statistical Analysis

- Data were analyzed by MANOVA, univariate ANOVA, and one-way ANOVA with repeated measures using SPSS for Windows version 16.0 software (Chicago, IL) and are presented as means±SD.

Results

- After 10 weeks, subjects in the HP group experienced significantly greater changes over time in body weight (HP =-4.4±3.6 kg, HC=-2.6±2.9 kg, E=-1.1±2.0 kg and C=-2.2±3.7 kg, p=0.00), fat mass (HP=-3.4±2.7 kg, HC=-1.7±2.0 kg, E=-0.8±1.9 kg, C=-1.8±3.3 kg, p=0.00), and percent body fat (HP=-0.9±1%, HC=-0.5±.9%, E=-0.3±.8%, C=-0.6±1.2%, p=0.01).
- When calculated as a percent of total weight loss, HP and HC lost more lean tissue mass (HP=20.1 %, HC=22.3 %, E=17.3 % , C=17.9 %).
- There were no significant interactions seen between types of diet for insulin (p=0.69) or HOMA (p=0.54) levels.
- For insulin, there was no effect over time, however the HP group had lower levels than HC and C with mean differences of -4.0 mg/dL (p=0.00) and -9.1 mg/dL (p=0.00), respectively.
- A similar result was found for HOMA levels with the HP group having lower levels than HC and C with mean differences of -0.98 (p=0.01) and -2.48 (p=0.00), respectively.

Conclusions

- A diet high in protein promotes greater losses in body weight, fat mass, and body fat percentage while participating in the Curves resistance training program.
- Additionally, a higher protein diet maintains a lower insulin and HOMA level compared to other diets.

Acknowledgements

We would like to thank Terri Mangrans-Courtney, Donovan Fogt, Jen Bunn, Chad Kerksick, Bill Campbell, Colin Wilborn, Melyn Galbreath, Rui Li, and Jean Jitomir who assisted in data collection.

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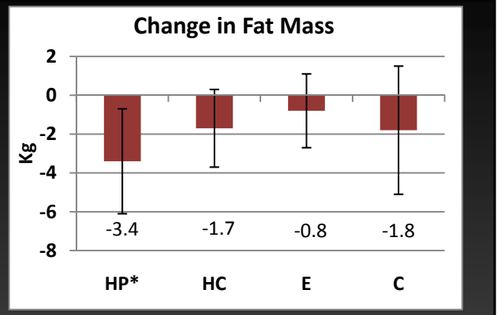

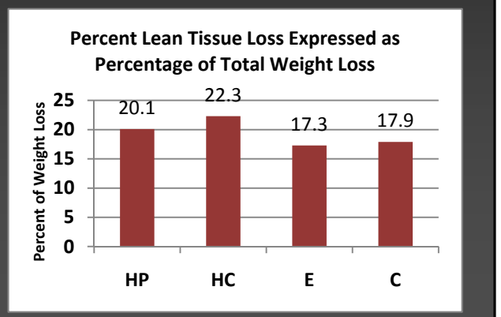

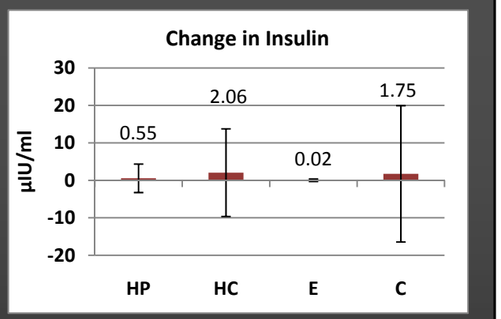

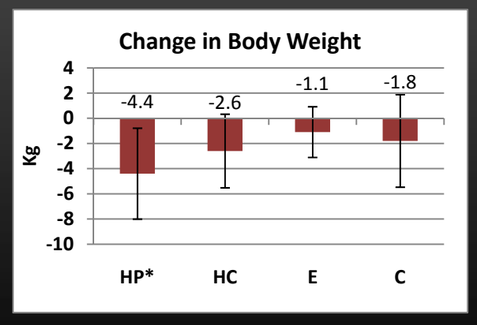

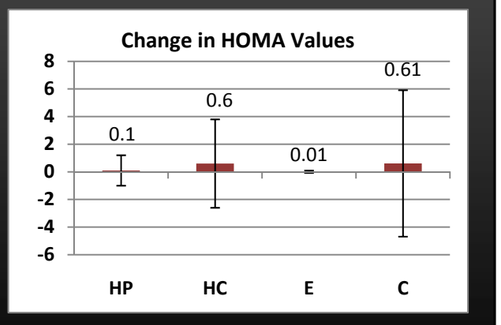

EFFECTS OF A HIGH PROTEIN DIET ON WEIGHT LOSS AND BODY COMPOSITION IN SEDENTARY WOMEN WITH NORMAL AND ELEVATED BLOOD GLUCOSE LEVELS

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Exercise & Sport Nutrition Lab

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Abstract

Elevated glucose levels and insulin resistance are associated with obesity. HP diets and resistance-training have been reported to improve markers of insulin sensitivity. PURPOSE: This study examined whether sedentary women with higher than median glucose levels (> 96 mg/dL) experience greater benefits from an exercise and weight loss program, and to determine whether macronutrient composition of isocaloric diets promote differential effects. METHODS: 170 sedentary women (44±12 yrs; 92±17 kg; 44±5 % fat) participated in an exercise program while maintaining a higher carbohydrate (HC, n=64) or higher protein diet (HP, n=106). Diets consisted of 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks. Diets were 55% CHO, 15% P, and 30% F (HC) or 7-15% CHO, 55-63% P, and 30% F (HP). Exercise groups participated in a supervised fitness program (3-d/wk), a 30 min of circuit-style resistance training interspersed with callisthenic exercises. Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks. Subjects were stratified into lower than median (LM, n=115) and higher than median (HM, n=55) glucose levels. Data were analyzed by MANOVA and presented as mean ± SD changes from baseline. RESULTS: Glucose levels in the LM group were significantly lower than the HM group (LM 90±8; HM 106±7, mg/dL, p=0.000). Diet and training significantly decreases weight, fat mass, body fat, and glucose levels while significantly increasing HOMA. Subjects in the HP group experienced greater weight loss (-3.0±1.3 lbs, p=0.02) and fat loss (-1.26±0.4 kg, p=0.003); less increase in HOMA (-0.52±0.18, p=0.004); lose more body fat (-0.6±0.3 %, p=0.08); with no difference in changes in fasting glucose (0.37±1.8 mg/dL, p=0.84). No differences were observed between types of diet based on stratifying subjects on median glucose values. A diet x median glucose interaction was observed in changes in fat free mass (HP/LM -1.0±1.9; HP/HM -0.01±1.8; HC/LM -0.20±1.8; HC/HM -0.5±1.6 kg, p=0.05). Although some trends were observed, no differences were seen among groups in changes in weight loss fat loss (HP/LM -4.6±3.9; HP/HM -4.0±2.7; HC/LM -2.7±3.0; HC/HM -3.1±2.0 kg, p=0.37); fat loss (HP/LM -3.4±2.8; HP/HM -3.3±2.4; HC/LM -2.1±2.0; HC/HM -2.0±2.2 kg, p=0.72); or, HOMA (HP/LM 0.13±0.6; HP/HM -0.12±1.1; HC/LM 0.42±0.9; HC/HM 0.62±2.0, p=0.21). CONCLUSION: A HP diet promotes more favorable changes in weight and fat loss during a circuit training program but did not preserve FFM in the HP/LM group with the greatest weight loss. Individuals with higher than median glucose levels did not experience greater benefits.

Supported by Curves, International, Waco TX.

Rationale

Elevated glucose levels and insulin resistance are associated with obesity. Additionally, loss of fat free mass (FFM) as one ages has also been associated with insulin resistance, glucose intolerance, and/or diabetes mellitus. Increasing dietary intake of protein and resistance training have been reported to maintain and/or increase FFM, improve insulin sensitivity, and help manage blood glucose. Theoretically, individuals with higher blood glucose levels may see a greater impact of an exercise and high protein weight loss program. The purpose of this study was to examine whether women stratified with higher and lower blood median glucose levels experienced differential effects from a following a higher carbohydrate or higher protein weight loss and exercise program.

Experimental Design

Subjects

- 170 sedentary women (44±12yrs; 92±17 kg; 43±5% body fat) participated in this study.
- Subjects were informed as to the experimental procedures and signed informed consent statements in adherence with the human subject guidelines of Texas A&M University.

Diet Protocol

- Based on baseline testing, subjects were assigned to:
  - a high carbohydrate (HC, n=64) (55% CHO, 15% PRO, 30% F); or,
  - a high protein diet (HP, n=106) (7-15% CHO, 55-63% PRO, 30% F)
- The diets involved consuming 1,200kcal/day for 1 week and 1,600 kcal/day for 9 weeks.
- Subjects were required to maintain the diet for the duration of the study.

Training Protocol

- Subjects participated in a supervised 30-min resistance training circuit program that was interspersed with calisthenic exercises and performed 3 days/week for the entire duration of the study.

Methods & Procedures

- DEXA body composition and fasting blood samples were obtained at 0 & 10 weeks.
- Subjects were stratified into lower than median (LM, n=115) and higher than median (HM, n=55) glucose levels.

Statistical Analysis

- Data were analyzed by MANOVA with repeated measures using SPSS for Windows version 18 software (Chicago, IL) and are presented as means ± SD changes from baseline..

Results

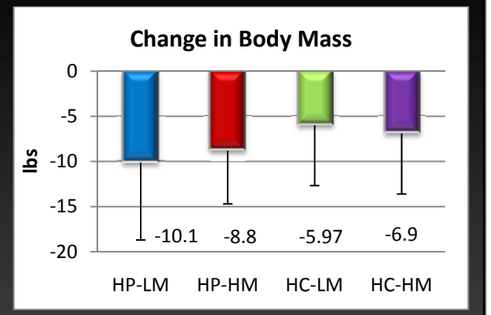
- Glucose levels in the LM group were significantly lower than the HM group (LM 90±8; HM 106±7, mg/dL, p=0.000).
- Diet and training significantly decreases weight, fat mass, body fat, and glucose levels while significantly increasing HOMA.
- Subjects in the HP group experienced greater weight loss (3.0±1.3 lbs, p=0.02) and fat loss (-1.26±0.4 kg, p=0.003); less increase in HOMA (-0.52±0.18, p=0.004); lost more body fat (0.6±0.3 %, p=0.08); with no difference in changes in fasting glucose (0.37±1.8 mg/dL, p=0.84).
- No differences were observed between types of diet based on stratifying subjects on median glucose values.
- A diet x median glucose interaction was observed in changes in fat free mass (HP/LM -1.0±1.9; HP/HM -0.01±1.8; HC/LM -0.20±1.8; HC/HM -0.5±1.6 kg, p=0.05).
- Although some trends were observed, no differences were seen among groups in changes in weight loss (HP/LM -4.6±3.9; HP/HM -4.0±2.7; HC/LM -2.7±3.0; HC/HM -3.1±2.0 kg, p=0.37); fat loss (HP/LM -3.4±2.8; HP/HM -3.3±2.4; HC/LM -2.1±2.0; HC/HM -2.0±2.2 kg, p=0.72); or, HOMA (HP/LM 0.13±0.6; HP/HM -0.12±1.1; HC/LM 0.42±0.9; HC/HM 0.62±2.0, p=0.21).

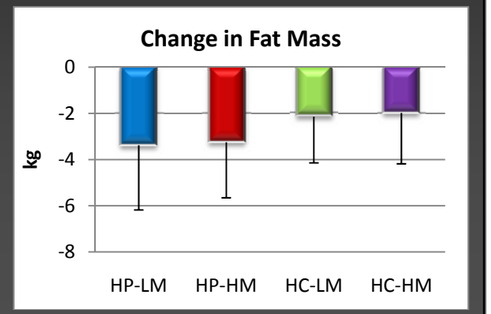
Conclusions

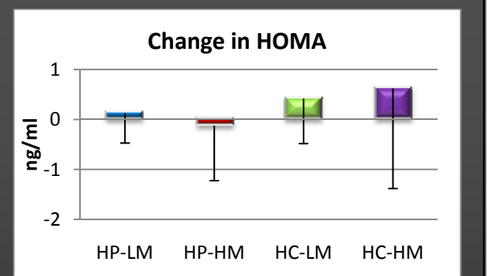
- A HP diet promotes more favorable changes in weight and fat loss during a circuit training program but did not preserve FFM in the HP/LM group with the greatest weight loss.
- Individuals with higher than median glucose levels did not experience greater benefits.

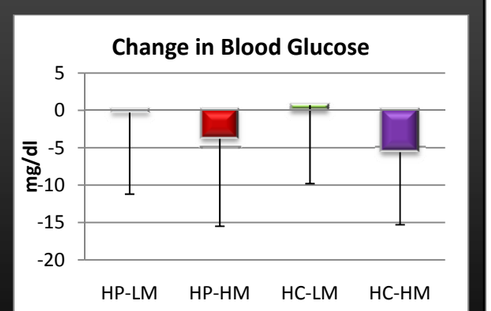
Acknowledgements & Funding

We would like to thank Terri Magrans-Courtney, Donovan Fogt, Jen Bunn, Chad Kerksick, Bill Campbell, Colin Wilborn, Melyn Galbreath, Rui Li, Jean Jitomir, and Mike Greenwood who assisted in data collection when the ESNL was located at Baylor University. This study was supported by Curves International Inc., Waco, TX









EFFECTS OF A HIGH PROTEIN DIET ON WEIGHT LOSS AND BODY COMPOSITION IN SEDENTARY WOMEN WITH NORMAL INSULIN SENSITIVITY AND INSULIN RESISTANCE

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Abstract

The homeostatic model assessment (HOMA) has been used as a measure of insulin sensitivity and resistance. Insulin resistance (IR) has been associated with obesity. Higher protein diets and resistance-training have been reported to help maintain fat free mass (FFM) and improve markers of insulin sensitivity. **PURPOSE**: This study examined whether sedentary women with elevated HOMA levels (> 3.5) experience greater benefits from an exercise and weight loss program. In addition, the purpose is to determine whether macronutrient composition of isocaloric diets promote differential effects. **METHODS**: 181 sedentary women (44±12 yrs; 92±17 kg; 44±5 % fat) participated in an exercise program while maintaining a higher carbohydrate (HC, n=66) or higher protein (HP, n=115) diet. Diets consisted of 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks. Diets were 55% CHO, 15% P, and 30% F (HC) or 7-15% CHO, 55-63% P, and 30% F (HP). Exercise groups participated in a supervised fitness program (3-d/wk) that involved 30 min of circuit-style resistance training interspersed with callisthenic exercises. Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks. Subjects were stratified into groups of less than (LH, n=163) and higher than (HH, n=55) 3.5 HOMA. Data were analyzed by MANOVA. **RESULTS**: HOMA levels in the LH group were significantly lower than the HH group (LH 0.6±0.8; HH 6.7±3.7, p=0.000). Diet and training significantly decreased (M±SEM) body weight (-3.6±0.4 kg, p=0.001), fat mass (-2.7±0.3 kg, p=0.001), body fat (-1.7±0.2 %, p=0.001, and glucose levels (-8.2±2.7 mg/dL, p=0.001), while not significantly affecting FFM (-0.38±0.23 kg, p=0.10), and HOMA (0.20±0.16, p=0.22). HOMA increased to a greater degree in the HP group (1.48±0.4) while glucose decreased to a greater degree in the HH group (-13.3±5 mg/dL). A significant diet x HOMA interaction (M±SD) was observed in glucose (HP/LH -0.9±15; HP/HH -27±60; HC/LH -2.3±10; HC/HH -3.1±21 mg/dL, p=0.02) with no differences observed among groups in changes in weight loss (HP/LH -4.3±3.7; HP/HH -3.9±2.2; HC/LH -2.8±3.1; HC/HH -3.1±2.2 kg, p=0.73); fat loss (HP/LH -3.3±2.7; HP/HH -3.0±2.2; HC/LH -2.1±2.1; HC/HH -2.3±1.8 kg, p=0.64); FFM (HP/LH -0.8±1.9; HP/HH -0.4±2.1; HC/LH -0.30±1.8; HC/HH 0.08±0.9 kg, p=0.98); or, HOMA (HP/LH 0.10±0.7; HP/HH 0.32±3.4; HC/LH 0.54±1.4; HC/HH -0.17±1.7, p=0.16). **CONCLUSION**: A HP diet during resistance training promotes more favorable changes in HOMA and individuals with higher HOMA values experience a greater reduction in fasting glucose levels. Supported by Curves International, Waco, TX

Rationale

The homeostatic model assessment (HOMA) is a method used to quantify insulin resistance and sensitivity. Insulin resistance (IR) is a physiological condition which becomes less effective at lowering blood glucose and which is associated with obesity excessive fat is accumulated to body. High protein diet has been shown to help facilitate muscle protein synthesis and increase fat free mass (FFM). In addition, resistance-training is a method of exercises used to develop the strength and size of muscles. These two factors have been reported to help maintain FFM and improve markers of insulin sensitivity.

Experimental Design

- Subjects were informed as to the experimental procedures and signed informed consent statements in adherence with the human subject guidelines of Texas A&M University.
- 181 sedentary women (44±12 yrs; 92±17 kg; 44±5 % fat) participated in this study.
- Subjects were assigned to a high protein group (HP, n=115); or, a high carbohydrate group (HC, n=66).
- Subjects were required to maintain the diet for the duration of the study.
- The diets involved consuming 1,200 kcal/d for 1-wk and 1,600 kcal/d for 9 wks.
  - High carbohydrate diet (HC) consisted of 55% CHO, 15% PRO and 30% FAT
  - High protein diet (HP) consisted of 7-15% CHO, 55-63% PRO, and 30% FAT
- Subjects participated in a supervised 30-min resistance circuit training program that was interspersed with calisthenic exercises and performed 3 days/week for the entire duration of the study.
- Subjects were stratified into groups of less than (LH, n=163) and higher than (HH, n=55) 3.5 HOMA

Methods & Procedures

Fasting blood samples, body mass, and DEXA body composition measurements were obtained at 0 & 10 wks.

Statistical Analysis

Data were analyzed by repeated measures MANOVA using SPSS for Windows version 18 software (Chicago, IL) and are presented as means ± SEM changes from baseline.

Results

- HOMA levels in the LH group were significantly lower than the HH group (LH 0.6±0.8; HH 6.7±3.7, p=0.000).
- Diet and training significantly decreased (M±SEM) body weight (-3.6±0.4 kg, p=0.001), fat mass (-2.7±0.3 kg, p=0.001), body fat (-1.7±0.2 %, p=0.001, and glucose levels (-8.2±2.7 mg/dL, p=0.001), while not significantly affecting FFM (-0.38±0.23 kg, p=0.10), and HOMA (0.20±0.16, p=0.22).
- HOMA increased to a greater degree in the HP group (1.48±0.4) while glucose decreased to a greater degree in the HH group (-13.3±5 mg/dL).
- A significant diet x HOMA interaction (M±SD) was observed in glucose (HP/LH -0.9±15; HP/HH -27±60; HC/LH -2.3±10; HC/HH -3.1±21 mg/dL, p=0.02) with no differences observed among groups in changes in weight loss (HP/LH -4.3±3.7; HP/HH -3.9±2.2; HC/LH -2.8±3.1; HC/HH -3.1±2.2 kg, p=0.73); fat loss (HP/LH -3.3±2.7; HP/HH -3.0±2.2; HC/LH -2.1±2.1; HC/HH -2.3±1.8 kg, p=0.64); FFM (HP/LH -0.8±1.9; HP/HH -0.4±2.1; HC/LH -0.30±1.8; HC/HH 0.08±0.9 kg, p=0.98); or, HOMA (HP/LH 0.10±0.7; HP/HH 0.32±3.4; HC/LH 0.54±1.4; HC/HH -0.17±1.7, p=0.16).

Conclusions

A HP diet during resistance training promotes more favorable changes in HOMA and individuals with higher HOMA values experience a greater reduction in fasting glucose levels.

Funding

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