Effects of exercise and diet-induced weight loss on markers of inflammation I: impact on body composition and markers of health and fitness

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Background

The purpose of this study was to determine the effects of participating in a resistance-exercise based circuit training program while adhering to a higher protein diet designed to preserve fat free mass (FFM) during weight loss on body composition and markers of health. Then, in a companion paper, determine if exercise and diet-induced weight loss affect markers of inflammation.

Methods

48 sedentary women (48.2±10.5 yr, 45.9±4.4% body fat, 35.6±5.6kg/m^2) were randomized to participate in the Curves® weight loss and exercise program (EX, n=28) or control group (C, n=20) for 12-wks. Participants followed an energy-restricted diet (1,200 kcal/d for 1-week and 1,500 kcal/d for 11 weeks; 30% CHO, 45% P, and 25% F) while participating in a circuit resistance-training (4 d/wk) program. On one of the four exercise days, Zumba® dance was interspersed with the circuit resistance stations, wherein participants completed 60 seconds of resistance exercise followed by 60 seconds of dance. On the other three days of the 4 d/wk program, the workout included 30 seconds of resistance-exercise interspersed with 30 seconds of continuous movement (calisthenics, dance, etc.). DEXA body composition and fasting blood samples were obtained at 0 and 12-wks and analyzed by MANOVA. Data are presented as changes from baseline after 12-wks for the EX and C groups.

Results

Overall MANOVA analysis revealed a significant group x time effect (p=0.004) for body composition measures. Univariate analysis revealed that participants in the EX group experienced greater changes in body weight (EX -4.0±4.4 kg; C 0.1±3.0 kg, p=0.001), fat mass (EX -3.8±4.0 kg; C -0.03±2.0 kg, p<0.001), and percent body fat (EX -2.7±3.4%; C -0.1±1.7%, p=0.002). No differences among groups were observed in FFM (EX -0.2±2.0 kg; C 0.1±2.3 kg, p=0.59). Overall MANOVA analysis revealed a non-significant group x time effect (p=0.21) for blood markers. Although positive trends were observed, univariate analysis revealed no significant differences among groups for triglycerides (EX -6.7±26.4%; C 0.1±24.4%, p=0.37), total cholesterol (EX -3.6±10.0%; C -2.2±10.7%, p=0.65), high density lipoprotein cholesterol (EX 2.5±15.1%; C -5.0±10.5%, p=0.06); low-density lipoprotein cholesterol (EX -4.7±11.5%; C -4.0±16.8%, p=0.86) or blood glucose (EX -0.6±14.5%; C -1.3±8.4%, p=0.85). Overall MANOVA analysis revealed a significant group x time effect (p=0.003) for measures of fitness. Univariate analysis revealed that participants in EX group experienced greater changes in peak oxygen uptake (EX 13.6±17.0%; C -2.2±10.3%, p=0.001) and upper body 1RM strength (EX 8.7±12.5%; C -1.2±13.9%, p=0.016) while no differences were observed among groups in changes in lower body 1-RM strength (EX 15.0±21.9%; C 13.8±23.7%, p=0.86).

Conclusion

Results indicate that 12-wks of participation in the exercise and diet-induced weight loss program involving a structured meal plan and a supervised exercise program promoted weight loss, improvements in body composition, and improvements in some markers of health and fitness. Theoretically, if obesity is associated with inflammation, effective weight loss may lessen levels of inflammation.

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Effects of exercise and diet-induced weight loss on markers of inflammation II: impact on microRNA 21 and microRNA 146a expression and their regulatory role

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Background

Obesity has been associated with inflammation. However, the mechanisms are not well understood. The purpose of this study was to determine if exercise and diet-induced weight loss would affect markers of inflammation via the Phosphatase and Tensin homologue Deleted from Chromosome-10 (PTEN), TNF receptor-associated factor 6 (TRAF6), Phosphatidylinositol-3-kinase (PI3k), Protein Kinase B (AKT or PKB), Nuclear Factor kappa Beta (NF-kB) signaling pathway through the regulation of microRNA 21 and microRNA 146a expression.

Methods

Forty-five overweight and sedentary women (48.16±10.5 yr, 45.9±4.4% body fat, BMI 35.6±5.6 kg/m^2) were randomized into a control group (C, n=18) or an exercise and diet-induced weight loss group (EX, n=27). Participants followed an energy-restricted diet (1,200 kcal/d for 1 week and 1,500 kcal/d for 11weeks; 30% CHO, 45% P, and 25% F) while participating in a circuit resistance-training (3d/wk) program. The resistance training program included 30 seconds of resistance exercise interspersed with 30 seconds of continuous movement (calisthenics). Whole blood samples were obtained at 0 and 12 wks and centrifuged immediately to obtain white blood cells buffy coat for mRNA isolation. The microRNA (21 and 146a) and mRNA of IL-6, TNF-a, (PTEN, TRAF6)/PI3k/AKT/NF-kB signaling pathway expression levels were measured in serum/WBC (buffy coat) by real-time RT-PCR and normalized using ΔΔCt formula with U6B as a normalization control for the microRNAs and Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) as an endogenous control for mRNAs. The ΔΔCt formula, Ct represents the real time cycle number at which microRNA and mRNA probe fluorescence is exponential. Data were analyzed by MANOVA and presented as changes from baseline after 12 wks.

Results

An overall significant MANOVA interaction was observed among EX and C groups (Wilks' Lambda $p<0.001$). MANOVA univariate analysis revealed no significant interactions among groups in changes in microRNA 146a (EX -0.73±2.0; C -0.28±2.1, p=0.46); TRAF6 (EX –1.35±2.7; C -0.74±3.5, p=0.52); mRNA expression levels of PI3K (EX -2.4±4.5; C -1.8±2.9, p=0.66); AKT (EX -1.34±4.2; C -0.67±7.4, p=0.70); or, mRNA NF-kB (EX -1.6±3.2; C -0.73±3.2, p=0.40). Significant interactions were observed among groups in changes in microRNA 21 (EX -1.5±2.34; C 0.13±2.2, p=0.03); mRNA expression level of its target gene PTEN (EX -4.5±3.2; C -1.6±3.4, p=0.005); mRNA IL-6 (EX -2.8±3.6; C 2.8±2.2, p=0.000); and, mRNA TNF-a expression levels (EX -0.52±2.5; C 2.3±1.9, p=0.000). Exercise and diet-induced changes in mRNA IL-6 and mRNA TNF-a expression were positively and significantly correlated to changes in body weight (r=0.47, r=0.30), fat mass (r=0.48, r=0.31), and percent body fat (r=0.48. r=0.32), respectively.

Conclusion

Results of this study indicate that exercise and diet-induced weight loss affects molecular changes in circulating microRNAs, significantly affects microRNA 21 and its target gene PTEN, mRNA TNF-a, and mRNA IL-6 levels suggesting a anti-inflammatory response compared to a control group. These findings suggest that exercise and diet-induced weight loss is significantly associated with a reduction in inflammation. However, more research is needed to understand microRNA regulation associated with inflammation in response to exercise.

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Effects of immediate and delayed nutrient timing following resistance exercise on changes in mixed muscle fractional synthesis rate (FSR) in post-menopausal women participating in a weight loss program

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Background

Ingestion of protein prior to and/or following RE has been reported to stimulate protein synthesis. Moreover, previous research from our lab found that older women who followed a higher protein hypo-energetic diet while participating in a resistance-exercise (RE) program experienced more favorable changes in body composition than those following a higher carbohydrate diet. Theoretically, ingesting protein following RE during a weight loss program may stimulate protein synthesis to a greater degree, therefore helping to preserve and/or increase fat free mass (FFM). The purpose of this study was to investigate the effects of immediate vs. delayed post-exercise intake of a commercially available protein supplement on muscle protein fractional synthesis rate (FSR) prior to and following participation in a RE based exercise and weight loss program in post-menopausal overweight women.

Methods

In a randomized and matched manner, 21 sedentary women (59.8±5 yr, 43.7±3% body fat, 31.0±3 kg/m2) participated in the Curves Complete® (CC) weight loss and circuit resistance-exercise program for 12-wks. Participants followed an energy-restricted diet (1,500 kcal/d; 30% C, 45% P, and 25% F) while participating in a circuit resistance-training (3 d/wk) and walking (10k steps, 4/d wk) program. Participants ingested a drink containing 15 g of protein immediately following (I) or 2-hr after (D) resistance exercise as part of their diet program. DEXA, body composition and muscle FSR were determined prior to and following the exercise and diet intervention. A stable isotope Deuterium Oxide (D2O or 2H2O) ingestion methodology was utilized, and muscle biopsies obtained from the right (pre training) and left (post-training) vastus lateralis muscle in order to assess the effect of nutrient timing on mixed muscle FSR with, or without RE training. The advantage of this methodology is that FSR can be assessed over a 24 h period to determine the influence of exercise and/or nutrient timing on the total daily anabolic response. Data were analyzed by repeated measures MANOVA and ANOVA.

Results

Participants in both groups lost weight (-3.9±3.2 kg, p=000) and fat mass (-4.1±2.4 kg, p=0.000) with no significant differences (mean±SD) observed among groups in weight (I -3.6±2.3; D -4.2±4.2 kg, p=0.68) or fat mass (I -3.5±1.4; D -4.8±3.3, p=0.26). FFM tended to increase (0.5±1.6 kg, p=0.12) with no differences observed among groups (I 0.03±1.7; D 1.11±1.3 kg, p=0.14). Based on prior analyses, no significant nutrient timing x training interactions (mean±SEM) were observed on muscle FSR expressed as a percent/day of the alanine pool (I Pre 13.6±4.3, I Post 21.1±4.3; D Pre 15.6±4.0, D-Post 23.8±4.0 %/d, p=0.93). However, FSR was augmented ($p<0.05$) in response to a bout of RE prior to training (14.6±2.9 %/d) and tended to be 54% higher (p=0.075) in response to a bout of exercise after training when compared to pre-training values (22.5±2.9 %/d).

Conclusions

Results indicate that the exercise and diet program investigated was effective in promoting weight and fat loss without loss in FFM. The exercise program was also adequately effective in stimulating muscle protein synthesis prior to training. This stimulus persisted, and tended to be more pronounced following 12-wks of training. However, while some trends were observed warranting additional research, there did not appear to be any advantage of immediate or delayed nutrient timing on 24-h FSR in this population. These findings suggest that, rather than the timing of ingestion, daily nutrient intake may be the primary concern when it comes to maintaining muscle protein anabolism with exercise..

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Analysis of efficacy and cost effectiveness of popular weight loss and fitness programs

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Background

Obesity is associated with many negative health outcomes. Diet and exercise has been shown to reduce obesity and various other factors linked to poor health. One of the major concerns is the expense of diet and exercise programs. This study compared the cost effectiveness of four popular weight loss programs and controls in terms of weight loss success and outcomes.

Methods

127 sedentary women (47±11 yr, 45.8±5% body fat, 35.4±5 kg/m2) were randomized to participate in a no diet or exercise control group (C) or the Curves Complete® 90-day Challenge (CC), Weight Watchers® Points Plus (WW), Jenny Craig® (JC), or Nutrisystem® Advance Select™ (NS) weight loss programs for 12-wks. Participants in the diet groups were encouraged to exercise (WW, JC, NS) while those in the CC group participated in a structured circuit-style resistance training (3 d/wk) and walking (3/d wk) program. Program and food cost were calculated for a random sample of 1 week for 10 participants for each group. Food costs were estimated based on determining the cost of purchasing foods described in diet logs reported by the participants. These costs were averaged and applied to each subject for the duration of the study. The cost per day (C 4.7±2.2, CC 6.4±1.6, WW 4.9±1.4, JC 2.2±1.1, NS 1.8±1.1 $/day), was used to calculate an average 90 day food cost (C 422±198, CC 579±147, WW 438±130, JC 200±101, NS 162±103 $/90day). This was added to the program participation costs (C 0, CC 300, WW 120, JC 2,400, NS 900 $/90day) to estimate a total cost (C 422±198, CC 879±147, WW 558±130, JC 2,600±101, NS 1,062±103 $/90day) per program. Measurements were taken for body composition, fitness, and health measures. The changes in these variables were then divided by the overall cost for each program to establish the cost effectiveness for each program. Changes from baseline after 12-wks intervention for weight, waist circumference, hip circumference, bone mineral content, fat mass, fat-free mass, and peak oxygen uptake were analyzed by one-way ANOVA.

Results

Mean ± SD changes for the measured variables are as follows: weight (C 0.22±6.8, CC -11.4±9.1, WW -9.2±7.7, JC -11.7±8.3, NS -11.3±9.8 lbs), waist (C 0.76±2.7, CC -1.5±2.2, WW -1.5±2.5, JC -1.5±1.5, NS -1.3±2.4 inches), hip circumference (C 0.32±1.3, CC -1.9±1.8, WW -1.1±1.1, JC -2.0±1.7, NS -1.7±1.6 inches), fat mass (C -0.03±2.0, CC -4.2.2±4.0, WW -2.2±2.7, JC -3.5±3.3, NS -2.3±2.5 kg), fat-free mass (C 0.1±2.3, CC -0.6±2.4, WW -1.6±2.1, JC -1.8±2.1, NS -2.4±2.2 kg), body fat percentage (C -0.06±1.7, CC -2.86±3.6, WW -0.79±2.4, JC -1.37±2.4, NS -0.19±1.7 %), peak oxygen uptake (C -2.2±5.5, CC 3.0±2.7, WW 0.3±5.5, JC 0.6±4.6, NS 0.8±1.4 ml/kg/min). Participants in the CC and WW groups tended to experience greater losses in weight (C 0.001±0.016; CC -0.013±0.01; WW -0.016±0.01; JC -0.005±0.003; NS -0.011±0.01 lbs/$, $p<0.001$), waist circumference (C 0.0018±0.006; CC -0.0017±0.003; WW -0.0027±0.004; JC -0.0006±0.001; NS -0.0012±0.002 inches/$, $p<0.001$), hip circumference (C 0.0008±0.003; CC -0.0022±0.002; WW -0.0020±0.002; JC -0.0008±0.001; NS -0.0016±0.002 inches/$, $p<0.001$), fat mass (C -0.08±0.04.8; CC -4.8±4.5; WW -4.0±4.9; JC -1.3±1.3; NS -2.2±2.3 g/$, $p<0.001$), and body fat percentage(C -0.0001±0.004.8; CC -0.0033±0.004; WW -0.0014±0.004; JC -0.0005±0.0009; NS -0.0002±0.0016 %/$, $p<0.005$) per dollar spent compared to some other diet and exercise interventions. However, the WW group lost more fat-free mass (C 0.33±5.4; CC -0.72±2.8; WW -2.87±3.7; JC -0.69±0.8; NS -2.3±2.1 g/$, $p<0.005$) per dollar spent compared to the other groups. All intervention groups improved peak oxygen uptake (C -0.0052±0.013; CC 0.0034±0.003; WW 0.0006±0.010; JC 0.0002±0.002; NS 0.0007±0.001 ml/kg/min/$, $p<0.005$) per dollar spent compared to the control.

Conclusion

Results indicate that participation in different diet and exercise programs may have variable effects body composition and fitness. The WW group tended to lose a lot of weight and fat mass per dollar spent, but also lost more fat-free mass resulting in a lower change in body fat percentage. The CC group tended to improve peak oxygen uptake and lose more weight and fat mass while preserving fat-free mass resulting in the greatest change in body fat percentage per dollar spent. This analysis suggests diet plus exercise is more beneficial to health and weight loss than diet alone.

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