EFFECTS OF EXERCISE AND DIET-INDUCED WEIGHT LOSS ON MARKERS OF INFLAMMATION: IMPACT ON BODY COMPOSITION AND MARKERS OF HEALTH AND FITNESS

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Abstract

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 1-RM 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.

Supported by Curves International (Waco, TX)

Rationale

Physical inactivity and poor nutritional health have led to a worldwide epidemic of obesity. The pattern of American obesity continues to rise as 78.4 million adults are now classified as obese (BMI ≥ 30 kg/m^2), which is nearly double the number of obese adults in 2003 (40 million). Dyslipidemia and high blood glucose levels in conjunction with physical inactivity have proven to be major contributors in the development of type 2 diabetes, heart disease, systemic inflammation, and some cancers. This alarming rise of obesity and prevalence of metabolic syndrome calls for identification of weight loss programs that utilize proven weight loss strategies to promote changes in body composition and improve markers of fitness and health. Curves International, Inc. is one of the most widely recognized commercial companies that provide weight management and dietary services that are based on scientifically validated principles. **PURPOSE**: 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.

Experimental Design

Subjects
- 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.
- Subjects were informed as to the experimental procedures and signed a consent statement in adherence with the human subject guidelines of Texas A&M University.

Training Protocol
- Subjects in the EX group participated in a supervised 30-min hydraulic resistance circuit training program interspersed with either callisthenic exercises (3 d/wk) or Zumba® (1 d/wk) 4 d/wk.

Dieting Protocol
- During the first week, subjects in the EX group consumed 1,200 kcals/d followed by ingesting 1,500 kcals/d for 11-wks.
- Diets were focused on a high protein intake consisting of a 45:30 protein to carbohydrate ratio.

Methods & Procedures

- Body mass, DEXA body composition, fasting blood samples, maximal cardiovascular and strength measures were obtained at 0 and 12 weeks.
- Lipid blood panel and blood glucose data were obtained using standardized serum measurement techniques to analyze each fasting blood sample.

Statistical Analysis

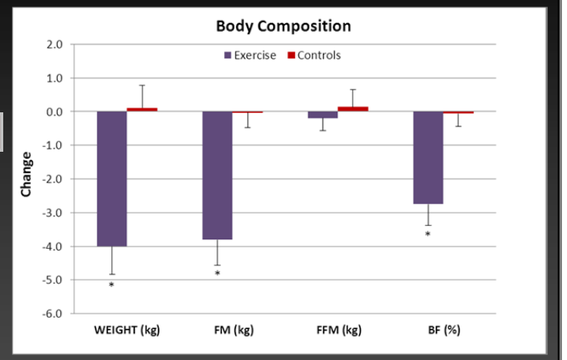
Data were analyzed by MANOVA with repeated measures using IBM SPSS for Windows version 20.0 software (Chicago, IL) and are presented as percent changes from baseline after 12-wks.

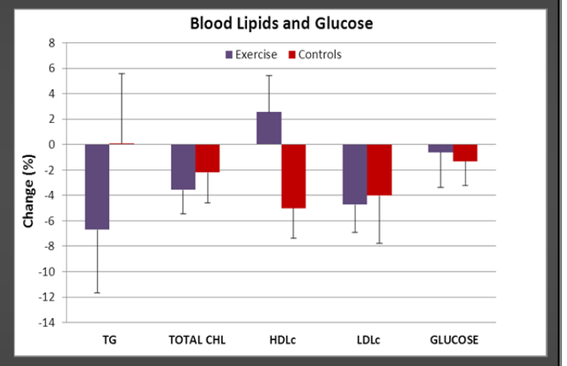
Results

Body Composition
- Participants in the EX group experienced greater changes in body wt (EX -4.0±4.4 kg; C 0.1±3.0 kg, p=0.001), FM (EX -3.8±4.0 kg; C -0.03±2.0 kg, p<0.001), and %BF (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).

Blood Markers
- No significant differences among groups were observed for TG (EX -6.7±26.4%; C 0.1±24.4%, p=0.37), total CHL (EX -3.6±10.0%; C -2.2±10.7%, p=0.65), HDLc (EX 2.5±15.1%; C -5.0±10.5%, p=0.06); LDLc (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).

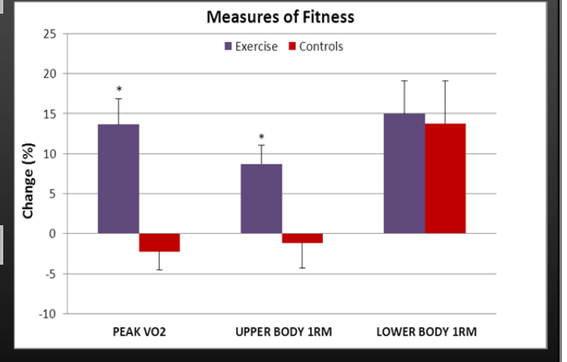
Fitness Measures
- Participants in EX group experienced greater changes in VO_2 max (EX 13.6±17.0%; C -2.2±10.3%, p=0.001) and upper body 1-RM strength (EX 8.7±12.5%; C -1.2±13.9%, p=0.016).
- No significant differences among groups were observed in lower body 1-RM strength (EX 15.0±21.9%; C 13.8±23.7%, p=0.86).





Conclusions

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, favorable changes in body composition, and improvements in some markers of health and fitness. Theoretically, if obesity is associated with inflammation, effective weight loss may reduce levels of inflammation.



* Significant differences observed compared to controls (C).

Acknowledgements and Funding

Supported by Curves International Inc., Waco, TX
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EFFECTS OF EXERCISE AND DIET-INDUCED WEIGHT LOSS ON MARKERS OF INFLAMMATION II: IMPACT OF *microRNA21* AND *microRNA*146*a* AND THEIR REGULATORY ROLE

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Abstract

Purpose
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-α, (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 ΔΔ Ct 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<0.001); and, mRNA TNF-α expression levels (EX -0.52±2.5; C 2.3±1.9, p<0.001). Exercise and diet-induced changes in mRNA IL-6 and mRNA TNF-α 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-α, and mRNA IL-6 levels suggesting an 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.

Rationale

Obesity has been associated with inflammation and the mechanism linking obesity and inflammation has not been fully established. Research scientists in the Exercise and Sport Nutrition Lab have shown positive results on markers of clinical health and weight loss after following the Curves fitness program. The Curves fitness program involves performing a 30-minute hydraulic resistance circuit training program 3 days per week. Results of initial studies have shown that the program promotes weight loss, improves markers of health, and improves fitness levels. The purpose of this study was to determine if exercise and diet-induced weight loss would affect markers of inflammation via the (PTEN, TRAF6/PI3k/AKT or PKB/NF-kB) signaling pathway through the regulation of microRNA 21 and microRNA 146a expression for a period of 12 weeks

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.
- 45 overweight (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 supervised 30-min circuit resistance-training (3d/wk) program.
- Participants in the C group maintained their normal daily diet and no physical activity.

Methods & Procedures

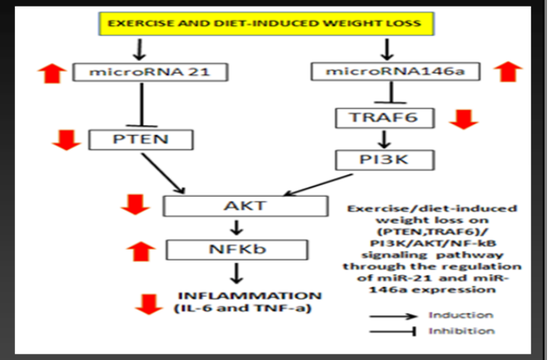
Serum/WBCs samples were obtained at baseline & 12 wks and analyzed for microRNA (21 and 146a) and mRNA of IL-6, TNF-α, (PTEN, TRAF6)/PI3k/AKT/NF-kB expression by real-time RT-PCR.

Statistical Analysis

Data were analyzed by repeated measures MANOVA analysis using SPSS for Windows version 21.0 software (Chicago, IL) and are presented as means ± SD changes from baseline.

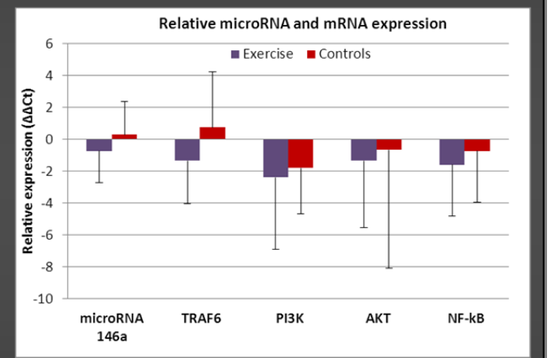
Results

- 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<0.001); and, mRNA TNF-α expression levels (EX -0.52±2.5; C 2.3±1.9, p<0.001).
- Exercise and diet-induced changes in mRNA IL-6 and mRNA TNF-α 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.



Conclusions

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-α, and mRNA IL-6 levels suggesting an 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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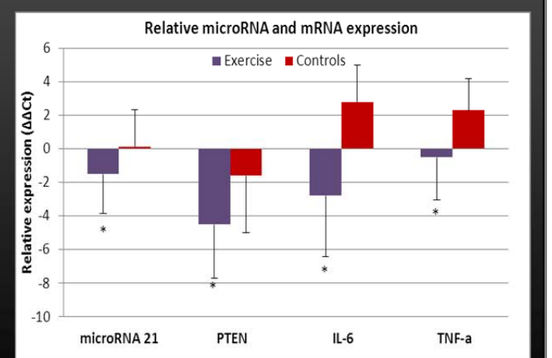

EFFECTS OF IMMEDIATE AND DELAYED NUTRIENT TIMING FOLLOWING RESISTANCE EXERCISE ON CHANGES IN MIXED MUSCLE FRACTIONAL SYNTHESIS RATE (FSR) IN POST-MENOPAUSAL WOMEN PARTICIPATING IN A WEIGHT LOSS PROGRAM

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Abstract

In a randomized and matched manner, 21 sedentary women (59.8±5 yr, 43.7±3% body fat, 31.0±3 kg/m^2) participated in the Curves Complete® weight loss and circuit resistance-exercise (RE) 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 (D_2O or ^2H_2O) 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. 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 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).

Supported by Curves International (Waco, TX)

Rationale

Researchers in the Exercise & Sport Nutrition Laboratory (ESNL) have conducted a number of studies over the past several years to assess the efficacy of the Curves fitness and weight loss programs. More recently, our lab found that older women who followed a higher protein hypo-energetic diet while participating in a RE program experienced more favorable changes in body composition than those following a proportionately higher carbohydrate diet. Ingestion of protein prior to, and/or following RE has been reported to stimulate protein synthesis. Many studies looking at post-exercise timed nutrition have revealed favorable results in various demographics, yet some have reported little or no benefit. 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). Nutrient timing continues to be an area of interest in various populations. Hence, the purpose of this study is to examine the effects of post-exercise immediate (I) or 2 hours delayed (D) timed nutrition via a commercially available shake (120kcal; 15g pro, 12g CHO, 1g fat) on muscle protein fractional synthesis rate (FSR) prior to, and following participation in a 12 week RE based prospective exercise and diet weight loss intervention.

Experimental Design

Participants were informed of the experimental procedures and signed informed consent statements in adherence with the human subject guidelines of Texas A&M University.

21 sedentary overweight post-menopausal women (59.8±5 yrs; 43.7±3% body fat, 31.0±3 kg/m^2) participated in this study.

- Participants were assigned to the Curves fitness, weight loss program, randomized, matched, and placed into one of two groups:
  - (I, n=9), which received the post exercise nutrition immediately post exercise, or
  - (D, n=12), which received the same nutrition at 2 hours post exercise.
- The Curves program involved a cyclic-energy restricted high protein diet, and participation in the Curves with Zumba circuit-training program. Zumba was interspersed with the Curves circuit resistance workout on 1 of the 3 day/wk exercise regimen, wherein circuit intervals were timed at 60 seconds. The remaining 2d/wk involved 30s intervals, and included calisthenics interspersed with the resistance stations.
- Both (I) and (D) groups consumed a higher protein diet [macronutrient composition ratio of 45:30:25 (pro:CHO:fat respectively)] which consisted of 1,200 kcal/d for the first week, and 1,500 kcal/d for the remaining 11 weeks of the study. Post exercise macronutrient and energy content (post-exercise timed nutrition) was included in the daily diet, but only on the days in which each participant exercised in the Curves circuit.
- D_2O dosing, plasma and biopsy samples were collected pre-training (T1) and post training (T4), over a 24 hour period.

Methods & Procedures

- Dietary analyses were accomplished through participant completion of 4-day Food Logs collected at each testing session, and analyzed via Food Processor software (ESHA Research, Salem OR) for macronutrient and caloric content.
- Weekly compliance checks were accomplished via activity log submission, and computerized circuit attendance records.
- Body composition was determined via a Hologic (Bedford, MA) Discovery W Dual Energy X-Ray Absorptiometer (DEXA).
- D2O dosages were calculated @ 70:30 ratio D_2O:Distilled H_2O, and administered based on calculation of 6.5 mL/kg Lean Mass (LM).
- Biopsies were obtained under local anesthesia via Berstrom suction technique: 1) pre-exercise; 2) post-exercise and 3) 24h post-initial dose of D_2O in the Human Countermeasures Lab (HCL) at Texas A&M. Tissue samples were flash frozen in LN_2 and stored at -80^o pending processing.
- Tissue samples were processed, and analyzed via GS/MS in the Muscle Biology Lab (MBL) at Texas A&M.

Statistical Analysis

Data were analyzed by repeated measures MANOVA and ANOVA, and are presented as changes from baseline after 12 weeks (for the I and D groups, respectively) using SPSS v. 20 (Chicago, IL) and Sigmastat v. 3.5 software (San Jose, CA), and are presented as means ± SD/SEM percent changes from baseline.

Results

Over 12 weeks, data reported are changes as compared to baseline for the I and D groups respectively.

- significant time effects were seen in body mass, fat mass, and body fat.
- participants in the D group generally experienced more favorable changes in
  - Body Mass (I -3.6±2.2; D -4.2±4.2kg, p=0.59),
  - Fat Mass (I -3.5±1.5; D -4.8±3.3kg, p=0.32),
  - FFM (I -0.0±1.7; D 1.1±1.1kg, p=0.24), and
  - Body Fat (I -2.8±1.9; D -4.4±3.1%, p=0.25).
- 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

Participation in the CC program with the addition of timed post-exercise nutrition may promote more favorable changes in body composition, while a more delayed time of ingestion may be preferable to immediately post-exercise ingestion. 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 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. Additional research should examine whether nutrient timing affects training adaptations in post-menopausal women who participate in an energy deficit, higher protein and low fat diet with resistance-exercise.

Acknowledgements and Funding

We would like to acknowledge the contributions of Vanessa Thompson for her assistance with food log data entry.

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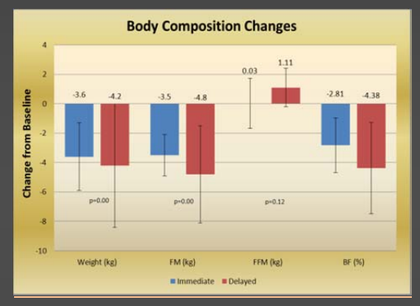

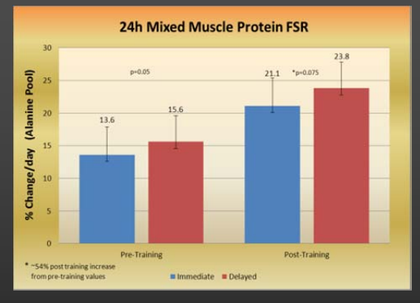

ANALYSIS OF EFFICACY AND COST EFFECTIVENESS OF POPULAR WEIGHT LOSS AND FITNESS PROGRAMS

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EDUCATION & HUMAN DEVELOPMENT
TEXAS A&M UNIVERSITY

Abstract

Background: 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: Subjects 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. Food costs were estimated based on determining the cost of purchasing foods described in diet logs reported by the participants and combined with the programs cost. Measurements were taken for body composition, fitness, and health measures. The changes in these variables were divided by the overall cost for each program to establish the cost effectiveness for each program.
Results: 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 participation in different diet and exercise programs may have variable effects on body composition and fitness. This analysis suggests diet plus exercise is more beneficial and cost effective to health and weight loss than diet alone.

Rationale

Obesity and physical inactivity are two of the leading causes of preventable death in the United States. 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.

Experimental Design

- 127 sedentary women (47±11 yrs; 45.8±5% body fat; 35.4±5 kg/m^2) participated in this study.
- Subjects were randomly assigned to the control group (C, n=20), Curves Complete® (CC, n=25), Weight Watchers® (WW, n=27), Jenny Craig® (JC, n=27), or Nutrisystem® (NS, n=28) weight loss programs.
- The CC diet involved consuming a high protein diet of a 45:30 protein to carbohydrate ratio which consisted of 1,200 kcal/d for 1-wk and 1,500 kcal/d for 11 wks. Subjects in the CC group participated in a supervised 30-min resistance circuit training program that was interspersed with callisthenic exercises and Zumba performed 4-d per week.
- Subjects in the WW group followed the Weight Watchers Points Plus Program, which consisted of food plans based on a points system and weekly meetings. Exercise was encouraged but not mandatory.
- Subjects in the JC or NS programs received meals for 12 weeks and were able to speak with a consultant each week regarding their weight changes and exercise protocol, as well as use online tracking methods. Exercise was encouraged but not mandatory.

Methods & Procedures

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 daily costs were used to find a 90 day food cost. These food costs were added to program participation costs to find a total cost per program for 90 days. The changes in each variable were divided by total costs to determine cost effectiveness.

90 Day Costs			
	Food	Program	Total
CC	$579	$300	$879
WW	$438	$120	$558
JC	$200	$2,400	$2,600
NS	$162	$900	$1,062
C	$422	$0	$422

90 Day Changes							
	WT(lbs)	WC(in)	HC(in)	FM(kg)	FFM(kg)	BF(%)	VO2(ml/kg/min)
CC	-11.40	-1.50	-1.90	-4.20	-0.60	-2.86	3.00
WW	-9.20	-1.50	-1.10	-2.20	-1.60	-0.79	0.30
JC	-11.70	-1.50	-2.00	-3.50	-1.80	-1.37	0.60
NS	-11.30	-1.30	-1.70	-2.30	-2.40	-0.19	0.80
C	0.22	0.76	0.32	-0.03	0.10	-0.06	-2.20

Statistical Analysis

Data were analyzed by one-way ANOVA using SPSS for Windows version 20 software (Chicago, IL) and are presented as means ± SD changes from baseline.

Results

- 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).
- 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/$, p<0.005).
- Body Fat Percentage (C -0.0001±0.004.8; CC -0.0033±0.004; WW -0.0014±0.004; JC -0.0005±0.0009; NS -0.0002±0.0016 %/$, p<0.005).
- 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).
    - Groups with differing symbols indicate significant differences

Conclusions

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 and cost effective to health and weight loss than diet alone.

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