Effects of the Curves for Women® Fitness and Weight Loss Program on Body Composition, Metabolism, and Exercise Capacity in Sedentary Overweight Females

RB Kreider, C Rasmussen, C Kerksick, C Wilborn, B Slonacker, A Thomas, S Ounpraseuth, P Casey, M Greenwood, B Leutholtz, R Bowden, B Lanning, R Wilson

Exercise & Sport Nutrition Lab
Center for Exercise, Nutrition & Preventive Health Research
Department of Health, Human Performance & Recreation
Baylor University · PO Box 97313 · Waco, TX 76798-7313
www3.baylor.edu/HHPR/ESNL

Research Status Update

- Ongoing Studies
  - Effects of the Curves Fitness & Weight Loss program I (Nearly Complete)
  - Effects of the Curves Fitness & Weight Loss program II (In progress)
  - Effects of Calcium Supplementation on Weight Loss in Post-Menopausal Women (In progress)
  - Biomechanical / Energy Expenditure Analysis of Curves Equipment / Circuit (In progress)
  - Curves for Kids Program (Planned)

Rationale

- Although the exercise and dietary interventions have been based on a good scientific rationale and have been highly successful, the impact of women engaged in various aspects of this program has yet to be examined.

Purpose of Study

- To examine the acute and chronic effects of Curves fitness and diet program on weight loss, body composition, metabolic rate, exercise capacity, and markers of health in sedentary overweight females.

Subjects

- 245 apparently healthy, sedentary, and overweight women met entrance criteria and volunteered to participate in this study.
- Subjects signed informed consent statements in compliance with Baylor University’s IRB and the American College of Sports Medicine.
Entrance Criteria

• Apparently healthy, untrained, and moderately overweight females (BMI > 27)
• 18-50 years old
• No current or recent participation in exercise program
• No recent weight loss of ≥ 20 lbs in last 6-months
• No current involvement in other weight loss programs or use of weight-loss products

Subjects

• This analysis includes 160 women that completed the first 14-weeks of study.
• Subjects were:
  - 38.5±9 yr
  - 94.0±19 kg (207±42 lbs)
  - 64.2±3 in
  - 43.8±4.3 % body fat
  - BMI of 35.6 BMI (Very High Risk)

Experimental Design

• 14 week study involving 2 familiarization sessions and 5 testing sessions (T1-T5) performed at 0, 2, 10, 10.4, and 14 weeks.
• Assigned to following groups based on baseline testing and responses to CHO tolerance questionnaire
  - No Diet or Exercise (Control)
  - Exercise + No Diet (ND+E)
  - Exercise + High Calorie Diet (HCD+E)
  - Exercise + Very High Protein Diet (LC-VHP+E)
  - Exercise + High Protein Diet (LC-HP+E)
  - Exercise + High CHO Diet (LC-HCHO+E)

Dietary Intervention Goal

• To promote weight loss during the first 10 W of study and then to see if alternating higher and lower caloric intakes could help maintain and/or prevent weight regain after weight loss.
• To determine whether alterations in caloric and macronutrient intake during training affected weight loss and/or body composition changes during weight loss

Dietary Intervention

• Exercise + HCD (n=11) – High/Mod/High CHO Diet
  - Women ≤ 90% of estimated REE (Wang et al, AJP, 279: E539-45, 2000)
  - Phase I – 2,600 kcal/d for 2 W (55% CHO, 15% PRO, 30% F)
  - Phase II – 2,600 kcal/d for 8 W (40% CHO 30% PRO, 30% F)
  - Phase III – 2,600 kcal/d for 4 W (55% CHO, 15% PRO, 30% F)
• Exercise + LC-VHP (n=35) – Very High PRO/Low CHO Diet
  - Women positive on CHO tolerance questionnaire
  - Phase I – 1,200 kcal/d for 2 W (7% CHO, 63% PRO, 30% F)
  - Phase II – 1,600 kcal/d for 8 W (15% CHO, 55% PRO, 30% F)
  - Phase III – 2,600 kcal/d (55% CHO, 15% PRO, 30% F) and 1,200 kcal/d (7% CHO, 63% PRO, 30% F) for 3/2, 3/2, 5/2, & 10/2 days
• Exercise + LC-HP (n=28) – High PRO/Low CHO Diet
  - Phase I – 1,200 kcal/d for 2 W (20% CHO, 50% PRO, 30% F)
  - Phase II – 1,600 kcal/d for 8 W (15% CHO, 55% PRO, 30% F)
  - Phase III – 2,600 kcal/d (55% CHO, 15% PRO, 30% F) and 1,200 kcal/d (20% CHO, 50% PRO, 30% F) for 3/2, 3/2, 5/2, & 10/2 days
• Exercise + LC-HCHO (n=32) – High CHO Diet
  - Phase I – 1,200 kcal/d for 2 W (55% CHO, 15% PRO, 30% F)
  - Phase II – 1,600 kcal/d for 8 W (55% CHO, 15% PRO, 30% F)
  - Phase III – 2,600 kcal/d (55% CHO, 15% PRO, 30% F) and 1,200 kcal/d (55% CHO, 15% PRO, 30% F) for 3/2, 3/2, 5/2, & 10/2 days
• All subjects were provided a low-dose liquid multivitamin to take during the course of the study
**Dietary Intervention**

- Subjects were given diets, meal plans, and food substitution lists to follow for each diet.
- Subjects watched a video prepared by a RD explaining how to follow the diet.
- Subjects had access to an RD to answer any questions about the diet throughout the study.
- All subjects were provided a low-dose liquid multivitamin during the course of the study.

**Training Program**

- 30-minute circuit training program performed 3 days/week
- Workouts were monitored by Curves trained fitness instructors who encouraged proper technique, effort, and monitored attendance
- Women were required to make up missed workouts
- Women who did not complete at least 90% of training workouts were dropped from the study
- Training compliance was ~98±1%

**Training Program**

- Training involved performing 3 rotations of 30-sec of exercise (8-12 repetitions) on eight bidirectional hydraulic exercise machines interspersed with 30-sec of calisthenics exercises designed to maintain an elevated heart rate and increase energy expenditure.
- Training was performed to music that had timing interval notifications

**Training Program**

- Resistance exercises included:
  - Leg extension/curls
  - Shoulder Press/Lat Pull
  - Squat Push/Pull
  - Seated bench press/rows
  - Hip Adduction/Abduction
  - Abdominal Curl/Back Extension
  - Leg press
  - Arm curls/extensions

**Training Program**

- Calisthenic exercises included low impact:
  - Jogging in place (primary)
  - Jumping jacks
  - Boxing
  - Knee lifts
  - Kicks forward
  - Side kicks
  - Skiing
  - Heel kicks
  - Skipping
  - Torso twists

**Assessments**

- At 0, 2, 10, 10.4, & 14 weeks subjects:
  - Dietary Records (4-d)
  - Psychometric Tests (SF-36 QOL Inventory, Impact of weight on QOL-Lite questionnaire, POMS, Beck Depression Inventory, Occupational Strain Questionnaire, Appetite/eating satisfaction questionnaire)
  - Body weight
  - Hip & waist measurement
  - Total Body Water (BIA)
  - Body Composition/Bone Density (DEXA)
  - Resting HR & BP
  - Fasting Blood Samples (12h)
  - Resting Energy Expenditure (REE) (20 min)
Assessments

- Subjects also completed the following tests at 0, 10, & 14 weeks of training/dieting:
  - Maximal Cardiopulmonary/ECG Stress Test (Bruce Protocol)
  - 1RM Bench Press
  - 80% of 1RM on Bench Press
  - 1RM Leg Press
  - 80% of 1RM on Leg Press
- Medical safety/side effects were monitored by a registered nurse on a weekly basis

Statistics

- Data were analyzed by SAS Version 8.3 software using repeated measures ANOVA with Tukey’s adjusted multiple comparison post-hoc tests.
- Data were considered statistically significant when the probability of error was 0.05 or less.
- Data are presented as means ± SD changes from baseline.

Preliminary Results

- DEXA Body Composition
- Resting Energy Expenditure
- Cardiopulmonary/Musculoskeletal Fitness
- Markers of Health

Body Composition

- Scanned Mass
- Fat Mass

Body Mass

- Control subjects gained 0.8±2.6 kg
- ND+E subjects lost/maintained weight (-0.4±2.1 kg)
- HCD subjects lost -1.1±3.1 kg
- Subjects in the HCHO (−4±3.1 kg) and HP groups (−4±3.8 kg) lost significantly more weight than ND and HCD groups
- Subjects in the VHP group (−5.7±4.3 kg) observed greatest weight loss which was significantly greater than the HCHO and HP groups
- Subjects maintained weight loss during the maintenance phase

Scanned Mass

- After 10 weeks, changes in scanned mass were:
  - Control (0.2±3.2 kg)
  - ND+E (-0.8±1.9 kg)
  - HCD (-1.2±3.1 kg)
  - HCHO (-3.7±3.0 kg)
  - HP (-4.1±5.7 kg)
  - VHP (-5.2±4.1 kg)
- After 14 weeks, changes in scanned mass were:
  - Control (0.6±3.5 kg)
  - ND+E (-0.7±2.2 kg)
  - HCD (-1.1±3.3 kg)
  - HCHO (-3.6±3.8 kg)
  - HP (-2.8±2.7 kg)
  - VHP (-5.4±4.8 kg)
- Greatest loss in VHP group
- No evidence of weight regain during maintenance phase

Fat Mass

- After 10 weeks, changes in fat mass were:
  - Control (0.1±2.6 kg)
  - ND+E (-0.8±1.6 kg)
  - HCD (-0.5±2.0 kg)
  - HCHO (-2.6±2.1 kg)
  - HP (-2.8±2.7 kg)
  - VHP (-3.7±3.1 kg)
- After 14 weeks, changes in fat mass were:
  - Control (0.4±2.7 kg)
  - ND+E (-0.9±1.8 kg)
  - HCD (-1.1±3.3 kg)
  - HCHO (-3.6±3.8 kg)
  - HP (-2.9±3.2 kg)
  - VHP (-4.1±3.7 kg)
- No evidence of weight regain during maintenance phase
**Body Composition**

- FFM typically accounts for 40-50% of weight loss on low calorie diets.
- Resistance training and increased dietary protein reported to lessen loss of FFM during weight loss.
- The majority of the weight loss was fat (76-100%).
- The percentage of FFM significantly increased in dieting groups.

**Resting Energy Expenditure**

- Weight loss typically decreases REE due to a reduction in FFM.
- Significant interactions (p<0.001) were observed among groups in absolute and relative REE.
- After 2 wks, REE generally decreased in all groups except the HCD+E group (+1.4±2.4 kcal/kg; mean ±4.2±6 kcal/kg).
- After 10 wks, REE increased by 1.2±2.7 kcal/kg (-0.7±2.0; 0.3±3.0; -1.4±2.4 kcal/kg; mean 1.7±3.5 kcal/kg).
- Results indicate that the increases in REE observed appear to play a significant role in promoting and/or maintaining weight loss.

**Anthropometric**

- Subjects experienced a significant decrease in waist (-2.5±7.3 cm), hip (-1.4±2.7 cm), and the ratio of waist to hip measurements (-0.01±0.05; -0.001±0.13; -0.03±0.08) which is a marker of CVD risk.
- Served to decrease the overall ratio for this age group from 0.84±0.09 (Very High Risk) to 0.81±0.06 (High Risk).
- No differences among groups.

**Weight Loss Summary**

- Program is effective in promoting weight loss particularly when following the diet program.
- All diet groups lost weight suggesting that the diet selection process is effective.
- Greatest weight loss observed in the VHP group.
- Subjects in the HCD group who added 500 – 1,000 kcals/day to their diet lost weight.
- Training and diet alterations allowed for an increase in REE which facilitated weight loss.

**Fitness**

- After 14 weeks, subjects experienced significant (p<0.001) increases in:
  - 1RM bench press (14.5±34% vs 0.1±14%).
  - 1RM leg press (19.1±25% vs 9.4±20%).
  - BP lifting volume (33.7±87% vs 10±34%).
  - LP lifting volume (40.5±87% vs 7.7±32%).
- Significant differences were observed among groups.
- Training also increased relative peak oxygen uptake (14.4±48%) with a significantly greater gain observed in the VHP diet group (32.5±78%) compared to a control value of 1.9±17%.
Subjects experienced significant decreases in:
- HR (-3.3±1%, p<0.03)
- SBP (-2.8±10%, p<0.04)
- DBP (-3.6±12%, p<0.02)
- MAP (-3.4±10%, p=0.007)
- RPP (-5.8±21%, p<0.005)
No differences observed among groups
Program promotes general improvement in resting cardiovascular and hemodynamic dynamics

Leptin is a hormone that regulates appetite and is correlated with obesity.
After 2 wks of training and dieting, leptin levels significantly decreased (-27.3±32%).
No significant differences were observed among exercise and diet groups (p=0.16)
When control group data were included in the analysis, a significant interaction was observed (p=0.001) with leptin levels in the E+ND, HCHO, HP, and VHP lower than C
Leptin levels were significantly correlated (p=0.05) with body mass, fat mass, and body fat at each data point with stronger relationships observed as the study progressed

At 2, 10, 10.4, and 14 weeks, subjects experienced a significant decrease (p<0.001) in:
- Total CHL:
  - 2 wks (-8.5±12%)
  - 10 wks (-4.5±12%)
  - 10.4 wks (-6.0±12%)
  - 14 wks (-1±13%)
- LDL-C
  - 2 wks (-7.4±19)
  - 10 wks (-2.4±21)
  - 14 wks (-1.1±21%)
No differences observed in HDL-C, the ratio of total CHL / HDL-C; or triglycerides
No significant differences observed among groups

No significant differences observed in serum total protein, blood urea nitrogen, creatinine, BUN/creatinine ratio, uric acid, AST, ALT, CK, LDH, GGT, albumin, globulin, sodium, chloride, calcium, carbon dioxide, total bilirubin, alkaline phosphatase
No significant differences in hemoglobin, hematocrit, red blood cell counts, MCV, MCH, MCHC, RDW, white blood cell counts, neutrophils, lymphocytes, monocytes, eosinophils, basophils
No clinically significant side effects or adverse events reported in weekly follow-up

Significant differences were observed in:
- Physical functioning (6.7±22; 9.3±19) scores
- Bodily pain (6.1±30; 4.9±25) scores
- General health (8.3±13; 7.3±14) scores
- Mental health (6.1±30; 7.3±14) scores
- Role emotional (-13.4±4; -16.5±4) scores decreased
- Social functioning scores were unchanged
The changes observed were not significantly correlated with changes in body weight, body composition, strength, or aerobic fitness.
Results indicate improved quality of life that is apparently independent to weight loss
Research Findings

Bottom Line

- Program is highly effective in promoting weight loss and improving general health & fitness in this population
- Improvements appear to be due to combination of exercise training and diet interventions which increase REE during weight loss
- Intermittent dieting appears effective to maintain and/or promote additional weight loss by increasing REE

- Program also promotes improvements in body image, self-esteem, and quality of life that appears to be independent to weight loss
- Additional research is ongoing to examine the short and long-term effects of this program as well as to identify optimal ways of maintaining weight loss

Exercise • Nutrition • Health • Performance

Baylor University Exercise & Sport Nutrition Laboratory

Reaching the world through exercise, nutrition, and preventive health research!

Richard_Kreider@baylor.edu
www3.baylor.edu/HHPR/ESNL