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Research Article

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Brief, Aerobic-surge Exercises for Effective Weight Loss: a Randomized, Controlled Trial

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Abstract

Background: *Obesity is a growing disease and a consistently effective protocol is needed to reduce this epidemic. The purpose of this study was to determine if a frequent, brief (2-minute) high intensity aerobic exercise (≥75% max HR) was effective in reducing subjects' weight (BMI) and girth sizes.*

Methods: *A randomized, controlled trial lasting 60 days was conducted at three sites and forty-six subjects completed this study (mean age 39 ± 8 and BMI 32 ±2). The Experimental group was shown how to make movements such as riding a stationary bicycle or lifting dumbbells into an 'Aerobic-surge' exercise at or above 75% of calculated maximum heart rate. Control subjects were simply told to "exercise more." No dietary changes were made for either group. The dependent variables were changes in weight and 'body summation' of 10 girth measurements. A 2x2 ANOVA was used to calculate differences. A post-hoc analysis of changes in BMI was also calculated.*

Results: *There was a significant difference between groups (P<0.0001). The mean change of the groups were as follows: Experimental (N=23) mean reductions = -18.lbs and -18.7" vs. Control (N=23) mean changes = +1.3.lbs and +1.3."*

Conclusion: *The repeated, brief (2-minute) aerobic-surge exercise protocol, performed 4.2 times/day was effective in reducing subjects' weight and body circumferences. Isolated tests of body composition showed that change were primarily in body fat. This could be a tool in reducing the obesity epidemic. The Aerobic-surge exercise was effective without a dietary changes.*
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Keywords: 2-minute Exercise, Aerobic Threshold, Energy-surge, Obesity Reduction

Abbreviations

ANOVA: Analysis of Variance
BMI: Body Mass Index
Cm: Centimeter
DEXA: Duel-energy X-ray Absorptiometry
EXP: Experimental Subjects
FIT: Frequency, Intensity, and Time
HIIT: High Intensity Interval Training
IRB: Institutional Review Board
HR: Heart Rate
Kg: Kilogram
MIT: Moderate Intensity Training
REE: Resting Energy Expenditure
USA: United States of America
VO²: Volume of Oxygen Consumed

Background

The obesity epidemic is approaching 40% in the USA and this disease effects the majority of western countries. Obesity is categorized when a patient s has a Body Mass Index (BMI) > 30 and BMI is calculated with the formula of weight over height squared (kg/m^2) [1]. The question of which protocols are the best to achieve weight reduction remains unanswered [1-30]. High BMI values are even more strongly correlated to adverse cardiovascular biomarkers than inactivity, which makes obesity reduction even more vital [2,3,7].

Exercise intervention is a common treatment for overweight patients and the most recent meta-analysis completed by Stoner et al supports this with analysis of 556 subjects in 15 trials [21]. They reviewed randomized, controlled studies to determine if exercise yielded consistent changes which improved body composition and Cardio metabolic risk factors. Their findings showed that exercise interventions showed significant reductions in the following tests: BMI (-2.0), Fat -3%, Waist circumference -3cm, Blood glucose - 39 mg/dl, and Systolic blood pressure -7.1 mmHg. The benefits are not in question, but we must find the Frequency, Intensity, and Time (FIT) of exercise best for the best compliance.

However exercise alone as a broad treatment category for weight loss, has shown mixed results in other studies [28-30]. Research shows that the frequency and intensity of exercise participation are more important than just time in exercise [5,7-10,20].

High Intensity exercise training (for fat loss) is a novel protocol that has been investigated with compelling results [5,7-10,12,20]. Siije et al examined high vs. moderate intensity training in overweight adolescent women (Mean age 19, BMI > 25) in a controlled study lasting 12 weeks [20]. All subjects trained five days per week and the high intensity group trained at 85% of peak VO^2 vs. the low intensity group trained at 50% of peak VO^2. The dependent variables were changes in body composition, left ventricular ejection fraction, resting heart rate, maximal oxygen uptake and ventilatory threshold. Both exercise groups showed significant change, but the high intensity group displayed the greatest change as calculated in 'effect size.'

This ties in conclusively with the study by Jakicic et al which compared four exercise groups with 201 obese, sedentary women (mean age = 37, mean BMI = 32) [12]. The four groups included 1) Vigorous intensity/Long duration exercise; 2) Moderate intensity/ Long duration; 3) Vigorous intensity/Moderate duration; 4) Moderate intensity/Moderate duration. The treatment duration was 12 months and 94% of the subjects completed the study. The weight loss was significant in all groups of that study ($p < 0.001$) and interestingly there was not a significant difference between groups ($p > 0.05$). This again proves that a shorter duration exercise (for higher compliance) with higher intensity had equal results in weight loss [12].

The questions of duration and intensity of exercise bouts were addressed by Grossman and Payne in their study that investigated short duration/high intensity exercise vs. traditional (long duration) walking exercise in a 12 week study (N=18, age 54±7, BMI=28±2) [8]. The Short duration/High intensity exercise trained five days per week for 15 minutes/bout and the walkers exercised for 40 minutes at 65% of age calculated peak VO^2. The dependent variables were body composition (DEXA duel-energy X-ray absorptiometry) and five anthropometric, body circumference, girth measurements. All subjects showed significant change and there was no difference between groups even though the high intensity group only trained 37% of the duration trained by the low intensity, long duration group [8].

Frequency of exercise was examined in a controlled trial by Willis et al, and that study revealed that higher frequency of exercise had the greatest impact on weight loss and body composition change [24]. Ninety sedentary subjects were recruited for that study (mean age 37.5 ± 13, range 22 – 74, BMI > 25) and they were prescribed cardiovascular exercise routines, 4 times/week for 30 minutes, in an 8 week study. Compliance was tracked and categorized into four frequency groups: 1) Control (0 Exercise/week), 2) Exercise ≤ 2 times/week, 3) Exercise 3-4 times/week, and 4) Exercise ≥ 4 times a week.

The dependent variable was change in fat mass, measured with the BodPod (air displacement plethysmography). The exercise groups achieved a significant change ($P < 0.001$), and the only significant difference between groups was for the group that exercise ≥ 4 times/week (P=0.004). The mean changes in body fat mass were as follows: 1) Control = +1.2 lbs; 2) Ex ≤ 2/week = -4.7 lbs; 3) Ex 3-4/week = -4.0 lbs; 4) Ex ≥ 4/week = -13.3 lbs.

A post-hoc analysis of that study, showed that neither the reported duration of exercise nor the reported intensity (scale of 1-10) showed a measurable difference in the outcomes of body fat mass reduction. That study showed that the greatest frequency of exercise had the largest, most significant change (reduction) of body fat mass [24].

These studies have shown that high intensity and frequency of exercise are more beneficial than total exercise time in obesity reduction. The purpose of this study was to determine if a frequent, brief (2-minute) high intensity exercise (≥ 75% max HR) was effective in reducing subjects' weight and girth sizes.

Methods

Subjects: Fifty-four obese adults were recruited for this study in Austin, Abilene, and Galveston Texas, USA. All subjects understood and completed written informed consent as required by the local IRBs. (See demographics, Table 1) Power analysis and data calculations were accomplished with the GraphPad, Instat program. The inclusion factor was BMI > 30 and exclusion factors included clinical pathologies such as cardiac anomalies of atrial fibrillation and uncontrollable hypertension. (Four volunteers were excluded when screened for these pathologies.)

Table 1: Demographics

Mean Age 39 ± 8, (Range 22-74)
Mean BMI = 32 ± 2, (Range 30-40)
Mean Weight = 215lbs.
36 Female, 18 Male
Caucasian 44, Hispanic 8, Black 4, Asian

Randomized categorization was performed and 25 Experimental subjects were taught how to measure their heart rate (HR). They were also taught how to calculate their estimated maximum heart rate (≥75%). The 25 control subjects were told to "exercises more" but were not told how to perform any specific exercises. Daily tracking and accountability were not required for this control group but frequency of daily exercise was recorded at conclusion of this study. No dietary changes were made for either group by investigators and no dietary changes were reported by the subjects.

Each experimental subject was taught several exercises which were performed initially under supervision. These indoor exercises included the following: supine scissor kicks, running in place, stationary bicycling, jumping jacks, biceps curls with triceps extensions, and medicine ball swings. Experimental were told to performed bouts/day at a high intensity level where the HR was ≥ 75% of calculated max HR for two minutes [(220 – age) .75 = target HR].

Experimental subjects reported their compliance with daily text messaging or email, and weekly phone conversations were held between each subject and one research assistant at each site. Subjects were told that 90% accountability in communication was required, even if the frequency of exercise was less than prescribed. Data from four subjects who did not comply with this communication requirement were eliminated from analysis (2 Experimental and 2 Control). Compliance and daily Aerobic-surge completion were tracked for Experimental subjects and they performed a mean 4.2 aerobic-surges each day. No dietary changes were made for either group.

Data Analysis

The dependent variables in this study were change in body weight and change in body girth summation which was the sum of 10 anthropometric, body circumference measurements including: Neck, Shoulders, Chest, Mid-humerus, Wrist, Waist, Hips, Mid-thigh, Calf, and Ankle, taken of each subject by the PI. These numbers in inches were added together as the 'Girth Summation.' A 2x2 Analysis of Variance (ANOVA) was calculated using the GraphPad, Instat program. A post-hoc analysis of changes in BMI was also calculated with ANOVA.

Results

There was a statistically significant difference in both the changes of weight and girth summations for Experimental (aerobic-surge) subjects vs. the Control subjects ($P < 0.0001$, $T=2.699$). The mean frequency of Aerobic-surge exercise bouts completed was 4.2/day (±0.2) or 29.4/week, while the control subjects reported exercising less than two times per week. The mean changes for the experimental vs control subjects were: EXP: -18.0 lbs (±7), -18.7" (±6) vs. Control: +1.3 lbs (±3), +1.7" (±4) (Figure 1). The post-hoc analysis of BMI change was calculated with ANOVA and there was a significant difference for the experimental subjects (mean change Exp -3.3 BMI, and Cont +0.2 BMI) and a significant difference between experimental and control subjects ($p < 0.001$, $t = 16.57$).

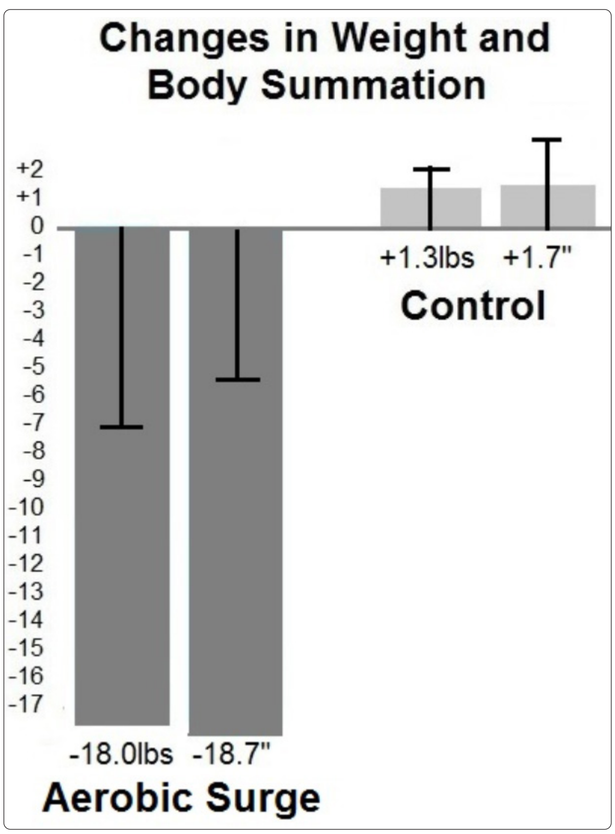

Figure 1: Changes in Weight and Body Summation

Discussion

The purpose of this study was to determine if a frequent, brief (2-minute) high intensity exercise (≥75% max HR) was effective in reducing subjects' weight and girth sizes. No dietary changes were included in this experimental design, however other research shows that removing hidden food allergens may be a key ingredient to in successful treatment of this disease [27].

Shorter durations of higher intensity exercise have also shown comparable, significant difference in a study by Fisher et al [7]. They compared a brief High Intensity Interval Training (HIIT) which included riding an indoor bicycle for 20 minutes at 15% max aerobic power which included four, brief 30-second surges (85% max Aerobic power). This was ridden three times each week for six weeks. This was compared to a group completing Moderate Intensity Training (MIT) (55-60% peak VO^2) for 45 minutes, 5 days per week.

Their results confirmed efficacy of the high intensity, aerobic surge protocol because there was no significant difference in six variables, even though the HIIT group only trained 27% of the time used by the MIT group (HIIT=360 total minutes vs MIT-=1350 total minutes). The variables included: Resting Energy Expenditure, Body Composition, Resting Blood Pressure, Oral Glucose Tolerance test (insulin sensitivity), Lipoprotein Analysis, and Total Cholesterol). The only difference between the two groups was a greater peak VO^2 improvement for the MIT group compared to HIIT (11.1% vs. 2.83%, $P = 0.0185$). As with the current study the HIIT exercise protocol was effective and did not require abundant amounts of time. A survey of overweight, sedentary women found that the "time required for exercise" was a uniform barrier to weight reduction for those women surveyed [26].

The old adage of "Caloric Intake / Expenditure" has been refuted because different therapeutic endeavors have shown elevations in metabolic rates throughout the day. Resting Energy Expenditure (REE) was tested anecdotally on three experimental subjects, before the next scheduled Aerobic-surge exercise bout. Those subjects' REE was still elevated, so the aerobic-surge protocol appears to yield metabolic acceleration. Fisher et al also examined REE and showed a significant change (elevation) from the high intensity exercise regime [7].

Brief durations of exercise have been shows effective for other pathologies and it is hypothesized that brief durations may increase compliance [7-9,12,15,24]. Harris et al stated clearly that "brief, repetitive, submaximal intensity exercise has been shown to be a potent physiological stimulant in adolescents" [9]. MacInnis and Gibala described that high intensity "sprint interval training increases mitochondrial content despite a reduced exercise volume" which allows one understand the sources of change [15]. This study of the 2-minute aerobic-surge exercise had 92% compliance and study completion.

Bagley et al confirmed the finding by Fisher et al in comparing efficacy across a substantially shorter duration of training [7]. Bagley et al examined brief, frequent, high intensity training using sprint interval training lasting just 10 minutes per day in a 12-week cohort study [2]. Forty-one subjects completed 4 bouts of 20-second 'maximal effort' sprints (175% of the peak VO^2) and each high intensity bout was followed by low intensity jogging (20% max VO^2), totaling a 10-minute daily training session. These subjects were not obese (mean BMI = 24.6) but there was still a significant decrease in body fat, measured with total-body dual-energy X-ray absorptiometry (-1.2%, P < 0.001) [2].

Conclusion

The 2-minute, aerobic-surge exercise protocol, performed 4.2 times/day was effective in reducing subjects' weight, body circumferences, and BMI without dietary changes. (No dietary changes were required in this study or conducted separately by subjects.) Future studies of this protocol, could examine changes in the following: Fat Mass Reduction (Body Composition) Resting Energy Expenditure, Resting Blood Pressure, Oral Glucose Tolerance test (insulin sensitivity), HbA1c test, and change in Total Cholesterol. A future study could also compare dietary changes with food allergen elimination.

This randomized, controlled trial showed efficacy of a frequent, brief (2-minute), high intensity, "Aerobic0surge" exercise (> 75% max HR), which achieved significantly reduced weight and body girth measurements. This study had 92% completion from all subjects in this 60-day trial.

Declarations

- ✓ Ethics approval was obtained the Galveston Clinical Research IRB, and each subject gave written consent to participate, in accordance with the Declaration of Helsinki.
- ✓ Each subject gave consent to publish their results.
- ✓ Availability of data and materials can be made upon request.
- ✓ There were no competing interests for either author.
- ✓ No Funding was acquired for conduction or completion of this trial.
- ✓ All authors contributed equally to this manuscript and read the final copy before submission.
- ✓ We acknowledge and appreciate the participation of all subjects.

References

1. CDC Obesity rates (2018) http://www.cdc.gov/obesity/data/adult.html.
2. Bagley L, Slevin M, Bradburn S, Liu D, Murgatroyd C, Morrissey G, et al. (2016) Sex differences in the effects of 12 weeks sprint interval training on body fat mass and the rates of fatty acid oxidation and VO^2 max during exercise. BMJ Open Sport Exerc Med 2: e000056.
3. Blair, SN and Church, TS (2004) The fitness, obesity, and health equation: is physical activity the common denominator? JAMA 292: 1232-1234.
4. Daley AJ, Copeland RJ, Wright NP, Roalfe A, Wales JK (2006) Exercise therapy as a treatment for psychopathologic conditions in obese and morbidly obese adolescents: a randomized, controlled trial. Pediatrics 118: 2126-2134.
5. De Feo P (2013) Is high-intensity exercise better than moderate-intensity exercise for weight loss? Nutr Metab Cardiovasc Dis 23: 1037-1042.
6. Deutz B, Benardot D, Martin D, Cody M (2000) Relationship between energy deficits and body composition in elite female gymnasts and runners. Medicine & Science in Sports & Exercise 32: 659-668.
7. Fisher G, Brown AW, Bohan Brown MM, Alcorn A, Noles C, et al. (2015) High Intensity Interval- vs Moderate Intensity-Training for Improving Cardiometabolic Health in Overweight or Obese Males: A Randomized Controlled Trial. PLoS OneOct 10: e0138853.
8. Grossman JA, Payne EK (2016) A randomized comparison study regarding the impact of short-duration, high-intensity exercise and traditional exercise on anthropometric and body composition measurement changes in post-menopausal women-A pilot study. Post Reprod Health 22: 14-19.
9. Harris N, Dulson D, Logan G, Warbrick I, Merien F, et al. (2017) Acute Responses to Resistance and High Intensity Interval Training in Adolescents. J Strength Cond Res 31: 1177-1186.
10. Hill JS, Wearing GA, Eynon RB (1971) Effect of Frequency of Exercise on Adult Fitness. Medicine & Science in Sports & Exercise 3(1):k (Poster Presentation, ACSM Annual Conference).
11. Irwin ML, Yasui Y, Ulrich CM, Bowen D, Rudolph RE, et al. (2003) Effect of exercise on total and intra-abdominal body fat in postmenopausal women: a randomized controlled trial. JAMA 289: 323-330.
12. Jakicic JM, Marcus BH, Gallagher KI, Napolitano M, Lang W (2003) Effect of exercise duration and intensity on weight loss in overweight, sedentary women: a randomized trial. JAMA 290:1323-1330.
13. Jahicic JM, Otto AD (2006) Treatment and prevention of obesity: what is the role of exercise? Nutr Rev 64: S57-S61.
14. Kreiger JW (2010) Single vs. multiple sets of resistance exercise for muscle hypertrophy: a meta-analysis. J Strength Cond Res 24: 1150-1159.
15. MacInnis MJ, Gibala MJ (2017) Physiological adaptations to interval training and the role of exercise intensity. J Physiol 595: 2915-2930.
16. Mazurek K, Zmijewski P, Krawczyk K, Czajkowska A, Kęska A, et al. (2016) High intensity interval and moderate continuous cycle training in a physical education programme improves health-related fitness in young females. Biol Sport 33: 139-144.
17. Mora S, Lee IM, Buring JE, Ridker PM (2006) Association of physical activity and body mass index with novel and traditional cardiovascular biomarkers in women. JAMA 295: 1412-1419.
18. Pescatello LS (2005) Exercise and hypertension: recent advances in exercise prescription. Curr Hypertens Rep 7: 281-286.
19. Rowland T (2016) Pediatric Exercise Science: A Brief Overview. Pediatr Exerc Sci 28: 167-170.
20. Sijie T, Hainai Y, Fengying Y, Jianxiong W (2012) High intensity interval exercise training in overweight young women. J Sports Med Phys Fitness 52: 255-262.
21. Stoner L, Rowlands D, Morrison A, Credeur D, Hamlin M, et al. (2016) Efficacy of Exercise Intervention for Weight Loss in Overweight and Obese Adolescents: Meta-Analysis and Implications. Sports Med 46: 1737-1751.
22. Warburton DE, Nicol CW, Bredin SS (2006) Health benefits of physical activity: the evidence. CMAJ 174: 801-809.
23. Wessel TR, Arant CB, Olson MB, Johnson BD, Reis SE, et al. (2004) Relationship of physical fitness vs body mass index with coronary artery disease and cardiovascular events in women. JAMA 292: 1179-1187.
24. Willis FB, Smith FM, Willis AP (2009) Frequency of exercise for body fat loss: a controlled, cohort study. J Strength Cond Res 23: 2377-2380.
25. Zwickert K, Rieger E, Swinbourne J, Manns C, McAulay C, et al. (2016) High or low intensity text-messaging combined with group treatment equally promote weight loss maintenance in obese adults. Obes Res Clin Pract 10: 680-691.
26. Baruth M, Sharpe PA, Parra-Medina D, Wilcox S (2014) Perceived barriers to exercise and healthy eating among women

from disadvantaged neighborhoods: results from a focus groups assessment. Women Health 54: 336-353.

27. Willis FB, Shanmugam R, Curran SA (2018) Food Allergen Eliminations and Combined Protocols for Obesity Reduction: a Preliminary Comparison Study. Food Science & Nutrition Research 1: 1-6.
28. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS (2014) The role of exercise and physical activity in weight loss and maintenance. Prog Cardiovasc Dis 56: 441-447.
29. Cox CE (2017) Role of physical activity for weight loss and weight maintenance. Diabetes Spectr 30: 157-160.
30. Franz MJ, Van Wormer JJ, Crain AL, Boucher JL, Histon T, et al. (2007) Weight-loss outcomes: a systematic review and Meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. J Am Diet Assoc 107: 1755-1767.

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