***JEP*online**
Journal of Exercise Physiologyonline
Official Journal of The American Society of Exercise Physiologists (ASEP)
ISSN 1097-9751
An International Electronic Journal
Volume 2 Number 2 April 1999

Exercise and Health

EFFECT OF DIET AND EXERCISE ON QUALITY OF LIFE AND FITNESS PARAMETERS AMONG OBESE INDIVIDUALS

F. PERNA[1,2,3], R. BRYNER[2], D. DONLEY[2], M. KOLAR[2], G. HORNSBY[2], J. SAUERS[2], I. ULLRICH[2] and R. YEATER[2]

[1] School of Physical Education, [2] School of Medicine, [3] Department of Counseling, Rehabilitation, & Counseling Psychology, West Virginia University, Morgantown, WV 26506-6116

ABSTRACT

Effect of Diet and Exercise on Quality of Life and Fitness Parameters Among Obese Individuals.
F. PERNA, R. BRYNER, D. DONLEY, M. KOLAR, G. HORNSBY, J. SAUERS, I. ULLRICH and R. YEATER
JEPonline 1999, 2(2):1-6. Use of very-low-calorie-diets (VLCD) for treatment of obesity has been adversely related to quality of life (QOL). Because exercise is known to alter mood and self-beliefs in a positive direction, it may offset the negative impact of dieting. The present investigation evaluated the physical and QOL effects of a 12-week VLCD and exercise program. Sedentary obese adults (N = 22) were randomly assigned to either: diet and aerobic training, diet and resistance training, or a wait-list control condition. Data analyses revealed significant increases after 12 weeks in mental health (3% and 7%), QOL (11% and 23%), perceived health (56% and 43%), Peak$V0_2$ (33% and 33%), and significant weight reduction (-19% and -16%) among the aerobic and resistance training groups, respectively, as compared to a control group (all p's < .05). However, resistance and aerobic exercise training were equally effective. Additionally, changes in QOL were unrelated to changes in weight and fitness. Results suggest that individuals who participate in either an aerobic or resistance training program while consuming a VLCD experience a greater QOL than control patients. Importantly, these results indicate that the changes in weight and QOL are similar when using either aerobic or resistance training with a VLCD. The results also support the contention that psychological effects of exercise may be independent of physical change.

KEY TERMS: aerobic, resistance, body fat, mood, body weight

INTRODUCTION

Research has demonstrated that overweight individuals, particularly women, may feel negatively stigmatized. This is commonly thought to contribute to the negative affect and decreased quality of life (QOL) noted among obese persons (1, 2). Quality of life refers to ones global appraisal of their life factoring in physical, social, and psychological factors. However, research has not generally found significant associations between obesity and psychological distress after pertinent socioeconomic and demographic factors have been adequately controlled (3, 4). Ross (4) has proposed that, independent of weight, the act of dieting in an attempt to fit social norms heightens unpleasant self-other comparisons and feelings of physical and psychological inadequacy among obese individuals pursuing sustained weight loss. In a large cross-sectional study, Ross demonstrated that rather than the state of being overweight, the act of dieting and the impact of obesity on perceived physical health

were both independently responsible for the mental health consequences of obesity.

Very-low-calorie diets (VLCD) are sometimes recommended in cases of extreme obesity (5). Their use has primarily been limited to persons who have failed to lose weight in more conventional diet programs and whose body mass index (BMI) is greater than 30 (6). The use of exercise in addition to a VLCD may ameliorate potential impairment in QOL among individuals using a VLCD (7, 8, 9). Moreover, it has been suggested that the beneficial effect of exercise on QOL may be independent of short-term weight loss, and the psychological effects of exercise in improving mood and self-efficacy may serve to promote long-term weight loss (8, 9, 10). While the majority of experimental studies exploring the effect of exercise on mental health have utilized aerobic activity as the mode of exercise, debate exists regarding the relative physical and mental health benefits of resistance training, particularly for obese individuals (11, 12, 13). For example, meta-analytic reviews have indicated that while aerobic exercise was superior to resistance training in reducing anxiety, resistance or aerobic exercise training produced moderate to large effects on depression with no one mode demonstrating a statistical superiority (14, 15).

We are aware of no published studies that have compared the physiologic and QOL effects of aerobic and resistance training among obese individuals consuming VLCD. The purpose of the present investigation was to examine the effect of mode of exercise on QOL, weight loss, and fitness among obese participants utilizing a VLCD. We hypothesized that aerobic and resistance training would be equally effective in improving fitness, weight loss, and QOL, and that both exercise conditions would be superior to an information wait-list control condition. A secondary aim of the study was to determine if change in QOL was independent of weight and fitness changes.

METHODS

Participants and Procedures

Sedentary adult men (n = 4) and women (n = 18) between the ages of 21 and 60 years of age (37.0 ± 10.4 years) with a body mass index greater than 30 (34.9 ± 3.1) who were otherwise healthy were recruited through newspaper advertisements to participate in a 12 week diet and exercise study. Eligible participants completed an informed consent and were asked to complete a QOL survey and a fitness assessment consisting of a symptom limited graded exercise treadmill test (GXT) and a body weight analysis.

Following baseline assessments, participants were randomly assigned to one of three conditions: aerobic exercise and VLCD (A-VLCD) (n = 10), resistance training and VLCD (R-VLCD) (n = 8), or a wait-list control (n =4). All participants were individually monitored at each exercise session to assure compliance with both the resistance and aerobic training protocols. Because our primary objective was to compare exercise modes and to maximize participant compliance and adherence with study procedures, we over sampled for exercise plus diet conditions and offered an exercise and VLCD program to control condition participants following completion of the study. Preliminary analyses indicated that groups were not significantly different at baseline with respect to demographic and outcome variables ($p > .10$). All control group participants reported that they refrained from exercise which was corroborated by non significant weight and VO_2 changes from baseline to follow-up ($p > .05$).

Diet and Exercise Training Protocols

The VLCD consisted of a liquid formula (40% protein, 49% carbohydrate, 11% fat) ingested five times a day yielding a total of 800 Kcals/day. Two multivitamin tablets were also consumed daily. Participants were instructed to consume the diet every day for the entire 12 weeks of the study, to drink at least 64oz of water or other non-caloric beverages, and to refrain from all other food or beverage intake. All subjects met with an investigator, trained in the use of dietary logs, each week and were questioned about their medical condition and their compliance to the dietary protocol. Only one week worth of supplement was given at a time requiring subjects to be present at the weekly weigh-in and meeting sessions. Adherence to

the diet was questioned if weight loss was less then two pounds per week. Each subject was asked to give a verbal declaration of adherence to the diet at each weekly meeting. Self reported compliance was excellent. Control subjects were also questioned about their level of activity and asked to give a verbal declaration that they did not participate in any regular form of exercise.

R-VLCD

The diet plus resistance training group performed a circuit-type workout of resistance exercises three days/week at 10 stations (Universal weight machine) inclusive of four lower body and six upper body exercises for 12 weeks. Weight was gradually increased until subjects were lifting 75% of one-repetition-maximum for 2 sets of 12-15 repetitions by the start of week three. Participants increased to three sets by week seven and to four sets by week nine. From week nine to 12, sets and repetitions were kept constant while weight was increased. Approximately one minute was allowed between each exercise in the circuit.

A-VLCD

The diet plus aerobic training group exercised four days/week by walking, biking, or stair climbing at 60-80% of maximal heart rate as determined by treadmill GXT. Exercise duration began at 20 min/day and it was increased each week by 10 minutes until subjects were exercising 50-60 minutes at each session. Heart rate was determined by radial artery palpation every ten minutes.

Measures

QOL

A short form of the Medical Outcomes Study Health Status Questionnaire (MOS-30), a widely used measure assessing eleven parameters of physical and psychological functioning, was used to assess participants′ QOL at study entry and at the end of 12 weeks (16,17). In addition to an overall QOL rating, two specific MOS sub-scales (mental health and perceived health change) were pre-selected as outcome measures because of their theoretical importance to the study and to reduce the likelihood of experiment-wise error of multiple comparisons with all eleven subscales.

Body Weight & Body Composition

Weight was measured at baseline and again at 12 weeks. In order to control for diurnal variations, weight was measured the same time of day. Hydrostatic weighing was used to determine percent fat and fat free mass at baseline and at 12 weeks by a previously validated method (18).

Peak VO_2

Peak oxygen consumption was determined at baseline and at 12 weeks by a symptom limited treadmill GXT using a modified Balke protocol. After reviewing procedures of the GXT subjects were fitted with a noseclip and a Hans Rudolph non-rebreathable mouthpiece. Briefly, the protocol was initiated at a comfortable but brisk walking speed (2.5 to 3.5 mph) at zero percent elevation. Treadmill speed remained constant throughout while the elevation was raised one percent each minute until volitional fatigue. Breath by breath oxygen analysis was done with an Aerosport metabolic system. Participants were encouraged to continue until volitional fatigue.

Data Analysis

Due the limited number of men recruited for study entry, gender was collapsed into treatment condition. MOS-30, weight, and Peak VO_2 data were assessed in six 3 x 2 (Group x Time) repeated measures analyses of variance (ANOVA) calculations corrected for unequal sample size. The ANOVA′s were calculated to derive appropriate mean-square and mean-square error terms for use in planned nonorthogonal simple effects contrast analyses. Simple effects planned contrasts tested the hypothesized difference between a) both exercise conditions (collapsed) versus the control; and b) the resistance versus aerobic exercise conditions for each outcome variable. Pearson Product moment correlation coefficients were then calculated to determine the relationship between the change in QOL and each of change in weight and Peak VO_2. Significance levels were set at the .05 level (two-tail) for all analyses.

RESULTS

Group means at baseline and at 12 weeks for QOL and fitness parameters are presented in Table 1. As can be seen in Table 1, decreases in body weight and percentage of fat and increases in Peak VO_2 and time to fatigue were observed for both the A-VLCD and

for R-VLCD conditions which were significantly different from the control group (Contrast t′s (19) = 8.03, 2.38, 2.83, and 3.83, $p < .02$ respectively). However, Peak VO_2, time to fatigue, body weight and percentage of fat were not significantly different between exercise conditions (all $p > .30$). Similarly, significant improvements in QOL, mental health, and perceived health were observed for the A-VLCD and the R-VLCD groups in comparison to the control condition (Contrast t′s (19) = 2.35, 3.04, and 3.93 $p < .05$ respectively), but again, exercise groups were not significantly different from each other, (all $p > .30$).

Pearson Product-Moment correlation coefficients were calculated to determine the degree to which changes in weight and Peak VO_2 were related to changes in quality of life indices. Correlational analyses indicated that changes in weight, percentage of fat, Peak VO_2, and time to fatigue were not significantly related to changes in perceived physical health (r′s = -.34 to .35) respectively), mental health (r′s = -.48 and .18 respectively), or overall QOL (r′s = -.30 and -.01 respectively) (all p′s >.05).

DISCUSSION

As predicted, combined diet and exercise programs out performed a standard control condition with respect to changes in weight and functional capacity. Moreover, both diet-exercise programs resulted in improved quality of life and mental health as compared to the control condition, but changes in QOL were independent of changes in weight or fitness. Resistance and aerobic training were similarly effective in producing short term improvements in weight, Peak VO_2, and QOL among individuals on a VLCD. Our findings regarding the relative effectiveness of resistance versus aerobic training are consistent with meta-analytic

investigations comparing exercise modality effects on mental health and a prior investigation of a long term weight loss study employing a moderately low calorie diet (13,14, 15).

Our results indicate that changes in physical parameters, especially weight change, were unrelated to quality of life changes. These results also parallel findings from prior investigations that

Table 1: Mean ± SD Weight, Peak VO_2, and MOS-30 Values for Diet-Exercise Groups

Measure (n=22)	*Baseline*			*12-Weeks Post-intervention*			*Contrast Effect Size*	
	A-VLCD	**R-VLCD**	**Control**	**A-VLCD**	**R- VLCD**	**Control**		**r**
Weight (kg)	93.8 ± 15.1	95.5 ± 17.3	96.1 ± 7.0	75.5 ± 10.5	80.7 ± 13.0	98.6 ± 7.2	(1) (2)	.90** .22
% Fat	44.5 ± 7.0	46.6 ± 5.8	40.3 ± 7.6	37.1 ± 6.0	38.1 ± 4.5	39.2± 10.1	(1) (2)	.47** .10
Peak VO_2 (ml/kg/min)	20.6 ± 3.0	21.1 ± 3.7	19.5 ± 2.4	27.5 ± 3.2	28.0 ± 5.1	21.1 ± 4.1	(1) (2)	.56** .05
Time to Fatigue (min)	12.1 ± 3.8	10.6 ± 2.7	13.0 ± 1.3	17.5 ± 2.8	14.8 ± 4.0	12.8 ± 1.5	(1) (2)	.67** .22
Mental Health	23.5 ± 1.7	21.6 ± 1.9	23.3 ± 1.7	24.1 ± 2.0	23.1 ± 1.6	20.8 ± 3.1	(1) (2)	.57** .02
Perceived Health	2.7 ± 0.5	2.8 ± 0.5	2.8 ± 0.5	1.2 ± 0.6	1.6 ± 0.9	3.0 ± 0.1	(1) (2)	.67** .24
Quality of Life	1.9 ± 0.3	2.6 ± 0.7	2.5 ± 0.7	1.7 ± 0.5	2.0 ± 0.5	2.5 ± 0.6	(1) (2)	.47* .05

Groups: aerobic exercise and diet (A-VLCD); resistance training and diet (R-VLCD); wait-list control (control). Effect sizes represent contrasts comparing (1) combined exercise conditions versus control and (2) A-VLCD versus R-VLCD. MOS-30 Scale ranges: Mental Health (0-26); Perceived health (1 = "much better" to 5 = "much worse"); Quality of Life (1 = "very well, could hardly be better" to 5 = "very bad, could hardly be worse").*$p < .05$; **$p < .01$

reported that depression, anxiety, and general mood disturbance changes following an exercise program can result without an improvement in fitness (11). Change in self-referent thought, which is well known to underpin change in affective states and capacity for behavioral self-regulation, may occur from exercise (19). For example, exercise induced changes in confidence, self-perception, and global self-
efficacy may be particularly important for overweight individuals attempting to pursue and maintain weight loss (8, 9). The influence of exercise on self referent though was not examined in our study but may contribute to QOL changes.

The favorable psychological changes associated with a combined diet and exercise program have important treatment implications for individuals considering a VLCD for weight loss. Since exercise is a predictor of long term weight loss, it is important to find an exercise mode that the person enjoys and will continue. Since aerobic exercise and resistance training are equally effective in improving quality of life and weight loss, the exercise prescription should be based on individual preferences. Utilizing different forms of exercise may limit boredom and decreased compliance. The long term effect of resistance exercise on weight loss maintenance is an important topic for future research.

Acknowledgment: The study was sponsored by Health Management Resources, Boston, MA who also provided the dietary supplements.

REFERENCES

1. Sarlio-Lahteenkorva S, Stunkard AJ, Rissanen A. Psychosocial factors and quality of life in obesity. *Int J Obesity* 1995; 19 (6 suppl.): S1-S5.
2. Sobel J, Stunkard AJ. Socioeconomic status and obesity: A review of the literature. *Psychol Bulletin* 1989; 105:260-275.
3. Crisp AH. McGuiness B. Jolly fat: Relation between obesity and psychoneurosis in a general population. *Br Med J* 1976; 1:7-9.
4. Ross CE. Overweight and depression. *J Health Social Behav* 1994; 35:63-78.
5. Alban HJ: Metabolic responses to low- and very-low-calorie diets. *Am J Clin Nutr* 49:745, 1989.
6. Bray GA, Gray DS: Obesity, I: pathogenesis. *West J Med* 149:429-441, 1988.
7. Biddle S. Exercise and psychosocial health. *Res Quart Exerc Sport* 1995; 66:292-297.
8. Brownell KD. Exercise and obesity treatment: Psychological aspects. *Int J Obesity Related Met Disorders* 1995; 19 suppl: S122-S125.
9. Duppert PM. Exercise in behavioral medicine. *J Consult Clin Psych* 1992; 60:613-618.
10. Heatherton TF, Renn RJ. Stress and the disinhibition of behavior. *Mind/Body Med* 1995; 1:72-81.
11. Leith L. Exercise and mental health. Morgantown, WV: Fitness Information Technology, 1994.
12. Pate RR. Physical activity and health: Dose-response issues. *Res Quart Exerc Sport* 1995; 66:313-317.
13. Wadden TA, Vogt RA, Anderson RE, Bartlett SJ, Foster GD, Kuehnel RH, et al. Exercise in the treatment of obesity: Effects of four interventions on body composition, resting energy expenditure, appetite, and mood. *J Consult Clin Psychol* 1997; 65:269-277.
14. North TC, McCullagh P, Tran ZV. Effect of exercise on depression. *Exerc Sports Sci Rev* 1990; 18: 379-415.
15. Petruzzello S, Landers D, Hatfield B, Kubitz K, Salazar W. A meta-analysis on the anxiety-reducing effects of acute and chronic exercise: Outcomes and mechanisms. *Sports Med* 1991; 11:143-182.
16. Wu AW, Rubin HR, Mathews WC, Ware JE, Brysk LT, Hardy WD, et al. A health status questionnaire using 30 items form the Medical Outcomes Study: A preliminary validation in persons with early HIV infection. *Med Care* 1991; 29:786-798.
17. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short Form Health Survey (SF-36): Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care* 1993; 31:247-263.
18. Warner J, Yeater R, Sherwood L, Weber K. A hydrostatic weighing method using total lung capacity and a small tank. *Brit J Sports Med* 1986;

1:17-21.
19. Bandura A. Self-Efficacy: toward a unifying theory of behavior change. *Psychol Rev* 1977; 84:191-215.

Address correspondence to: Randall W. Bryner, Ed.D., Division of Exercise Physiology
PO Box 9227, 8317 HSC, Morgantown, WV 26506-6116, Phone: 304-293-0441,
Fax: 304-293-7105
e-Mail: rbryner@mail.hsc.wvu.edu