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Effect of Exercise and/or Fitness Education on Fitness in Older, Sedentary, Obese Women

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This paper reports on fitness changes in sedentary, obese (M BMI = 32.0 kg/m^2), 60- to 70-year-old women following 4 months of exercise-based intervention. One hundred eighty-two women were randomly assigned to the following groups: health and fitness education (ED) (n = 70), health and fitness education combined with aerobic training (EX) (n = 76), and control (CO) (n = 36). Pre- and postintervention assessments included predicted VO_2max, body composition, resting blood pressure, muscular strength, and flexibility. Significant improvements in aerobic power (31.9%, $p < .001$), percent body fat (–5.4%, $p < .05$), and dominant hand-grip strength (4.1%, $p < .001$) were found in EX compared to ED and CO. Also observed was a significant improvement in flexibility for both EX (13.8%) and ED (12.5%, $p < .01$) compared to CO. Ninety percent (n = 164) of the women adhered to the program. Program factors contributing to adherence are discussed.

Key Words: obesity exercise program, VO_2 max, health promotion, adherence

Sedentary, obese women over 60 years of age are at increased risk for cardiovascular and cerebrovascular disease, hypertension, diabetes, musculoskeletal disorders, and falls (Department of Health and Human Services [DHHS], 1990; Gibson, Andres, Isaacs, Radebaugh, & Worm-Peterson, 1987; Stewart, King, & Haskell, 1993). Long-term participation in exercise by obese, older women may have a major impact on their physical independence and physical health by improving underlying fitness parameters, such as aerobic power (Blumenthal et al., 1989; Johannessen, Holly, Lui, & Amsterdam, 1986; Posner et al., 1992; Steinhaus et al., 1990), body composition (Thompson, Jarvie, Lahey, & Cureton, 1982), muscular strength, muscular endurance, and flexibility (Pollock & Wilmore, 1990; Stewart et al., 1993), and resting systolic and diastolic blood pressure (Cononie et al., 1991), and may potentially decrease future demands on the health-care delivery system (Branch et al., 1981; Stewart et al., 1993; Thompson et al., 1982).

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Exercise programs offered to obese, older women should be convenient and age-appropriate, and, if possible, should be composed of peers of similar weight range, age, and fitness levels (Dishman, 1981; Gillett, 1993). Programs should focus on minimizing exercise-related risks specific to this group, such as falls due to balance difficulties (Stelmach & Worringham, 1985), musculoskeletal injury due to the lack of muscular strength and flexibility and increased stress on muscle–tendon units (Shephard, 1987), and increased sensitivity to heat stress (Yousef, Sagawa, & Shiraki, 1986). At present, an increasing number of exercise training studies are being conducted with women over 60 years of age, but few of these studies focus on sedentary, obese women. An exercise program designed exclusively for obese older women, using specially trained leaders and age-appropriate content, may help address the special needs of this group.

Obese women are generally poorly motivated to participate in exercise programs, often due to perceived negative consequences, such as shame and embarrassment at bodily exposure, real or imagined negative attention or ridicule from those more fit than themselves, and anxiety about time taken away from work, family, or other pleasurable activities (Knapp, 1988). Obese women may also perceive themselves as having low energy levels and poor self-efficacy related to exercise (Foreyt & Goodrick, 1991). Several exercise adherence strategies reported in the literature may provide needed motivation for this population. For example, obese women are more likely to exercise if exercise intensity is low and fitness goals are realistic and achievable (American College of Sports Medicine [ACSM], 1991; Epstein, Koeske, & Wing, 1984). Exercise habit formation and maintenance may be reinforced (a) when exercises offer low risk of injury, (b) when group camaraderie is developed among exercise participants (Brownell, 1982; Epstein et al., 1984; Gillett, 1988; Gillett et al., 1993; Oldridge, 1984), (c) when exercise activities are perceived as enjoyable and fun (Franklin, 1994; Wankel, 1994), (d) when demonstrable changes in fitness and health status occur as a result of participation (Kriska et al., 1986; Martin & Dubbert, 1984; Ward & Morgan, 1984), and (e) when goal setting is used to assist in developing commitment and motivation (Epstein et al., 1984; Gillett, 1988; Martin & Dubbert, 1984; Oldridge, 1984).

The purpose of this study was to test the effect of two nurse-delivered exercise/education programs specifically designed for obese, older women. The programs consisted of health and fitness education only (ED) and health and fitness education with aerobic training (EX). Pre- and postprogram measures of aerobic power, body composition, resting blood pressure, muscular strength, and flexibility were used to assess the effectiveness of the two interventions relative to a sedentary, nonintervention control group (CO).

Hypothesized physiological changes for the EX group and to a lesser extent for the ED group included reductions in body fat and blood pressure, and improvements in aerobic power, muscular strength, and flexibility compared to the CO group.

Method

SAMPLE

Newspaper and radio recruitment advertisements generated 347 inquiries. Selected from this sample were women who were nonsmokers, nonexercisers (< 3 times/week) (ACSM, 1991), and obese (RISKO categories C and D) (Heyward, 1991). Excluded were women with known cardiovascular, pulmonary, neurological, or kidney disease; women with hypertension not currently taking medication; and women with self-reported musculoskeletal problems severe enough to preclude them from easily arising from a supine position or requiring them to use a cane or crutch for ambulation. Based on these criteria, 182 60- to 70-year-old women (*M* age = 64.4, *SD* = 3.0) were selected and interviewed by a nurse practitioner who took their blood pressure and an in-depth health history. On completion of the intake interview, each woman signed an informed consent (approved by the University of Utah Institutional Review Board) and provided a medical clearance from her primary physician. The women were classified by body mass index (BMI) and percent body fat (%BF) as moderately to severely obese (*M* BMI = 32.0 kg/m^2, *SD* = 4.0; *M* %BF = 40.9, *SD* = 4.1).

INSTRUMENTS

Subjects completed the following tests at baseline and immediately following 4 months of intervention: predicted VO_2max, body composition analysis, resting blood pressure, dynamic muscular strength, and flexibility. Testing took place at a human performance laboratory. Additionally, the ED and EX groups kept weekly activity records and marked a class attendance roster.

Submaximal Bike Test. A modified Åstrand–Ryhming protocol was used to estimate VO_2max. Tests were performed on Bodyguard (Sandnes, Norway) cycle ergometers that were calibrated before each testing session using standard 1-, 2-, and 3-kg weights. Before the test, a Polar heart rate monitor was positioned on each subject and seat height was adjusted to a comfortable level. Each subject was then asked to pedal at 50 rpm for the duration of the test. Initial resistance was set at 300 kpm/min and increased every 2 min thereafter, based on heart rate response, until a plateau near 70% of age-predicted maximal heart rate was achieved. Average heart rate for the last exercise stage and the final workrate were recorded and used to calculate predicted VO_2max (Pollock & Wilmore, 1990).

Body Composition Analysis. Percent body fat and fat-free mass were estimated using the Jackson, Pollock, and Ward (1980) prediction equation. Three consecutive skinfold measurements were taken at each of three sites—triceps, suprailiac, and thigh—using Harpenden calipers. The average score (in millimeters) for each site was used to determine body fat. All skinfold measurements were made by a single exercise physiologist with several years of clinical assessment experience.

Resting Blood Pressure. Systolic and diastolic blood pressures were measured by the brachial artery auscultation technique using a calibrated standard aneroid sphygmomanometer after each woman had been sitting quietly for at least 5 min. The first and fourth Korotkoff sounds were recorded as millimeters of mercury (mmHg) (ACSM, 1991; Heyward, 1991).

Dynamic Muscular Strength. Upper and lower body strength was assessed using separate one-repetition maximum (1-RM) tests. To determine upper body 1-RM, a bench press (Universal Gym Equipment) exercise was used. Each subject began with a resistance of 4.5 kg. During subsequent trials the resistance was increased by 4.5 kg and then progressively smaller increments (2.3 and 1.1 kg) until failure. The maximum weight lifted was recorded (Gettman, 1988; Pollock & Wilmore, 1990).

Lower body strength was assessed using a leg press (Universal Gym Equipment) exercise. Subjects were positioned so that the knees were flexed to 90° prior to the extension movement. Initial resistance was set at 22.7 kg and was increased by 9.1 kg and then progressively smaller increments as described previously.

Flexibility. Flexibility of the lower back, hip, and posterior thigh was evaluated using a sit-and-reach test. The test used a box placed on the floor with a scale measuring 10 cm beginning at the feet and extending away from the body. Each woman sat with both legs extended, knees in contact with the floor, and placed her flexed feet against the lateral surface of the box. She then reached as far as possible toward or beyond her feet using a smooth, consistent movement. The highest score of three trials was recorded (Heyward, 1991).

Activity Records. Women in the ED and EX groups kept 7-day physical activity records (PARs). The PARs were used to record all aerobic exercise, both supervised group exercise and unsupervised home-based exercise. Daily records listed the type of aerobic activity (if any) and the number of minutes spent exercising at a heart rate of 60 to 80% of maximum heart rate reserve (MHRR) (Karvonen, Kentala, & Mustala, 1957). Women turned in their records weekly. CO subjects were not asked to complete these records because there was concern that by doing so they would change their normal activity patterns. COs, however, completed a questionnaire at the postfitness test indicating whether they had exercised regularly (3 times/week) since the initial fitness test.

Attendance Roster. Attendance was quantified at exercise and fitness education classes using a daily attendance roster.

INTERVENTION PROCEDURES

Women were randomly assigned to a health and fitness education group (ED) (n = 70), a health and fitness education with aerobic training group (EX) (n = 76), and a control group (CO) (n = 36). The uneven distribution was a result of an a priori power analysis (Fleiss, 1981). This analysis indicated that a significance level of $p < .05$ at 80% power could be achieved with intervention group sample sizes equal to a minimum of 60 each and a control group of 30 or more. Both ED and EX groups were led by geriatric nurse practitioners with teaching and counseling experience. The leaders were fit women in their 50s who were neither thin nor athletic looking. Nurses were given 14 weeks training in exercise and education protocols by an ACSM-certified health and fitness instructor (Gillett et al., 1993).

Both the ED and EX groups received separate 1 hr per week health and fitness education classes for 16 weeks. The women were instructed in 16 specific health and fitness topics salient to their age group. These topics included the following: the role of exercise in health, exercise safety and injury prevention, exercise prescription, physiological responses to exercise, self-monitoring techniques, cardiorespiratory fitness, muscular strength and endurance, flexibility, women's health issues (hormone replacement, calcium, chronic disease management), cholesterol management, nutrition, and weight control. A seminar/discussion teaching format was used, with visual aids, exercise demonstrations, and handouts. Women were carefully instructed on the principles of warm-up, cool-down, and flexibility.

ED Exercise Protocol. The ED subjects were instructed to exercise aerobically on their own. They were given their individual baseline fitness test results, along with fitness norms, and were taught the components of an exercise prescription. The prescription followed ACSM (1991) guidelines of exercise frequency, intensity, and duration. Women were taught how to monitor exercise intensity using radial or carotid pulse palpation. Initially, the ED subjects were instructed to exercise 3 days a week for 10 to 15 min at an intensity of 60 to 80% of their MHRR (Karvonen et al., 1957). In subsequent weeks, they were instructed to maintain this exercise frequency and intensity and to gradually increase the duration to 30 min.

EX Exercise Protocol. The EX group received 1 hr of supervised low-impact dance exercise, 3 days per week, for 16 weeks. To tailor the exercise program to this group, a discontinuous training format was used, in which aerobic dance was alternated with short periods (10 to 30 s) of walking recovery (ACSM, 1991; Gillett, 1993; Gillett & Eisenman, 1987). Exercise was accompanied by slow to moderately paced music appropriate for this cohort. Gradually, the intensity and duration of the aerobic exercise were increased over the 16-week period. Simultaneously, the number and length of the recovery periods were decreased. The women began with 12 min of aerobic exercise at an intensity of 60 to 70% MHRR. At Week 3, the duration was increased to 16 min. At Week 5, the duration was increased to 22 min and the intensity to 60 to 80% MHRR. Exercise intensity remained at this level for the remaining weeks with duration gradually increasing to 30 min. The group warmed up for approximately 15 min before and cooled down for 5 min following the aerobic activity. The slow, lengthy warm-up was designed to safely and thoroughly prepare the women for vigorous exercise (Idiculla & Goldberg, 1987). In addition, a portion of each class was devoted to exercises for muscular endurance, strength, and flexibility. The group members monitored exercise intensity using carotid or radial pulse palpation. Their measurements were verified during the early weeks by the nurse leaders.

Control Group (CO). CO group fitness measurements were taken at baseline and at 16 weeks. Test results along with fitness norms were mailed to the women 3 weeks after each test. The CO group received no information or instruction about exercise and were asked to continue their normal daily activities. The CO group did not keep PARs, but to verify that they had remained sedentary, this group completed a 1-page questionnaire at posttesting, reporting whether they had regularly exercised (3 or more times a week) for the preceding 16 weeks.

Results

ADHERENCE

Of the 182 women who entered the study, 164 women (90%) completed the posttest assessment. None of the women sustained injuries as a result of the intervention; however, 18 women dropped out before posttest as follows: ED ($n = 7$), EX ($n = 6$), and CO ($n = 5$). Reasons cited included nonrelated medical problems ($n = 6$), time pressures ($n = 6$), moved from area ($n = 3$), caregiver responsibilities ($n = 2$), and lost interest ($n = 1$). On the average, both the ED and EX groups attended 86% of their class sessions. Twenty-six percent ($n = 8$) of the CO group reported that they had exercised regularly.

FITNESS AND BODY COMPOSITION OUTCOMES

To assess whether the hypothesized changes had occurred, analysis of variance (ANOVA) with repeated measures was employed. Of particular importance in experimental designs is a significant group-by-time interaction, which indicates that changes from baseline to 4 months are not the same for each group (Keppel, 1991). When this was detected, post hoc tests were performed on the group means to determine if these changes were due to one or both of the treatments, while accounting for baseline levels. The results of the repeated measures analyses, presented below, were further confirmed by analysis of covariance. Table 1 presents mean baseline and posttest values for fitness and body composition.

Table 1 Baseline and Posttest Means and Standard Deviations of Selected Fitness and Body Composition Outcomes for EX ($n = 69$), ED ($n = 64$), and CO ($n = 31$) Groups

	Baseline		4 Months			Significant effects (F ratio)[a]		
Outcome/group	*M*	*SD*	*M*	*SD*	% Gain	Group	Time	Group × Time
VO_2max (ml/kg^{-1}/min^{-1})								
EX	23.8	5.5	31.4[b,c]	6.2	31.9	10.47***	55.38***	14.23***
ED	22.6	7.5	24.6[b]	8.2	8.8			
CO	21.5	5.8	23.9[c]	6.0	11.2			
Body fat (%)								
EX	40.8	4.5	38.7[c]	5.4	−5.4	NS	29.13***	3.98*
ED	40.7	4.4	39.8	4.0	−2.2			
CO	41.6	3.5	40.9[c]	4.1	−1.7			
Weight								
EX	83.1	11.8	81.1	12.0	−2.4	NS	9.43**	NS
ED	86.0	10.4	85.7	10.9	−0.3			
CO	84.3	11.4	82.3	11.0	−2.4			
Systolic blood pressure (mmHG)								
EX	139.1	16.8	135.7	17.4	−2.4	NS	4.53*	NS
ED	142.7	17.0	138.3	16.7	−3.1			
CO	139.3	13.3	137.6	16.2	−1.2			
Diastolic blood pressure (mmHG)								
EX	81.3	7.9	81.7	9.1	0.5	NS	NS	NS
ED	81.9	10.0	79.6	9.5	−2.8			
CO	80.8	9.1	79.3	6.7	−1.9			

[a] F ratios based upon analyses of variance with repeated measures (only significant effects are presented, for clarity). [b] Pairwise difference between EX and ED. [c] Pairwise difference between EX and CO.
*$p < .05$. **$p < .01$. ***$p < .001$.

No group differences were observed at baseline for any of the measures, although overall group effects (ignoring time) were found for predicted VO_2max ($p < .001$). We observed significant changes over time for all fitness and body composition variables with the exception of diastolic blood pressure. Effects due to fitness training were evidenced by significant group-by-time interactions for VO_2max and percent body fat. Tukey pairwise difference tests were performed on posttest means to determine which group or groups accounted for the interactions. According to these post hoc tests, EX had significantly greater predicted VO_2max values at posttest than ED and CO. A single pairwise difference was observed between EX and CO in percent body fat at posttest.

The EX group's improvement in predicted VO_2max ($p < .001$) was the largest observed treatment effect in this study. The 31.9% increase in VO_2max for the EX group was comparable to other training studies. Although some decrease in body fat was observed in the exercise group, no differences in body weight were noted among the three groups. A slight decrease in systolic blood pressure ($p < .05$) was observed among all groups; however, this change cannot be attributed to either of the treatments. Resting diastolic blood pressures did not significantly change over the intervention period.

MUSCULAR STRENGTH AND ENDURANCE OUTCOMES

Table 2 presents mean baseline and posttest values for muscular strength measures. One-way ANOVA at baseline revealed significant differences for absolute bench press strength ($F = 13.73$, $p < .001$) and absolute leg press strength ($F = 4.15$, $p < .01$). According to post hoc tests, the EX group had significantly lower bench press strength than ED and CO and had lower leg press strength than ED. These preliminary differences were maintained at posttest, thus confirming the absence of a significant group-by-time interaction on these measures.

Although significant changes over time on all strength measures were detected, significant group-by-time interaction was evident only for hand-grip strength ($p < .001$) and flexibility ($p < .01$). Dominant hand-grip strength increased significantly ($p < .001$) for the EX group, whereas it decreased for both ED and CO groups. This was confirmed by the post hoc tests performed on the posttest means where EX significantly differed from ED and CO. Pairwise tests also indicated that both EX and ED groups demonstrated greater flexibility ($p < .01$) than CO at 4 months.

ACTIVITY RECORDS

Table 3 presents the average frequency and duration of physical activities pursued by both ED and EX groups during the study. As expected, approximately 75% of the reported activity of the EX group was low-impact dance exercise as performed in their exercise class. The other 25% represents aerobic activities additional to the intervention. The most frequently reported aerobic activity for the ED group was walking (approximately 48%) followed by stationary bicycling (20%).

To accommodate long-term follow-up, activity data were aggregated in 6-week blocks with the intervention groups recording activity frequency (days/week) and duration (minutes/session) data over an 18-week period. Analysis

Table 2 Baseline and Posttest Means and Standard Deviations of Selected Muscular Strength and Flexibility Outcomes for EX (n = 69), ED (n = 64), and CO (n = 31) Groups

	Baseline		4 Months			Observed effects (F ratio)[a]		
Outcome/group	*M*	*SD*	*M*	*SD*	% Gain	Group	Time	Group × Time
Absolute bench press strength (1-RM kg)								
EX	17.3[b,c]	8.8	19.8[b,c]	4.8	14.1			
ED	21.5[b]	10.6	23.8[b]	5.4	10.3	12.31***	29.15***	NS
CO	22.1[c]	16.4	23.1[c]	7.6	4.7			
Absolute leg press strength (1-RM kg)								
EX	84.3[b]	48.8	90.5[b]	24.0	7.3			
ED	96.6[b]	46.5	105.0[b]	19.4	8.7	6.02**	49.49***	NS
CO	92.5	57.2	101.0	22.4	9.2			
Hand grip strength (kg)								
EX	27.0	4.6	28.1[b,c]	4.6	4.1			
ED	27.9	3.8	24.2[b]	3.8	−13.3	NS	33.24***	33.40***
CO	27.3	6.5	25.0[c]	5.3	−8.4			
Flexibility (cm)								
EX	23.9	8.6	27.2[b,c]	8.1	13.8			
ED	20.8	7.9	23.4[b]	7.4	12.5	3.37*	18.16***	6.69**
CO	23.4	6.1	22.6[c]	6.1	−3.4			

[a]F ratios based upon analyses of variance with repeated measures (only significant effects are presented, for clarity). [b]Pairwise difference between EX and ED. [c]Pairwise difference between EX and CO.
*$p < .05$. **$p < .01$. ***$p < .001$.

indicated that on average both the EX and ED groups exercised from 3 to 4 days per week. No statistical differences between these groups with respect to exercise frequency were observed.

There were statistical differences in exercise duration during the first 12 weeks between EX and ED. According to PARs, the EX group exercised aerobically for shorter periods of time: 6.5 min per session less for Weeks 1 through 6 ($p > .001$) and 3.7 min less per session for Weeks 7 through 12 ($p < .05$). Statistically significant differences disappeared in the final 6 weeks. For the entire 18-week period, the ED subjects reported they had exercised an average of 3.9 min longer per exercise session than the EX group ($p < .01$).

Discussion

FACTORS RELATED TO ADHERENCE

A number of elements to promote exercise adherence were built into the program to make it unique for this population. Individual exercise prescriptions were

Table 3 Average Frequency and Duration of Low- to Moderate-Intensity (60–80% MHRR) Supervised and Nonsupervised Exercise for EX (n = 69) and ED (n = 64) Groups During and 2 Weeks After Conditioning Period

	EX		ED		
Measure	*M*	*SD*	*M*	*SD*	*t*
Frequency (days/week)					
Weeks 1–6	3.8	1.0	3.5	1.4	1.14
Weeks 7–12	3.9	1.1	3.7	1.5	0.93
Weeks 13–18	3.6	1.3	3.2	1.6	1.93
18-week average	3.8	0.9	3.6	1.1	1.10
Duration (min/session)					
Weeks 1–6	19.6	5.0	26.1	10.5	4.51***
Weeks 7–12	25.8	6.1	29.5	11.9	2.24*
Weeks 13–18	30.4	7.5	31.5	3.2	0.59
18-week average	25.3	4.9	29.2	9.6	2.71**

*$p < .05$. **$p < .01$. ***$p < .001$.

used extensively with both intervention groups, although it was much easier to individualize training under the EX condition. Individual instruction was given to women who had very low initial fitness levels, hypertension, or problems breathing (secondary to weight) in how to moderate exercise intensity (Gillett et al., 1993). In addition, women with chronic health problems (e.g., arthritis, mastectomy, and back pain) were taught how to decrease range of motion, modify stretching exercises, and avoid exercises that stressed the lower back and knees.

Exercise intensity and duration were progressed at a reasonable rate to promote self-efficacy, and nurse leaders provided positive, nonthreatening modeling for the women. At the end of 16 weeks, both groups were pleased with their ability to exercise for 25 to 30 min and stated they felt comfortable being with other women the same age, weight, and fitness levels as themselves. EX group women reported that exercising to slower paced, cohort-appropriate music increased their enjoyment.

In weekly education classes, the women enjoyed interacting with their peers and had lively discussions about health and fitness changes that worked and did not work for each of them. The social support inherent in these classes may have contributed to the higher than average adherence rate (King, Haskell, Taylor, Kreamer, & DeBusk, 1991). Many women stated they found the fitness, health, and nutrition information highly valuable in guiding self-care and had learned to appreciate their bodies and recognize that positive change is possible at any age. Providing this type of program as an initial exercise experience may lead to greater self-efficacy (McAuley, Courneya, & Lettunich, 1991) and may provide the basis for a more intensive program that will lead to greater improvements in fitness (Samitz & Bachal, 1991) and improved ability to carry out tasks of daily living.

FITNESS AND BODY COMPOSITION FINDINGS

VO_2max Changes. The 31.9% improvement in VO_2max by the EX group was higher than the VO_2max changes reported in similar exercise training studies: 8.6% (Blumenthal et al., 1989), 18.9% (Johannessen et al., 1986), 8.5% (Posner et al., 1992), and 15.9% (Foster et al., 1989). Our findings, however, are lower than those of Steinhaus and colleagues (1990), whose subjects increased their VO_2max by 45%.

The ED group's self-reported activity level was slightly greater than the activity level of the EX group. The disparity between the ED group's self-reported aerobic activity level and relatively small increase in VO_2max (8.8%) suggests that subjects in this group may have overestimated their exercise intensity. This may have been due to exercise inexperience combined with the lack of leadership. Nurse leaders provided exercise that was more closely tailored to the women's fitness levels, thus producing greater aerobic fitness improvements for EX. In addition, the group setting may have motivated the women to exert more effort. In contrast, the ED group may not have modified intensity to match their abilities as fitness improved and, therefore, did not improve as much.

Body Composition. The EX group demonstrated a decrease in body fat that was significantly greater than that for CO. This 5% decrease was similar to the findings of Cowan and Gregory (1985) and Kohrt, Obert, and Holloszy (1992). However, all three groups showed decreases. It is possible that a longer and/or more intense intervention would result in greater differences between groups. Dietary factors, which were not modified in the present study, also play a major role in body composition.

Flexibility. Women in the EX group performed 5 to 8 min of static stretching at the conclusion of each exercise class. Women in the ED group were given demonstrations of stretches and were instructed to stretch for 5 to 8 min at the end of each of their exercise sessions. The significant flexibility improvements by both the EX and ED groups suggest that flexibility protocols were followed.

MUSCULAR STRENGTH AND FLEXIBILITY

Bench and Leg Press Strength. After 16 weeks, all groups demonstrated increased bench press and leg press strength scores, indicating that the two interventions were probably not responsible for the improvements. It is more likely that a test–retest effect resulted in improvements in muscular strength over time for all groups as each improved in equal fashion. Because the subjects were not familiar with either the bench press or leg press exercises, an accommodation test session may have been useful. Such an orientation may have increased the subjects' confidence, thus allowing a more valid measurement during the actual testing sessions.

Members of both EX and ED groups commented on increased abilities to perform daily living tasks, some of which require strength as well as flexibility, such as getting in and out of a car, zipping a dress in the back, and carrying groceries and laundry. These comments suggest that improvements had occurred, although no systematic measures of daily living tasks were made to compare the three groups.

Grip Strength. The EX group increased grip strength slightly after training, while both the ED and CO groups decreased on this measure. The difference may be due to the specificity of the EX exercise protocol, which included use of hand weights.

Summary

The written comments we collected at posttest from the ED and EX groups indicated that the women had a positive learning experience. They reported improvements in functions such as range of motion, mobility, and strength and also reported improved sleep, increased energy, better posture, and an enhanced ability to manage stress. Greater confidence, increased flexibility, and modest muscular improvements induced by an exercise intervention may result in greater ability to function in everyday activities. Therefore, it may be possible to improve health, physical function, and quality of life without a substantial increase in fitness level (Minor, 1991; Soucie, 1993). This becomes increasingly crucial as people age (O'Brien & Vertinsky, 1991; Shephard, 1987, 1990). Future studies should include measures of physical function and activities of daily living that reflect these more practical improvements. However, since functional changes appear to be highly individual, appropriate measurement tools are difficult to find.

Because no training-related injuries occurred during the 4-month exercise program, and in view of the improvement in fitness, we concluded that the EX protocol was both safe and effective for a relatively healthy population of 60- to 70-year-old obese women in the presence of medical and physiological monitoring. The ED group's modest fitness improvements suggest that unsupervised exercise, when combined with fitness education, may be instrumental in promoting physical activity in older, obese women. However, this intervention was not as effective as supervised exercise. Fitness tests and test results alone may have served to motivate the women to increase physical activity, as demonstrated by improvement in the CO group. Future studies with this population would be strengthened by lengthening the training period, thereby allowing a greater increase in training intensity and duration; by using electronic monitoring devices to measure exercise intensity for unsupervised activity; by including muscle strengthening exercises in the protocols; by incorporating tests that measure physical function in daily living; and by using more sensitive physical fitness measures. Promoting long-term exercise in older, obese women through initial participation in an enjoyable exercise and fitness education program holds promise.

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