A 6-Month Exercise Intervention Among Inactive and Overweight *Favela*-Residing Women in Brazil : The Caranguejo Exercise Trial

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Objectives. We examined the viability and efficacy of a known quantity of exercise in facilitating weight loss among previously sedentary or irregularly active overweight and obese adult women residing in a slum (*favela*) in Brazil.

Methods. In this randomized controlled trial, 156 women were randomized to a control or intervention group (78 in each group). Exercise was supervised, consisting of three 50-minute aerobic sessions each week for 6 months.

Results. Ninety-one percent (71) of the participants in the intervention group completed 6 months of the exercise program. At 6 months, women in the treatment group showed significant reduction in weight (mean=–1.69 kg; 95% confidence interval [CI]=–2.36,–1.03) and body mass index (mean=–0.63 kg/m^2; 95% CI=–0.97, –0.30) compared with controls (*P* for both<.001).

Conclusions. A moderately intense, structured exercise program resulted in modest weight loss in women when sustained for 6 months. (*Am J Public Health.* 2008;99:76–80. doi:10.2105/AJPH.2007.124495)

The deleterious effect of obesity on health has been well documented over the last century.[1] Obesity and overweight have been implicated in the etiology of a wide range of chronic diseases, including coronary heart disease,[2–4] stroke,[5] hypertension,[6] diabetes,[7] selected cancers,[8] and certain psychiatric conditions,[9] all of which demand considerable health care expenditure. Other, more-subtle negative consequences of obesity have been described: adults who were overweight as adolescents report lower prevalence of marriage, levels of educational attainment, and income,[10,11] presumably as a result of discrimination in their professional and social lives.

The rise in obesity is as clear as its various health and social consequences, with increases reported both in high-income countries[12] and in developing societies.[13] Recent evidence from Brazil also suggests that the current trend in adult obesity levels is upward and is more pronounced among the most socioeconomically disadvantaged groups.[14] Thus, from a public health perspective, the socioeconomically disadvantaged may be a particularly important target for behavior modification.

Although obesity is a complex metabolic disorder, it is ultimately the result of energy intake and expenditure. Therefore, the fundamental goal in treatment of obese persons is to attain negative energy balance by reducing food intake or increasing levels of physical activity, or both.[15] Systematic reviews examining the effect of exercise on weight loss in adults have been conducted,[16–22] resulting in the finding that exercise alone, particularly of higher intensity, results in some weight reduction.

Many studies examining obesity and overweight are characterized by methodological shortcomings such as an absence of intention-to-treat analyses, small sample size, short duration of follow-up, and failure to verify the quantity of physical exertion of study participants. We are unaware of any randomized controlled trial of exercise as a treatment for obesity in women carried out in a developing country, where the resources needed to conduct such an investigation are obviously scarce. Our purpose was to examine the viability and efficacy of conducting a trial of a known quantity of exercise in facilitating weight loss among previously sedentary, overweight women residing in a typical slum (*favela*) in Brazil.

METHODS

Setting and Participants

The trial took place in Caranguejo, a *favela* in the northeastern city of Recife with an average income per capita of less than US $1.00/day and a registered population of 3733,[23] as of 2005. Eligible women met 4 criteria: (1) baseline body mass index (BMI; weight in kilograms divided by height in meters squared) of 25 kg/m^2 or more,[24] (2) aged 20 to 60 years, (3) sedentary or irregularly active (0–149 min/wk, per recommendations from the American College of Sports Medicine[25]) at baseline, and (4) lacking a history of myocardial infarction, not currently having insulin-dependent diabetes or pregnant, and not taking medications (e.g., β-blockers) that would limit heart rate response to physical exertion. A total of 1208 women were screened for trial eligibility, of which 1052 were excluded (979 had normal BMI, 60 were physically active, 2 had health problems, and 11 were excluded for other reasons, such as insufficient time to participate). One hundred fifty-six women enrolled in the trial.

Interviewers administered to study participants the Portuguese short version of the 7-day International Physical Activity Questionnaire (available at http://www.celafiscs.org.br).[26] Participants provided a detailed medical history and information concerning number of children at home, race/ethnicity, marital status, income, educational attainment (years completed), religious affiliation, and television set ownership.

Exercise Intervention

We used Epi Info 6 (Centers for Disease Control and Prevention, Atlanta, GA) to randomly assign participants to either the treatment (exercise) or the control group. No advice regarding dietary modification was offered. The intervention group participated in three 50-minute exercise sessions each

week for 6 months (August 2005 to January 2006). The exercise session was aerobic in nature, consisting of a 5-minute warm-up followed by 40 minutes of moderate-intensity exercise (such as walking and rhythmical continuous movements in time to fast-tempo music) and a 5-minute cool-down. During the most physically demanding phase of the session, exercise intensity was 40% to 60% of heart rate reserve, as measured with a rating of perceived exertion (using the Borg Scale[27]). All on-site exercise was supervised by a trained physical education instructor in a courtyard of the local church (the only covered area within easy walking distance of the *favela* large enough to hold the study participants). The control group experienced no intervention during this 6-month period.

Weight Assessments

Assessments were performed at baseline and after 6 months in both the treatment and control groups. Measurements were made while participants were shoeless and wearing light clothing. Height was measured with a wall-mounted stadiometer to the nearest 0.1 cm. Weight was measured on a calibrated balance beam scale to the nearest 0.1 kg.

Statistical Analyses

We calculated that, given an α of .05 and a power of 80%, 64 participants would be required in each group for the study to detect a meaningful difference in mean body weight of 2 kg (SD=4 kg).[28] To allow for attrition, we added 10% to this estimated number of participants. The effect of the intervention was evaluated with an intention-to-treat analysis. For the few participants for whom follow-up data were not available, the baseline observation was carried forward. To check that randomization of participants had produced 2 comparable groups, we compared baseline characteristics in the intervention and control group with the Student *t* test for unpaired samples for continuous variables and the χ^2 test for categorical variables. The Student *t* test for unpaired samples was also used to compare differences between groups in weight and BMI at baseline and study completion at 6 months.

Preliminary analyses revealed that baseline weight and height varied significantly between

TABLE 1—Baseline Characteristics of Study Participants: Caranguejo Exercise Trial, Recife, Brazil, August 2005 to January 2006

	Treatment Group (n = 78)	Control Group (n = 78)	*P*
Age, y, mean ± SD	39.4 ± 11.0	37.0 ± 10.6	.160
Weight, kg, mean ± SD	71.2 ± 7.82	74.5 ± 11.0	.033
Height, cm, mean ± SD	155.1 ± 5.5	156.9 ± 6.64	.063
Body mass index, kg/m^2, mean ± SD	29.7 ± 3.13	30.3 ± 3.37	.309
No. children at home, mean ± SD	3.12 ± 1.59	3.18 ± 1.41	.790
Age, y, no. (%)[a]			.231
< 30	19 (26.8)	20 (26.7)	
30–34	12 (16.9)	24 (32.0)	
35–48	18 (25.4)	15 (20.0)	
> 48	22 (31.0)	16 (21.3)	
Race/ethnicity, no. (%)			.243
Black	18 (23.1)	25 (32.1)	
White	42 (53.8)	42 (53.8)	
Mixed	18 (23.1)	11 (14.1)	
Marital status, no. (%)			.544
Married or partnered	41 (52.6)	39 (50.0)	
Separated or divorced	24 (30.8)	22 (28.2)	
Widowed	11 (14.1)	11 (14.1)	
Never married	2 (2.6)	6 (7.7)	
Income per capita/day, US $, no. (%)			.659
≤ 0.6	15 (19.2)	17 (21.8)	
0.7	21 (26.9)	22 (28.2)	
0.8	25 (32.1)	28 (35.9)	
0.9	17 (21.8)	11 (14.1)	
Educational attainment, y, no. (%)			.528
≥ 4	43 (55.1)	46 (59.0)	
< 4	21 (26.9)	23 (29.5)	
Illiterate	14 (17.9)	9 (11.5)	
Employment status, no. (%)			.257
Employed	4 (5.1)	10 (12.8)	
Unemployed	51 (65.4)	52 (66.7)	
Student	12 (15.4)	6 (7.7)	
Retired	7 (9.0)	8 (10.3)	
Other	4 (5.1)	2 (2.6)	
Religious affiliation, no. (%)			.243
Catholic	48 (61.5)	52 (66.7)	
Other	25 (32.1)	17 (21.8)	
None	5 (6.4)	9 (11.5)	
Television at home, no. (%)			.731
Yes	73 (93.6)	74 (94.9)	
No	5 (6.4)	4 (5.1)	
Physical activity, no. (%)			.383
Sedentary	26 (33.3)	21 (26.9)	
Irregularly active	52 (66.7)	57 (73.1)	

[a]Age data were missing for 3 participants in the control group and 7 in the treatment group.

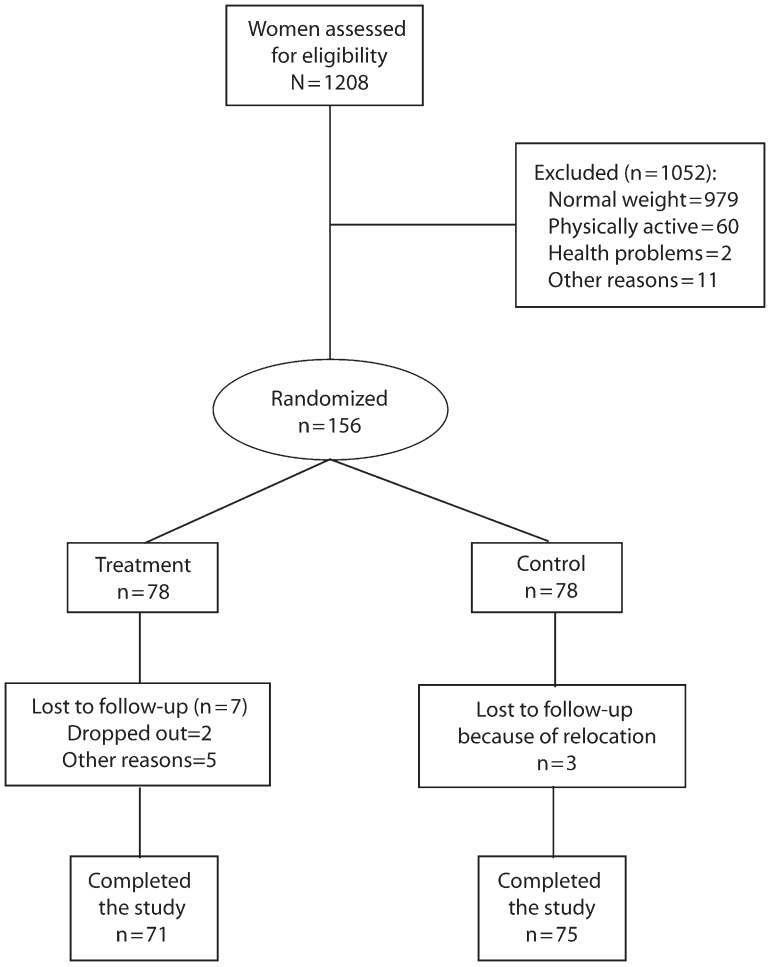

FIGURE 1—Participant flowchart: Caranguejo Exercise Trial, Recife, Brazil, August 2005 to January 2006.

the treatment and control groups (Table 1). Thus, to determine whether absolute changes in outcomes in the treatment group were significantly different from those in the control group, we used an analysis of variance with adjustment for baseline weight and height. We performed the Student *t* test for paired samples to determine whether there were significant within-group changes in outcomes. All analyses were performed using SPSS version 14 (SPSS Inc, Chicago, IL).

RESULTS

Initially randomized were 156 women (78 each to intervention and control; Figure 1). Ten women (7 in the treatment group and 3 in the control group) were lost to follow-up and failed to complete the trial. There was no difference in baseline age, weight and BMI between the 146 participants who completed and the 10 who dropped out of this study (data not shown).

Baseline physical and socioeconomic characteristics of the randomized participants are presented according to group allocation in Table 1. We observed no differences between treatment and control groups in age, BMI, number of children in the home, race/ethnicity, marital status, income, educational attainment, employment status, religious affiliation, or television ownership. However, the treatment group had a lower mean weight (P=.033) and height (P=.063).

In Table 2, weight and BMI at baseline and follow-up according to group are shown for the 156 women who started the trial. Of the participants, 96% (n=75) in the intervention group completed 6 months of the exercise program; in the control group, 91% (n=71) completed the program. When we imputed missing data on final weight and BMI with baseline measurements for the 10 women who did not finish the trial (intention-to-treat analyses); women in the treatment group had a significant decrease in both body weight and BMI. Mean difference in weight and BMI between the treatment and control groups were –1.69 kg (95% confidence interval [CI]=–2.36, –1.03) and –0.63 kg/m^2 (95% CI=–0.97, –0.30), respectively (P<.001 for both weight and BMI). After adjustment for baseline differences in height and weight, these results changed little: mean differences in weight and BMI between treatment and control were –1.66 kg (95% CI=–2.34, –0.98) and –0.62 kg/m^2 (95% CI=–0.9, –0.28), respectively (P<.001 for both weight and BMI).

We also ran complete case analyses that included only those women who finished the trial. After adjustment for baseline differences in height and weight, women in the treatment group had a significant decrease in both body weight (mean difference=–1.81 kg; 95% CI=–2.54, –1.08) and BMI (mean difference=–0.68 kg/m^2; 95% CI=–1.04, –0.31) at 6 month follow-up (P<.001 for both weight and BMI).

DISCUSSION

The objective of this trial was to examine the efficacy of a known quantity of exercise, without dietary intervention, in facilitating weight loss in previously sedentary or irregularly active and overweight or obese women in an exceptionally poor area of a developing country. The main finding was that exercise resulted in a significant reduction in body weight and BMI after 6 months. Despite randomization, we observed unexpected differences in weight and height at baseline; however, the weight-lowering effect of physical activity at trial completion persisted after

TABLE 2—Mean Body Weight and Mean Body Mass Index at Baseline and at 6 Months: Caranguejo Exercise Trial, Recife, Brazil, August 2005 to January 2006

	Treatment Group (n = 78), Mean (SD)	Control Group (n = 78), Mean (SD)	Difference (95% CI)	P
Weight, kg				
Baseline	71.2 (7.8)	74.5 (11.0)	−3.28 (−6.30, −0.28)	.033
Final	69.9[a] (8.2)	74.9 (11.3)	−4.98 (−8.12, −1.84)	.002
Percentage change	−1.83 (3.2)	0.53 (2.7)	−2.36 (−3.29, −1.43)	<.001
Absolute change, kg	−1.26 (2.4)	0.40 (2.4)	−1.69 (−2.36, −1.03)	<.001
Adjusted[b] absolute change, kg			−1.66[a] (−2.34, −0.98)	<.001
Body mass index, kg/m^2				
Baseline	29.8 (3.1)	30.3 (3.4)	−0.53 (−1.56, −0.50)	.309
Final	29.2[c] (3.5)	30.4 (3.5)	−1.16 (−2.26, −0.07)	.038
Percentage change	−2.00 (3.7)	0.24 (3.3)	−2.25 (−3.36, −1.14)	<.001
Absolute change, kg/m^2	−0.56 (0.1)	0.05 (0.1)	−0.63 (−0.97, −0.30)	<.001
Adjusted[a] absolute change, kg/m^2			−0.62[a] (−0.96, −0.28)	<.001

Note. CI = confidence interval.
[a]Significantly different from corresponding baseline value at $P = .02$ (Student t test).
[b]Adjusted for differences in baseline height and weight.
[c]Significantly different from corresponding baseline value at $P = .004$ (Student t test).

adjustment for these characteristics. Retention of study participants was high: in the active group of the trial, 96% completed the 6-month program.

The weight loss achieved in the intervention group in 6-month trial was, at 2%, statistically significant at conventional levels, although modest in absolute terms. This is generally consistent with findings in other trials that examined the effect of physical activity without dietary restriction.[21] A loss of 5% to 10% of body weight is generally regarded as necessary to achieve reduction in coronary heart disease risk factors, including levels of hypertension,[29] lipids,[30] and plasma glucose.[31] However, other evidence suggests that even smaller weight losses may have a normalizing effect on high-density lipoprotein cholesterol and insulin levels.[32] In developing countries such as Brazil, the increasing prevalence of obesity and its associated complications represents a considerable challenge for health care delivery and financial systems for the foreseeable future. Given that the problem of obesity and overweight is widespread—among Brazilian women aged 15 to 49 years, 1997 estimates for obesity and overweight combined were 35%[33]—it is likely that reducing body weight even modestly on a population level, provided it were sustained, could lead to a decrease in costs of medical therapy, hospitalization, and chronic care.

Our study has strengths: randomized design, large sample size resulting in greater statistical power than many comparable trials, minimal dropout, and a focus on an understudied, socioeconomically marginalized population. However, the trial is not without limitations. First, although similar studies in high-income populations have shown that weight loss can be achieved in the short term, this loss typically is not sustained by a majority of participants.[34] Few studies have evaluated the effect of exercise over more than a 6-month period, including our own. Second, we evaluated the impact of aerobic exercise, and it is possible that other forms of physical activity—for example, resistance exercise[35]—might also be useful treatment modalities. Third, we did not gather data on diet. It is possible that the intervention group, in addition to altering their energy expenditure, also made other behavioral changes, and it is known that exercise with dietary modification generally leads to greater weight loss than does exercise alone.[21,22] Fourth, economic analysis was not a feature of this trial; thus, we could not assess the financial sustainability of our intervention. Finally, although our intervention led to a reduction in adiposity as measured by BMI, we performed no assessment of body composition, as has been done by previous researchers.[36,37]

In the Caranguejo trial, a physical-activity intervention for weight loss that required significant assets in terms of time, facilities, and staff in an extremely resource-poor environment resulted in significant weight reduction. Replication of this intervention in similar settings is required to confirm our findings. ■

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Contributors

J. G. Alves designed the trial, was awarded funding, coordinated implementation, developed the analyses, and helped write the article. C. R. Gale developed data analyses, carried out all analyses, and helped write the article. N. Mutrie and J. Correia commented on an earlier version of the article. G. D. Batty developed analyses and helped write the article.

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Human Participant Protection

The protocol was approved by the Instituto Materno-Infantil Professor Fernando Figueira. All participants provided written informed consent before initiating this study.

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