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The Impact of Self-Preference Community Fitness Interventions in High Risk African Americans

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Abstract

African Americans have a high prevalence of obesity and physical inactivity, but few interventions have been successful long-term. We describe a one-year intervention program to increase physical activity and reduce cardiometabolic risk. Interventions incorporated the premise that self-selection into flexible venues and varying exercise modalities would result in improvement in fitness and risk factors. Results of this single group pretest/posttest observational study show one-year overall group reductions in body weight and BMI and cardiometabolic factors including hsCRP, and increases in DEXA-derived absolute and percent lean mass and lean-fat ratio, and decreased fat mass.

Keywords

African Americans; physical activity; intervention studies

Introduction

Physical inactivity is a well-known independent predictor of increased risk of cardiovascular disease (CVD) and all-cause mortality, and is strongly associated with diabetes, reduced lean fat mass, and concomitant metabolic syndrome components.^{1–8} Sedentary lifestyle and its attendant biological risk factors may be responsible in part for observed racial disparities in a variety of dimensions of health and chronic illness.^{9–11} Among adult African-Americans (AA), only 17.2% (24.6% of males and 11.2% of females) met both aerobic activity (150 minutes a week of moderate-intensity or 75 minutes a week of vigorous intensity activity, in

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episodes of at least 10 minutes spread throughout the week) and muscle-strengthening (moderate or high intensity that involve the major muscle groups, at least 2 days a week) guidelines¹² from the 2008 Physical Activity Guidelines for Americans.¹³ Additionally, 38.7% of AA men and 54.4% of AA women are obese¹² and have lower amounts of lean muscle mass relative to fat mass,¹⁴ which influences metabolic risk factors for CVD.^{15, 16} The resultant metabolic risk substrate may be in part attributed to low levels of physical activity.¹²

Lifestyle changes to reduce cardiometabolic risk factors in AA still primarily consist of dietary restrictions and increased aerobic physical activity.¹⁷ Weight loss diets, either on a community or individual level, have been difficult to sustain to maintain weight loss of sufficient magnitude to mitigate cardiometabolic risk, reduce obesity, and improve lean muscle mass.^{18–20} Dietary change is perhaps the most difficult behavior to achieve; there has, however, been modest but inconsistent success with interventions to increase physical activity and fitness among individuals on a community wide level.²¹ Most community physical activity intervention studies to date²¹ have used highly standardized interventions, a “one size fits all” approach, requiring all individuals in an intervention group to participate in the same pre-specified activities. Because the presence of social norms and social interactions and readily accessible exercise facilities in the community are most frequently cited as predictors of a beneficial response to exercise interventions,^{22, 23} we designed a portfolio of varying community-based interventions for otherwise apparently healthy sedentary, overweight and obese AA with a strong family history of early-onset cardiovascular disease. These interventions incorporated combinations of social norms, including exposing sedentary AA individuals to community sites with large numbers of physically active AA individuals, who served as role models and often provided social support, and access to flexible extant community-based physical activities, including pre-specified activities as well as the choice of any activity offered at community facilities, and the use of flexible home-based interventions. The interventions emphasized the availability of variations of exercise modalities, times, and venues to meet the unique needs of unique individuals. We report the fitness and cardiometabolic risk factor outcomes in a single group pretest/posttest observational study of persons who were sedentary and overweight or obese at baseline.

Methods

This study was approved by the Johns Hopkins Medicine Institutional Review Board. All participants gave written informed consent prior to entry level screening for the study.

African American subjects were identified from families participating in the longitudinal GeneSTAR (Genetic Study of Atherosclerosis Risk) cohort study examining factors that predict incident coronary artery disease (CAD) in initially healthy family members of hospitalized index cases with demonstrated early onset CAD under 60 years of age.²⁴ Briefly, in the larger primary GeneSTAR study, AA index cases were identified during hospitalization for a documented CAD event prior to 60 years of age.²⁴ Index cases were not included in the intervention, but were identified only to access apparently healthy family members, whose risk is markedly increased by virtue of a family history of early onset

disease. Apparently healthy siblings and offspring of the CAD index case and the offspring of the initially healthy siblings and co-parents of the offspring were identified and were invited for exercise testing and cardiometabolic risk factor screening between 2008 and 2012. Only those AA family members free of CAD or any CVD who were overweight or obese (body mass index ≥ 25), sedentary (not currently participating in any formal exercise program and/or no consistent exercise program maintained over the prior six months), not pregnant, and not being treated with hypoglycemic agents for diabetes were invited to participate in the present fitness intervention study.

Baseline and One-Year Measurements

All measures were assessed at baseline and at one year at an academic outpatient setting. Baseline demographic information was obtained from standardized questionnaires. Medical history was obtained and a cardiovascular physical examination was performed by a study cardiologist. We also assessed the use of all medications and supplements. Smoking status was self-reported with standardized questions from the MONICA Smoking Questionnaire,²⁵ and social support was assessed with the Social Support and Exercise Survey.²⁶ Habitual physical activity was assessed with the Stanford 7-Day Physical Activity Recall²⁷; kilocalories expended per week were calculated and used in analyses. Fitness was assessed as the highest achieved maximal oxygen uptake (VO_{2peak}), as determined from a maximal graded metabolic treadmill test using a CareFusion Vmax229 Metabolic/ECG system. We used a treadmill exercise protocol where the test began at 3 mph, 0% grade. The speed was held constant, and the grade increased 2.5% every 3 minutes. A 12 lead electrocardiogram was recorded at each exercise stage, and blood pressure was measured during the last 30 seconds of each stage. Subjects performed until self-reported volitional fatigue. They were encouraged to exercise to a level ≥ 18 using the Borg Rating Scale of perceived exertion (RPE),²⁸ and to reach a respiratory exchange ratio (RER) level > 1.1 .

Resting blood pressure was measured according to The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.²⁹ Participants were seated quietly for five minutes prior to each of three blood pressure measurements taken one minute apart using a standard Dinamap automated cuff. The average of the three measures was used to characterize resting blood pressure. Hypertension was defined as resting blood pressure $\geq 140/90$ mmHg and /or current use of antihypertensive medications.

Blood was collected after a minimum eight hour overnight fast. Blood levels of glucose, insulin, high sensitivity C-reactive protein (hsCRP), total and HDL-cholesterol and triglycerides were measured in the Core Laboratory at the Clinical Research Unit; LDL-cholesterol was calculated using the Friedewald formula.³⁰ A measure of insulin sensitivity, the quantitative insulin sensitivity check index (QUICKI), was calculated as $1/(\log_{10} \text{glucose} + \log_{10} \text{insulin})$.³¹

Height and weight were measured on a calibrated digital scale and stadiometer respectively; body mass index (BMI) was calculated as weight (kg)/height squared (m^2). Waist circumference was measured twice using the methods of the NIH Obesity Guidelines and averaged.³²

Dual-energy x-ray absorptiometry (DEXA) was performed using a GE Medical Systems Lunar Prodigy machine, software version 13. Total fat, lean, and bone mass in kilograms and percent fat and lean mass were calculated. Lean mass to fat mass ratio was calculated as lean mass divided by fat mass, hereafter referred to as the lean-fat ratio.

Exercise Interventions

In the absence of clear and consistent biopsychosocial intervention models predicting improvement in fitness and lean mass among high risk AA individuals in community-based fitness programs, we initially designed a trial of a community-site physical fitness intervention compared with home-site self-interventions, with cross-over to the other site expected after six months. Our prior work found a preference for community sites among high-risk AA families,³³ but while successful, it was not sufficiently flexible for many participants. Thus, we designed this study with maximal flexibility. The community sites all used personal exercise coaches, seemingly easy access, and social support via venues where other persons also exercised at the same time. The self-guided home-based intervention enabled people to exercise with friends and/or family, or alone according to personal preference at home. Notably, because the unique needs of most participants change dramatically over even short periods of time, there was fluid cross-over throughout all sites and venues based on preference throughout the year study. We thus used all study observations in the total group with a before-after design and catalogued factors that predicted the “most successful” participants in terms of fitness attainment at the end of one year.

The study was designed using three different types of venues for exercise, (1) two similarly structured healthcare-based community exercise sites provided by an academic medical center, (2) three community YMCA facilities, and/or (3) exercise at home using standardized exercise approaches (i.e., walking, music-based aerobic exercise). After screening and metabolic exercise testing, all participants were given individually tailored exercise prescriptions based on their treadmill performance by an exercise physiologist for initial and progressive intensity and duration. Each subject was given a Polar Heart Rate Monitor for tracking key exercise prescription parameters and a set of elastic resistance bands with an instruction manual for strength training. All exercise prescriptions were phased for each individual over the initial eight weeks to achieve the recommended aerobic exercise of 30–45 minutes at 70 to 80% of maximal heart rate two to three days a week and included a recommendation to use the provided resistance bands every other day for 10 minutes. Participants moved freely among all of the intervention sites according to their own needs. When using the community sites, they had their choice of several types of aerobic equipment including treadmills, recumbent bicycles, step machines, or elliptical machines, as well as their choice of resistance equipment, either weight machines or free weights. Their initial instructions encouraged them to cross-train using different equipment. All community sites had coaches available to assist participants at all times, as well as an ethnically and otherwise heterogeneous population exercising at the same time as our participants. These coaches and other exercisers, often including other study participants, provided encouragement and support to participants during all exercise sessions; coaches provided additional encouragement via telephone calls. Participants could come as often as they

wished at almost any time of day, but were encouraged to attend at least once a week, and preferably three times a week. The YMCA sites were enhanced by the presence of free child-care facilities, easy parking, extended hours, along with the ability to exercise without an appointment, and the use of the FitLinxx system (FitLinxx, Shelton, CT), an electronic system which tracks fitness parameters and progress while providing virtual coaching. The use of all community sites, both the YMCA sites and the community healthcare-based sites, was free of charge to all study participants.

The home-based exercise intervention was designed and standardized for the study. All participants in the study were provided with the same standard kit including a Polar Heart Rate Monitor, elastic resistance bands, resistance band instruction manual, and an exercise manual with instructions for walking exercise. Home exercise could be carried out with any choice of aerobic modalities (running, walking, basketball, aerobics, dance, cycling) and many options for use of the elastic resistance bands. All of these activities could be performed alone or with any co-exercisers of their own choice, including family and friends.

Data were recorded for each participant for each exercise session at all five participating community venues over the course of a year, and were either mailed back to the study coordinating center or entered at the exercise sites electronically (via the exercise equipment and a unique ID number through the FitLinxx system) and entered into the study database. Attendance was recorded at the community sites, tracked, and provided to the study coordinating center on a weekly basis. Measures including frequency, dates/times, equipment use, and kilocalories expended were provided through the site's electronic systems; heart rate data were downloaded electronically from the Polar heart rate monitors at regular follow-up visits. All participants who exercised at home or at self-selected non-study exercise venues were asked by questionnaire at follow-up about duration and frequency of exercise performed. Data from their Polar heart rate monitors were collected also at follow-up periods.

Statistical Analyses

Data were analyzed using SAS v.9.2 (SAS Institute Inc., Cary, NC, 2002–2008). Categorical variables were analyzed with frequencies, contingency table arrays, chi-squared and Fisher's exact tests. Continuous variables were natural-log-transformed to normality as needed, and analyzed using student's t-tests and Wilcoxon rank-sum tests. Change between baseline and one-year was calculated by subtracting the baseline value from the one-year value.

"Intention-to-treat", hereafter referred to as carry-forward analyses, were used as the primary analysis, such that baseline values were used as one-year values for participants who did not return for the final one year testing, conservatively estimating the absence of any change over one year; standard analyses using only the participants who completed both baseline and one-year screenings were also performed. Analyses were performed with the "most successful" participants, defined as those in the upper quintile of the change in fitness as determined by VO_{2peak} . Multivariate regression models were performed using the GEE adjustment to account for intra-familial correlations. Statistical significance was defined as a p-value < 0.05.

Results

Study recruitment and enrollment is shown in Figure 1. Of the 201 participants completing baseline screening, two became pregnant during the study and were withdrawn; thus, 199 constituted the final sample.

Overall, the majority of participants were middle-aged and female; all participants were overweight and sedentary at baseline, with elevated levels of most cardiometabolic risk factors. The average age of participants was 44.9 ± 11.3 years; 67.8% (n=135) were women; 77.9% (N=155) were employed, 45.2% (N=90) were married, and 21% (N=42) were currently smoking.

The 199 participants came from 99 families. Most (75%; N=150) participated in the study with one or more family members by choice. The average family size was 2.0 ± 1.3 , range 1 to 8. The most common family relationship was a sibling (28/50 non-singlet families, 56%).

The majority of participants (87.9%; N=175) completed the one-year testing. In comparison with the persons who returned for the one-year follow-up, the persons who did not return (n=24) completed fewer exercise sessions ($p<0.0001$) over the year and were less likely to be employed ($p=0.0138$); no other statistically significant ($p<0.10$) demographic, intervention, or biological differences were observed between participants who did and did not return at one year. Of the 24 persons who did not return for the one-year follow-up visit, only 11 (5.5% of the total sample) were total dropouts, ie, persons who did not participate after the initial screening visit, and who never completed any exercise sessions. These 11 dropouts had significantly lower baseline BMI ($p=0.0004$) and waist circumference (0.0033) than participants who came back for follow-up and/or participated in any exercise sessions, but no other demographic or biological factor was significantly different between the 11 dropouts and other participants.

Because of high cross-over among participants in the course of a year, it is not possible to evaluate the impact of any one site. Of the total who exercised at any time, 40% exercised at home, 37% exercised at a YMCA, 33% exercised at a healthcare-based community site, and a smaller number, 7%, exercised at a private community venue of their own choice. Overall, 59.8% of the total sample participated in exercise sessions throughout the year of follow-up; on average, the number of documented sessions attended was 17.5 ± 30 , range 0–133.

Overall baseline to one-year fitness, body composition and risk factor changes are shown for all 199 participants in the aggregate in Table 1 using the carry-forward analysis as noted, a conservative estimate of total program effect. Although not significant, the direction of effect was mostly beneficial, with overall decreases from baseline to one-year in body weight, BMI, hsCRP, total and LDL cholesterol, and systolic blood pressure; statistically beneficial changes were noted for percent total body fat and percent trunk body fat. Significant favorable increases from baseline to one-year were also observed for total % lean, lean-to-fat ratio, and social support from family. Significantly unfavorable increases were observed only for triglycerides, along with minimal increases in glucose and insulin which were not statistically significant. The findings were similar for those who completed one year of follow-up (n=175).

In the overall group analysis of 199 using the carry-forward analysis, the “most successful” participants (the upper quintile of fitness change, ie, those with the greatest increase in $\text{VO}_{2\text{peak}}$ over one year; specifically, those with an increase in $\text{VO}_{2\text{peak}}$ greater than 2.2 ml/kg/minute) were compared to those in the lower four quintiles of fitness change (those with either a decrease in $\text{VO}_{2\text{peak}}$ over one year or minimal (0.2–2.0 ml/kg/minute) increase in $\text{VO}_{2\text{peak}}$) (Table 2). The “most successful” were significantly more likely to have improvements in weight, BMI, hsCRP, and body composition at one year (2% more lean, 2% less fat, 2.5% less trunk fat) and were significantly more likely to have attended sessions in a community-based venue. While not statistically significant, those in the “most successful” group also had favorable changes in waist circumferences, HDL cholesterol, and social support from both friends and family. Results were similar for only those 175 participants who returned for one-year follow-up.

Characteristics for participants who used the community venues are shown in Table 3, dichotomized by the “most successful,” the upper quintile of one year fitness change, versus all others. In general, the “most successful” participants attended more community-based sessions and exercised for a longer duration with greater intensity during their exercise sessions.

Multivariable linear regression was performed to predict being in the “most successful” group out of the total of 199 participants at one year (Table 4). Male participants with lower baseline fitness who did more community-site exercise were more likely to be in the “most successful” group, after adjustment for age, education, marital and employment status, and baseline levels of physical activity. Regression analysis limited to only the 175 participants who completed one-year follow-up demonstrated similar results, with attenuation for sessions attended. Sensitivity analyses for the multivariable regression were conducted with additional variables added to the model. The addition of the use of any community-site exercise (yes/no) ever and BMI yielded nearly identical beta estimates and p-values; while BMI was not statistically significant ($p=0.2138$), the lean-fat ratio showed slight attenuation ($p=0.073$). The addition of social support scores also yielded nearly identical beta estimates and p-values with no attenuation of effects, while neither social support score was notable nor statistically significant. Social variables including marital status and employment, and specific community exercise sites yielded little, if any, predictive value.

Discussion

This pretest/posttest observational intervention study showed that when self-preference for an exercise intervention, access to varying community sites and exercise modalities, and access to social environments that support exercise were allowed, an improved health profile could be achieved. This remained true even when using carry-forward analysis whereby 12% of the sample who did not return for one-year follow up testing retained their baseline outcome values by design. Importantly, those in the highest quintile of physical fitness level change were found to have even better improvement in body composition and cardiometabolic risk factors. Any improvement in cardiometabolic risk, even if in only one-fifth of the population, could have an important public health impact among higher risk overweight and obese individuals in AA communities. The most unique characteristic of the

intervention is that it allowed frequent shifts over the year, according to the self-preference of the participant, in the choice of a venue in which to exercise and in the choice of exercise modalities. The improvements in body weight and BMI, DEXA-derived increased absolute and percent lean mass and increased lean-fat ratio, and reductions in cardiometabolic factors including insulin and hsCRP observed in our study are highly desirable. While our overall weight loss (–1.3 pounds on average) and risk reduction were less than other community intervention studies, given that secular trends show weight gain and increased risk over time,^{34, 35} an intervention that generally improves risk factors, especially in a high-risk AA population, is notable. In addition, the favorable changes in fat and lean mass may be more important for overall health than modest weight loss. It is important to mention that prior studies of this high-risk population have found no increased awareness of genetic or other risk factors,^{36, 37} and thus we feel that these findings are likely generalizable to any high-risk AA population.

While most parameters improved after this intervention, triglycerides actually increased on average, statistically significantly so in the overall study population. This is counterintuitive, given the correlation of triglycerides with other metabolic factors which improved. The increased levels of triglycerides are not clinically meaningful, but still warrant awareness for future studies.

Studies including self-selected interventions have most commonly allowed participants to self-select an intervention as only one arm of a trial.^{38, 39} Participants who were allowed to select either the modality or frequency of an intervention showed greater weight loss and higher session attendance in addition to lower dropout rates than participants who were assigned an intervention.^{38, 39} Our study is rare in that all participants were allowed to select the intervention venue. While this was not our original design, it may be more appropriate for the real world, particularly in a situation where neither randomization nor even delayed cross-over was acceptable to participants.

Although the cross-over between sites and between community and home interventions throughout the year trial precluded carrying out our planned traditional trial design, the observation that most participants had unique location and schedule needs which changed dramatically over even short periods of time is an invaluable finding and forms the template for future studies where preference and variation should be considered. Variation in exercise modalities, social opportunities for support, and the availability of high quality equipment and coaches likely influenced the fact that people moved in and out of the various options based on their week-to-week or month-to-month lifestyle needs. The frequent shifts precluded characterizing any individual by their choice of modality but this could be explored in future studies. Additionally, once introduced to a regimen by a coach, some individuals felt they could continue it at home with less disruption to their lifestyles, work or personal needs. Similarly, some people who began at home and felt the need for exposure to equipment and training later came to a supervised exercise site for some training sessions. Variation across modalities was so great that scaling exposures or looking for a dominant theme was not possible nor the focus of the present study. The expectation that there should be a large degree of fitness and metabolic risk factor change in the aggregate of any specific exercise intervention is likely unrealistic given the unique challenges of unique individuals

from these communities. Nonetheless, participants in the aggregate showed improvement in fitness and body composition measures, in spite of their prior sedentary and body composition status. Lack of flexibility offers a possible explanation for high (>20%) dropout rates and the failure to maintain other more traditional uni-modality exercise intervention trials,⁴⁰ particularly over a time period as long as one year.

Financial inaccessibility, inconvenience, and lack of support have been suggested as barriers to participation in regular physical activity for African Americans.^{41, 42} Our study addressed each of these barriers: the intervention was provided at no cost, the locations and times were at the convenience of the participants, and support was provided by study staff, exercise venue staff and often, other family members also participating in the study. Additional as yet undefined barriers remain to be identified and addressed to engage the few (5.5%) persons who did not participate in any exercise sessions or return for follow-up. While the cessation of study funding led to the end of the intervention being offered at no cost, the YMCAs continued to offer a lower cost membership to study participants. In addition, participants kept all materials provided for the study.

Our study showed that a reasonable proportion of participants could be defined as successful, with significant improvements in fitness and body composition. It is noteworthy that non-modifiable factors such as age and sex did not predict the most successful participants, while potentially modifiable factors such as higher baseline fitness, higher lean mass to fat mass ratio, and greater session attendance were the most important predictors of success.

Our results are likely to underestimate the true impact of this self-preference approach to exercise where we used a carry-forward method to include those persons who did not engage in the study once screened. Secular trends show that AA adults are more likely to gain weight, increase cardiovascular risk, and decrease fitness over time, rather than remain the same.^{34, 43} While it is possible that the participants who did not return and did not provide data for home or alternate-site exercise sessions actually exercised as much as the participants with documented data from supervised exercise sessions, given the secular trends, this is unlikely.

We observed little difference between the carry-forward (N=199) and standard analyses (N=175). This may be due to the small number of persons who did not come back for one-year follow-up screening or any exercise session: only 5.5% of the total sample was defined as a “total dropout”, ie, a person who we never saw or heard from after the initial screening visit. These dropouts had lower levels of baseline risk factors, and perhaps considered themselves to be less in need of an exercise intervention and self-selected out of the intervention. Our intervention’s flexibility likely reduced dropouts compared to other community exercise studies, where the average dropout rate is greater than 20%.⁴⁰

There are limitations to our study. The instrument we used to assess social support only included one question on social norms, thus precluding our ability to fully explore the relevance of social norms to our findings. Data collected from home exercise sessions was sparse compared to data collected from community-site exercise sessions, which could have

produced bias in assessing site differences in exercise parameters; however, since the participation between sites was fluid, we were unable to truly assess site differences. As our follow-up at one year was incomplete, the use of carry-forward analysis was necessary; however, our retention rate was still 88%, which is sufficient to feel confident that our results were not biased by dropouts. As our study population was limited to African Americans from families at high risk for early onset CAD, generalizability may be limited only to high-risk African Americans. Our primary limitation was the inability to complete our planned classical randomized controlled trial design. However, this limitation turned out to be a strength, in that we were able to perform a study of self-selected interventions, which findings may turn out to be more valuable for informing future studies.

In conclusion, we found that varying combinations of community site interventions can improve fitness, lean-fat mass ratio, and cardiometabolic risk for sedentary, overweight and obese African Americans from families at high risk for CVD. Although a true randomized controlled trial would be necessary to test the magnitude of the effects of these combinations, our study points to the fact that multimodal activities, accessible venues, and self-preference may be important parameters for improvements in fitness in this population and would add to future intervention studies in higher risk individuals in African American communities.

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Figure 1.
Overall Study Design and Flow

Table 1

Overall Sample Characteristics, Baseline, One-Year Follow-up, and Change at One Year: Carry-Forward Analysis (N=199)

	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	p
Body Weight (lbs)	213 (37)	212 (39)	-1.3 (11)	0.1020
Waist Circumference (inches)	40.1 (4.8)	40.2 (5.0)	0.1 (2.6)	0.5643
Body Mass Index (kg/m ²)	34.1 (5.1)	33.9 (5.5)	-0.2 (1.7)	0.1003
Glucose (mg/dl)	99.0 (16)	101 (19)	1.9 (14)	0.0602
Insulin (uU/l)	24.8 (15)	25.4 (20)	0.6 (19)	0.6312
QUICKI	0.302 (0.022)	0.302 (0.024)	0 (0.017)	0.9325
hsCRP (ug/ml)	6.0 (6.2)	5.4 (5.7)	-0.5 (5.5)	0.1848
Total cholesterol (mg/dl)	194 (42)	194 (43)	-0.4 (30)	0.8350
LDL cholesterol (mg/dl)	119 (39)	118 (41)	-1.1 (24)	0.5095
HDL cholesterol (mg/dl)	55.6 (17)	55.8 (17)	0.2 (9.6)	0.7393
Triglycerides (mg/dl)	94.9 (50)	101 (56)	6.2 (42)	0.0388
Systolic blood pressure (mmHg)	124 (15)	124 (16)	-0.3 (14)	0.7902
Diastolic blood pressure (mmHg)	72.0 (10)	72.4 (9.8)	0.5 (8.3)	0.4439
Peak systolic blood pressure exercise (mmHg)	188 (23)	187 (25)	-1.1 (20)	0.4175
Peak diastolic blood pressure exercise (mmHg)	80.0 (11)	78.0 (12)	-1.9 (12)	0.0242
VO _{2peak} (kg/ml/min)	24.6 (6.1)	24.5 (6.1)	-0.1 (3.7)	0.5749
Physical activity (kcal/week)	14026 (780)	14101 (1091)	75.1 (1148)	0.3571
% Lean Total	54.3 (8.6)	55.1 (8.9)	0.8 (3.0)	0.0004
% Fat Total	42.2 (8.9)	41.5 (9.2)	-0.8 (3.0)	0.0003
% Fat Trunk	45.6 (7.8)	44.4 (8.2)	-1.1 (3.5)	<.0001
Lean-Fat ratio	1.4 (0.7)	1.5 (0.8)	0.1 (0.4)	0.009
Social support from friends	18.5 (10)	19.2 (11)	0.70 (9.0)	0.277
Social support from family	18.4 (11)	20.5 (11)	2.0 (10)	0.006

Table 2

Characteristics of the “Most Successful” Participants (Upper 20% of Fitness Change, Defined by Change in $\text{VO}_{2\text{peak}}$ expressed as ml/kg/min): Carry-Forward Analysis (N=199)

Characteristic	Lowest Quintiles (Quintiles 2–5)* for Change in $\text{VO}_{2\text{peak}}$ N=159					Upper Quintile (Quintile 1)* for Change in $\text{VO}_{2\text{peak}}$ N=40			
	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	Within group Change p-value		Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	Within group Change p-value
Body Weight (lbs)	212 (37)	212 (38)	0.5 (9.9)	0.5597		218 (36)	210 (40)	-8.1 (12)	<.0001
Waist (inches)	40.1 (5.0)	40.4 (5.1)	0.3 (2.7)	0.2320		39.7 (4.1)	39.2 (4.6)	-0.5 (2.1)	0.1348
Body Mass Index (kg/m^2)	34.0 (5.1)	34.1 (5.4)	0.1 (1.6)	0.5833		34.1 (5.2)	32.8 (5.8)	-1.3 (1.9)	<.0001
Glucose (mg/dl)	98.3 (16)	100 (19)	2.0 (13)	0.0498		102 (20)	103 (20)	1.3 (18)	0.6524
Insulin (uU/l)	24.6 (16)	26.0 (21)	1.4 (21)	0.3981		25.2 (12)	22.9 (10)	-2.3 (11)	0.2064
QUICKI	0.303 (0.022)	0.302 (0.024)	-0.001 (0.017)	0.5161		0.299 (0.020)	0.303 (0.024)	0.004 (0.020)	0.2237
hsCRP (ug/ml)	5.8 (5.5)	5.8 (6.1)	0 (5.0)	0.9633		6.5 (8.6)	4 (3.6)	-2.5 (7.1)	0.0310
Total cholesterol (mg/dl)	194 (44)	193 (44)	-1.2 (28)	0.5921		196 (36)	199 (40)	2.6 (34)	0.6287
LDL cholesterol (mg/dl)	118 (40)	116 (42)	-1.6 (23)	0.3732		124 (35)	125 (35)	1.0 (26)	0.8076
HDL cholesterol (mg/dl)	56.0 (18)	55.6 (17)	-0.4 (9.1)	0.5649		53.8 (15)	56.5 (15)	2.8 (11)	0.1219
Triglycerides (mg/dl)	95.6 (50)	102 (55)	5.8 (42)	0.0842		92.1 (50)	99.7 (58)	7.6 (41)	0.2492
Systolic blood pressure (mmHg)	125 (15)	125 (16)	0.1 (13)	0.8928		123 (15)	121 (19)	-1.9 (17)	0.4901
									0.4881

Characteristic	Lowest Quintiles (Quintiles 2-5) * for Change in VO _{2peak} N=159				Upper Quintile (Quintile 1) * for Change in VO _{2peak} N=40				Between group p-values: One-Year Change
	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	Within group Change p-value	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	Within group Change p-value	
Diastolic blood pressure (mmHg)	71.9 (9.9)	72.5 (9.5)	0.6 (7.8)	0.3367	72.4 (11)	72.3 (11)	-0.1 (10)	0.9508	0.6940
Peak systolic blood pressure (mmHg)	188 (22)	186 (25)	-2.2 (19)	0.1501	190 (27)	193 (25)	3.0 (23)	0.4222	0.1456
Peak diastolic blood pressure (mmHg)	79.9 (11)	78.1 (11)	-1.8 (12)	0.0517	80.4 (12)	78.0 (14)	-2.4 (13)	0.2631	0.7763
VO _{2peak} (kg/ml/min)	24.8 (6.2)	23.3 (5.6)	-1.5 (2.5)	NA	23.8 (5.7)	28.9 (6.3)	5.1 (2.7)	NA	NA
Physical Activity (kcal/week)	14032 (787)	14006 (699)	-26.6 (871)	0.7005	13999 (758)	14478 (1970)	480 (1847)	0.1086	0.0988
Total % Lean	53.8 (8.5)	54.2 (8.6)	0.4 (2.6)	0.0559	56.1 (9.0)	58.4 (9.8)	2.2 (4.0)	0.0010	0.0079
Total % Fat	42.7 (8.7)	42.3 (8.8)	-0.4 (2.5)	0.0610	40.3 (9.3)	37.9 (10)	-2.3 (4.0)	0.0006	0.0044
Trunk % Fat	46.1 (7.6)	45.3 (7.6)	-0.7 (2.8)	0.0012	43.6 (8.4)	40.9 (9.6)	-2.7 (5.1)	0.0020	0.0256
Lean-Fat ratio	1.4 (0.6)	1.4 (0.6)	0 (0.2)	0.0560	1.6 (0.9)	1.8 (1.3)	0.3 (0.8)	0.0406	0.0640
Social support from friends	18.7 (11)	19.3 (11)	0.61 (8.9)	0.3898	17.6 (9.7)	18.7 (10)	1.1 (9.6)	0.4915	0.7838
Social support from family	18.6 (11)	20.6 (11)	1.9 (9.6)	0.0130	17.6 (8.9)	20.0 (10)	2.3 (12)	0.2338	0.8400
Total supervised sessions attended over one year	15.0 (28)				27.7 (34)				0.0152
YMCA site supervised sessions attended over	3.8 (8.8)				13.8 (27)				0.0260

Characteristic	Lowest Quintiles (Quintiles 2–5) * for Change in VO _{2peak} N=159			Upper Quintile (Quintile 1) * for Change in VO _{2peak} N=40			Between group p-values: One-Year Change
	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)	Within group Change p-value	Baseline Mean (SD)	One-Year Mean (SD)	Change Mean (SD)
one year							
Healthcare-based site supervised sessions attended over one year		10.5 (27)		NA		13.9 (27)	
							0.4755

* Quintile 1 comprised those with change in VO_{2peak} ranging from +2.5 to +13.6 ml/kg/minute; Quintiles 2–5 comprised those with change in VO_{2peak} ranging from –13.8 to +2.4 ml/kg/minute

Table 3

Exercise Session Characteristics of the “Most Successful” Participants (Upper 20% of Fitness Change, Defined by Change in VO_{2peak} expressed as ml/kg/min): All Persons who Participated in Supervised Exercise Sessions and Completed a Stress Test at One Year (N=112)

	Lowest Quintiles (Quintiles 2–5)* for Change in VO_{2peak} (n=87)	Upper Quintile (Quintile 1)* for Change in VO_{2peak} (n=25)	
Exercise characteristics	Mean (SD)	Mean (SD)	pvalue
Sessions attended over one year	27.0 (33)	41.6 (36)	0.0164
Aerobic activity /session (kcal)	317 (122)	393 (193)	0.2303
Aerobic time/session (minutes)	38.3 (8.2)	42.6 (12)	0.0275
VO_{2peak} / session (L/min)	1.6 (0.5)	1.7 (0.6)	0.3411
VO_{2peak} /session (ml/kg/min)	16.5 (4.9)	18.4 (6.5)	0.2866
METS /session	4.7 (1.4)	5.3 (1.9)	0.2866
MET-minutes /session	187 (73)	235 (110)	0.2072
Resistance activity /session (kcal)	148 (64)	190 (67)	0.0560
Resistance time/session (minutes)	26.4 (6.1)	28.8 (5.3)	0.1824
Site**	% (N)	% (N)	pvalue
Healthcare-based #1	26.4 (23)	24.0 (6)	
Healthcare-based #2	13.8 (12)	16.0 (4)	
YMCA #1	46.0 (40)	36.0 (9)	
YMCA #2	8.1 (7)	16.0 (4)	
YMCA #3	5.8 (5)	8.0 (2)	0.7429
Healthcare-based	40.2 (35)	40.0 (10)	
YMCA	59.8 (52)	60.0 (15)	0.9835

* Quintile 1 comprised those with change in VO_{2peak} ranging from +2.2 to +13.6 ml/kg/minute; Quintiles 2–5 comprised those with change in VO_{2peak} ranging from −13.8 to +2.0 ml/kg/minute

** Site was categorized as the most commonly used exercise site for each participant.

Table 4

Multivariable Logistic Regression Prediction of the “Most Successful” Participants (Upper 20% of Fitness Change, Defined by Change in $\text{VO}_{2\text{peak}}$ expressed as ml/kg/min): Carry Forward Analysis (N=199)

Parameter	Beta	SE	P-value
Age (years)	−0.0069	0.0183	0.7052
Female Sex	0.1254	0.7560	0.8683
Baseline $\text{VO}_{2\text{peak}}$ (ml/kg/minute)	−0.0930	0.0407	0.0222
Physical Activity (kcal/week)	0	0.0002	0.8879
Exercise Sessions Attended	0.0132	0.0055	0.0169
(log) Lean-Fat Ratio	2.1595	0.9841	0.0282
Education (years)	0.0239	0.0925	0.7964
Employed	0.6190	0.5059	0.2211
Married	0.2338	0.4242	0.5815