The Maximum Exercise Stress Test: Is It a Behavior-Modification Tool?

David A. Driggers, MD, Jay Swedberg, MD, Raymond Johnson, PA-C, Eric Lie, PA-C, Steve Ross, MD, Clint Duval, MD, and Carolyn Fink, MBA, RRA
Casper, Wyoming

The controlled study presented demonstrates the results obtained when using the maximum exercise stress test (MEST) as a behavior-modification tool for coronary artery disease risk factors. Changes in attitudes, behaviors, and objective measurements of health were assessed in a low-risk population. Only exercise level was significantly altered ($P < .03$). Changes in the other measured parameters were insignificant. The MEST test is also expensive, and no benefit has been demonstrated in terms of its ability to decrease the morbidity and mortality seen in coronary artery disease.

The maximum exercise stress test (MEST) has been identified as a safe, effective screening procedure for coronary artery disease.[1,2] The MEST is also used in exercise prescription, possibly helping indirectly to reduce certain coronary artery disease risk factors.[3,4] The purpose of this study was to determine whether the maximum exercise stress test alone was of such significance that it could also be an effective behavioral modification tool for physicians attempting to reduce coronary artery disease risk factors in their patients. This possibility has been suggested in the past medical literature, but not from a controlled study.[5]

From the Family Practice Residency, University of Wyoming, Casper, Wyoming. Requests for reprints should be addressed to Dr. David A. Driggers, University of Wyoming Family Practice Residency-Casper, 1522 East "A" Street, Casper, WY 82601.

Methods

Following the experimental design in Figure 1, 58 healthy, active male volunteers were entered into the study, and an initial data base was gathered, which included assessment of attitudes, quantification of certain behaviors such as smoking, alcohol intake, and exercise level, and finally, assessment of objective health parameters based upon a history, physical examination, and laboratory testing.

Attitudes were assessed with a modified Likert-type questionnaire consisting of five statements. Responses ranging from 1 to 5 quantitated the level of agreement.

Quantification of behavior included amount of smoking in terms of packs per day, alcohol intake in terms of ounces of alcohol equivalent per day, and exercise level in terms of MET (metabolic equivalent equal to 3.5 mL O_2 consumed/kg body weight/min) at least three times per week.[3]

Objective health parameters included supine blood pressure, height, weight, and fasting high-density lipoprotein (HDL) cholesterol (Consolidated Biomedical Laboratory, Denver, Colorado). Pulmonary function tests performed included forced expiratory volume (FEV), midmaximal flow rate (MMFR), and slow vital capacity (SVC) using the Collins 13.5-L respirometer. The percentage of total body fat was estimated by a threefold skin-thickness measurement (thigh, abdomen, chest) with Lange's skinfold calipers (using age and sex-adjusted fat and ideal-weight tables[6]).

From 29 age- and weight-matched pairs, one subject from each pair was randomly assigned to the control group. The remaining 29 subjects (MEST group) underwent a standard maximal exercise stress test following the Bruce protocol on a Burdick TMS 400 treadmill.[1] Continuous electrocardiographic (ECG) monitoring was accomplished with a 12-lead system connected to a Marquette 3000 electrocardiograph and a Physio-control oscilloscope and defibrillator. A 12-lead ECG and blood pressure were obtained every three minutes during the actual test and every minute for seven minutes during the recovery phase. Functional aerobic impairment, METs generated, and ECG response were reviewed with the subject.[1,2] No counseling, such as that concerning an exercise program, smoking and alcohol use, or possible lifestyle change benefits, was given to the subjects in either group. At the end of four months, the entire initial data-base series was repeated in both groups and analyzed. P values noted were obtained through Student's t test.

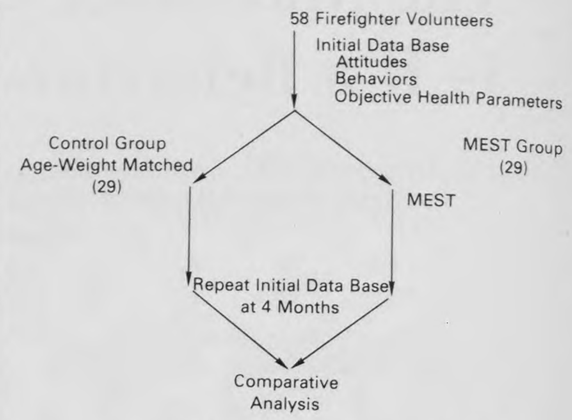

Figure 1. MEST: Experiment design

Results

Initial Data

Both groups felt that their lifestyle was affecting both their present and their future health status, and that concern about coronary artery disease influenced their exercise regimen. Their occupation (firefighter) did not seem to influence their exercise program.

The MEST group smoked approximately one-third pack of cigarettes per day. Both groups were very active and had regular exercise at least three times a week, achieving greater than 5 METs of activity during these times.

Table 1 compares the objective health parameters of the subject groups. There was little difference in age, weight, supine blood pressure, or total percent body fat in either group. There was no difference in the pulmonary function tests.

Comparative Data After Four Months

Comparisons in attitude after four months revealed no differences in the groups. Examination of their behaviors, however, showed that the MEST group increased its exercise level when compared with the control group ($P < .03$) (Figure 2). Alcohol intake remained approximately the same.

The objective measurements of health revealed no significant changes, but certain trends are noted. Those in the control group actually increased their weight, whereas those in the MEST group decreased theirs slightly. Those in the MEST group decreased their total body fat from an average of 19.1 percent to 16.3 percent. Interestingly, neither the decrease in total body fat, decrease in blood pressure, decrease in smoking, nor a general increase in exercise level translated into a rise in HDL cholesterol, as has been previously

Table 1. Baseline Objective Health Parameters of Subject Groups

	MEST Group	Control Group	P Value (Student's *t* Test)
Age (yr)	33.0	33.37	.87
Weight (lb)	183.1	176.1	.42
Blood pressure systolic (mmHg)	125.5	125.9	.90
Blood pressure diastolic (mmHg)	79.7	80.7	.58
Total body fat (%)	19.1	18.42	.70
HDL cholesterol	44.0	49.0	.07
FEV, 1 sec (liters)	4.22	4.07	.37
MMFR L/sec	4.71	4.31	.37
Slow vital capacity (liters)	4.95	5.08	.42

HDL—high-density lipoproteins
FEV—forced expiratory volume
MMFR—midmaximal flow rate

reported.[7] No significant changes were noted with the pulmonary function tests.

The only morbidity seen in the MEST group was in one patient who experienced exercise-induced bronchospasm; this was easily reversed medically. Eight patients had nondiagnostic ST-T wave changes during their treadmill test.[8] No MEST test was considered "positive" for coronary artery disease.[8]

Finally, six subjects in the MEST group had a functional aerobic impairment greater than or equal to zero using the nomogram for active male subjects described by Bruce et al.[9] Four of the six (67 percent) increased their exercise level and lost a total of 43 pounds.

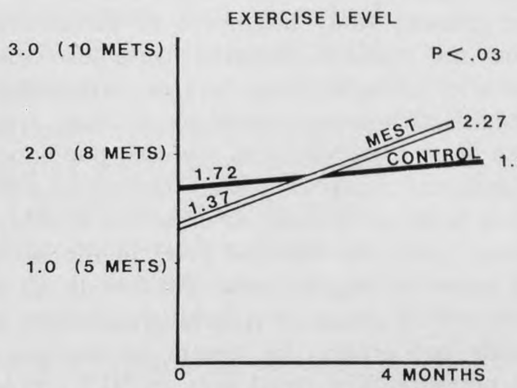

Figure 2. Comparison of increase in exercise levels of MEST and control groups after four months

Discussion

Over 500,000 individuals die each year from coronary artery disease.[4] Unfortunately, once symptomatic coronary artery disease occurs, little can be done to reverse the disease process; therefore, the preventive aspects of this illness have received much attention in the medical literature over the past 20 years. The Framingham Study identified individual risk factors such as hypertension, obesity, smoking, diabetes, stress, and hypercholesterolemia as leading to accelerated coronary artery disease.[10] It has been postulated that improvement of these risk factors would prevent, or at least decrease, the morbidity and mortality from coronary artery disease. Results from the Multiple Risk Factor Intervention Trial, however, failed to show a statistically significant mortality improvement in a large group of high-risk individuals in spite of certain risk factors, such as blood pressure, cholesterol, and amount of smoking, being lowered.[11]

Except for the physician identifying certain risk factors and possibly treating diabetes and hypertension, individual patient motivation could play a more important role in risk-factor reduction. Supporting this theory was a study by Cooper et al,[4] who found an inverse relationship between physical fitness and blood pressure, cholesterol, weight, stress, and blood sugar. A computerized literature search, however, revealed only one study addressing this problem. Specifically, Bruce et al,[5] in a retrospective, uncontrolled study of symptomatic, high-risk individuals, used a questionnaire to examine the motivational effects of the MEST test to modify risk factors and health habits. They found that persons with an abnormal functional aerobic impairment as demonstrated by the exercise stress test were more likely to be motivated to change, and raised the possibility that exercise testing may play an important role in modification of coronary risk factors and health habits.

The present study attempted to demonstrate whether the maximal exercise stress test would indeed alter attitudes, behaviors, or certain objective health parameters related to coronary artery disease in an asymptomatic, low-risk population. No significant change was seen throughout either group in terms of attitude or objective health parameters. Only the exercise level in the MEST group increased significantly. Total body fat decreased in both groups. No definite statement can be made concerning the weight or changes in blood pressure. The trend seen in HDL cholesterol adds to the recent observations that the relationship between HDL cholesterol, exercise, alcohol, and smoking needs further study.[12,13]

Within the MEST group the same trend noted by Bruce et al was seen.[5] Specifically, those patients with abnormal functional aerobic impairment tended to be motivated toward change (increased exercise level, decreased weight). One can only speculate upon the results of the present study if it had been aimed at a more sedentary, higher-risk population.

As to whether the maximum exercise stress test can be used as a behavior modification tool, the answer is "possibly." With an active, healthy male population, the changes in attitude and behavior and their effect on objective health parameters are, however, modest. Only one parameter was altered significantly in this study. In view of the "normal" charge of $150, the MEST is certainly an expensive means of behavior modification.

Two additional points should be made. First, this study covered that short time period during which most behavior modification techniques have their greatest impact. Second, the control group also had changes in attitude, behavior, and objective measurements of health, although less than the MEST group. This crossover effect is similar to that seen in other studies. Simply by being part of a "health study," patients will alter behaviors and attitudes.

The real question of whether changes such as those demonstrated in this study would alter the morbidity and mortality from coronary artery disease remains unanswered.

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