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**EXPERIENCES WITH PHYSICAL CONDITIONING  
PROGRAMS IN MIDDLE-AGED MEN**

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INTRODUCTION

The great exercise fad has swept the United States with literally thousands of juveniles, adults, and senior citizens puffing along the sidewalks, tracks, and roadways of America. The slogan "run for your life" has stimulated the minds of many with the fond expectations of weight reduction, improved physical fitness, lowering of cholesterol, and prevention of coronary heart disease.

What is the medical evidence that confirms the value of a regular exercise program? Numerous studies in universities, YMCA's, and the military have shown marked changes in the heart rate, muscular stamina, and psychological responses in individuals performing prescribed, regulated programs of physical conditioning. When sufficient regular physical activity is carried out by jogging, bicycling, swimming, walking, etc., the medically well adult can expect improvement in the body responses. Charts are available (e.g., Cooper's aerobic program) that prescribe the level of physical activity required to promote a high level of physical conditioning.

However, little or no evidence is so far available to document the long term effect of improved physical conditioning. Much has been written about the relationship of physical activity to the incidence of coronary artery disease and the possibility exists that lack of regular exercise is associated with higher frequency of heart attacks. The question, "Does regular exercise reduce the danger of heart attacks and prolong life?" still remains unanswered.

The Cox Heart Institute of Dayton, Ohio, is now in the process of studying the long-term effects of physical exercise and conditioning in the prevention and treatment of coronary heart disease. This paper deals with some aspects of the problem and points out difficulties encountered in a group of middle-aged business executives using a carefully prescribed, but non-regimented and loosely supervised conditioning program employing commonly used forms of exercise (bicycling and jogging).

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## METHODS

Fifty-six middle-aged (38-60 years) white male executives (engineers, corporate vice-presidents, treasurers, etc.) of Dayton, Ohio, industrial and commercial firms were matched with 56 controls. Questionnaires had originally been sent to 200 high level business executives asking for voluntary participation in the program, either as a participant or as a control. Those individuals indicating an interest in a four to six months program of progressive aerobic exercise were then instructed as to the type of testing to be performed, the manner of exercise, i.e., on a bicycle or jogging, and the methods of recording exercise performance.

The bicycle used was a narrow-tired, 1-5/8" (60 lbs. pressure), continental style, three-speed bicycle. It has a standard saddle, handle bars, hand brake, and weighed 12 lbs. A speedometer and mileage meter were added to permit recording of mileage to control the exercise intensity. All bicycling was performed on bicycle routes or residential streets with no grade greater than 10%. A sheet for recording the number of miles ridden daily was given to each participant at the start of the program and it was to be filled out and mailed to the exercise laboratory monthly.

The subjects who selected jogging were instructed by the local YMCA as to the method of running. The men were to exercise at the running track at the local YMCA, a local high school track, or the sidewalks of their community. A form sheet similar to the bicycle group was utilized.

No attempt was made to change the habits of the participants (dietary, smoking, alcohol, etc.). Since the occupations of the participants involved traveling in some cases, they were encouraged to continue the progressive exercise program even while away from home.

## TESTING TECHNIQUES

Each subject had an initial examination, including history, physical examination, blood sugar, cholesterol, and blood count. A chest X-ray, resting electrocardiogram, double Master's two-step test, and pulmonary function tests were performed. Only exercising subjects and controls who were judged essentially normal from a cardiovascular standpoint were placed in the study group. Blood cholesterol and a physical examination were repeated at the completion of six months of the program.

A submaximal exercise test was performed prior to the start of the program and was repeated at two, four, and six months for the exercising subjects and at six months for the controls. At least one hour, following a light meal, the subject wearing tennis shoes and gym shorts was brought to the exercise lab. A resting supine 12-lead standard electrocardiogram was performed and bipolar ECG electrodes (Beckman) were attached to the right scapular and left chest (V-4) positions. The subject was then seated on a Godart variable resistance bicycle ergometer, and the sitting electrocardiogram recorded on a Sanborn 500 recorder. The left brachial blood pressure was also recorded using a sphygmomanometer. Expired air was collected in 200 liter bags using low resistance valves (McKesson one-way) and rubber mouth piece. Total volume of expired air was measured using a Tissot spirometer. Oxygen concentration was determined by a Beckman E-2 electromagnetic oxygenator and carbon dioxide was determined by a Godart capnograph. Daily calibration of the meters was made from compressed gas tanks, with known concentrations of oxygen and carbon dioxide determined by micro Sholander techniques.

After a two-minute warm-up period at zero workload the subject exercised at a 300 Kgm setting for four minutes. The bipolar ECG and blood pressure were recorded at two and four minutes respectively and the expired air collected during the fourth minute of exercise. The subject then rested (on the bicycle) for four minutes and repeated the test at a 600 Kgm workload. Following another four minutes rest period, a workload of between 750-900 Kgm was selected so that the heart rate would approach or exceed 150 beats per minute. Two-and-four minute recovery heart rates and blood pressure recording were obtained with the subject sitting on the bicycle. A standard post exercise 12-lead electrocardiogram was then recorded in the supine position.

The standard and bipolar electrocardiograms were coded according to Blackburn's criteria for resting and exercise ECG's. The computation of oxygen consumption, ventilation and respiratory quotient were performed by standard techniques using a program written for the IBM 1800 computer. Oxygen pulse, pulse workload (heart rate 130 and 150) and ventilatory equivalent were calculated by standard techniques. Predicted maximum oxygen consumption was calculated from the heart rate, using Astrand's nomogram. Body surface area and calculated lean body mass were determined using height, weight, and skin caliper measurements.

The accumulated data were punched on IBM cards and statistical analysis performed on an IBM 1800 computer. A two-way analysis of variance was performed on the data for comparison of the results of pretraining, and at two, four, and six months periods. Significance of change was evaluated using the Student T test and P values.

## RESULTS

There was considerable variation in the amount of exercise performed and the diligence with which the participants continued the prescribed program. The individuals were classified according to the amount of exercise performed as poor, fair, and good exercisers. (Table I). This information was derived from the log which the participant kept and turned in monthly to the exercise lab. The "good" category included the individuals who completed the required number of miles, the "fair" up to one-half of the requirement and the "poor" less than one-fourth of the program. Three men in the bicycle group and four men in the jogging group failed to turn in log sheets.

In 56 controls, only 44 were available for testing at the end of six months. Some of these men had moved out of town and others did not have the necessary interest to continue. Of 26 men who started the bicycle conditioning program, 25 completed six months and 17 are still exercising after 30 months. The one man who dropped out of the program in the first 6 months sustained a myocardial infarction. It is interesting that he is the only man in the group who actually showed deterioration in his fitness studies during the program. Of the 34 men who started on the jogging program at the YMCA, 28 were continuing at six months and 24 were still exercising at 24 months.

The comparison of the controls with the two groups of exercising men in the initial (baseline) study demonstrates several similarities. The average age of the control group was three years older (48-45) while the total body weight was identical, 81.3 Kgm. The serum cholesterol was similar (239-225) with an average caloric intake of 2450 calories with 40% fat. The resting and exercise heart rates of the controls were lower than the two groups in the baseline study, while all other parameters were quite similar. (Table II). It is of some importance to note the baseline and six months test results in the control group. All parameters are essentially unchanged indicating the stability of the physiologic variables in a group of men exercising.

The six month results in the exercising groups showed several parameters that changed in the direction expected with improvement in physical conditioning. A small decrease in systolic pressure was noted in the resting and two levels of work. The heart rate showed the greatest change (up to 14% decrease) following the exercise program. The decrease was present in the resting, peak exercise, and recovery heart rates. In general, the decrease in heart rate was greater in the bicyclers compared to the joggers. The  $O_2$  consumption, ventilation,

and respiratory quotient parameters (Tables III and IV) did not show any trend associated with the program except for a slight decrease in variation at high work loads, i.e., 750-900 Kkm. The oxygen pulse ( $O_{2p}$ ) Table V) did show an increase (probably related to the decrease in heart rate) with physical training. No change occurred in total or lean body weight and serum cholesterol.

After four months of physical conditioning in both bicycling and jogging subjects, changes in the amount of exercise performed were observed. (Table V). The maximum heart rate and recovery heart rate parameters appeared to have decreased in both the good and fair joggers, with no meaningful change occurring in poor joggers.

In the Bicycle group an apparently greater improvement occurred in the fair exercisers than in the good exercisers (Table V). This may be due to selection bias, as the seven individuals in the good group had lower heart rates and perhaps better physical conditioning at the time of the baseline study.

The two-way analysis of variance performed on these changes did not reach a significant level of confidence ( $P > 0.05$ ) which indicates that the changes in heart rate may not have been due to the level of exercise. Therefore, while there was considerable difference between the six month tests in exercisers and controls, the results may not be considered statistically significant. All other parameters also failed to meet the two-way analysis of variance test for significance.

#### SUMMARY

1. An exercise program was instituted for middle aged business executives in a community setting. Both jogging and bicycling were selected as the methods of exercising.
2. The level of exercise performance varied markedly in an unsupervised program.
3. Improvement occurs in physical conditioning with a self-regulated non-supervised program:
  - a. Related to amount of activity engaged in by participants.
  - b. A rigid statistical analysis suggest the variability in individual changes is so great that significance of changes is doubtful.

4. Exercise performance in well informed and motivated executives will not, under the conditions obtained in this study, result in a very great improvement in physical conditioning. The participants separated into three groups---good, fair, and poor exercisers, depending on motivation, job demands, time available, etc.
5. A short term study will not indicate the effect of regular exercise on prevention of heart disease. No change occurred in body weight and serum cholesterol, if other measures (diet, smoking, alcohol, etc.) were not changed.

No attempt was made to study psychological changes, such as lessening of tensions, improved sleep, sense of well being, increased efficiency on the job, but nearly all of the participants in the exercise studies seemed satisfied that they had engaged in the study, and the majority are continuing in the long-range program which is now going into its second year. It is believed that the beneficial effects of exercise failed to be significant in this study as in other short term studies because the effects require a matter of years for manifestation.