THE EFFECTS OF 12 WEEKS OF EXERCISE TRAINING ON HIGH DENSITY LIPOPROTEIN CHOLESTEROL IN MEN AGED 30-50

By

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Bachelor of Arts

Oral Roberts University

Tulsa, Oklahoma

1979

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
For the Degree of
MASTER OF SCIENCE
December, 1981

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ACKNOWLEDGMENTS

I would like to express my sincere appreciation to Dr. Aix B. Harrison, my major adviser, for his direction, interest and assistance in this study.

I also want to thank Dr. Betty Abercrombie and Dr. John Bayless for serving as committee members and for their valuable help in my master's program.

I would like to thank Dr. James A. Schwane and Dr. Daniel MacNeil for their guidance and assistance in this investigation.

A special thanks to the subjects who volunteered for this project. Their dedication of time and faithful participation in this study made it a success.

My thanks to TOP Services Unlimited for the excellent processing of this thesis.

Finally, I extend my love and appreciation to my wife, Kathy. Her understanding, support and sacrifice were greatly appreciated throughout the course of this study.

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CHAPTER I

INTRODUCTION

Extensive investigation has centered around the function of high density lipoprotein cholesterol (HDL-C). This research is a product of evidence by the Framingham study and others of an inverse relationship between plasma (or serum) HDL-C levels and incidence of coronary heart disease (CHD) (1-6). Several theories have been put forth to characterize the role of HDL-C in CHD. Glomset suggests that HDL-C plays a major role in the removal of cholesterol from the peripheral tissues to the liver, thus decreasing deposition (7). Carew and his associates found that cells incubated with equal or higher HDL-C concentrations show no accumulation of cholesterol deposition. It is suggested that HDL-C acts in removal of cholesteryl ester and phospholipid decomposition of very low density lipoprotein from the plasma (8). The precise function of HDL-C in its association with CHD is still unclear at present.

Collaborating research related to CHD has been supportive of a decreased incidence of CHD associated with regular physical activity (9-13). There may be a possible connection between a decreased incidence of CHD with higher HDL-C levels and regular physical activity. It has been suggested that chronic physical activity increases concentrations of HDL-C in the blood. There is evidence to support modification of risk factors by physical acitivty (14-17); however, increased HDL-C concentrations associated with physical activity is contradictory.

Several studies have demonstrated higher HDL-C levels in trained than in non-trained individuals (18-29). Increased levels of HDL-C have been found in cross country skiers, male and female middle-aged runners, elite long distance runners and marathoners, and male and female tennis players. Contradictory evidence by other investigators has not been supportive of the physical activity-HDL-C relationship (30-35). The research design of these studies has contributed to the contradictory evidence of the exercise-HDL-C association. Cross sectional design, insufficient dietary and physical activity data, small numbers of subjects, and the small number of randomized training studies has contributed to this variability. Therefore, further investigation into the relationship of exercise to HDL-C is warranted.

Statement of the Problem

The purpose of this investigation was to characterize the effect of 12 weeks of exercise training on plasma high density lipoprotein cholesterol in men aged 30-50.

Hypothesis

Twelve (12) weeks of exercise training will have no effect on plasma high density lipoprotein cholesterol.

Significance of the Study

This study offered a randomized training protocol with experimental and control groups utilizing large numbers of subjects (> 30 subjects per group). This design provided further experimental data to characterize the effect of exercise on HDL-C.

Assumptions

1. It was assumed that all subjects answered truthfully the questionnaires on diet, alcohol consumption, smoking history, and physical activity history.
2. It was assumed that all subjects adhered to the instructions to maintain their dietary and alcohol consumption habits prior to the study, during the course of the study.

Limitations

1. The subjects involved in this study were volunteers and not a random sample from a normal population.
2. The methods used to assess dietary and alcohol consumption habits lacked quantitative analysis.
3. The training period for this study was only 12 weeks.
4. The subjects were under no obligation and retained the right to withdraw from the study at any time.

Delimitations

1. Seventy-two men from the Tulsa area, aged 30-50, were examined in this investigation.
2. All subjects were "inactive", exercising less than three times per week six months prior to the study.
3. Only subjects free of known CHD or symptoms of CHD were selected for this study.
4. Only HDL-C was examined in this study, not the apolipoproteins of HDL-C.

Definition of Terms

Beckman Metabolic Measurement Cart: A cardioplumonary instrument utilized in the measurement of oxygen consumption ($\dot{V}O_2$) (36).

Control Group: The group that did not receive the treatment effect of 12 weeks of organized exercise.

Experimental Group: The group that underwent the treatment effect of 12 weeks of organized exercise.

CHAPTER II

REVIEW OF LITERATURE

Interest in HDL-C has sparked a large number of studies examining the effect of physical activity on HDL-C. Because of the large number of studies in this area, the author did not attempt to present a comprehensive review of literature. Rather, selected studies which are representative of the research in the area are presented. The review of literature focused on three specific areas in regard to the exercise-HDL-C: (1) cross sectional research on exercise-HDL-C; (2) exercise training protocols on HDL-C; and (3) related effects of diet, alcohol consumption, and cigarette smoking.

Cross Sectional Research

Research by Wood (21, 22) evaluated HDL-C concentrations in male and female runners. The study involved comparing HDL-C levels in 41 male and 43 female runners with a random subset of 147 male and 93 female control subjects. The control subjects were derived from 747 males and 923 females who were generally sedentary and inactive. A few active individuals were included in the control group. The runners exercised a minimum of 15 miles per week for the previous year. Following a 12-16 hour fast, blood samples were taken and lipid concentrations compared. Significantly higher HDL-C levels were found in the runners than in the control subjects, both males and females.

Adner and others (25) studied the effects of distance running on HDL-C levels in 50 distance runners. These runners were matched for age and sex with a control group of 43 subjects. Each group had one female subject, all other subjects were male. Distance runners were defined as individuals who ran more than 500 miles per year. In contrast, control subjects were defined as individuals who did not run more than 500 miles per year. Upon evaluation of HDL-C concentrations, the distance runners had significantly higher HDL-C compared with the matched controls.

Middle-aged marathon runners (n = 59), joggers (n = 85), and inactive men (n= 74) were studied by Hartung and his associates (19). The marathon runners and joggers averaged 40 miles per week and 11 miles per week running, respectively. Blood samples were drawn after a 12-16 hour fast, and mean HDL-C levels for the groups were as follows: 1) marathon runners - 65 mg per deciliter; 2) joggers - 58 mg per deciliter; and 3) inactive men - 43 mg per deciliter. Hartung found significantly higher HDL-C concentrations in joggers and marathon runners than in inactive men. Marathon runners also demonstrated significantly higher HDL-C levels than joggers.

Martin and others (24) did a similar study on young male (26-30 years of age) elite runners (n = 20), good runners (n = 8), and age matched controls (n = 72). The categories of elite runners, good runners, and control subjects were determined by the activity level indicated by the subject on a physical activity questionnaire. Analysis of HDL-C demonstrated significantly higher values in all groups of runners versus their control counterparts.

Contrasting data has also appeared which has not been supportive of the exercise-HDL-C association. Mjos and Thelle (32) compared a highly active group of 139 females and 110 males with a sedentary control group of 112 females and 84 males. The highly active group was determined by those individuals who exercised more than four hours per week, all other subjects comprised the sedentary control group. When HDL-C levels were compared between the groups, no significant difference was found.

Ho and Chan (30) studied the effect of exercise on HDL-C. Their study of young Chinese adults compared a group of 19 who engaged in hard frequent exercise to a group of 22 who did little or no exercise. The criteria for determining the exercise group was physical activity in excess of three hours per week. After a 12-hour fast, blood samples were drawn and lipids assayed. Statistical analysis did not demonstrate significantly higher HDL-C levels in the exercise group.

Schwane and Cundiff studied HDL-C in relationship to physical activity and cardiorespiratory (CR) fitness. One hundred and fifty college aged adults, 66 males and 84 females, volunteered to participate in the study. Physical ativity and HDL-C showed no significant correlation in males or females. However, CR fitness and HDL-C did show a significant positive correlation in both males and females.

From the cross sectional research it is evident that conflicting results have been found in regard to the exercise-HDL-C question. The cross sectional design has been useful in identifying extremes in HDL-C levels (distance runners vs. sedentary individuals), however, it can not demonstrate a cause-effect relationship. As a result, it is necessary to further examine the exercise-HDL-C question with more powerful research designs which can demonstrate a cause-effect relationship.

Exercise Training Protocols

A 16-week training study involving 100 asymptomatic middle-aged men was undertaken by Huttunen (29). All subjects were assessed for fitness and blood lipids before the training session. Subjects were randomized into exercise and control groups. Controls were instructed to maintain current activity level, while the exercise group met three or four times per week for 30 minutes of exercise. The primary form of exercise was walking and jogging. Following the 16-week training period, all subjects were reassessed on fitness and blood lipids. The exercisers demonstrated significantly higher HDL-C levels than did the sedentary control group. Also, an increase fitness level was demonstrated by increased $\dot{V}O_2$ in the exercise group.

Leon and his associates (28) studied the effects of 16 weeks of vigorous treadmill walking on blood lipids in six sedentary obese men. Subjects exercised for 90 minutes, five days per week at 3.2 miles per hour up a 10 percent grade. Following the training period the group demonstrated a 15.6 percent increase in HDL-C over the pretraining levels.

Farrell and Barboriak (27) studied the effects of eight weeks of endurance training on lipoproteins concentrations. Sixteen subjects were studied, seven males and nine females. The subjects exercised at 70 percent $\dot{V}O_2$ maximum, 30 minutes per day, and three or four days per week. Evaluation of HDL-C concentrations showed significantly higher values at post-training.

Other training protocols have not been supportive of the exercise-HDL-C association. Moll (31) studied the effect of six weeks of vigorous exercise on 14 non-obese women ages 22-26. The subjects exercised

30-45 minutes by jogging five days per week. The subjects were assessed before and after the training program on aerobic performance, total cholesterol, and HDL-C. The subjects demonstrated a significant increase in aerobic performance. Total cholesterol fell significantly, but HDL-C was not significantly different, however, it was slightly lower.

Wood and others (35) looked at the effects of one year of exercise on plasma lipoproteins in 81 males ages 30-55. The subjects were randomly assigned to either the exercise group (n = 48) or the control group (n = 33). Following one year of training the average miles run per week by the exercise group ranged from 0-21 (median 8.6). No significant difference was observed in HDL-C levels between the exercise group and the control group. A significant positive correlation was found between HDL-C and miles per week run.

Research by Allison studied the effect of eight weeks of aerobic exercise on 49 women and 39 men of college age. Subjects were randomized into three groups: 1) control-group - no exercise; 2) exercise group - three times per week for 30 minutes; and 3) exercise group - three times per week for 45 minutes. All subjects exercised at 80-85 percent of maximum heart rate. Following the eight weeks of training, fitness and blood lipids were reassessed. Allison found that both training groups failed to increase HDL-C above the control group, and both training groups showed a slight decrease in HDL-C (5 mg/dl). CR fitness was increased for both exercise groups, but had no significant relationship to HDL-C.

The complex nature of the factors involved in lipid metabolism require stringent controls to effectively define exercise effects on

HDL-C. Upon examination of the research related to the exercise-HDL-C relationship, it was evident that no clear conclusion could be made. Obvious differences in HDL-C levels are well demonstrated in extreme groups; however, further research is necessary to clarify exercise effects on HDL-C.

Related Research

Dietary data related to HDL-C has been variable and inconsistent. Some studies have demonstrated increased HDL-C with dietary intake of polyunsaturated and saturated fat (37-38). However, conflicting evidence has not been supportive of this relationship (39). Further information and research on the effect of dietary intake of fat on HDL-C is needed to clarify this relationship.

The effect of alcohol consumption on HDL-C has been fairly well established. A large number of studies have demonstrated a positive correlation between alcohol consumption and HDL-C (39-42). Therefore, it is assumed that alcohol consumption will have a positive effect on HDL-C.

The relationship of cigarette smoking to HDL-C has been extensively studied. It is generally accepted that cigarette smoking has a negative effect on HDL-C levels (41, 43-45). Therefore, for the purposes of this study cigarette smoking will be assumed to lower HDL-C levels.

CHAPTER III

METHODS AND PROCEDURES

This chapter describes the methods and procedures employed in this investigation.

Research Design

A schematic presentation of the experimental design is shown in Figure 1. Seventy-two volunteer subjects were recruited from the Tulsa area. Three weeks prior to the training period all subjects underwent a medical screening and T1 laboratory studies. T1 tests collected pre-treatment data on cardiorespiratory fitness, blood lipids, and body composition. Following the T1 testing, the 72 subjects were randomly assigned to either the experimental group or the non-exercising control group. Thirty-six subjects were assigned to each group, and the 12-week treatment period of organized exercise was begun for the experimental group. Within three weeks of the termination of the treatment period, 94.4 percent (34/36) of the subjects from the experimental group and 91.7 percent (33/36) of the subjects from the control group were reassessed at the T2 laboratory studies. For the purposes of statistical analysis only subjects with complete data were studied.

Subjects

Subjects were recruited from the Tulsa area by an advertisement published in a local newspaper and the distribution of a flier

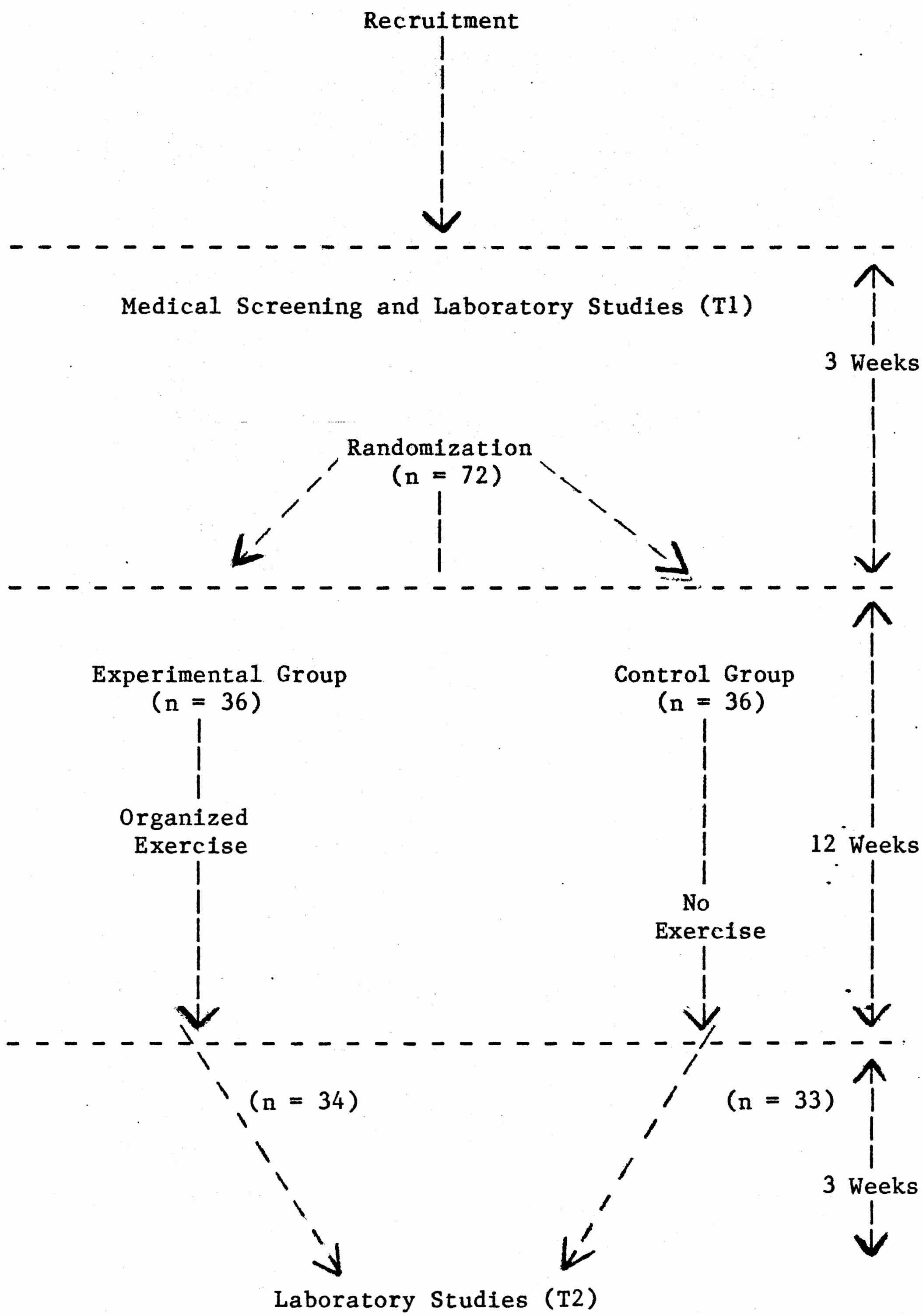

Figure 1. Schematic of Experimental Design

published in a local newspaper and the distribution of a flier (see Appendix A). In order to be eligible for this study, subjects had to meet the following criteria: (1) male; (2) between 30 to 50 years of age; (3) "inactive" (i.e. exercising less than three times per week over the prior six months); and (4) free of known CHD and symptoms of CHD; (5) willing to be randomly assigned to either the experimental group or the control groups. Assessment of physical activity revealed: (1) 77.8 percent of the subjects indicated they had not engaged in exercise in the past six months; (2) 11.1 percent of the subjects indicated they had engaged in exercise occasionally; (3) 11.1 percent of the subjects indicated they had engaged in exercise once each week. The activities of the latter group varied from tennis, raquetball, basketball, soccer and jogging.

Before the subjects were permitted to participate in the study, an informed consent (see Appendix A) was signed by each subject detailing the design of the research project and the testing involved. No subject was under any obligation and retained the right to withdraw at any time. None of the subjects were excluded or withdrew from the study because of stipulations outlined in the informed consent.

A medical screening was given to all subjects who met the eligibility criteria in the Human Performance Laboratory, Oral Roberts University. This test battery included a brief medical history (see Appendix A), a 12-lead resting electrocardiogram (ECG), a resting blood pressure, and a physician supervised graded exercise test (GXT). The purpose of this testing was to further screen out individuals with CHD or symptoms of CHD. The Bruce Treadmill Protocol (see Appendix B) was employed for the GXT, and subjects were instructed to perform to their maximal endurance. Continuous monitoring of ECG was employed to determine the maximum heart rate of each subject. No subject was eliminated from the study as a result of underlying CHD or symptons of CHD.

Data

Cardiorespiratory Fitness

CR fitness was assessed on each subject at T1 and T2 by means of direct measurement of $\dot{V}O_2$ during a Balke Treadmill Test (see Appendix B). The Beckman Metabolic Measurement cart was utilized to measure $\dot{V}O_2$ (36). The maximal heart rate achieved on the Bruce Treadmill Test was utilized to calculate a submaximal work load of 80 percent of maixmal heart rate range. The Balke Test was terminated when the subject reached their 80 percent of maximal heart rate range.

Maximal $\dot{V}O_2$ was estimated by correlating each subjects heart rate response to their measured $\dot{V}O_2$. Their maximal heart rate was then used as a predictor of maximal $\dot{V}O_2$. Three parameters were used to assess the effects of 12 weeks of exercise on CR fitness: (1) $\dot{V}O_2$ measured at a heart rate of 150 on all subjects; (2) $\dot{V}O_2$ measured at 80 percent of maximal heart rate range on all subjects; and (3) estimated maximal $\dot{V}O_2$. One subject in the experimental group could not be assessed on CR fitness at T2, therefore, only 33 subjects were used for statistical analysis of CR fitness data.

Blood Lipids

The major variable of interest in terms of the purpose of this study was HDL-C. To provide a more complete profile total cholesterol (TC) and triglycerides (TG) were assayed. These tests were performed on all 72 subjects at T1, and 34 subjects in the experimental group and 33 subjects in the control group at T2. Blood samples were drawn after a 12-hour fast. Assays were performed at the Oklahoma City Lipid Research Clinic, which employs standard procedures of the Lipids Research Clinics Program (46). The method employed in the lipid assay was the heparin-Mn^{2+} precipitation technique. One subject in the experimental group did not have sufficient quantity of plasma in this T2 blood sample to assay HDL-C; therefore, only 33 subjects were used for statistical analysis of HDL-C.

Body Composition

Body weight was assessed on all subjects at T1 and T2. Percent body fat was estimated by the skinfold procedure of Durnin and Rahaman (47). A trained technician measured skinfold sights for all subjects. Because of the technique involved, if the technician was unable to locate the skinfold sight or if the skinfold was tight and measurement unreliable, the technician marked the data invalid. For the purposes of statistical analysis 28 subjects in each group had valid skinfold measures.

Percent body fat was also assessed by hydrostatic weighing technique. The procedure of Siri was utilized in the determination of percent fat (48). Once again a trained technician was used to assess hydrostatic weight. Because of the technique, the validity of the measurement was dependent on the ability of the subject to perform the procedure. Certain subjects had difficulty performing the procedure underwater; therefore, their data was marked invalid by the technician. For the purposes of statistical analysis 27 subjects in the experimental group and 26 subjects in the control group had valid hydrostatic weighing measures.

Treatment Protocols

Experimental Group

Subjects in the experimental group were enrolled in special classes of the Oral Roberts University Adult Aerobic Fitness Program. These classes were conducted by the author and met for the 12-week treatment period. The classes met for one hour, three times per week. The first class met Monday, Wednesday, and Friday evening, and the second class met on Tuesday, Thursday, and Saturday mornings.

Each subject was given an individual exercise prescription based on the position statement of the American College of Sports Medicine (49). The maximal heart rate achieved on the medical screening and the resting heart rate (HR) on the 12-lead ECG were utilized to determine heart rate ranges for exercise intensities. The Karvonan Formula (49) was used to determine the exercise intensities for each subject:

(Maximum Heart Rate - Resting Heart Rate) Percent of Heart Rate range + Resting Heart Rate = Exercise Intensity

The following exercise progession was employed to allow the subjects to progress to a target intensity of 75 percent of heart rate range, and a duration of 30 minutes or more of continuous walking or jogging (see Table I).

All subjects were instructed in monitoring their heart rate intensities by carotid palpation. Heart rate intensities were monitored periodically during the activity by counting the number of heart beats in ten seconds and then multiplying the number of beats by six. All intensities were recorded in their activity log (see Appendix A).

TABLE I

EXERCISE PROGRESSION

Week	Intensity	Duration
1	60% Heart Rate Range	10-20 minutes
2	60% Heart Rate Range	20-25 minutes
3	65% Heart Rate Range	25-35 minutes
4	70% Heart Rate Range	25-35 minutes
5	75% Heart Rate Range	30-40 minutes

Each subject in the experimental group was given an individual activity log. The activity log contained the subject's exercise prescription and recording forms for activity data. The subjects were instructed in the proper methods for recording the information over the 12-week treatment period. Subjects indicated the type of activity in which they engaged, the intensity of the activity (by heart rate), and the duration of the activity. In order to gain maximal improvements in CR fitness, the subjects were encouraged to exercise outside of the organized classes as well and record all information in the activity log.

Control Group

The subjects in the control group were instructed to refrain from exercise as much as possible over the 12-week treatment period. The author contacted each control subject bimonthly by phone to quantify any activity in which they may had engaged. At the termination of the treatment period, 69.7 percent (23/33) of the control subjects had not engaged in any exercise over the previous 12 weeks. A total of 24.2 percent (8/33) of the control subjects indicated they participated in some type of exercise over the 12-week treatment period. These activities varied from downhill skiing, golf, soccer, softball, walking, and jogging. All subjects in this category engaged in these activities less than four times over the treatment period. The final group of 6.1 percent (2/33) of the control subjects indicated they engaged in tennis or raquetball once per week over the twelve week treatment period.

Diet

Diet was assessed during the T1 studies by means of a questionnaire (see Appendix A). The purpose of this data collection was not to provide quantitative data on dietary intake, but rather, to identify individuals who demonstrated extreme dietary patterns. After reviewing the data no subject demonstrated extreme dietary patterns. All subjects were instructed not to intentionally alter their eating habits over the course of the study. During the T2 laboratory studies each subject was asked if they had altered their dietary patterns during the course of the study. No subject indicated that he had changed his diet.

Alcohol Consumption

Alcohol consumption was also assessed by the aforementioned questionnaire. The questionnaire provided identification of the following subgroups: (1) non-drinkers (n = 24); (2) light drinkers (<1 -3 drinks per month of either beer, wine, or liquor) (n = 23); (3) moderate drinkers (1 - 6 drinks per week of either beer, wine, or liquor (n = 16); and (4) heavy drinkers (1 - 3 drinks per day of either beer, wine, or liquor) (n = 4). Ideally, a multivariate matrix would be appropriate to analyze alcohol consumption data in relation to physical activity and HDL-C; however, this statistical process was unavailable. Therefore, a simple t-test was used to determine if a statistically significant difference existed between mean HDL-C levels in non-drinkers versus drinkers.

Smoking History

Smoking status was assessed during T1 laboratory studies by means of a questionnaire (see Appendix A). A total of nine subjects indicated they were current cigarette smokers, the remainder of the subjects indicated they were non-smokers. As was mentioned earlier, a multivariate approach more appropriately analyzes the effect of cigarette smoking in relation to other variables (exercise, alcohol consumption, HDL-C, etc.). However, since this option was not available a t-test was run between non-smokers and smokers to test for significant differences in mean HDL-C levels.

Statistical Analysis

Statistical analysis of the data collected in this investigation was run at the Oral Roberts University computer center using a Data

General Computer (AOS). Several statistical procedures were used to evaluate the data. The analysis of covariance was used to adjust for the differences in the means between the experimental and control groups and to determine the effects of treatment from pretesting to post-testing. Dependent t-tests were run to determine treatment effects within the groups. Independent t-tests were run to determine differences between the mean HDL-C levels of non-drinkers and drinkers, and non-smokers and smokers. Finally, a Pearson Product-Moment correlation was run to determine the relationships between physical activity, CR fitness, and HDL-C (50).

CHAPTER IV

RESULTS AND DISCUSSION

Age and height assessed at T1 studies are found in Table II. The mean age for the experimental and control groups were 40.8 years and 40.6 years, respectively. The mean height for experimental and control groups were 70.4 inches and 70.2 inches, respectively. Independent t-test showed no significant differences between the groups.

TABLE II

AGE (YEARS) AND HEIGHT (INCHES) FOR THE EXPERIMENTAL AND CONTROL GROUPS

	n	Mean	Standard Deviation	Range	t-Ratio
Age					
Experimental	34	40.8	± 4.7	30 - 50	.13
Control	33	40.6	± 5.8	30 - 49	
Height					
Experimental	34	70.4	± 1.8	67.5 - 74	.25
Control	33	70.2	± 3.2	63 - 77	

Analysis of Covariance of Pretreatment and Posttreatment Data

After the 12-week treatment period, pretraining and posttraining data underwent statistical analysis using the analysis of covariance. The results of the body composition data for the experimental and control groups are found in Table III. Both groups demonstrated a reduction in body weight. The reduction for the experimental group was more pronounced than that of the control group, but not statistically significant. Percent body fat assessed by skinfolds was lower for both groups, but the experimental groups was significantly lower ($p < .05$). Percent body fat assessed by hydrostatic weighing was 1 percent lower in the experimental group and .2 percent higher in the control group. However, there was no statistically significant difference between the groups.

Analysis of covariance of the blood lipid data is found in Table IV. No statistical significance was found between the experimental and control groups on total cholesterol, trigycerides, HDL-C, and HDL-C percent. Both groups demonstrated a reduction in total cholesterol; however, the reduction for the experimental groups was more pronounced than the control group. Trigycerides were virtually unchanged for the control group, but a slight reduction was noted for the experimental group. The experimental and control groups showed a reduction in HDL-C, 2.97 (mg/dl) and 3.24 (mg/dl), respectively. The experimental group increased .1 percent, and the control groups decreased 1.1 percent in HDL-C percent; but, no significance was found between the groups.

Finally, the analysis of covariance was run on the CR fitness parameters of: (1) $\dot{V}O_2$ HR 150; (2) $\dot{V}O_2$ 80 percent HR; and (3) estimated

TABLE III

ANALYSIS OF COVARIANCE OF BODY COMPOSITION DATA

Experimental	n	Weight (lbs)	n	% Body Fat (Skinfolds)	n	% Body Fat (Hydrostatic Weight)
T1 Mean	34	190.1	28	22.3	27	22.5
Standard Deviation		± 31.0		± 5.5		± 5.6
Range		132.5 - 271.5		14.8 - 27.1		7.4 - 32.8
T2 Mean	34	185.9	28	20.5	27	21.8
Standard Deviation		± 31.0		± 7.6		± 6.3
Range		131 - 266		10 - 27.9		7.9 - 32.8
Control						
T1 Mean	33	185.5	28	22.7	26	21.8
Standard Deviation		± 24.3		± 6.3		± 4.4
Range		144 - 244.5		14.8 - 27.5		14.6 - 32.8
T2 Mean	33	183.6	28	21.8	26	22
Standard Deviation		± 23.3		± 6.3		± 3.8
Range		144.25 - 241.5		15.8 - 27.8		15.3 - 29.4
F Ratio		2.99		4.05		3.07
Critical F (.05 level)		4.00		4.00		4.00

TABLE IV

ANALYSIS OF COVARIANCE OF BLOOD LIPIDS

Experimental	n	TC(mg/dl)	n	TG(mg/dl)	n	HDL-C(mg/dl)	n	HDL/TC X100 (%)
T1 Mean	34	204.9	34	111.5	33	46.2	33	23
Standard Deviation		± 30.5		± 60.7		± 10.6		± 6.2
Range		146 - 264		45 - 386		24 - 75		10 - 38
T2 Mean	34	190.1	34	105.6	33	43.2	33	23.1
Standard Deviation		± 30.7		± 53.5		± 8.5		± 5.7
Range		135 - 285		37 - 267		27 - 66		13 - 36
Control								
T1 Mean	33	204.5	33	129.3	33	45.7	33	23.5
Standard Deviation		± 38.5		± 76.5		±11.5		± 8.6
Range		133 - 342		45 - 340		26 - 79		10 - 49
T2 Mean	33	196.5	33	130.6	33	42.5	33	22.4
Standard Deviation		± 33.0		± 85.7		± 8.9		± 5.7
Range		120-284		53 - 365		27 - 69		10 - 41
F Ratio		2.25		.944		.142		2.06
Critical F (.05 level)		4.00		4.00		4.00		4.00

$\dot{V}O_2$ maximum. The results of the CR fitness data are found in Table V. On all three parameters, the experimental group was sigificantly higher in fitness following the 12-week treatment period ($p < .01$) than the control group. The experimental group demonstrated a 19.2 percent increase in $\dot{V}O_2$ measured at a heart rate of 150, a 19.1 percent increase in $\dot{V}O_2$ measured at 80 percent of maximum heart rate range, and a 20.3 percent increase in estimated $\dot{V}O_2$ maximum. Comparatively, the control group demonstrated an increase in fitness of 4.5 percent, 7.1 percent and 7.6 percent, respectively.

Dependent t-Tests Within Groups

Dependent t-tests were run to assess the effects of 12-week treatment period within the groups (T1-T2). The statistical results for the expermiental group are found in Table VI. The experimental group demonstrated a significant reduction in weight and percent body fat by skinfolds ($p < .001$). The experimental group also showed a significant reduction in total cholesterol and HDL-C, $p < .001$ and $p < .01$, respectively. Cardiorespiratory fitness assessed at a heart rate of 150, 80 percent of heart rate range, and estimated maximum were significantly higher on all parameters ($p < .001$).

The statistical results of the dependent t-tests run for the control group are found in Table VII. The control group also demonstrated a significant reduction in percent body fat assessed by skinfolds ($p <.01$). The control group also demonstrated significant reductions in total cholesterol and HDL-C, $p <.05$ and $p <.01$, respectively. The control group demonstrated increased CR fitness at estimated maximum ($p < .001$) and at a heart rate of 150 ($p < .05$). No significant increase in

TABLE V

ANALYSIS OF COVARIANCE TABLE OF CARDIORESPIRATORY FITNESS

Experimental	n	$\dot{V}O_2$HR 150 ($ml_2/kg \cdot min^{-1}$)	$\dot{V}O_2$HR 150 (LO_2/min)	$\dot{V}O_2$ HR 80% HR ($mlo_2/kg \cdot min^{-1}$)	$\dot{V}O_2$ HR HR (Lo_2/min)	Est. $\dot{V}O_2$ Max ($mlo_2/kg \cdot min^{-1}$)	Est. $\dot{V}O_2$ Max (Lo_2/min)
T1 Mean	33	24.5	2.10	26.7	2.28	32	2.73
Standard Deviation		± 3.7	± .36	± 4.0	± .38	± 4.7	± .43
Range		18.5 - 34	1.43 - 2.65	20.3 - 34.7	1.48 - 2.89	23.3 - 43.2	1.96 - 3.43
T2 Mean		29.2	2.44	31.8	2.66	38.5	3.22
Standard Deviation		± 4.1	± .41	± 4.7	± .46	± 6.0	± .59
Range		22.7 - 38.9	1.6 - 3.22	23 - 42.1	1.79 - 3.68	28.2 - 50.9	2.01 - 4.46
Control							
T1 Mean	33	24.4	2.05	26.6	2.24	31.5	2.65
Standard Deviation		± 3.3	± .42	± 3.1	± .39	± 4.3	± .50
Range		18.6 - 30.9	1.4 - 3.25	21 - 32.2	1.63 - 3.35	24.5 - 40.9	1.85 - 3.91
T2 Mean		25.5	2.14	28.5	2.37	33.9	2.83
Standard Deviation		± 3.8	± .46	± 3.9	± .45	±4.9	± .55
Range		17.4 - 35.8	1.41 - 3.45	22.4 - 37.7	1.65 - 3.5	26.8 - 46.9	1.9 - 4.15
F Ratio		22.3	18.7	11.2	16.9	20.2	18.4
Critical F (.05 level)		7.08	7.08	7.08	7.08	7.08	7.08

TABLE VI

DEPENDENT t-TEST FOR EXPERIMENTAL GROUP (T1-T2)

	t-Ratio	Significance Level
Body Composition		
Weight	5.40	.001
% Body Fat (Skinfolds)	5.34	.001
% Body Fat (Hydrostatic weight)	1.84	N.S.
Blood Lipids		
Total Cholesterol	3.93	.001
Triglycerides	0.69	N.S.
HDL-C	3.51	.01
HDL-C/TC x 100	0.24	N.S.
Cardiorespiratory Fitness		
$\dot{V}O_2$ HR 150 ($mlo_2/kg \cdot min^{-1}$)	7.86	.001
$\dot{V}O_2$ HR 150 ($LO_2/min.$)	7.52	.001
$\dot{V}O_2$ 80% HR ($mlo_2/kg \cdot min^{-1}$)	8.61	.001
$\dot{V}O_2$ 87% HR ($LO_2/min.$)	7.71	.001
$\dot{V}O_2$ Est. Max ($mlo_2/kg \cdot min^{-1}$)	8.74	.001
$\dot{V}O_2$ Est. Max ($LO_2/min.$)	8.11	.001

N.S. - No significance

TABLE VII

DEPENDENT t-TEST FOR CONTROL GROUP (T1-T2)

	t-Ratio	Significance Level
Body Composition		
Weight	1.89	N.S.
% Body Fat (Skinfolds)	3.51	.01
% Body Fat (Hydrostatic weight)	0.52	N.S.
Blood Lipids		
Total Cholesterol	2.54	.05
Triglycerides	0.13	N.S.
HDL-C	2.85	.01
HDL-C/TC x 100	1.58	N.S.
Cardiorespiratory Fitness		
$\dot{V}O_2$ HR 150 ($mlO_2/kg \cdot min^{-1}$)	2.32	.05
$\dot{V}O_2$ HR 150 (LO_2/min.)	2.19	.05
$\dot{V}O_2$ 80% HR ($mlO_2/kg \cdot min^{-1}$)	1.99	N.S.
$\dot{V}O_2$ 87% HR (LO_2/min.)	4.06	.001
$\dot{V}O_2$ Est. Max ($mlO_2/kg \cdot min^{-1}$)	4.57	.001
$\dot{V}O_2$ Est. Max (LO_2/min.)	4.85	.001

N.S. - No significance

CR fitness was found at 80 percent of heart rate range.

Physical Activity Data

Physical Activity Data For the Experimental Group

The physical activity data for the experimental groups is found in Table VIII. Data was collected in four major areas: (1) frequency of activity; (2) intensity of activity (percent of heart rate range); (3) duration of activity (minutes); and (4) distance run or walked (miles). The mean frequency of run-walk activities was 27.2 workouts, which averages to 2.3 workouts per week. The average intensity per workout was 73.3 percent of heart rate range. The average duration of a run-walk workout was 31.8 minutes. The total distance run or walked ranged from 7.66 - 150.63 miles, the mean was 85.2 miles. The group averaged 7.1 miles per week, and averaged 3 miles per run-walk workout.

Relationships of Cardiorespiratory Fitness and HDL-C to Physical Activity

The Pearson Product-Moment correlation was run to characterize the relationships of CR fitness and HDL-C to physical activity. The results of these tests are found in Table IX. The change (T2-T1) in estimated maximum $\dot{V}O_2$, HDL-C, and HDL-C percent also demonstrated a significant positive correlation with miles per week run-walked, $p < .05$, $p < .05$, and $p < .01$, respectively.

TABLE VIII

PHYSICAL ACTIVITY DATA FOR EXPERIMENTAL GROUP DURING THE 12-WEEK TREATMENT PERIOD (n = 34)

	Mean	Standard Deviation	Range
Frequency			
All Activities	28.3	± 8.0	4 - 47
Run-walk	27.2	± 7.7	4 - 43
Run-walk/week	2.3	± .64	.33 - 3.58
Intensity			
All Activities (% HR Range)	72.4	± 7.3	38.9 - 82.1
Run-walk (% HR Range)	73.3	± 5.5	56.2 - 82.1
Duration			
All Activities (minutes)	909.2	±313.8	94.5 - 1591.53
Run-walk (minutes)	873.5	±312.6	94.5 - 1506.53
Per Workout Run-walk (minute)	31.8	± 5.7	15.85 - 45.05
Distance			
Total Miles Run-walk	85.2	± 34.8	7.66 - 150.63
Miles Run-walk/week	7.1	± 2.9	.64 - 12.55
Miles Run-walk/workout	3.0	± .68	1.85 - 4.86

TABLE IX

RELATIONSHIPS OF CARDIORESPIRATORY FITNESS AND HDL-C TO PHYSICAL ACTIVITY: PEARSON PRODUCT-MOMENT CORRELATION

12-Week Change For:	Control (n = 33)	Exercise (n = 33)	Correlation vs. miles/week	Significance Level
Est. Max $\dot{V}O_2$ ($mlo_2/kg \cdot min^{-1}$)	2.42	6.46	.39	.05
HDL-C (mg/dl)	-3.25	-2.97	.41	.05
HDL-C/TC X 100 (%)	-1	.2	.45	.01

Statistical Analysis of Smoking and Alcohol Consumption

To determine whether HDL-C levels were effected by smoking and alcohol consumption, independent t-tests were run. The results of of statistical analysis of smoking and alcohol consumption are found in Tables X and XI. Non-smokers versus smokers did not demonstrate significantly different HDL-C levels. Independent t-test between non-drinkers and drinkers were run, but no significant difference was found between the groups.

TABLE X

INDEPENDENT t-TEST: EFFECT OF SMOKING ON HDL-C LEVELS (T1)

Smoking Data	Mean (mg/dl)	Standard Deviation (mg/dl)	t-Ratio	Significance Level
Non-Smokers (n = 58)	45.6	± 11.0	-.58	N.S.
Smokers (n = 9)	47.9	± 11.4		

N.S. - Significance

Discussion

The main variable of interest in terms of this investigation was HDL-C. When this data was analyzed using the analysis of covariance, no significant difference in HDL-C was found from pretreatment to post-treatment between the groups. However, when the changes (T2-T1) in HDL-C and HDL percent were correlated to the miles run-walked per week in the experimental group, a significant positive correlation was found. This suggests that a mechanism is at work in the lipid metabolism to improve the HDL-C profile through physical activity. The exact nature of this mechanism is unclear, but an apparent undetermined threshold of physical activity improves the HDL-C profile.

TABLE XI

INDEPENDENT t-TEST: EFFECT OF ALCOHOL CONSUMPTION ON HDL-C LEVELS (T1)

Smoking Data	Mean (mg/dl)	Standard Deviation (mg/dl)	t-Ratio	Significance Level
Non-Drinkers (n = 24)	44.3	± 9.7	-.90	N.S.
		± 11.6		
Drinkers (n = 43)	46.8			

N.S. - No Significance

Because of the multiplicity of variables interacting during the treatment period, several factors may have confounded the effect of physical activity on the absolute value of HDL-C. The reductions noted in total cholesterol in the experimental and control groups undoubtedly had an effect on HDL-C, since HDL-C is a subfraction of total cholesterol. Also, the reductions in weight and percent body fat may indirectly reflect changes in dietary patterns in both groups. Exercise, however, undoubtedly played a major role in weight and percent fat reduction in the experimental groups. The duration of the treatment period may not have been sufficiently long enough to demonstrate pronounced differences in HDL-C in primarily sedentary individuals.

Both the experimental group and the control group demonstrated significant improvements in CR fitness. The control group may have improved as a result of the learning process. The improvements noted in the experimental groups were a result of the exercise training and to a lesser degree the learning process.

Other studies have demonstrated significantly lower HDL-C levels in cigarette smokers and significantly higher HDL-C levels in those who consume alcohol. These results did not surface in this investigation. No significant difference in HDL-C was found in non-smokers versus smokers and non-drinkers versus drinkers.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purpose of this study was to determine the effect of 12 weeks of exercise training on plasma high density lipoprotein cholesterol in men aged 30-50. On the basis of the analysis covariance, no significant difference in HDL-C levels was demonstrated as a result of 12 weeks of exercise training. Therefore, the null hypothesis was accepted. Dependent t-tests run on T1 and T2 data for both groups demonstrated a significant reduction in HDL-C. However, significant positive correlations were found between changes (T2-T1) in HDL-C and HDL-C percent, and miles run-walked per week for the experimental group. Although no significant increase in the absolute value of HDL-C was demonstrated, exercise had a positive effect on HDL-C profiles.

Recommendation for Further Study

1. A longitudinal treatment protocol should be implemented to study the effect of regular exercise on HDL-C.
2. Attention should be given to specific thresholds of physical activity, in this case miles per week, in relation to improved HDL-C profiles.
3. Several experimental and control groups should be used in studying the exercise-HDL-C relationship to better characterize

treatment effects.

4. Better controls and assessment of diet, alcohol consumption, and cigarette smoking are needed to characterize more accurately exercise effects on lipid metabolism.

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APPENDIXES

APPENDIX A

FORMS USED IN PUBLICITY AND DATA COLLECTION

FOR MEN ONLY

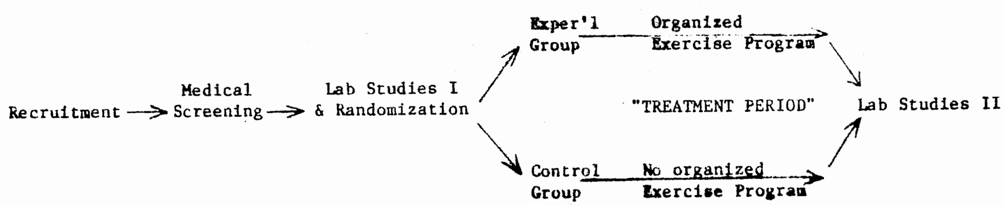
Here's your chance to have a physical evaluation and a 12-week exercise program at the ORU Human Performance Labaoratory and Aerobics Center. Participation is free and at no obligation.

We are looking for eligible men (30-50-year-olds) who would like to receive important health and fitness information about themselves and enter an organized fitness program (either immediately or in the near future), while assisting in important scientific research.

This is a special research project to be conducted by the ORU Human Performance Laboratory to study the effects of regular exercise on blood cholesterol.

To be eligible you must be:

Male (30-50)
Not engaged in a regular exercise program
Free of known cardiovascular disease or any other condition which places one at increased risk with exercise (the initial screening tests will evaluate this)
Willing to be randomly assigned to either an organized exercise group or a control group for approximately 12 weeks.



The Schedule: Medical Screening Tests: late January-early February
Lab Studies I: mid-February
"Treatment Period": late February to Late May
Lab Studies II: completed early June

During the treatment period, those assigned to the experimental group will have special classes, 3 days a week, in the ORU Aerobics Center. Indiviually prescribed exercise programs will emphasize aerobic or cardiorespiratory conditioning, with walking and jogging the principal activities. Those assigned to the control groups wil be given the opportunity to take part in an organized exercise program free of charge, at the close of the testing period. Exercise class will tentatively be held on Tuesdays and Thursdays at 6 a.m. and on Saturdays at 9 a.m., subject to group preference.

The following studies will be made and the results of your tests will be made available to you:

Medical Screening:	Brief medical history, resting electrocardiogram (ECG), resting blood pressure (BP), pulmonary function, exercise tolerance (treadmill test with ECG and BP monitored)
Lab Studies I:	Blood lipids (cholesterol, HDL-Cholesterol, trygycerides, and perhaps others); body composition (percent fdat by both underwater weighing and skinfold estimates); cardiorespiratory fitness (oxygen consumption during treadmill exercise), coronary risk profile
Lab Studies II:	Repeat of all tests in Lab Studies I

If you will participate or would like more information,contact Jim Freyman or Dr. James Schwane, Human Performance Laboratory, Oral Roberts University, 492-6161, ext. 2415 or 2416.

TULSA WORLD, SUNDAY, MARCH 1, 1981

FOR MEN ONLY--Over the next several months, the Oral Roberts University Human Performance Laboratory will be conducting a research project to study the effects of exercise training on blood cholesterol. Subjects who meet this criteria are needed: men, 30-50 years of age, not presently engaged in a regular exercise program, free of known cardiovascular disease, and willing to be randomly assigned to an exercise or control group for the period of study. This project provides an opportunity for men who meet our criteria to have thorough fitness evaluations and an organized exercise program for 12 weeks. Participation is free and at no obligation. For further information contact Jim Freyman or Jim Schwane, 492-6161 ext. 2415 or 2416.

ORU HUMAN PERFORMANCE LABORATORY
PERSONAL MEDICAL HISTORY

NAME ______________________ AGE ____ SEX: M F DATE ________

ADDRESS ____
(street) (city) (state) (zip)

PHONE (HOME) ____________ (WORK) ________________

PHYSICIAN'S NAME ________________________________

ADDRESS ____
(street) (city) (state) (zip)

PHONE _______________

DATE OF LAST MEDICAL EXAMINATION ___________________________

PLEASE ANSWER THE FOLLOWING AS ACCURATELY AS POSSIBLE.

1. Have you ever had a heart attack? YES ____ NO _____

   If "yes," explain (e.g. when, etc.) ______________________

2. Have you ever had heart surgery? YES ____ NO _____

   If "yes," explain (e.g. when, type, etc.) __________________

   ____

3. Do you ever experience chest pain? YES ____ NO ____

   If "yes," check the items which apply:

   a) Intensity-- slight ____ moderate ____ severe ____

   b) Frequency-- frequent (at least once a day) ____
      moderately frequent ____
      infrequent (only a few times each month) ____

   c) Duration-- pains lasts less than 5 minutes ____
      pain lasts 5 minutes or longer ____

   d) Relation to activity-- pain occurs at rest ____
      pain occurs only with exertion ____
      pain is unrelated to activity ____

   e) Do you take medication to relieve chest pain? YES ____ NO ____

      If "yes," list medication(s) ___________________________

4. Are you aware of any other heart related problems?

a) murmer ____ b) palpitations ____ c) ECH abnormalities ____

d) other (explain)____________________

5. Please check any of the following which may apply to you.

a) high blood pressure ____
b) low blood pressure ____
c) diabetes ____
d) high blood cholesterol ____
e) high blood trigycerides ____
f) obesity ____
g) smoking ____
h) sedentary lifestyle ____

6. Do you ever experience dizziness? YES ____ NO ____

If "yes," explain ____________________

7. Do you ever experience shortness of breath? YES ____ NO ____

If "yes," explain ____________________

8. Do you ever experience calf pain when walking short distances?

YES ____ NO ____

9. Do you experience any other physical disorders which may effect the type or amount of exercise in which you should participate (e.g. back problems, knee or ankle injuries, etc)? If so, explain ____________

____

SIGNATURE ____________________ DATE ____________

EXERCISE PRESCRIPTION

NAME ________________________________ Tu. Th. S. AM / M. W. F. PM

WEEK 1 Intensity 60% Duration 10-20 minutes

60% Heart Rate ____ ____

WEEK 2 Intensity 60% Duration 20-25 minutes

60% Heart Rate ____ ____

WEEK 3 Intensity 65%n Duration 25-35 minutes

65% Heart Rate ____ ____

WEEK 4 Intensity 70% Duration 25-35 minutes

70% Heart Rate ____ ____

WEEK 5 Intensity 75% Duration 30-40 minutes

75% Heart Rate ____ ____

EXERCISE -- HDL_c STUDY

Name ____________________ Social Security No. ____________

Age ______ Birth Date ______________________ Sex: Male/Female

---

In the past 6 months, have you exercised more than two times per week on a regular basis? Yes/No If yes/what activities? ____________
Have you ever participated in a regular exercise program (YMCA, Fitness Center, Hospital, etc)? Yes/No If yes/ what program? ____________ When did you participate? ____________ How long did you participate? ____________
Were you an athlete in High School? Yes/No What sport(s)? ____________
____________ How long did you participate? ____________
Were you an athlete in College? Yes/No What sport(s)? ____________
____________ How long did you participate? ____________

Physical Activity Comments: ____________

Have you ever had a heart attack? Yes/No Chest Pain? Yes/No Are you aware of any other heart related problems (murmur, palpitations, etc.)? ____________
Do you have high blood pressure? Yes/No
Are you taking any medications? Yes/No If yes/please list medication(s):

Medical Assessment		Exercise Prescription	
Resting 12-Lead ECG	____	Max Heart Rate (HR)	____
Resting blood pressure	____	90% of Max. HR	____
Treadmill GXT	____	80% of Max. HR	____
Results:	____	70% of Max. HR	____

Group: Experimental ____________ Control ____________
Phone Number: HM ____________ WK ____________
Calling Time: ____________ AM/PM ____________ Day

	Lab Test 1	Lab Test 2
Body Composition	____	____
Pulmonary Function	____	____
Resting blood pressure	____	____
12-hr fasting blood sample	____	____
Treadmill GXT	____	____

Comments: ____________

Physical Activity Check: ____ Wk 1 ____ Wk 2 ____ Wk 3 ____ Wk 4
____ Wk 5 ____ Wk 6 ____ Wk 7 ____ Wk 8 ____ Wk 9 ____ Wk 10
____ Wk 11 ____ Wk 12 ____ Wk 13 ____ Wk 14

Comments: ____________

SMOKING HISTORY

Social Security No. __________________ Name ____________________________

Test Date ______________ Age _____ Birth Date _____________________

INSTRUCTIONS: Please answer all questions as accurately and completely as possible.

1. Have you ever smoked cigarettes, cigars, or pipes? _____ Yes _____ No
   If you answer to #1 is No, the questionnaire is complete/If yes, Proceed.

---

2. At what age did you begin to smoke? _____

3. How many years have you smoked on a regular basis? _____

4. Do you smoke now? _____ Yes _____ No
   If no, how long ago did you quit smoking? ____ 0-3 months ____ 3-12 months
   _____ 1-2 years _____ 2-5 years _____ More than 5 years
   If your answer to question #4 is No, skip to question #9/If yes, Proceed.

---

5. Do you currently smoke cigarettes? _____ Yes _____ No
   If so, how many cigarettes per day (on the average) do you currently smoke?
   _____ 1-10 _____ 11-20 _____ 21-30 _____ 31-40 _____ 41-60 _____ 60+

6. Do you currently smoke cigars? _____ Yes _____ No
   If so, how many cigars per day (on the average) do you currently smoke?
   _____ 1 _____ 2-3 _____ 4-6 _____ 7-10 _____ more than 10

7. Do you currently smoke a pipe? _____ Yes _____ No
   If so, how many pipefuls per day (on the average) do you currently smoke?
   _____ 1 _____ 2-3 _____ 4-6 _____ 7-10 _____ more than 10

8. Have you ever quit smoking? _____ Yes _____ No
   If yes, how long ago did you quit smoking? ____ 0-3 months ____ 3-12 months
   _____ 1-2 years _____ 2-5 years _____ More than 5 years
   If yes, how long did you quit smoking? _____ 0-3 months _____ 3-12 months
   _____ 1-2 years _____ 2-5 years _____ More than 5 years

---

9. Describe your smoking history: For how many years of your life have you smoked? _____ On the average over the years that you have smoked, how many cigarettes (cigars or pipes) have you smoked per day?

   ______ cigarettes per day
   ______ cigars per day
   ______ pipes per day

10. What is the maximum number of cigarettes per day you have ever smoked? _____
    For how long a period did you smoke at this rate? _____ When, in relation to the present, did you smoke at this rate? _____

DIET QUESTIONNAIRE

Please indicate as accurately as possible the frequency with which you eat the following foods.

FOOD	3+ day	2-3 day	1 day	3-6 week	1-2 week	1-3 month	Less than 1/month	Never	Comments
MILK (whole) 1 cup									
2%-Fat 1 cup									
Non-Fat 1 cup									
CHEESE									
Low-Fat									
ICE CREAM 1 scoop									
Ice Milk 1 scoop									
Milkshake/Malt									
Sherbet/Yogurt									
BUTTER									
MARGARINE									
EGGS									
MEATS:									
Hamburger									
Hotdogs									
Bacon/Sausage									
Pork									
Chicken									
Turkey									
Fish									
Shellfish									
Liver									
Veal									
Lamb									
Luncheon Meats									
SOFT DRINKS:									
Regular 12 oz. can									
Artificial sweetner 12 oz. can									
Other									
COFFEE:									
With sugar 1 tsp.									
With cream									
TEA:									
With sugar 1 tsp.									
With cream									
ALCOHOL:									
Beer 12 oz. can									
Wine 1 glass									
Liquor 1 shot									
SWEETS AND MISCELLANEOUS:									
Cakes/Pies									
Pudding/Gelatin									
Cookies									
Jam/Jelly									
Syrup/Honey									
Candy									
Pancakes/Waffles									
Peanut Butter									

ORU HUMAN PERFORMANCE LABORATORY

COMPOSITE DATA

Study____________

NAME______________________________ SS#____________________ Sex: M F

BIRTHDATE__/__/__ · RACE__________ U.S. CITIZEN? Y N

STATUS__________ "ADMISSION" STATUS__________ INF. CONSENT? Y N

QUESTIONNAIRE

Personal History of CV Disease? (/ /) Y N ____________________

Family History of CV Disease? (/ /) Y N

Smoking History (/ /): CURRENT / FORMER / NEVER

Physical Activity (/ /):______________________________

____

RESTING CARDIOVASCULAR

	DATE	TIME	VALIDITY	DATA
Resting HR	______	______	Y N	__________
Resting BP	______	______	Y N	___/___/___
Resting ECG	______	______	Y N	__________________

____

ANTHROPOMETRY (/ /) Valid? Y N

Ht:________cm/in Wt:________kg/lb

SF: triceps__________mm

subscapular__________mm

suprailiac__________mm

biceps__________mm

B.D. (est. / meas.) =__________

% Fat (est. / meas.) =__________

PULMONARY FUNCTION (/ /)

Spirometer: P-B / O-M Valid? Y N

Position: Stand / Sit

FVC(BTPS)________L

FEV-1(BTPS)________L

RV(BTPS)________L -(meas. / est.)

BLOOD (/ / - Time:) Valid? Y N Meds?__________________

Total Chol________ HDL_c________ LDL_c________-(meas. / est.) TG________

Glucose________ Hematocrit________

EXERCISE TEST (/ / - Time:) Valid? Y N

Wt:_______ kg/lb Protocol:_________ Ergom. #_____ Prev. TM Exp? Y N

Test Duration__________ Motivation: BELOW / AVG / ABOVE

			$\dot{V}_E$(BTPS)	TV(BTPS)	$\dot{V}O_2$(STPD)		
PROTOCOL/MIN	HR	BP	L/MIN	ML	L/MIN	ML/KG/MIN	R
		/ /					
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ACTIVITY LOG

NAME ______________________ WEIGHT ______

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting / Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

DATE: ___/___/___

Activities:		Intensity (HR)	Duration	Distance (Laps/Miles)
Running	___	___	___	___
Run/Walk	___	___	___	___
Walking	___	___	___	___
Cycling	___	___	___	___
Weight Lifting	___	___	___	___
Other	___	___	___	___

ORU HUMAN PERFORMANCE LABORATORY

INFORMED CONSENT for PARTICIPATION as a SUBJECT in the RESEARCH PROJECT

"EFFECTS OF 12 WEEKS of EXERCISE TRAINING on PLASMA HIGH DENSITY LIPOPROTEIN CHOLESTEROL and APOPROTEINS A-I AND A-II in MEN AGED 30 - 50"

NAME OF SUBJECT ______________________________ TELEPHONE NO. __________

ADDRESS ______________________________________ BIRTHDATE:

______________________________________ ______________________
MO. DAY YEAR

PROJECT DESCRIPTION

A. Purpose of the Project. The amount of cholesterol in and the protein composition of high density lipoproteins (HDL) in the blood are apparently related to risk of coronary artery disease (CAD), i.e., it is desirable to have high levels of HDL-Cholesterol (HDL-C). There is evidence that regular exercise increases HDL-C levels and thus lowers risk of CAD, but a cause-and-effect relationship has not been established. Therefore, the purpose of this study is to describe the effects of 12 weeks of aerobic exercise training on plasma HDL-C and certain HDL proteins (e.g., apoproteins A-I and A-II) in a group of men aged 30-50 years.

B. Research Methodolgy: All subjects will initially undergo medical screening tests: resting blood pressure and ECG, personal medical history, physician chest exam, and graded exercise test (GXT) with ECG and blood pressure monitoring. Results of these tests will be used to give the final medical clearance of subjects for vigorous exercise and participation in the project. Subjects will then undergo "lab studies I" (T1) to provide baseline data on cardio-respiratory (CR) fitness, percent body fat (% fat), and blood lipids and lipoproteins. Following T1, subjects will be randomly assigned to either an exercise or a control group. The exercise group will have organized aerobic conditioning classes for 12 weeks; the control group will have no such classes. After 5-6 weeks of "treatment," the blood studies and skinfold % fat measures will be repeated on all subjects. At the completion of the 12 weeks, all subjects will undergo "lab studies II" (T2), identical studies to those of T1, to documents any changes over the 12 weeks.

Each subject will perform 3 exercise tests on a motor-driven treadmill, one at medical screening, one at T1, and one at T2. All 3 tests will involve gradual increases in exercise intensity at set time intervals. Intensities will be very low initially and will be increased by increasing treadmill speed and/or incline. The subject will e xercise to his volitional maximum on the medical screening test, and to about 90% of that level on the T1 and T2 tests. During the T1 and T2 exercise tests, the subject will breathe through a mouthpiece-valve assembly with a nose clamp in place for collection of expired air and determination of oxygen consumption.

For the blood studies, about 15 cc of blood will be sampled from a forearm vein. These studies require that the subject be in the fasted state, i.e., no food or drink other than water for the previous 12 hours.

Percent fat will be estimated both from measurements of skinfold thickness and by underwater weighing. The subject will be weighed in a specially designed tank while completely submerged in water. Either before or after underwater weighing, residual volume of the lungs will be measured, since corrections for buoyancy of air in the lungs at the time of weighing must be made. The subject's underwater weight will be taken at the point of maximal expiration (i.e, residual volume). The subject must hold this submerged maximal expiration state for only a few seconds, while scale weight is recorded.

At both T1 and T2, data on past and current smoking status, alcohol consumption, dietary patterns, and regular physical activity will be obtained from each subject by questionnaire and interview.

Subjects in the exercise group will be given a personal exercise prescription based upon their GXT results and following guidelines of American College of Sports Medicine. Exercise sessions will be held on Tuesday, Thursday, and Saturdays for 12 consecutive weeks. Each session will last about one hour, with time in each session allotted for warm-up, flexibility and strength exercises, aerobic conditioning (walking and jogging), and cool-down. Each subject will be given explicit instructions regarding the amount and kind of exercise he should do. A log of each subject's training activity will be updated each exercise session.

Subjects in the control group will have no organized exercise sessions and are expected to not alter their pre-study patterns of regular exercise. Each will be contacted weekly to update records of exercise engaged in.

C. Potential Risks to Subjects. The possibility exists of certain changes occurring during the exercise tests or exercise sessions. These include abnormal blood pressure, fainting, disorders of heart beat, and in very rare instances, heart attack. With blood sampling by venipuncture, there is the possibility of bruising the arm, and rarely, of infection or clot formation.

D. Benefits of the Research. This project will help to establish whether or not regular aerobic exercise lowers CAD risk by raising HDL-C. If HDL-C is raised with training in this study, as hypothesized, this study will also elucidate specific conditions in which this effect occurs. Thus, clinicians will be armed with additional evidence of specific benefits of exercise and with concrete guidelines for prescribing such exercise.

WRITTEN CONSENT

I, ________________________________, have read in its entirety and
(Print in your full name)
understand the "PROJECT DESCRIPTION" for the project "Effects of 12 Weeks of Exercise Training on Plasma High Density Lipoprotein Cholesterol and Apoproteins A-I and A-II in Men Aged 30-50. I have been informed, either by reading the "PROJECT DESCRIPTION" or from persons associated with the study above-described, of all physical and psychological risks, as well as medical side effects which may occur during the course of the study, and I agree to accept all disclosed risks or potential side effects. I realize that risks will be minimized in the following ways:

1. Before undergoing any exercise tests, my medical history will be reviewed to determine if any condition is present which would indicate I should not submit to these tests.

2. During the performance of the exercise test, a physician or trained observer will keep me under close surveillance by monitoring my pulse and electrocardiogram.

3. I may stop any exercise test at my discretion.

4. My assigned exercise program will be personalized (i.e., based on my exercise tolerance as indicated by the exercise tests), and I will be observed by trained personnel during exercise sessions. Pulse rate will be frequently checked to assure appropriate exercise intensities.

5. Emergency equipment and trained personnel will be available during exercise testing and training sessions to deal with unusual situations which may arise.

6. Blood sampling will be performed by trained phlebotomists under medical supervision, using aseptic techniques.

I have been told that Oral Roberts University, like virtually all other universities in the United States, does not have a mechanism for compensation of the injured research subject; therefore, I understand that I canno look to any such mechanisms to receive financial remuneration for any such injuries resulting from my participating in this research project.

I understand that the data collected here will be used for scientific research and will receive only impersonal statistical treatment with my right of privacy protected. None of my data will be revealed in individualized form to another person without my prior written consent. Further, I recognize that I can discontinue participation in this research study at any time without penalty of any kind.

I have been given adequate opportunity to ask questions, and any questions which have occurred to me concerning this project or this informed consent have been answered to my satisfaction.

In recognintion and understanding of the above-described project, I hereby freely consent to participate as a research subject.

Witness	Signature of Research Subject
DATE ______ MO DAY YEAR	______ MO DAY YEAR

APPENDIX B

TREADMILL PROTOCOLS

BRUCE TREADMILL PROTOCOL

Time	Speed	Incline
0 - 3 minutes	1.7 miles per hour	10%
3 - 6 minutes	2.5 miles per hour	12%
6 - 9 minutes	3.4 miles per hour	14%
9 - 12 minutes	4.2 miles per hour	16%
12 - 15 minutes	5.0 miles per hour	18%
15 - 18 minutes	5.5 miles per hour	20%

BALKE TREADMILL PROTOCOL

Time	Speed	Incline
0 - 2 minute	3.3 miles per hour	0%
2 - 3 minute	3.3 miles per hour	2%
3 - 4 minute	3.3 miles per hour	3%
4 - 5 minute	3.3 miles per hour	4%
5 - 6 minute	3.3 miles per hour	5%
6 - 7 minute	3.3 miles per hour	6%
7 - 8 minute	3.3 miles per hour	7%
8 - 9 minute	3.3 miles per hour	8%
9 - 10 minute	3.3 miles per hour	9%
10 - 11 minute	3.3 miles per hour	10%
11 - 12 minute	3.3 miles per hour	11%
12 - 13 minute	3.3 miles per hour	12%
13 - 14 minute	3.3 miles per hour	13%
14 - 15 minute	3.3 miles per hour	14%
15 - 16 minute	3.3 miles per hour	15%
16 - 17 minute	3.3 miles per hour	16%
17 - 18 minute	3.3 miles per hour	17%
18 - 19 minute	3.3 miles per hour	18%
19 - 20 minute	3.3 miles per hour	19%
20 - 21 minute	3.3 miles per hour	20%
21 - 22 minute	3.3 miles per hour	21%
22 - 23 minute	3.3 miles per hour	22%
23 - 24 minute	3.3 miles per hour	23%
24 - 25 minute	3.3 miles per hour	24%

APPENDIX C

PRETREATMENT (T1) AND POSTTREATMENT (T2)
DATA FOR THE EXPERIMENTAL GROUP AND THE
CONTROL GROUP SUBJECTS

AGE (YEARS) AND HEIGHT (INCHES) FOR THE
EXPERIMENTAL GROUP AND CONTROL GROUP

	Experimental		Control	
Subject	Age	Height	Age	Height
1	41	70	39	70.5
2	41	69	41	65
3	37	72	41*	70*
4	36	69	44	63
5	34	72	37	71
6	33	70	44	71
7	40	72	45	75
8	44	72.5	38	70
9	37*	76*	37	69
10	32	70	43	69
11	43	69	30*	70*
12	44	72	34	70
13	36	71	39	64.75
14	35	69	39	70
15	32	70	43	73
16	30	71	49	68
17	40	71	30	70.5
18	40	67.5	39	77
19	45	72	42	66
20	46	74	35	69
21	36	72	34	72
22	50	74	42	69.5
23	36	69	35	72
24	50	70	44	77
25	37	71	46	72
26	50	67.5	42	70.5
27	47	71.75	45	69
28	33	67.5	40	72
29	40	72	42	69
30	45	70	33	71.5
31	43	68	43*	72*
32	49	71	48	70
33	49	67.5	45	66
34	43	69.5	45	74
35	43	68.5	39	71
36	31*	73*	47	69.5

* Withdrew From Study

BODY COMPOSITION DATA FOR THE EXPERIMENTAL GROUP AND THE CONTROL GROUP: WEIGHT (POUNDS)

	Experimental		Control	
Subject	T1	T2	T1	T2
1	188	177	185	184
2	179.75	173	173.25	171.25
3	202	199.75	187	--
4	171.5	165.5	161	161.25
5	213	200	168.75	168.5
6	190.25	184.75	211.5	213.5
7	225.5	212.5	170.75	168.5
8	228	227.25	165	163.25
9	253.25	--	184.25	181.25
10	169.25	160.25	207.55	203.75
11	132.5	131	192.25	--
12	177.5	172	178	183.75
13	154	154/75	169	170
14	156	154	244.25	241.5
15	179.5	180	239	221
16	157.5	155	148	144.25
17	154.25	153	156.75	161.75
18	271.5	266	204.75	206
19	208.5	199.5	144	144.5
20	193.5	189.25	168.75	162
21	198	198	192	192
22	179.5	175	208	208.5
23	166	1163.5	193.75	196
24	207.5	210.75	199.75	195
25	247.75	247.25	192.25	189.5
26	173	169.75	173	178
27	220	219.5	176.5	168.5
28	168	165.5	175.25	177.5
29	251	252	183.5	184.75
30	200.25	195.5	180.5	182.25
31	186.5	180	191	--
32	213.5	203.5	192	169.5
33	165	149.5	157	156
34	169.5	171	231.75	233.25
35	165.5	164	179.75	178
36	201	--	207.5	200.5

BODY COMPOSITION DATA FOR THE EXPERIMENTAL GROUP: PERCENT BODY FAT BY SKINFOLDS AND HYDROSTATIC WEIGHING

	Skinfolds		Hydrostatic Weighing	
Subject	T1	T2	T1	T2
1	23	20.5	21.7	20.7
2	23.2	21.2	—	—
3	23.2	21	20.4	20.6
4	23.4	24.1	—	—
5	24.1	20	23.4	22.6
6	—	—	16	14.2
7	23.8	18.8	27.1	24.8
8	27.1	27.9	28	28.6
9	—	—	—	—
10	—	—	23.9	21.1
11	15.4	17.4	—	—
12	20.3	16.8	23.5	22
13	16.2	14	17.3	17
14	16.2	10	—	—
15	23.8	21.2	18.6	18.9
16	23.8	22.5	22.7	16.1
17	18.2	17.1	20.9	18.1
18	—	—	34.2	32.8
19	24.3	24.3	—	—
20	22.8	19.8	21.2	18.8
21	—	—	28	26.8
22	22.3	20.5	23.4	24.1
23	18.2	13.6	11.2	8.7
24	22	20.3	25.9	26.4
25	24.5	25	29.8	30
26	25	24	23.1	23.5
27	23.2	21	24.2	25.5
28	21.8	18.2	18	18.8
29	—	—	—	—
30	20	19.6	—	—
31	26.5	27.1	27.5	26.9
32	23.4	19.8	27.5	21
33	19.1	13.2	20.7	14.4
34	14.8	15.8	7.4	7.9
35	—	—	22.5	23.3
36	—	—	—	—

BODY COMPOSITION DATA FOR THE CONTROL GROUP: PERCENT BODY FAT BY SKINFOLDS AND HYDROSTATIC WEIGHING

	Skinfolds		Hydrostatic Weighing	
Subject	T1	T2	T1	T2
1	15.1	16.8	21.7	20.3
2	23.4	21.2	18.8	18
3	—	—	—	—
4	26.8	25	24.3	24.8
5	24.3	23.4	21.5	22.8
6	26.8	25.9	27.1	27.2
7	14.8	17.4	14.6	17.7
8	22	20	—	—
9	21.4	18.8	23.2	23
10	20.3	19.3	20.6	21.6
11	—	—	—	—
12	26.2	27.8	26.9	24.5
13	21.2	21.2	22.1	22.1
14	27.5	27.3	26.9	26.2
15	—	—	32.8	29.4
16	—	—	—	—
17	21.1	22	19.1	21.
18	26.4	25.9	—	—
19	20	18.2	16.6	15.3
20	21.8	18.5	16.3	17.4
21	—	—	15.7	16.2
22	25.5	25.2	24.6	26
23	19.3	20.5	—	—
24	20.5	20.3	19.3	17.7
25	20	20	—	—
26	22	21.2	22.3	22.9
27	—	—	23.9	22.4
28	—	—	14.9	16.7
29	21.4	21.2	24.6	25.6
30	17.7	15.8	20.3	20.8
31	—	—	—	—
32	21.4	19.1	—	—
33	25	23.6	—	—
34	23	21.6	20.9	21.9
35	24.3	22.5	21.1	22.6
36	23.4	21.2	27.7	27.1

BLOOD LIPID DATA FOR THE EXPERIMENTAL GROUP:
TOTAL CHOLESTEROL AND TRIGYCERIDES (mg/dl)

	Total Cholesterol		Triglycerides	
Subject	T1	T2	T1	T2
1	177	194	102	86
2	214	193	71	173
3	179	161	97	58
4	211	184	196	71
5	187	150	111	58
6	206	193	71	58
7	261	285	161	267
8	195	198	92	78
9	175	—	82	—
10	173	144	81	73
11	200	215	85	45
12	183	176	161	177
13	146	135	45	37
14	186	163	59	130
15	221	205	102	80
16	250	239	112	85
17	180	151	90	88
18	174	172	130	130
19	219	207	110	86
20	221	183	121	103
21	192	195	106	157
22	201	192	88	72
23	202	182	90	91
24	230	190	286	216
25	150	146	58	74
26	220	201	136	120
27	165	169	113	131
28	210	189	73	66
29	185	174	55	54
30	264	205	220	141
31	240	222	112	110
32	244	214	70	73
33	262	181	97	51
34	221	243	103	181
35	199	213	178	169
36	162	—	55	—

BLOOD LIPID DATA FOR THE EXPERIMENTAL GROUP: PERCENT HDL-C (mg/dl) AND HDL-C /TC X100 (%)

	HDL-C (mg/dl)		HDL-C (%)	
Subject	T1	T2	T1	T2
1	43	43	24	22
2	67	47	31	24
3	33	—	18	—
4	45	44	21	24
5	34	32	18	21
6	57	55	28	28
7	39	38	15	13
8	37	39	19	20
9	43	—	25	—
10	43	40	25	28
11	75	66	37	31
12	38	41	21	23
13	55	49	38	36
14	44	40	24	25
15	39	37	18	18
16	49	47	20	20
17	57	53	32	35
18	43	41	25	24
19	41	41	19	20
20	33	37	15	20
21	40	41	21	21
22	52	48	26	24
23	51	46	25	25
24	24	27	10	14
25	41	36	27	25
26	46	35	21	17
27	43	35	26	21
28	57	51	27	27
29	47	50	25	29
30	47	40	18	20
31	40	35	17	16
32	40	41	16	19
33	59	61	23	34
34	62	55	28	23
35	35	35	18	16
36	36	—	22	—

BLOOD LIPID DATA FOR THE CONTROL GROUP: TOTAL CHOLESTEROL AND TRIGLYCERIDES (mg/dl)

	Total Cholesterol		Triglycerides	
Subject	T1	T2	T1	T2
1	155	171	112	81
2	295	248	61	109
3	226	—	92	—
4	176	167	106	87
5	243	227	231	357
6	205	206	115	120
7	233	212	108	72
8	159	169	108	85
9	178	170	152	99
10	198	164	170	228
11	122	—	76	—
12	232	254	227	151
13	243	220	229	365
14	219	215	73	90
15	153	152	123	60
16	242	224	168	189
17	133	120	60	65
18	154	149	46	53
19	223	220	118	107
20	183	167	65	72
21	195	175	293	237
22	170	170	60	56
23	222	208	162	171
24	169	183	80	89
25	209	196	93	75
26	185	195	78	56
27	234	203	213	64
28	205	195	82	116
29	211	188	58	98
30	213	207	88	104
31	170	—	77	—
32	205	191	45	87
33	342	284	340	234
34	227	225	140	315
35	223	205	95	105
36	203	204	97	114

BLOOD LIPID DATA FOR THE CONTROL GROUP:
HDL-C (mg/dl) AND HDL-C /TC X100(%)

	HDL-C (mg/dl)		HDL-C(%)	
Subject	T1	T2	T1	T2
1	40	46	26	27
2	56	51	27	21
3	45	—	20	—
4	44	38	25	23
5	35	33	14	15
6	39	33	19	16
7	51	45	22	21
8	51	47	32	28
9	36	35	20	21
10	36	31	18	19
11	35	—	29	—
12	36	40	16	16
13	26	32	11	15
14	46	45	21	21
15	47	46	31	30
16	43	39	18	17
17	46	37	35	31
18	75	44	49	30
19	48	52	22	24
20	55	47	30	28
21	36	34	18	19
22	79	69	46	41
23	52	47	23	23
24	43	41	25	22
25	39	38	19	19
26	46	50	25	26
27	37	37	16	18
28	45	40	22	21
29	50	52	24	28
30	46	44	22	21
31	41	—	24	—
32	70	64	34	34
33	33	27	10	10
34	44	37	19	16
35	40	40	18	19
36	38	40	19	20

CARDIORESPIRATORY FITNESS FOR THE EXPERIMENTAL GROUP: $\dot{V}O_2$ AT A HEART RATE OF 150 ($mlo_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$) T1	($mlo_2/kg \cdot min^{-1}$) T2	(LO_2/min) T1	(LO_2/min) T2
1	23.6	—	2.01	—
2	22.2	23.8	1.81	1.87
3	23.4	28.1	2.15	2.55
4	29.6	31.2	2.3	2.35
5	25.1	35.5	2.43	3.22
6	29	35.9	2.5	3.01
7	18.5	27.1	1.89	2.61
8	25.6	28.1	2.65	2.90
9	23.3	—	2.67	—
10	29.6	36.9	2.28	2.68
11	26.2	27.7	1.57	1.65
12	21.3	29.2	1.72	2.28
13	23.3	28.4	1.62	1.99
14	20.7	34.1	1.46	2.38
15	25.1	28.4	2.04	2.32
16	24.1	28.2	1.73	1.97
17	20.5	23.1	1.43	1.60
18	20.7	25.7	2.55	3.10
19	24.2	29.9	2.28	2.71
20	24.8	28.5	2.17	2.45
21	27.3	30.6	2.46	2.74
22	22.1	27.6	1.80	2.19
23	34	38.9	2.56	2.89
24	20.1	23.2	1.89	2.22
25	23.3	26	2.62	2.91
26	22	26.9	1.72	2.07
27	24	22.7	2.40	2.26
28	27.2	30.2	2.07	2.27
29	20.5	27.8	2.52	2.38
30	27.8	26.8	2.52	2.38
31	19.6	26.2	1.66	2.14
32	21.8	27.8	2.11	2.57
33	27.2	37	2.04	2.51
34	32.1	29.4	2.47	2.28
35	27.6	31.5	2.06	2.34
36	19.3	—	1.75	—

CARDIORESPIRATORY FITNESS FOR THE EXPERIMENTAL GROUP: $\dot{V}O_2$ AT 80% OF HEART RATE RANGE ($mlo_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$) T1	($mlo_2/kg \cdot min^{-1}$) T2	(LO_2/min) T1	(LO_2/min) T2
1	25.9	—	2.21	—
2	26.4	28.1	2.15	2.21
3	26.4	32.5	2.42	2.95
4	31.3	33.9	2.44	2.54
5	27.2	39.5	2.63	3.58
6	33.2	38.8	2.87	3.25
7	22.5	32.8	2.30	3.16
8	26.8	32.8	2.77	3.38
9	26.9	—	3.08	—
10	31.1	37.2	2.39	2.70
11	25.4	30.2	1.52	1.79
12	21.6	29.5	1.74	2.30
13	26	33.9	1.81	2.38
14	20.9	33.0	1.48	2.29
15	27.8	33.4	2.27	2.72
16	29.7	33.7	2.12	2.37
17	24	27	1.67	1.87
18	20.3	24.6	2.50	2.97
19	27	31.2	2.55	2.82
20	26.2	31.5	2.29	2.71
21	29.5	32.8	2.66	2.95
22	24.1	32	1.96	2.54
23	34.3	39.1	2.58	2.91
24	22.5	24	2.12	2.29
25	25.7	28	2.89	3.13
26	22.8	27.9	1.79	2.15
27	25.7	23.6	2.57	2.35
28	32.4	36.3	2.47	2.73
29	23.3	32.3	2.65	3.68
30	24.1	23	2.19	2.04
31	21	26.6	1.77	2.17
32	25.3	30.8	2.45	2.84
33	31.1	42.1	2.34	2.86
34	34.7	33.9	2.67	2.63
35	29.2	33.8	2.19	2.48
36	25.9	—	2.37	—

CARDIORESPIRATORY FITNESS FOR THE EXPERIMENTAL GROUP: ESTIMATED $\dot{V}O_2$ MAXIMUM ($mlo_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$)		(LO_2/min)	
	T1	T2	T1	T2
1	32.3	—	2.75	—
2	30.5	32.2	2.49	2.53
3	31.2	40.4	2.86	3.66
4	37.4	41.8	2.91	3.14
5	35.2	49.2	3.40	4.46
6	39.8	48.5	3.43	4.06
7	27.7	39.9	2.83	3.85
8	31.8	38.8	3.29	4.00
9	32.7	—	3.75	—
10	35.6	45.7	2.73	3.32
11	32.6	33.9	1.96	2.01
12	26.1	35.3	2.10	2.75
13	33	40.5	2.30	2.84
14	29.8	43.1	2.11	3.01
15	33.9	37.3	2.76	3.04
16	35.1	39.5	2.51	2.78
17	28.8	31.6	2.01	2.19
18	23.3	30.4	2.87	3.67
19	29.9	37.8	2.83	3.42
20	31.2	37.8	2.83	3.42
21	34.3	39.1	3.08	3.51
22	29.4	38.1	2.39	3.02
23	40.2	47.7	3.03	3.54
24	26.8	28.8	2.52	2.75
25	29.8	34.3	3.35	3.85
26	27.7	32.5	2.17	2.50
27	30.8	28.5	3.07	2.84
28	39.7	44.1	3.03	3.31
29	28.1	39	3.20	4.46
30	28.6	28.2	2.60	2.50
31	24.6	34.7	2.08	2.83
32	29.5	38.7	2.86	3.57
33	37	50.9	2.77	3.45
34	43.5	41.7	3.32	3.23
35	34.7	40.7	2.60	3.03
36	30.2	—	2.75	—

CARDIORESPIRATORY FITNESS FOR THE CONTROL GROUP: $\dot{V}O_2$ AT A HEART RATE OF 150 (($mlo_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$)		(LO_2/min)	
	T1	T2	T1	T2
1	28.1	27.8	2.36	2.32
2	30.9	35.8	2.43	2.79
3	25.6	—	2.17	—
4	25.0	22.2	1.82	1.62
5	21.4	24.4	1.64	1.86
6	25.3	25.3	2.43	2.45
7	26.7	26.0	2.07	2.00
8	20.4	22.3	1.53	1.65
9	22.4	24.5	1.87	2.01
10	27.9	24.7	2.63	2.28
11	26.2	—	2.29	—
12	23.4	21.8	1.88	1.82
13	21.0	22.3	1.61	1.72
14	29.3	31.5	3.25	3.45
15	19.5	24.5	2.11	2.43
16	21.4	23.7	1.44	1.55
17	23.6	22.9	1.62	1.67
18	23.9	23.2	2.22	2.17
19	21.5	21.5	1.40	1.41
20	29.6	28.7	2.26	2.10
21	23.9	30.6	2.09	2.67
22	29.5	31.5	2.78	2.98
23	26.4	27.0	2.32	2.44
24	26.0	27.5	2.36	2.44
25	18.6	23.6	1.62	2.02
26	24.8	25.1	1.94	2.03
27	22.2	29.2	1.77	2.23
28	27.8	28.0	2.21	2.26
29	27.2	28.9	2.27	2.42
30	23.8	27.7	1.95	2.29
31	19.4	—	1.68	—
32	21.2	24.2	1.84	1.93
33	20.9	22.1	1.49	1.56
34	20.4	19.6	2.14	2.07
35	23.2	17.4	1.89	1.41
36	24.6	26.0	2.32	2.36

CARDIORESPIRATORY FITNESS FOR THE CONTROL GROUP: $\dot{V}O_2$ AT 80% OF HEART RATE RANGE (($mlo_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$)		(LO_2/min)	
	T1	T2	T1	T2
1	29.5	31.6	2.47	2.64
2	32.2	37.7	2.53	2.92
3	29,0	—	2.46	—
4	25.1	22.6	1.83	1.65
5	24.6	25.2	1.88	1.93
6	28.0	30.6	2.69	2.96
7	30.6	28.8	2.37	2.21
8	23.6	25.2	1.76	1.86
9	24.7	27.8	2.07	2.28
10	26.0	28.6	2.44	2.64
11	28.0	—	2.44	—
12	25.6	22.4	2.07	1.87
13	21.2	22.4	2.07	1.87
14	30.2	32.0	3.35	3.50
15	22.3	28.1	2.41	2.81
16	24.5	25.9	1.64	1.70
17	28.7	29.5	2.04	2.16
18	27.1	25.2	2.51	2.35
19	26.0	28.4	1.69	1.86
20	31.6	35.9	2.41	2.63
21	27.1	32.4	2.36	2.82
22	31.0	32.8	2.93	3.10
23	30.0	29.0	2.64	2.58
24	27.2	29.8	2.47	2.63
25	21.0	26.4	1.83	2.22
26	27.2	26.4	2.14	2.13
27	26.4	32.2	2.12	2.46
28	30.8	31.4	2.45	2.52
29	29.0	31.2	2.41	2.61
30	27.7	33.8	2.27	2.79
31	25.4	—	2.20	—
32	22.2	28.2	1.94	2.17
33	24.4	24.7	1.73	1.75
34	23.6	24.7	2.48	2.61
35	26.5	24.4	2.16	1.97
36	23.4	25.0	2.20	2.27

CARDIORESPIRATORY FITNESS FOR THE CONTROL GROUP:
ESTIMATED $\dot{V}O_2$ MAXIMUM ($mlO_2/kg \cdot min^{-1}$ and LO_2/min)

Subject	($mlo_2/kg \cdot min^{-1}$)		(LO_2/min)	
	T1	T2	T1	T2
1	36.9	37.0	3.10	3.09
2	40.9	46.9	3.21	3.64
3	34.9	—	2.96	—
4	30.3	28.8	2.21	2.11
5	27.0	29.5	2.07	2.25
6	33.1	35.8	3.17	3.47
7	36.1	35.2	2.80	2.69
8	27.1	30.0	2.03	2.22
9	30.2	35.2	2.52	2.89
10	26.9	32.0	2.53	2.96
11	34.6	—	3.02	—
12	29.1	32.0	2.53	2.96
13	24.5	26.8	1.88	2.07
14	35.3	37.9	3.91	4.15
15	26.1	32.3	2.83	3.24
16	27.5	29.0	1.85	1.90
17	34.4	34.7	2.45	2.55
18	32.3	30.3	3.00	2.83
19	29.7	32.3	1.94	2.12
20	38.4	43.7	2.94	3.21
21	33.2	38.9	2.89	3.39
22	38.3	39.6	3.61	3.74
23	35.1	36.0	3.08	3.20
24	35.5	35.5	3.21	3.14
25	26.4	30.0	2.30	2.58
26	31.5	31.0	2.47	2.50
27	31.0	39.5	2.48	3.02
28	36.4	38.6	2.89	3.11
29	33.7	36.3	2.80	3.21
30	32.7	38.8	2.68	3.21
31	29.9	—	2.59	—
32	24.6	34.6	2.14	2.66
33	28.7	28.9	2.04	2.04
34	28.2	29.0	2.96	3.07
35	31.5	29.3	2.57	2.37
36	26.8	29.0	2.52	2.64

SMOKING AND ALCOHOL CONSUMPTION DATA FOR THE EXPERIMENTAL GROUP AND CONTROL GROUP (SMOKER - * DRINKER (ALCOHOL - +)

	Experimental		Control	
Subject	Smokers	Drinkers	Smokers	Drinkers
1	*	+		+
2				+
3			—	—
4				
5				+
6		+		+
7				
8			*	+
9	—	—		+
10				+
11	*	+	—	—
12			*	+
13		+		+
14				
15		+		+
16			*	+
17		+		
18		+		
19		+		
20		+		+
21				+
22		+		+
23		+	*	+
24		+		+
25		+	*	+
26		+		+
27		+		
28		+	*	+
29		+		+
30	*	+		+
31			—	—
32				+
33		+		
34		+		
35		+		
36	—	—		

VITA

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Candidate For the Degree of

Master of Science

Thesis: THE EFFECTS OF 12 WEEKS OF EXERCISE TRAINING ON PLASMA HIGH DENSITY LIPOPROTEIN CHOLESTEROL IN MEN AGED 30-50

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Biographical:

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Contractions with Exercise in Young Adults." Paper presented at the American College of Sports Medicine, Annual Meeting, Las Vegas, Nevada, 1980.

Principal investigator of an unpublished paper, James F. Freyman and James A. Schwane, "The Effects of 12 Weeks of Exercise Training on Plasma High Density Lipoprotein Cholesterol in Men Aged 30-50." A paper presented to the Central States Chapter American College of Sports Medicine Annual Meeting, Lawrence, Kansas, 1981.