THE RELATIONSHIP BETWEEN AEROBIC EXERCISE HABIT AND PLASMA LIPOPROTEIN LEVELS IN FEMALE NURSES: A FOLLOW-UP STUDY

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TABLE OF CONTENTS

Index of Tables

Increasing evidence supports the role of lack of exercise, excess consumption of saturated fats and cholesterol and emotional stress in the pathogenesis of coronary heart disease. Among women worldwide, women in the United States have the highest rates of coronary heart disease (CHD) and CHD is the leading cause of death (Gibbons, 1983). Increasing attention is being given to the importance of CHD for women in the United States, to identify modifiable risk factors for coronary disease in women.

Increased blood cholesterol levels are causally related to an increased risk of coronary heart disease. Coronary risk rises progressively with an increase in cholesterol level, particularly when cholesterol levels rise above 200mg/dl (National Institute of Health [NIH], 1989). Multivariate statistical analysis has shown that high-density lipoprotein (HDL) cholesterol has a protective effect for coronary heart disease (CHD) risk that is about twice as strong as the atherogenic low-density lipoprotein (LDL) cholesterol effect (Kannel, 1987).

Triglycerides (TG) are also known to contribute to the atherogenic process and subsequently CHD. Extremely high levels of TG are associated with a high total cholesterol/HDL ratio which is a strong indicator of CHD

risk in both sexes. High TG have also been shown to be a highly significant risk factor for CHD in women (Castelli, 1986).

Significance for Nursing

A major priority for nursing research identified by the American Nurses' Association is that of promoting health, well-being and the ability to care for one's self (Woods and Catanzaro, 1988). Thus, studies which contribute to the current body of knowledge regarding the interventions which identify, control, or eliminate the major modifiable risk factors for heart disease are important to nursing practice. Nurses make up the largest number of health care workers, which provides them with the opportunity to assume an active role in the evaluation and treatment process for those individuals at risk for coronary heart disease.

The purpose of this study was to determine the variables that may correlate with favorable lipid profiles in nurses performing deliberate regular aerobic exercise. This study assessed the presence of major modifiable risk factors for CHD and measured lipid profiles in a population of hospital staff nurses.

Determinants of Cholesterol and Lipoprotein Levels in Women

Cholesterol and lipoprotein concentrations in blood plasma are influenced by many factors. Genetics, dietary

cholesterol and saturated fats, alcohol consumption, obesity, stress and aerobic exercise are known to influence lipid levels in women. Another determinant of cholesterol and lipoprotein concentrations in women are the endogenous and exogenous sex hormones estrogen and progestin, and menstrual cycle phases (Bush, Fried and Barrett-Connor, 1988). Other factors include drugs (Dukes and Beeley, 1990); cigarette smoking (Bush et al., 1988); and seasonal variations (Gordon, Hyde, Trost, Whaley, Hannan, Jacobs and Ekelund, 1988).

Genetics. There are a variety of lipid disorders associated with genetic defects, the most common being familial hypercholesterolemia which involves deficient or defective LDL receptors, leading to an increase in plasma LDL levels (Chappel and Spector, 1991). In the American population, only 2% of hypercholesterolemia is associated with a genetic defect (Chappel and Spector, 1991).

Dietary Saturated Fats and Cholesterol. It has been hypothesized that a variety of dietary components influence lipids and lipoprotein levels in humans. In their review of numerous studies exploring the connection between dietary components and serum lipid levels, Grundy and Denke (1990) note there is a substantial amount of research to support the claim that saturated fat, cholesterol and excess calorie

intake leading to obesity will raise serum LDL. However, a consistent correlation between quantitative levels of dietary cholesterol and cholesterol levels has not been established in this area of research (Grundy and Denke, 1990).

Numerous studies have shown saturated fat intake to increase total cholesterol and LDL concentrations. When saturated fats are replaced with monounsaturated fat, polyunsaturated fat and carbohydrates, LDL-cholesterol levels are reduced (Grundy and Denke, 1990). A few studies have demonstrated dietary fiber can significantly decrease plasma cholesterol concentrations. In their study of 62 nonhypercholesterolemic subjects, Stasse-Wolthuis et al. (1980) found that the daily addition of 6 to 8 grams of dietary fiber in the form of pectin containing food, significantly decreased plasma cholesterol levels ($p < 0.02$). A recent study of 41 male subjects with mild hypercholesterolemia suggest an inverse relationship between dietary fiber intake and plasma TC and LDL concentrations (Tinker, Schneeman, Davis, Gallaher and Waggoner, 1991).

Recent research demonstrates a large inter-individual variability in response to cholesterol and saturated fat in the diet (Zanni, Zannis, Blum, Herbert and Breslow, 1987; Edington, Geekie, Carter, Benfield, Ball, and Mann 1989).

One explanation of this varied response is that some individuals are hyporesponders to dietary cholesterol consumption while others are hyperresponders (Barnard, 1991).

Alcohol. A strong positive relationship between alcohol intake and HDL cholesterol level has been well documented in cross-sectional studies (Gordon, Ernst, Fisher and Rifkind, 1981). The Lipid Research Clinics Program Prevalence Study determined alcohol consumption is strongly associated with increased HDL cholesterol in both men and women (Ernst, Fisher, Smith, Gordon, Rifkind, Little, Mishkel and Williams, 1980). Social drinkers have mean HDL levels that may be higher than those of abstainers by as much as 30% (Pietinen and Huttunen, 1987).

The smallest amount of alcohol by which significant increases of HDL cholesterol have been observed in clinical experiments is 30-40 ml per day in a study of 45 healthy males. This intervention study used randomly assigned experimental groups, each group consuming low alcohol content beer for 6 weeks and normal alcohol content beer for 6 weeks in a reverse design (Masarei, Puddey, Rouse, Lynch, Vandougen and Beilin, 1986).

Endogenous and Exogenous Sex Hormones. Endogenous and exogenous sex steroid hormones have been shown to influence

plasma lipoprotein levels in women. TC levels have been recorded to be at their lowest during the menstrual phase and peak during the follicular phase, with an average increase of 9.2% in TC values. TG levels followed a similar trend, with their lowest levels occurring during the menstrual phase (Lussier-Cacan, Xhignesse, Desmarais, Davignon, Kafrissen and Chapdelaine, 1991). Other observations have not shown fluctuations in HDL and LDL through the menstrual cycle (Lebech, Kjaer and Lebech, 1990), highlighting the importance of performing the blood sampling during the menstrual phase when values are expected to be the lowest.

Several studies have established a relationship between oral contraceptives and changes in lipid and lipid profiles, linking oral contraceptives with an increased cardiovascular risk (Burkman, 1988; Burkman, Robinson, Kruszon-Moran, Kimball, Kwiterovich and Burford, 1988; Fotherby, 1985; Knopp, Walden, Wahl and Hoover 1982). Among current oral contraceptive users, clinical coronary heart disease is quite rare. The risk of coronary heart disease appears to be significant only in women over 35 years old using oral contraceptives and particularly if they are smokers (Fotherby, 1985).

Hormone replacement therapy (HRT) for post-menopausal women is another factor influencing lipoprotein levels, but this association has not been widely studied. Following a cohort of 2270 white women for 8.5 years, Bush and her associates (1987) analyzed the association between estrogen use, lipoprotein levels and cardiovascular disease and suggest that estrogen's protective effect is mediated through estrogen-induced increases in HDL (Bush, Barrett-Connor, Cowan, Criqui, Wallace, Suchindran, Tryoler and Rifkind, 1987). In most studies oral estrogens tend to have a favorable effect on serum lipids and lipoproteins, with an elevation in HDL and a decrease in LDL (Burkman, 1988).

Obesity. Obesity is related to abnormal lipid metabolism and can be predictive of an increased risk of CHD (Grundy and Denke, 1990). In many studies body mass in the highest quintile is positively correlated with total cholesterol and inversely associated with HDL cholesterol in both men and women. These correlations are independent of age, smoking, alcohol intake and the use of estrogens (Bush et al., 1988). Tran and Weltman (1985) have reported that exercise accompanied by a decrease in body weight is associated with decreases in cholesterol levels and increases in HDL levels.

Stress. The impact of stressful life events on serum lipid levels has been studied through a variety of approaches over the years. In a literature review of sixty studies primarily done with males looking at the effects of emotional arousal on plasma lipids, Dimsdale and Herd (1982) concluded that there is a strong association between emotional arousal and plasma lipids. Cholesterol levels increased from 8% to 65% under stressful conditions, and they found a range of 5% to 150% elevations in free fatty acid levels among the studies they reviewed.

A study looking at the effect of psychological factors on variations in total cholesterol levels compared the response of male and female students during examination stress (VanDoornen and Blokland, 1987). They found that anticipation of an exam induced a significant rise in cholesterol levels in males, but there was no increase in TC in the female students.

In another recent study investigating the impact of stress on plasma lipid levels in men and women subjects, TC, TG, LDL, HDL and very low density lipoprotein (VLDL) were measured along with dietary intake and self-reported stress and workload (McCann, Warnick and Knopp, 1990). Increases in total plasma cholesterol were significantly positively

correlated with increases in perceived stress ($p<0.05$) and high workload periods ($p<0.01$).

Exercise. There is a considerable amount of evidence that regular physical exercise is beneficial in reducing the risk of coronary heart disease. Overall mortality, cardiovascular mortality, and CHD mortality have been found to be inversely related to deliberate aerobic exercise in a variety of epidemiologic studies (Kannel, Wilson and Blair, 1985). However, the investigations of the association of regular exercise and cardiovascular disease have been plagued by the lack of adequate measures to standardize exercise in order to determine a dose-response effect. It is not clear what frequency, intensity and duration of activity is necessary and over what period of time in order to see a reduced risk of CHD.

A number of studies have investigated the effect of aerobic exercise on lipid and lipoprotein levels, and while a definite relationship between aerobic exercise and serum lipid levels has not been established, many studies have shown a positive relationship between HDL cholesterol and high levels of physical exercise (Rotkis, Boyden, Pamenter, Stanforth and Wilmore, 1981). In their study of the effects of an endurance program on plasma TC and HDL concentrations in women runners, Rotkis and his associates (1981) found a

mean increase in HDL of 5.0 mg/dl ($p < 0.01$), when each subject increased her average weekly running by 30 miles for at least two consecutive weeks. Higher levels of exercise (e.g., jogging 12 miles per week) may favorably influence lipid levels through other factors such as lower total body weight and higher levels of caloric intake, which independently influence lipoprotein regulation (Wood, Terry and Haskell, 1985).

In a cross-sectional analysis, the Lipid Research Clinic Study found men and women at all ages who reported strenuous exercise tended to have higher HDL levels than those who reported no such exercise. The data from this study indicated that for women, the relationship between self-report of strenuous exercise and HDL cholesterol concentration is independent of its relationship to adiposity, smoking and alcohol consumption (Haskell, Taylor, Wood, Schrott and Heiss, 1980).

There is support that on-going exercise reduces elevated TG levels, yet the evidence is less conclusive for women than it is for men (Frank, 1991). Intervention and prospective studies done on women who exercise have shown inconsistent effects of exercise on the serum lipid profile. Some investigators have found aerobically trained women (Wood, Haskell, Stern, Lewis and Perry, 1977) and

anaerobically trained women (Goldberg, Elliot and Schutz, 1984) have significant lowering of total cholesterol.

On the other hand, other investigators have been unable to show significant differences in lipid profiles that could be attributed to regular physical exercise. Brownell and associates (1982) found a borderline 4% reduction in total cholesterol concentration and a nonsignificant 4.3% decrease in LDL cholesterol after a 10-week exercise program of 37 women, but no changes in HDL cholesterol. This exercise program consisted of three sessions of aerobic exercise each week, with 15-20 minutes of activity at 70% of maximal heart rate.

A lack of significant changes in lipids after exercise among women in some reports may be attributed to pre-exercise low risk lipid profiles in some subjects. The finding of more favorable lipid and lipoprotein risk factors in women may be due to greater lipoprotein lipase activity in women than in men after exercise conditioning (Goldberg and Elliot, 1985).

Overall, the findings on exercise and its effect on lipid profiles are inconclusive. Small sample sizes, a dearth of studies involving women, and the lack of controlling for confounding variables such as diet, alcohol

consumption, and medication use limit the conclusions that can be drawn.

In summary, the complexity of the body's mechanisms for manufacturing and metabolizing and transporting lipids can be influenced by numerous intervening variables. This review has outlined those which are presently thought to have the greatest impact on lipid profiles of women. In addition to understanding the impact of these individual variables, there is the opportunity to determine an individual's potential risk for coronary heart disease, and thus take appropriate measures towards decreasing that risk by decreasing or eliminating the modifiable variables.

Methods

All women included in this study were participants in the study of Ralstin and Simmons (1991) which analyzed the relationship of regular aerobic exercise and work-related stress. Their sample of 44 nurses, 20 non-exercisers and 24 exercisers, was drawn from nurse employees of a northwest university hospital.

Sample. Following approval by the Human Subject's Committee, subjects were recruited by personal contact from the sample of the first study. Inclusion criteria consisted of female subjects, 20-50 years of age, non-smoking, free of medical problems, and non-pregnant for one year. Subjects

taking medications that could potentially interfere with lipid concentrations, i.e., sulfonylureas and beta blockers (Fotherby, 1985); anabolic androgens, cyclosporins, hydrochlorothiazide, glucocorticoids, donazol and lynestrenol (Dukes and Beeley, 1990); and lipid lowering drugs such as cholestyramine, nicotinic acid and lovastatin (Talbert, DiPiro, Hayes, Yee, and Posey 1989) were excluded from the study. The subjects were involved in direct patient care of adults in an acute care setting and employed full-time ($\geq$0.8 FTE) in their current position for a minimum of one year.

At the time of recruitment one year later, eleven subjects agreed to participate in the follow-up study, 7 exercisers, and 4 non-exercisers. Of the remaining subjects, 8 had left the health care agency, 7 declined, 5 changed their job status, 1 was dropped from the primary study, and 1 was unable to be reached. Eleven had medical reasons for exclusion, e.g., 6 were pregnant within the previous year, 3 had hysterectomies, one was started on a medication which required her exclusion and one had a recent physical injury.

Measures. Health history was obtained by questionnaire during the initial contact with each subject. Questionnaires included: medical history information, menstrual cycle history, family history, personal history of high

cholesterol, medication use, dietary patterns, alcohol and tobacco use and exercise patterns.

The subjects' completed a prospective 4-day dietary intake record within one week prior to their blood being drawn. A study of 252 diet records of 18 outpatients attending a lipid clinic was carried out in order to determine the least number of day-set records that would accurately monitor calories and lipids of clinic outpatients (Jackson, Dujovne, DeCoursey, Beyer, Brown & Hassanein 1986). Each subject recorded their food intake for 14 consecutive days. From 11 possible combinations of 4 day-sets of records, all but three were considered the minimum required for a 95% confidence limit of the mean for calories, cholesterol, saturated fat and polyunsaturated fat. Consequently, 4 consecutive days of diet records was chosen for this study as an acceptable level of food intake recordings for analysis.

The diets were analyzed for nutrient content using Nutritionist III, a computerized diet analysis program with a database of 5,000 foods (N-Squared Computing, Salem, OR). The nutrients included in analysis were: total calorie intake; breakdown of calorie intake to percent from protein, carbohydrates and fats; crude and dietary fiber; dietary cholesterol, sugar, and alcohol; and a breakdown of fat

intake to oleic, linoleic, monounsaturated, polyunsaturated and saturated fatty acids.

The sample was divided into exercise and non-exercise groups using a one-week prospective diary in which exercise frequency, type, duration, resting heart rate, achieved maximum heart rate, and perceived exertion were recorded. The exercise record was completed during the same week as the food records. Each subject indicated whether the one-week diary was consistent with her customary exercise program, and a training index was calculated using the American College of Sports Medicine's (1990) guidelines. This consists of a continuous rhythmic activity involving large muscle groups at a frequency of three times a week, 20 minute duration, and age-adjusted intensity of 70% of maximum heart rate. Subjects with scores equal to or greater than 42 were included in the exercise group; those with scores less than 42 were considered non-exercisers.

A standardized procedure for measuring exercise patterns is not currently available, and a prospective diary is the most practical and commonly used method for exercise research (Washburn & Montoye, 1986). Self-report diaries may influence the subject to alter their usual exercise patterns, thus possibly detracting from this measure's reliability. In addition, the ACSM's definition of exercise

does not include some leisure activities, which may influence the validity of an exercise diary. Time spent participating in housework, gardening and occupational activity is not accounted for, thus potentially influencing the validity of the exercise record.

Lipid profiles were determined following the NCEP guidelines (NCEP, 1988). The profile included an analysis of total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL), and a calculated very low density lipoprotein (VLDL) and low density lipoprotein (LDL). Five milliliters of plasma was collected after the fifth day of the beginning of the subjects' menses during two separate cycles, and after the subject had fasted for 12 hours. The samples were subsequently spun and the serum frozen and then analyzed, using an enzymatic cholesterol method standardized to NCEP guidelines (Boehringer Mannheim Corporation, Indianapolis, IN).

Body fat was determined by measuring skin fold thickness in millimeters with Harpenden calipers at the triceps, abdominal and suprailiac sites. These measures together with the subject's age and weight were used to estimate percent body fat for an additional measure of fitness (Jackson and Pollock, 1985).

The Hassles Scale by Kanner, Coyne, Schaefer and Lazarus (1981) was used in this study to measure other sources of stress for the subjects. This 117-item scale asked respondents to indicate occurrences which have hassled them in the past month. Each hassle is rated on a three-point scale: "somewhat", "moderate", or "extreme" and frequencies and intensities of hassles were calculated. The scale has a high test-retest reliability with an average correlation of .79 between adjacent months over a nine-month period for hassles frequency, and .48 for intensity (Kanner et al., 1981).

To measure work-related stress the Job Stress Scale was used. This 49-item Likert scale developed by Bailey and Claus (1977-78) and modified by Hinshaw and Atwood (Atwood, 1990) is designed to measure work-related stress. The scale includes items such as decision-making, coping abilities, and confidence in abilities and level of clinical knowledge. A scale standard alpha of .86 and theta of .87 was reported to indicate moderate to strong reliability and construct validity with this four-point scale. These two scales, the Hassles scale, and Job Stress scale, were completed by each subject during their initial contact when they completed the health questionnaires at the beginning of the data collection period.

Blood pressure measurements were taken twice on separate dates on all subjects, following the guidelines from the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (Joint National Committee, 1988). Measurements were taken in the same fashion with each subject, in the right arm with a calibrated cuff, with the subject seated, after a five-minute resting period. These measurements were taken during various contacts with the subjects, either their initial contact, subsequent contacts when food diaries were collected, or during the time of measuring the subjects' height and weight. The height and weights were recorded at the end of each individual's data collection period, with the standing scale used by the investigators in the primary study.

The results of Ralstin and Simmons (1991) study of these subjects found the groups' clinical workload and demographic characteristics to be the same. The non-exercise group was slightly taller (65.6 inches vs 63.7 inches) and disproportionately heavier (158 pounds vs 126.4 pounds) than the exercise group. The three fitness variables also demonstrated significant differences: VO_{2max} ($p=.002$), fitness category ($p<.001$) and percent body fat ($p=.0002$),

demonstrating exercisers were more fit than the non-exercisers.

The exercisers had higher VO_{2max} ($p=0.002$) and fitness category ($p<0.0001$), lower percent body fat ($p=0.0002$); perceived less stress (JSS $p=0.02$, STAI $p=0.0005$), and had lower hassles frequency ($p=0.04$) and severity ($p=0.02$) than non-exercisers. Ralstin and Simmons found high intercorrelations between their fitness measures ($p<0.0001$) and the three stress measures ($p<0.0001$). 12.4% of the variance on the job stress scale was accounted for by exercise alone. They concluded that deliberate regular aerobic exercise can effectively modulate the perception of job-related stress in female nurses.

Non-parametric statistical analyses were performed on the data of the current study. These included the Mann-Whitney U test for differences between the exercise and non-exercise groups and the Kruskal-Wallis ANOVA by ranks. In addition, a 2x2 cross tabulation was used to compare nominal data of the two groups.

Results

Subject Characteristics

The non-exercise group was taller (67.4±2.2 inches vs 63.5±1.7 inches) and heavier (151.8±29 pounds vs 122±9 pounds) than the exercise group. Since the previous study,

body weight measurements showed a mean body weight increase of 11.7 pounds in the 8 subjects demonstrating weight gain, a mean body weight decrease of 5 pounds in the 2 subjects with weight loss, and one subject with no change in weight. Percent body fat measures increased in all subjects, with a mean increase of 8.7%. Subjects' who gained weight did not have consistent increases in their percent body fat measures. This result was most likely due to instrumentation error by a novice investigator, and for this reason, the percent body fat measures were excluded from further analyses.

There were no differences between the two groups on measures of body weight, and there were no obese subjects as determined by calculated body mass index (BMI) W/H^2 (W=body weight, kg; H^2=height, m). The mean BMI of the non-exercise group was 24.5 and the mean BMI of the exercise group was 23. Comparisons of the characteristics of the two groups can be found in table 1.

Lipoprotein Distributions

The exercising subjects had a significantly higher HDL cholesterol than the non-exercising subjects (p=.02). There were no significant differences found between groups on the measures of TC, VLDL, LDL, TC/HDL ratio or TG (Table 2).

Dietary Analysis

Dietary analysis results for each group are included in table 3. There were statistically significant differences between the two groups whereby the exercisers had a lower intake of sugar ($p=.04$). There was a trend towards the non-exercise group consuming more crude fiber ($p=0.09$) and dietary fiber ($p=0.09$) than the exercise group. There were no differences between groups on the analysis of other dietary components.

Exercise

Based on the training index calculated from each subjects' exercise diary, 5 subjects maintained their aerobic exercise habit since the primary study, 3 subjects remained non-exercisers, two subjects began a regular exercise program and one subject discontinued her previous aerobic exercise habit. The non-exercise group had a mean training index of 9, with a mean intensity level of 15% of maximum heart rate. The exercise group had a mean training index of 99, with a mean intensity level of 76% of maximum heart rate. Subjects reported a wide variety of exercise modes. The most frequent mode of exercise was walking, followed by running, biking, swimming, stair-stepper, cross-country ski machine and aerobic dance.

Other Measures

Statistical analysis revealed no difference between the two groups on the Hassles scale and Job Stress scale. All subjects demonstrated an increase in their weighted Job Stress score and subscale score, indicating less perceived stress for the group as a whole. Blood pressure measurements demonstrated no statistical difference between groups. However, there was a trend towards a higher systolic blood pressure ($p=0.07$) of the 4 subjects in the non-exercise group. The non-exercisers had a mean blood pressure of 114/71, and the exercisers had a mean blood pressure of 106/68.

Discussion

This study examined the effects of regular aerobic exercise on plasma lipid and lipoprotein concentrations in female nurses. The finding that HDL cholesterol was significantly higher in the exercise group is in agreement with numerous studies demonstrating that vigorous exercise is associated with high HDL cholesterol levels (Haskell et al., 1980; Rotkis et al., 1981; Wood et al., 1977; and Stray-Gundersen, Denke and Grundy, 1991).

Potentially confounding variables that could influence HDL cholesterol levels, such as smoking, exercise habit and medications were controlled or measured in this study.

Therefore, one very likely explanation for the difference in HDL concentrations between the exercise and non-exercise groups is the regular aerobic exercise habit of the exercising subjects.

The lack of significant differences between the two groups on the other lipid and lipoprotein components is similar to findings of other studies done on women who exercise. A consistent relationship between regular exercise habit and favorable lipid profiles has not been established. Most cross-sectional studies have not demonstrated a significant difference in total cholesterol between vigorous exercisers and sedentary individuals (Superko, 1991). Variables that could influence the lipoprotein concentrations such as dietary intake, menstrual cycle fluctuations in lipid levels, medications and smoking were controlled for or measured in this study. In comparing the lipid profiles with the stress scale measures, no statistically significant differences were found between the two groups.

The lack of statistically significant differences in the two groups on TC, VLDL, LDL and TG may be accounted for by the variability in type and amount of nutrients in the subjects' diets. The subjects' dietary composition was not controlled in this study. Exercisers did not consume more

total calories as would be expected following the principles of thermodynamics. It is possible that the exercise group may have decided to work towards a goal of weight reduction in light of their average weight gain of 9.8 pounds over the last year, even though they maintained their regular aerobic habit over this same time period.

There are a few good studies that have investigated the association between exercise and dietary composition, and they suggest that more active individuals have a higher intake of total calories (Blair, Jacobs and Powell, 1985). When these studies compare dietary composition between exercisers and non-exercisers, there is little difference between the two groups from the data that is available (Blair et al., 1985). However, self-report food records are associated with under-reporting and alterations in intake because of record keeping, and subjects may also make errors in estimating their food portions. The small sample size and unequal groups in this data analysis may also confound these findings.

The sample in this study was not a representative subgroup of the primary study, because they did not show the same differences in variables of total body weight, percent body fat, hassles scores and job stress scores as were seen

in the subjects in the earlier study. This is most likely due to the small sample size and the unequal groups.

In summary, the results of this study demonstrate that healthy female nurses who maintain a regular aerobic exercise habit had higher HDL cholesterol levels than the non-exercising subjects. This result was achieved with the subjects' in the exercise group maintaining a regular exercise program with an intensity level of 76% of maximum heart rate.

Additional studies need to be done in order to collect more data on the intensity of exercise that is necessary to increase HDL levels, and to further clarify the relationship between aerobic exercise and lipid levels in women. Health care providers can feel confident in continuing to encourage women to maintain regular aerobic exercise in order to lower their risk for coronary events. Exercise is one risk factor for CHD that carries great potential for modification. The results of this study may help to build a stronger case for promoting the health benefits of exercise.

Nurses in a variety of work settings are in an ideal position to initiate risk factor modification interventions and promote coronary disease prevention. In addition, it is important that future women's health research focus on the practice domain. With women's heart disease statistics

currently on the rise, it is crucial that women at risk of CHD be identified early, and that our health practice recommendations are relevant to women's lived experience of heart disease. Women's coronary risk factors and lifestyle interventions are not identical to men with heart disease. Therefore, nurses as well as other health care professionals may benefit from additional studies which focus on women's health care issues.

TABLE 1
Comparisons of the means of subjects' characteristics between Non-Exercisers and Exercisers

	Non-Exercisers (n=4)	Exercisers (n=7)
Age	35±8	35.3±7
Height	67.4±2 inches	63.5±2
Weight	151.8±29 pounds	122±9 pounds
Time in Nursing	15±7 years	10±5 years
Body Mass Index	24.5±4.5	23±2.3
Percent Body Fat	35.3±5	34.6±5
Training Index	9±10	99±43.7
Job Stress scale	139±10	130±8
Hassles Frequency score	41±17	41±25

TABLE 2
Comparisons among lipids and lipoprotein variables
of Non-Exercisers and Exercisers

	Non-Exercisers (n=4)		Exercisers (n=7)	
Variable	Mean	Range	Mean	Range
Total Cholesterol	180	155-210	195	137-264 mg/dl
HDL*	57	55-60	72	61-85 mg/dl
VLDL	18	14-23	18	9-26 mg/dl
LDL	105	85-132	116	61-184 mg/dl
TC/HDL ratio	3.2	2.8-3.8	2.8	2.05-4.0
TG	91	68-116	76	46-130 mg/dl

* Significant at p=0.08

CHD RISK INTERPRETATION

Test	**Reference Range**	
Total Cholesterol	<200 mg/dl	Optimal
	200-239 mg/dl	Borderline - High
	≥240 mg/dl	High Risk
HDL Cholesterol	>35 mg/dl	Optimal
VLDL	<37 mg/dl	Optimal
LDL	<130 mg/dl	Optimal
	130-159 mg/dl	Borderline - High
	≥160 mg/dl	High Risk
TC/HDL Ratio - Female	3.27	Optimal
	4.44	Average
	7.05	Above Average
Triglycerides	30-150 mg/dl	

TABLE 3
Comparisons among dietary component average daily intake of Non-Exercisers and Exercisers

	Non-Exercisers	Exercisers	RDA
Kilocalories	2285 Kc	1649 Kc	2200 Kc
Percent calories			
Protein	15%	14%	20%
Carbohydrates	55%	52%	50%
Fat	29%	34%	30%
Fiber			
Dietary	18 Gm	10 Gm	22 Gm
Crude	4.1 Gm	2.8 Gm	---
Sugar	105 Gm	61 Gm	---
Fats			
Cholesterol	266 Gm	211 Gm	300 Gm
Saturated	25 Gm	20 Gm	24 Gm
Mono-unsaturated	28 Gm	20 Gm	24 Gm
Poly-unsaturated	13 Gm	11 Gm	24 Gm
Oleic Fat Acid	25 Gm	17 Gm	---
Linoleic Fat Acid	11 Gm	9 Gm	4.9 Gm
Alcohol	6.8 Gm	2.1 Gm	---

--- No RDA

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Appendix 1

Research Proposal

The Relationship Between Aerobic Exercise Habit and Plasma Lipoprotein Levels in Female Nurses: A Follow-Up Study

Laura Braaten

In Partial Fulfillment of the
Requirements for Master of Science

Oregon Health Sciences University
School of Nursing

Running head: LIPOPROTEIN LEVELS IN FEMALE NURSES

The Relationship Between Aerobic Exercise Habit and Plasma Lipoprotein Levels in Female Nurses: A Follow-up Study

Increasing evidence supports the role of lack of exercise, excess consumption of saturated fats and cholesterol and emotional stress in the pathogenesis of coronary heart disease. Women in the United States have the highest rates of coronary heart disease (CHD) compared with the rest of the world and CHD is the leading cause of death in women with 259/100,000 deaths per year (Gibbons, 1983). In the United States, increasing attention is being given to the importance of CHD for women, and subsequently the importance of identifying potentially modifiable risk factors for coronary disease in women.

Scope of the Problem

Increased blood cholesterol levels are causally related to an increased risk of coronary heart disease. Coronary risk rises progressively with an increase in cholesterol level, particularly when cholesterol levels rise above 200mg/dl (National Institute of Health [NIH], 1989). Investigations have shown that more than half of all Americans fall into this category (Schectman, McKinney, Pleuss and Hoffman, 1990).

Multivariate statistical analysis has shown that high-density lipoprotein (HDL) cholesterol has a protective effect for coronary heart disease (CHD) risk that is about twice as strong as the atherogenic low-density lipoprotein (LDL) cholesterol effect (Kannel, 1987). For every 10 mg/dl increase in HDL cholesterol there is a 50% reduction in risk of coronary heart disease, and it is currently felt that HDL cholesterol appears to be the most important lipid that relates to coronary artery disease risk reduction in women (Bush, Fried and Barrett-Connor, 1988).

Triglycerides (TG) are known to contribute to the atherogenic process and subsequently CHD. Extremely high levels of TG are associated with a high total cholesterol/HDL ratio which is a strong indicator of CHD risk in both sexes. High TG have also been shown to be a highly significant risk factor for CHD in women (Castelli, 1986). In Castelli's assessment of the Framingham Heart Study data TG proved to be a strong predictor of CHD in women over age 50 when their HDL concentration is below 40mg/dl. Some factors associated with elevated TG are: obesity, increasing age, oral contraceptive use, diabetes mellitus, high alcohol intake, liver disease and systemic lupus erythematosus (Castelli, 1986).

Significance for Nursing

A major priority for nursing research identified by the American Nurses' Association is that of promoting health, well-being and the ability to care for one's self (Woods and Catanzaro, 1988). Thus, studies which contribute to the current body of knowledge regarding the interventions which identify, control, or eliminate the major modifiable risk factors for heart disease, e.g., primarily smoking, high cholesterol and high blood pressure, are important to nursing practice.

Heart disease will affect nursing practice and the lives of many individuals for many years to come. It is crucial that nurses work towards the prevention of heart disease, since it accounts for one third of all deaths (Leon, Connett, Jacobs and Rauramaa, 1987).

Nurses may potentially serve as role models for healthful living, whatever the clinical setting may be. Personal health habits can have a great impact on the nurses' credibility when recommending lifestyle changes to the patient population (Pender, 1987).

In addition, nurses have been identified with health promotion and education efforts, and they make up the largest number of workers in the health care field. Therefore, nurses have a prime opportunity to assume an

active role in the evaluation and treatment process for those individuals at risk for CHD due to unfavorable lipid profiles.

A study was conducted among a random sample of 206 nurses from a major academic medical center in New York City to assess the nurses' knowledge, attitudes and practice patterns concerning cholesterol levels and CHD (Wilt, Hubbard and Thomas, 1990). The interest for this study developed in response to the National Cholesterol Education Panel (NCEP) diagnostic guidelines, which recommend that all adults know their total cholesterol levels. Wilt and her associates were looking for a better understanding of the nurses' role in effective participation of the diagnosis and treatment of patients with high cholesterol levels.

The authors concluded that nurses who are relatively more knowledgeable about cholesterol evaluation and management will feel more prepared or confident in their ability to counsel, and will perceive less barriers to counseling. The researchers felt that the personal experience of the nurses who monitored their own cholesterol levels or followed low cholesterol diets contributed to the nurses' knowledge level, and may be a valuable educational tool in preparing nurses to counsel patients.

Purpose of the Study

The purpose of this study is to determine what are the variables that correlate with favorable lipid profiles in nurses that perform deliberate regular aerobic exercise. This study builds on the research of Ralstin and Simmons entitled "Aerobic Exercise Habit and Perceived Work-related Stress in Female Nurses" (1991). The current study will assess the presence of major modifiable risk factors, and correlate it with lipid levels in this same population of hospital staff nurses.

Review of the Literature

Lipoprotein Metabolism

Lipoproteins are dynamic particles that transport lipids in the circulation. These particles are composed of a variety of lipids, including triglycerides, phospholipids, free and esterified cholesterol, and specific proteins known as apolipoproteins. There are five major classes of lipoproteins: chylomicrons, very low-density lipoproteins (VLDL), intermediate-density lipoproteins (IDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL). HDL are divided further into

HDL_2 and HDL_3.

Chylomicrons are produced in the intestine in response to the intake of fat in the diet. The enzyme lipoprotein

lipase (LPL) initiates hydrolysis of the chylomicrons, VLDL and IDL and converts them to small particles that transfer cholesterol esters to the peripheral tissues. During this process TG is removed by lipolysis to form free fatty acids (Schaefer and Levy, 1985).

The enzyme hepatic lipase (HL) plays a role in the metabolism of cholesterol ester-rich lipoproteins. Chylomicron constituents such as apolipoprotein A-I and apolipoprotein A-II, apolipoprotein C and phospholipids are transferred to the HDL particles. Chylomicron remnants that contain apolipoprotein B-48 and apolipoprotein E are taken up in the liver. Apolipoprotein I facilitates the uptake of chylomicron remnants, whereas apolipoprotein C-III inhibits this process (Schaefer and Levy, 1985).

Very low-density lipoprotein synthesis which occurs in the liver is regulated in part by dietary fats and hormones and is inhibited by uptake of chylomicron remnants in the liver. VLDL, TG and phospholipids are hydrolyzed by LPL and HL. In this process some VLDL constituents are transferred to HDL particles while apolipoprotein B-100 remains with the particle. The end products of VLDL catabolism are LDLs. Chylomicrons and VLDL are the major TG carriers in plasma.

About 50-70% of the circulating cholesterol in the blood is carried in LDL. Most LDLs appear to be derived from

catabolism of VLDL. The major protein constituents of LDLs is apolipoprotein B-100. LDLs can be catabolized in various cell types by both receptor-dependent and receptor-independent mechanisms. After binding to their receptors, LDLs are internalized and degraded, and the resultant free cholesterol inhibits the activity of β-hydroxy β-methylglutaryl coenzyme A reductase (HMGR) the rate limiting enzyme in intracellular cholesterol synthesis (Schaefer and Levy, 1985).

The mechanism by which LDL contributes to harmful cholesterol levels can be explained in part by the LDL receptor system. A high intake of animal fat is associated with a high intake of cholesterol. This intake leads to an accumulation of cholesterol in the liver, which in turn decreases the synthesis of LDL receptors (Marinetti, 1990). Diets that consist of high amounts of saturated animal fats increase plasma cholesterol levels by increasing the synthesis of VLDL and decreasing the amount of LDL receptors in the liver. The effect of unsaturated fatty acids is to increase the level of LDL receptors (Marinetti, 1990).

The omega fatty acids (fish oils) have been shown to lower cholesterol levels, although the mechanism is not completely understood. And added effect of the omega fatty acids is their action of inhibiting thrombus formation by

inhibiting platelet aggregation. The impact of dietary cholesterol on plasma cholesterol levels has been studied quite extensively. Dietary cholesterol affects the synthesis of cholesterol in the liver. As the intake of cholesterol rises, there is a negative feedback control of the enzyme HMGR, which action is to regulate the synthesis of cholesterol in the liver (Marinetti, 1990).

Direct production of HDLs occurs in both the liver and the intestines. HDL constituents are also derived from chylomicron and VLDL catabolism. HDLs also serve as acceptors of lipid, especially free cholesterol from the peripheral tissues. HDLs are the substrate for lecithin:cholesterol acyltransferase (LCAT), an enzyme which catalyzes the conversion of both free cholesterol esters and lecithin to lysolecithin (Schaefer and Levy, 1985).

Cholesterol esters are transferred from HDLs to other lipoproteins non-specifically, as well as by a cholesterol ester transfer protein. This process provides core constituents for TG-depleted particles such as the chylomicron remnants. Apolipoprotein A-1 and A-II are the major proteins of HDLs. Concentrations of HDLs in plasma are usually higher in women than in men because of increases in HDL_2. Hepatic lipase is involved in the metabolism of HDL phospholipids and TG. Both the liver and kidney appear to be

major sites of HDL catabolism (Schaefer and Levy, 1985). High TG levels have been shown to decrease the concentration of HDL, and increase levels of chylomicron remnants, VLDL remnants, IDL and LDLs (Grundy and Denke, 1990).

Mechanisms of Atherosclerosis

Many different scientific disciplines have focused their research on the mechanisms of atherosclerosis and have produced substantial evidence in support of the "lipid hypothesis". This hypothesis states that blood lipid levels, particularly total cholesterol and LDL cholesterol are causally related to promoting atherosclerosis and that interventions to lower these lipid levels will slow down or reverse the progression of this process (Wallace and Anderson, 1987).

The development of atherosclerosis involves a very complex process, proceeding over many years. The earliest lesion is a fatty streak commonly found in children which consists of a flat lipid-laden lesion, with macrophages and some smooth muscle (Ross, 1986). The fibrous plaque represents a variety of forms of advanced atherosclerosis. It is made up of intimal smooth muscle cells surrounded by a connective tissue matrix and contains varied amounts of cholesterol, cholesterol esters, and phospholipids. Other components that accumulate in fibrous plaque are live and

dead cells, calcium and proteoglycans (Ross, 1986).

At the lumen of the artery, the lesion is covered by a dense fibrous cap of smooth muscle and connective tissue, and beneath this cap there may be necrotic debris, cholesterol crystals and calcification (Ross, 1986). Substantial research has been conducted which supports the proposal of a "response-to-injury" hypothesis of atherogenesis. This hypothesis proposes that injury to the endothelium, which may be caused by factors such as high blood pressure, high levels of LDL, chemical agents or physical agents such as a balloon catheter, initiate a series of events which lead to the development of an atheroma (Ross, 1986).

At the site of injury the endothelial cells can have a profound effect on monocytes and smooth muscle cells by producing vasoactive agents, growth factors such as platelet derived growth factor (PDGF) and growth inhibitors. It is thought that PDGF is important to atherogenesis because it is chemotactic and mitogenic which can induce both smooth muscle migration and proliferation (Ross, 1986).

Smooth muscle cells are the predominant type of cell in fibrous plaques. They form a large amount of connective tissue matrix, can accumulate lipids, and they also contain

LDL and PDGF receptors. These cells migrate into the intima, ingest LDL and β-VLDL and then proliferate. They also synthesize and secrete collagen, elastin and proteoglycans which form the matrix of fibrous plaque (Ross, 1986).

Platelets are involved in atherogenesis by interacting with endothelium or connective tissue, and platelet aggregation leads to the release of several factors including PDGF, serotonin, epinephrine, thromboxane A-2, adenosine diphosphate and calcium. The matrix of fibrous plaque may enhance platelet binding, leading to platelet aggregation, which results in either plaque growth or a thrombus (Ross, 1986). The occlusion of vital organs by thrombus formation, such as the heart, brain and kidneys is the major process that contributes to the mortality and morbidity of arterial occlusive disease from atherosclerosis.

Monocytes have been shown to have a role in the atherogenic process. Monocytes and smooth muscle cells take up lipoproteins and de-esterify and re-esterify cholesterol, which is important in their ability to become foam cells which proliferate fibrous plaque formation. Diet induced hypercholesterolemia leads to alterations in endothelium and monocytes that lead to increased monocyte adherence, migration of endothelial cells, accumulation of lipids to

form foam cells and gradual accumulation of smooth muscle cells to form fatty streaks (Marinetti, 1990).

Determinants of Cholesterol and Lipoprotein Levels in Women

Cholesterol and lipoprotein concentrations in blood plasma are influenced by many factors. Genetics, dietary cholesterol and saturated fats, alcohol consumption, and aerobic exercise are known to have an influence on lipid levels in women. One of the strongest determinants of cholesterol and lipoprotein concentrations in women are the endogenous and exogenous sex hormones estrogen and progestin, and menstrual cycle phases (Bush, Fried and Barrett-Connor, 1988). Other factors are obesity, drugs, cigarette smoking, seasonal variations and stress.

Genetics. The genetic component of abnormal lipoprotein regulation is a deficiency in LDL, classified as Type I hyperlipoproteinemia. This is an uncommon, familial autosomal recessive disease, where fewer than normal LDL receptors are present on cell surfaces, leading to less LDL entering the cells and more LDL remaining in the circulation and leading to increased plasma LDL levels (NCEP, 1988a). In the American population, only 2% of hypercholesterolemia is associated with a genetic defect.

Dietary Saturated Fats and Cholesterol. The connection between dietary intake of saturated fats and cholesterol and

serum cholesterol levels has been explored for many years. Research in the 1950s looked at the role of dietary cholesterol in humans, but the research reports failed to indicate whether the subjects were male or female. The reports claimed serum cholesterol concentrations in humans respond to specific dietary nutrients such as cholesterol, vegetable and dairy fats (e.g. corn oil, cocoa butter and butter), and carbohydrates (Kinsell, Partridge, Boling, Margen and Michaels 1953; Ahrens, Insull, Tsaltas, Blomstrand and Peterson 1957).

This basic observation continued to be confirmed into the 1960s with systematic investigations on how different nutrients affect levels of serum cholesterol in normal humans (Keys, Anderson & Grande, 1965; Hegsted, McGandy, Myers and Stare, 1965). From these studies, it was discovered that the various kinds and amounts of fats influenced serum cholesterol levels. These studies also brought forth the popular polyunsaturated-to-saturated (P/S) ratio which is used to design a diet where less calories come from saturated fats and more calories are provided from polyunsaturated fats. Through their Family Heart Study, Connor and Connor (1986) collected data from 403 families in hopes of determining the extent to which typical families could modify their dietary intake. To simplify the process

of selecting foods that are both low in cholesterol and saturated fats, they developed a Cholesterol-Saturated Fat Index (CSI). The lower the CSI number, the better the food choice is for preventing heart disease, with a goal of no more than 5 or 6 percent of total calorie intake per day coming from saturated fats.

Recent research studies have focused on the effect of lipids in the diet on plasma lipoproteins, demonstrating a large inter-individual variability in response to cholesterol and saturated fat in the diet (Zanni, Zannis, Blum, Herbert and Breslow, 1987; Edington, Geekie, Carter, Benfield, Ball, and Mann 1989). Zanni and her associates evaluated the effect of corn oil and lard alone or in combination with egg yolk cholesterol on plasma lipids, lipoproteins and apoproteins of nine women. Their sample subjects were 22 to 37 years old, and did not use oral contraceptives, alcohol, or cigarettes. The subjects were given four different diets over a 60-day period, and fasting plasma samples were drawn at the beginning, middle and end of each dietary period.

They found that corn oil and coconut oil had the only significant effect on lipids, lipoproteins and apoprotein E but found no effect when 1 gram per day of cholesterol was added. Saturated fat and cholesterol both increased the

number of LDL particles and the cholesterol content of the LDL particles. This study confirms the previous findings that plasma cholesterol levels can be decreased by reducing the cholesterol content and increasing the polyunsaturated fat content of the diet.

This study involved strict diet protocols and controlled other variables known to affect lipoprotein levels, such as hormone use, alcohol and smoking. The small sample size precludes any conclusions that may be generalizable to other female populations. Their results demonstrated considerable inter-individual heterogeneity in response to diet, which would be expected where measuring parameters in humans subjects. (Zanni et al, 1987). An explanation of this varied response to dietary fats on plasma lipoprotein levels is that some individuals are hyporesponders to dietary cholesterol consumption while others are hyperresponders (Barnard, 1991).

Another study done comparing food intake with plasma lipids was a cross-sectional sample from a large prospective cohort study of men and women eating different diets in Britain (Thorogood, Roe, McPherson and Mann, 1990). This study was designed to examine the relationship between diet and plasma lipids. There were four different diet groups: vegans, vegetarians, fish eaters who do not eat meat, and

meat eaters, with 52 subjects in each group. These investigators controlled for age, sex and body mass index. The subjects kept a four day diet record which was analyzed by a nutrient analysis computer program. The subjects' general practitioner drew their blood for analysis. In this study, there was no significant relationship between total fat intake and plasma total cholesterol concentrations, but there was a relation between the polyunsaturated to saturated fatty acid ratio and plasma total cholesterol values (Thorogood et al, 1990).

To summarize, investigations spanning the past three decades have provided strong evidence that dietary cholesterol and saturated fatty acids raise cholesterol levels, and that saturated fatty acids and cholesterol act synergistically to raise cholesterol levels. Variability in inter-individual responsiveness is a factor needing further clarification, and the mechanisms whereby saturated fatty acids raise LDL levels need further delineation (Grundy and Denke, 1990).

Alcohol. A strong positive relationship between alcohol intake and HDL cholesterol level has been well documented in cross-sectional studies (Gordon, Ernst, Fisher and Rifkind, 1981). The Lipid Research Clinics Program Prevalence Study determined that alcohol consumption is strongly associated

with increased HDL cholesterol in both men and women (Ernst, Fisher, Smith, Gordon, Rifkind, Little, Mishkel and Williams, 1980).

Alcohol intake appears to raise HDL cholesterol and lower LDL cholesterol, a potentially dual protective effect since HDL cholesterol is inversely linked and LDL cholesterol is positively linked to CHD. Social drinkers have mean HDL levels that may be higher than those of abstainers by as much as 30% (Pietinen and Huttunen, 1987). Alcohol consumption is measured from a 7-day retrospective diary, and the smallest amount of alcohol by which significant increases of HDL cholesterol have been observed in clinical experiments is 30 to 40 ml per day (Masarei, Puddey, Rouse, Lynch, Vandongen and Beilin, 1986).

Exercise. There is a considerable amount of evidence that regular physical exercise is beneficial in reducing the risk of coronary heart disease. Overall mortality, cardiovascular mortality, and CHD mortality have been found to be inversely related to deliberate aerobic exercise in a variety of epidemiologic studies (Kannel, Wilson and Blair, 1985). A number of studies have investigated the effect of aerobic exercise on lipid and lipoprotein levels, and while a definite relationship between aerobic exercise and serum lipid levels has not been established, data suggests that

exercise can substantially increase HDL cholesterol while modestly reducing total and LDL cholesterol (Huttunen, Länsimies, Voutilainen, Ehnholm, Hietanen, Penttilä, Siitonen and Rauramaa, 1979; Wood and Haskell, 1979).

The intensity level of physical exercise necessary to significantly increase HDL is unclear. It has been suggested that HDL changes correlate strongly with the quantity of exercise performed over time (Wood and Haskell, 1979). Physical activity of shorter duration has not consistently demonstrated changes in lipid and lipoprotein levels, especially among previously sedentary individuals (Goldberg and Elliot, 1985).

Intervention and prospective studies done on women who exercise have shown inconsistent effects of exercise on the serum lipid profile. However, a cross-sectional investigation involving women runners, joggers and sedentary controls, all around the age of 40, found a highly significant gradient in HDL cholesterol concentrations (Moore, Hartung, Mitchell, Kappus and Hinderlitter, 1983). Multivariate analysis in this study showed that the difference in HDL concentrations could not be attributed to differences in dietary intake or body fat content.

Another cross-sectional analysis, the Lipid Research Clinic Study (Haskell, Taylor, Wood, Schrott and Heiss,

1980) found a consistent relationship between HDL cholesterol and self-report of strenuous exercise habits. This study involved plasma lipoprotein profiles and treadmill testing on 2319 white men and 2067 white women ages 20-70 years old. Each participant's level of habitual physical activity was determined by questions asked during a medical interview before the exercise test. Subjects performed a modified Bruce protocol until they reached 85-90% of their age-adjusted, predicted maximal heart rate. The test was stopped if the subjects became fatigued or if medical contraindications to continued exercise became evident. Bruce protocol is one of the most commonly used treadmill tests for diagnostic purposes and for the determination of VO_2 max., which is used to identify cardiorespiratory fitness (Pollock and Wilmore, 1991)

The men and women at all ages who reported performing some strenuous exercise on a regular basis tended to have higher HDL cholesterol values than those who reported no such exercise. The data from this study indicated that for women, the relationship between self-report of strenuous exercise and HDL cholesterol concentration is independent of its relationship to adiposity, smoking and alcohol consumption ($p=0.02$).

On the other hand, other investigators have been unable to show significant differences in lipid profiles that could be attributed to regular physical exercise. Brownell and associates (1982) found a borderline 4% reduction in total cholesterol concentration and a nonsignificant 4.3% decrease in LDL cholesterol after a 10-week exercise program of 37 women, but no changes in HDL cholesterol. This exercise program consisted of three sessions of aerobic exercise each week, with 15-20 minutes of activity at 70% of maximal heart rate.

A lack of significant changes in lipids after exercise among women in some reports may be attributed to pre-exercise low risk lipid profiles in some subjects. The finding of more favorable lipid and lipoprotein risk factors in women may be due to increased lipoprotein lipase activity, which has been suggested as the difference between men and women after exercise conditioning (Goldberg and Elliot, 1985).

A study carried out by Goldberg et al (1984) demonstrated that weight training with gym equipment increased the mean value of HDL from 77.4 mg% before training to 81.1 mg% after training in women. The men increased their HDL level from 50.6 mg% before training to 58.6 mg% after training. This study measured lipid and

lipoprotein levels in previously sedentary men (mean age, 33 years) and women (mean age, 27 years) who completed 16 weeks of weight-training exercise.

Overall, the findings on exercise and its effect on lipid profiles are inconclusive. The small sample sizes, a dearth of studies involving women, and the lack of controlling for confounding variables such as diet, alcohol consumption, and medication use limit the conclusions that can be drawn.

Endogenous and Exogenous Sex Hormones. Endogenous and exogenous sex steroid hormones have been shown to influence plasma lipoprotein levels in women. Cyclic changes in lipids during the normal menstrual cycle have been reported (Lussier-Cacan, Xhignesse, Desmarais, Davignon, Kafrissen and Chapdelaine, 1991). Lipid values are at their lowest during the menstrual phase and peak values are increased during the middle to late part of the follicular phase.

Other observations have not shown any fluctuations in HDL and LDL throughout the menstrual cycle (Lebech, Kjaer and Lebech, 1990). These discrepancies highlight the importance of performing the blood sampling once per cycle during the menstrual phase in order to miss any cyclic fluctuations in blood lipids.

Another factor influencing lipoprotein levels in women is the use of exogenous sex hormones. It is estimated that between 10 and 15 million women in the United States use oral contraceptives (OCs) and about 4 million women are receiving hormonal replacement therapy (Burkman, 1988). Several studies have established a relationship between oral contraceptives and changes in lipid and lipid profiles, thus linking oral contraceptives with an increased cardiovascular risk (Burkman, 1988; Burkman, Robinson, Kruszon-Moran, Kimball, Kwiterovich and Burford, 1988; Fotherby, 1985; Knopp, Walden, Wahl and Hoover 1982).

Among current oral contraceptive users, clinical coronary heart disease is quite rare. The risk of coronary heart disease appears to be significant only in women over 35 years old and particularly if they are smokers (Fotherby, 1985). Studies done in the past demonstrating increased risk of myocardial infarction among current users of oral contraceptives involved preparations containing doses of estrogen and progestin that were 3-4 times higher than those in current use.

In an analysis of several studies that looked at the effect of oral contraceptives on serum lipid concentrations, Fotherby (1985) found it difficult to determine if variations were due to the oral contraceptives formulations

or individual variation. Serum cholesterol and LDL concentrations are increased by preparations such as Ovral and Ortho-Novum and this effect may be related to the progestin component of the pill (Fotherby, 1985).

Knopp and his associates (1982) found that women taking high-progestin contraceptives have higher LDL-cholesterol levels than women taking preparations with less progestin and that five out of six oral contraceptives significantly elevated the triglyceride/cholesterol ratio of LDL particles.

The total effect of an oral contraceptive on HDL-cholesterol is determined by the estrogen/progestin ratio (Tikkanen and Nikkilä, 1986). HDL is decreased when progestin dose or potency increases, while an increased estrogen dose raises HDL levels. Therefore, it is important to know the oral contraceptive formulation, as studies have reported some preparations will increase HDL, whereas others will decrease HDL or not significantly change it (Tikkanen and Nikkalä, 1986).

Another factor influencing lipoprotein levels in women using oral contraceptives is the contraceptive cycle. Demacker and his associates (1982) studied fluctuations in serum lipoprotein concentrations within one cycle both in women using and not using oral contraceptives. In women

using oral contraceptives, HDL-cholesterol dropped from 57mg/100ml to 50mg/100ml ($p<0.05$) and rose again to the initial level during the pill-free days.

Hormone replacement therapy (HRT) for post-menopausal women is another factor which can influence lipoprotein levels. Changes associated with HRT have not been widely studied. Burkman (1988) in his review of lipids and lipoprotein changes in relation to oral contraceptives and HRT, found seven out of eight case-control studies and four of six cohort studies suggest beneficial changes in lipid levels with HRT. Oral estrogens tend to have a favorable effect on serum lipids and lipoproteins, and in most studies, HDL is elevated and LDL is lowered (Burkman, 1988).

Following a cohort of 2270 white women for 8.5 years, Bush and her associates (1987) found those subjects on HRT to have significantly higher HDL (67 vs 57mg/dl) and significantly lower LDL (145 vs 156mg/dl) than those subjects not using estrogens. Their analysis of the association between estrogen use, lipoprotein levels and cardiovascular disease suggest that estrogen's protective effect is mediated through estrogen-induced increases in HDL (Bush, Barrett-Connor, Cowan, Criqui, Wallace, Suchindran, Tryoler and Rifkind, 1987). The mechanisms for estrogen's effects on lipid levels is not fully understood, and further

research in this field is necessary before definitive recommendations will be made for clinical applications.

Stress. The impact of stressful life events on serum lipid levels has been studied through a variety of approaches over the years. Recent studies done on the effect of shift work with employees who work for several years in rotating day and night shifts have indicated that there may be an increase in CHD in these shift workers (Knutsson, Åkerstedt, Jonsson and Orth-Gomér, 1986). In this research of a sample of 504 papermill workers who were followed up for fifteen years, there was an association between shift work which involves rotating day and night shifts, and high risk of CHD that was independent of age and smoking history.

In a literature review of sixty studies looking at the effects of emotional arousal on plasma lipids, Dimsdale and Herd (1982) concluded that there is a strong association between emotional arousal and plasma lipids. The cholesterol levels increased from 8 to 65% under stressful conditions, and free fatty acid levels increased from 5 to 150%. The majority of these studies included male subjects, such as medical students, race car drivers, novice flyers, accountants, and military personnel. Interest in this area of research has moved away from examining the physiology and stress and lipid measures, to studying the consequences of

more enduring personality traits such as Type A behavior, and the effect of dietary factors on lipid levels.

A research study designed to compare the stress reactions between men and women at work analyzed the responses of 49 men and 99 women in professional occupations. The stratification of occupations of the respondents was not provided in the findings. Subjects were asked to indicate their physiological responses to stress, which were categorized into the musculo-skeletal system, cardiovascular system, respiratory system, gastrointestinal system, immune system and other (Rossi and Lubbers, 1989).

The respondents identified the musculo-skeletal system (60.4%) and cardiovascular system (20.8%) as the most prevalent physiological response to stressors at work. The researchers found a high positive relation between the responses of men and women, and determined that men and women are similar concerning physiologic responses to stress. One difference they found was that women reported a greater percentage of physiological responses (men 32% of the responses, females 68% responses). These results are important to the nursing workforce, in that these findings may help nurses to understand the physiological responses to stress which may be related to the occupation of nursing.

In another recent study investigating the impact of stress on plasma lipid levels, TC, TG, VLDL, LDL, and HDL were measured along with the subjects' dietary intake and self-reported stress and workload. The subjects were fourteen employees, 3 men and 11 women (McCann, Warnick and Knopp, 1990). Increases in total plasma cholesterol were significantly positively correlated with increases in perceived stress ($p<0.05$) and perceived workload ($p<0.01$). The dietary assessment data in this study revealed that during high workload subjects consumed more calories, total fat, and saturated fat and a greater percent of calories from total fat than during low workload.

Another study looking at the effect of psychological factors on variations in serum cholesterol levels, investigated the response of male and female students during examination stress (VanDoornen and Blokland, 1987). They found that anticipation of an exam induced a significant rise in cholesterol levels in the male subjects, but in the females there was no relationship at all between cholesterol measures and psychological variables.

Further research into the physiological responses to stress may help to identify individuals who are prone to developing cardiovascular disease, and help direct future

efforts in the health promotion and disease prevention arena of health care.

Obesity. Evidence has been accumulating that obesity is related to abnormal lipid metabolism and can be predictive of an increased risk of CHD (Grundy and Denke, 1990). In many studies body mass is positively correlated with total cholesterol and inversely associated with HDL cholesterol in both men and women. These correlations are independent of age, smoking, alcohol intake and the use of estrogens (Bush et al, 1988). There is also evidence demonstrating a positive correlation of total cholesterol, triglycerides, apo B and an inverse association with levels of HDL cholesterol when the proportion of body fat is greater in the trunk than in the extremities (Bush et al, 1988). Studies have reported that exercise accompanied by decreased body weight was associated with decreases in cholesterol levels and increases in HDL levels (Tran and Weltman, 1985).

Medications. Numerous medications have been noted to adversely affect lipid and lipoprotein levels. Sulfonylureas and beta blockers may decrease HDL (Fotherby, 1985). Anabolic androgens decrease HDL; cyclosporins and hydrochlorothiazide increase triglycerides; glucocorticoids increase VLDL, TG and apo B; and donazol and lynestrenol which are used to treat endometriosis have been shown to

decrease HDL and apo A and increase LDL (Dukes and Beeley, 1990). Probucol which is used to treat hypercholesterolemia, may cause a rise in serum TG concentration (Davies, 1989).

There are many efficacious lipid-lowering drugs used in the treatment of lipoprotein disorders such as cholestyramine, nicotinic acid, gemfibrozil and lovastatin (Talbert, DiPiro, Hayes, Yee, and Posey 1989). Drugs known to increase HDL include: nicotinic acid, clofibrinate, phenytoins, barbiturates, blutethinnide and pesticides (Fotherby, 1985).

Smoking. The association between smoking and blood lipid profiles is complex at best, and results from studies examining this association are inconclusive (Bush, Fried and Barrett-Connor, 1988). For the purpose of the study proposed here, smokers were excluded from the sample, so further discussion of this association will be excluded.

Seasonal variation. Seasonal plasma lipid and lipoprotein cycles have been examined, and several studies have suggested cholesterol levels are higher in the fall and winter than in the spring and summer (Fager, Wiklund, Olofsson and Bonkjers, 1982; Gordon, Hyde, Trost, Whaley, Hannan, Jacobs and Ekelund, 1988). An analysis of the lipid cycles in the Lipid Research Clinics Coronary Primary Prevention Trial, which is a cohort of 1,446

hypercholesterolemic 35-39 year old men followed for 7 years, found a seasonal cycle of high TC, LDL and HDL in December and January and low levels in June and July. The researchers noted a distinct trend towards smaller amplitudes in the lipid levels at the northern centers, and larger amplitudes in the region with the greatest mean in the summer and winter temperature differences (Gordon et al, 1988).

In summary, measuring lipid profiles provides the clinician or researcher with a snapshot picture of the individual's lipid metabolism at one moment in time. The complexity of the body's mechanisms for manufacturing and metabolizing and transporting lipids can be influenced by numerous intervening variables. This review has outlined those which are presently thought to have the greatest impact on lipid profiles. In addition to understanding the impact of these individual variables, there is the opportunity to determine an individual's potential risk for coronary heart disease, and thus take appropriate measures towards decreasing that risk by decreasing or eliminating the modifiable variables.

Research Question

The hypothesis for this study is that the study sample of exercising nurses will have more favorable lipid profiles

than the sedentary controls. A favorable lipid profile would consist of a total cholesterol of less than 200 mg/dl, an HDL of greater than 50 mg/dl, and/or a total/HDL cholesterol ratio of 3.5, and a triglyceride level of less than 135mg/dl for women, and less than 145 mg/dl for men (NCEP, 1988b).

Study Design

The previous study design on which this study was based was a non-experimental, static two group comparison. A convenience sample of nurses currently exercising and nurses not currently exercising were recruited from one university hospital. The two groups of nurses were compared as to their perceived levels of work-related stress.

Sample of the First Study

The sample of 40 nurses, 20 in each group by self-description, was drawn from one acute health care agency. This number was chosen to allow for attrition and application of appropriate statistics to evaluate the findings. Nurses from five adult care units were invited to participate through direct invitation at staff meetings, and through fliers, hospital newsletters, and referrals.

Nurses eligible for the study were involved in direct patient care of adult clients in an acute care setting and employed full-time ($\geq$0.8 FTE) in their current position for a minimum of one year. All participants were female, between

the ages of 20 to 50 years of age. They were non-smokers for the past 12 months and free of chronic illnesses that could interfere with their ability to exercise and perform a cycle ergometry test. None of the subjects had been pregnant within one year prior to the beginning of the study.

The sample was divided into exercise and non-exercise groups using a one-week prospective diary in which exercise frequency, type, duration, and achieved maximum heart rate were recorded. Each subject indicated the length of time in months that this pattern had lasted and whether the one-week diary was consistent with her customary exercise program or how the usual exercise activity pattern differed. A training index was then calculated on each subject, and subjects with scores equal to or greater than 42 were included in the exercise group; those with scores less than 42 were considered non-exercisers.

Selection bias was minimized by recruiting nurses from one health care agency and from similar work areas within that agency. Threats to external validity in the primary study may be affected by the reaction and the novelty of being involved in the study.

Study Results

Ralstin and Simmons found high intercorrelations between their fitness measures ($p<0.0001$) and the three

stress measures ($p<0.0001$). The groups' clinical workload and demographic characteristics were the same. The exercisers had higher VO_2 max ($p=0.002$) and fitness category ($p<0.0001$), lower percent body fat ($p=0.0002$); perceived less stress (JSS $p=0.02$, STAI $p=0.0005$), and had lower hassles frequency ($p=0.04$) and severity ($p=0.02$) than non-exercisers. 12.4% of the variance on the job stress scale was accounted for by exercise alone. They concluded that exercise can effectively modulate the perception of job-related stress in female nurses.

Design for Follow-up Study

The design chosen for this follow-up study is quantitative, descriptive and correlational. The threats to this study's internal validity are: instrumentation error, selection bias, subject recall, and attrition.

The sample will include subjects from the sample of the first study. They will be asked by informed consent to complete a brief health history questionnaire, which will include medical, menstrual cycle, family disease and medication information. They will be asked to complete a 4-day food and beverage intake record, have two separate analyses of their plasma lipid profile, complete a 7-day aerobic exercise diary, complete two stress questionnaires, have two blood pressure readings taken, and have skin fold

measurements obtained. See appendix A for a table comparing the measurements taken in the first study and the second study.

Follow-up Study Data Collection Methods

Health History Questionnaire

Information regarding the subjects' health history will be obtained by questionnaire. In addition to the data previously collected on these subjects, the questionnaire will include: medical history information, menstrual cycle history, family history, history of high cholesterol, and medication use (See Appendix B).

Food and Beverage Information

Food and beverage intake information will be obtained by having the subjects' complete a prospective 4-day intake record. They will be given a food and beverage record and complete instructions as to how to accurately record everything they eat or drink for four days. The time of the meal, quantity of food, type of food (fresh or prepared, including brand names) will be included on the record. Specific directions will be given in regards to the method of food and beverage descriptions (See Appendix C).

A study of 252 diet records of 18 outpatients attending a lipid clinic was carried out in order to determine the least number of day-set records that would accurately

monitor calories and lipids of clinic outpatients (Jackson, Dujovne, DeCoursey, Beyer, Brown & Hassanein 1986). Each subject recorded their food intake for 14 consecutive days. From 11 possible combinations of 4 day-sets of records, all but three were considered the minimum required for a 95% confidence limit of the mean for calories, cholesterol, saturated fat and polyunsaturated fat. Consequently, 4 consecutive days of diet records was chosen for this study as an acceptable level of food intake recordings for analysis.

The validity of self-report data may be influenced by systematic error, e.g., accurate measurements; or response sets, social desirability and education level of the respondents. The reliability of the food records will be minimized by one investigator coding the data. The food and beverage records will be analyzed using Nutritionist III, version 7.0 (N-Squared Computing, Salem, OR). This computerized diet analysis program has a database of 5,000 foods including raw materials, ready-to-cook foods, fast foods, frozen dinners and snack foods.

Blood Lipid Profile

Lipid profiles will be determined on these subjects following the guidelines established by the NCEP (NCEP, 1988b). Five milliliters of plasma will be collected during

the subjects' menstrual cycle and after the subjects have fasted for 12 hours, and plasma will be drawn on two separate dates for a total of ten milliliters. Subjects will be advised to avoid heavy exercise, alcohol consumption and any major diet changes for 48 hours prior to blood collection.

During their blood draw, subjects will be seated for at least 5 minutes before collection, and the tourniquet will be removed within one minute. The blood specimens will be frozen and run together for batches analysis by Physicians Medlab facility in Portland, Oregon. The profile will include an analysis of TC, TG, HDL, and a calculated VLDL and LDL.

Aerobic Exercise Information

Activity patterns of all subjects will be evaluated by a one week prospective self-report exercise diary. The diary will include recording of the type, frequency, duration and mode of exercise, and the maximum heart rate achieved. Subjects will be instructed in one method for measuring their maximal heart rate with a 10-second pulse count method (See Appendix D).

Stress Measurement

To control for the effect of stress on the alteration of lipid levels, two stress scales will be used in this

study. The Hassles Scale (Appendix E) by Kanner, Coyne, Schaefer and Lazarus (1981) will be completed by the subjects. This scale was also used in the previous study of this sample. This 117-item scale asks respondents to indicate occurrences which have hassled them in the past month. Each hassle is rated on a three-point scale: "somewhat", "moderate", or "extreme", and frequencies and intensities will be determined from this measure. The scale has a high test-retest reliability with an average correlation of .79 between adjacent months over a nine-month period for hassles frequency, and .48 for intensity (Kanner et al, 1981).

Another stress scale used in the first study of these nurses was the Job Stress Scale (Appendix F). This scale will be included as a measurement in this follow-up study. This 49-item Likert scale developed by Bailey and Claus (1977-78) and modified by Hinshaw and Atwood (Atwood, 1990) is designed to measure work-related stress. The scale includes items such as decision-making, confidence in abilities and level of clinical knowledge, and coping abilities. A scale standard alpha of .86 and theta of .87 was reported to indicate moderate to strong reliability and construct validity with this four-point scale.

Blood Pressure Measurement

Blood pressure measurements will be taken twice on separate dates on all subjects to see how the two groups compare in regards to their resting blood pressures. The guidelines from the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (Joint National Committee, 1988) will be closely followed and are listed below:

- Subjects will be seated with their arm bared, supported, and positioned at heart level. They should not have smoked or ingested caffeine within 30 minutes prior to measurement.
- Measurement will begin after five minutes of quiet rest.
- The appropriate cuff size will be used to ensure an accurate measurement. The rubber bladder should encircle at least two thirds of the arm.
- Measurements will be taken with a recently calibrated aneroid manometer.
- Both the SBP and DBP will be recorded. The disappearance of sound (phase V) will be used for the diastolic reading.
- Two readings will be taken on two separate occasions, and the readings will be averaged.

Skin Fold Measurements

Skin fold measurements will be obtained to compare with the measurements previously taken during the primary study. Calipers will be used to measure skinfolds at the triceps, abdomen, and suprailium, and the sum of these skinfolds in millimeters together with the subject's age and weight will be used to estimate percent of fat (Jackson and Pollock, 1985).

Potential threats to internal validity will be minimized by limiting the data collectors to the primary investigator. This investigator will be trained and will utilize a uniform approach to data collection and analysis of the data during the entire data collection period.

Research Procedures

Pending approval by the Human Subjects' Committee, the study subjects will be accessed by obtaining a list of the primary study participants from the original investigators. Written informed consent will be obtained from each subject prior to data collection, with a complete explanation of the purpose of the follow-up study, procedures and risks involved (Appendix G). Testing will be done at various locations near the subjects' worksites.

Analysis of Follow-up Study Data

The primary focus of this proposed study is the

distribution of the lipid profiles of the two groups of nurses. The exercise habit, intake records, medical history, use of medications and stress measures will be examined as potential factors to explain any variance in the subjects' lipid profiles. Descriptive statistics (e.g., means, modes, medians and standard deviations) will be calculated for each group and for the total sample. Inferential statistical methods, including multivariate analyses will also be utilized for data analysis.

Utilization of Findings

With heart disease remaining the number one cause of mortality for women in the United States, the results of this proposed research project could offer insight into which risk factors contribute to an individual's overall cardiovascular risk. By determining the independent contribution of physical activity on an individual's lipid profile, we may gain further understanding of how regular physical activity contributes to improved cardiovascular health.

Exercise is one risk factor for CHD that carries great potential for modification. A broad consensus now exists in the health care community that regular exercise is beneficial to maintaining a healthy system. This results of

this study may help to build a stronger case for promoting the health benefits of exercise.

The major Framingham Heart Study has demonstrated that lipid profiles play a central role in predicting coronary risk (Kannel, 1987). By measuring the lipid profiles of nurses in clinical practice settings, we may increase their individual awareness of the importance of detecting, treating and managing high blood cholesterol. This knowledge may in turn enhance their clinical efforts with patient education and assist them with making appropriate recommendations for lifestyle changes for those patients at risk.

In the long run, this project may motivate nurses to become more knowledgeable regarding the current dietary recommendations and exercise guidelines for their own personal benefit and for their patient populations at risk for coronary heart disease. With the incidence of heart disease on the rise for women, health care professionals need to look closely at how they can maintain an active role in reversing this trend.

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Appendix A

Table of Measurements

TABLE OF MEASUREMENTS

PRIMARY STUDY	CURRENT STUDY
Measurements that are the same	
Height and Weight	Height and Weight
Shift Work	Shift Work
Exercise Habits	Exercise Habits
One Week Exercise Diary	One Week Exercise Diary
Job Stress Scale	Job Stress Scale
Hassles Scale	Hassles Scale
Skin Fold Measurements	Skin Fold Measurements
Past Health History	Past Health History
Measurements that are different	
Demographics	Four Day Food & Beverage Intake
Bicycle Ergometry Test	Blood Lipid Information
State/Trait Anxiety Inventory	Father & Mother Health History
General Activity (Paffenbarger)	Medications
	Reproductive History Information
	Blood Pressure Measurements
	Two Lipid Profiles
	Present Health History

Appendix B

Questionnaires

LIPOPROTEIN DISTRIBUTION STUDY IN FEMALE NURSES

QUESTIONNAIRE **PAGE 1**

A. Background Information

I.D. Number_____Sex_____Race_____

Age_____ Height_____(inches) Weight_____(pounds)

Length of Employment on Current Unit_____ Unit name _____

Usual Hours You Work _____

Hours of Shift(s) Worked in the Past Month _____

B. Past and Present Medical History

Has your physician ever diagnosed you as having any of the following: (Please check all that apply.)

	NO	YES	Year of onset
1. Coronary heart disease	_____	_____	_____
2. High blood pressure	_____	_____	_____
3. Diabetes mellitus	_____	_____	_____
4. Thyroid disease	_____	_____	_____
5. Other major disease	_____	_____	_____

(Please list the disease) _____

C. Blood Lipid Information

If you have had your cholesterol level drawn in the past, and know your lab values, please list them here:

Total Cholesterol_____(mg/dl) Date of test:_____

LDL_____(mg/dl)

HDL_____(mg/dl)

Triglycerides_____(mg/dl)

Have you ever been told you have any of the following blood lipid disorders:

	NO	YES	Date of test
6. Hypercholesterolemia (High cholesterol)	_____	_____	_____
7. Hypertriglyceridemia (Hightriglycerides)	_____	_____	_____

D. Father's Health History

a. Age if alive_____ or b. Age at death_____

c. Cause of death_____

	NO	YES	AGE OF ONSET
d. Coronary heart disease	_____	_____	_____
e. Stroke	_____	_____	_____
f. High Blood Pressure	_____	_____	_____
g. Diabetes Mellitus	_____	_____	_____
h. Hypercholesterolemia	_____	_____	_____
i. Obesity	_____	_____	_____

E. Mother's Health History

a. Age if alive_____ or b. Age at death_____

c. Cause of death_____

	NO	YES	AGE OF ONSET
d. Coronary heart disease	_____	_____	_____
e. Stroke	_____	_____	_____
f. High Blood Pressure	_____	_____	_____
g. Diabetes Mellitus	_____	_____	_____
h. Hypercholesterolemia	_____	_____	_____
i. Obesity	_____	_____	_____

Please check any of your blood relatives who have been diagnosed with hypercholesterolemia.

Paternal grandmother	[ ]	Paternal aunt	[ ]
Paternal grandfather	[ ]	Paternal uncle	[ ]
Maternal grandmother	[ ]	Maternal aunt	[ ]
Maternal grandfather	[ ]	Maternal uncle	[ ]
Siblings	[ ]		

F. Medications

Please list any medications you are currently taking. Include prescription drugs, over-the-counter medications and vitamin and mineral supplements.

Medication (Generic and Brand Name)	Dosage	Frequency
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

G. Reproductive History

Menstrual cycle history: Please check one. My usual menstrual cycle is:

Less than 21 days between periods	[ ]
Between 21 and 34 days	[ ]
More than 34 days	[ ]

	YES	NO
Any possibility that you could be pregnant now?	_____	_____
Are you currently taking oral contraceptives?	_____	_____

If yes, please list by brand name _____

How long have you been taking this? _____months_____years

	YES	NO
Are you currently experiencing menses on a regular basis?	_____	_____
Have you ever had your ovaries surgically removed?	_____	_____
Have you experienced a sudden change in the regularity of the onset of your menstrual cycle?	_____	_____
Any change in the quantity or quality or duration of your menstrual flow?	_____	_____
Are you currently taking estrogens or pills for hot flashes or other menopause-related symptoms?	_____	_____
Are you currently taking estrogens or pills for regulating your periods?	_____	_____

H. Exercise Patterns

How many days a week are your exercising?

(Please check the box which is the closest match to your weekly exercise program)

zero to one	[ ]	four to five	[ ]
one to two	[ ]	five to six	[ ]
two to three	[ ]	six to seven	[ ]
three to four	[ ]		

How long do you exercise per session? _____minutes

QUESTIONNAIRE **PAGE 5**

When you are exercising in your usual fashion, how would you rate your level of exertion (degree of effort)?

Please circle one number

Very weak	1
Weak	2
Moderate	3
Somewhat Strong	4
Strong (heavy)	5
	6
Very Strong	7
	8
	9
Very, Very Strong Almost maximal	0

Score the type of exercise with 1 being the most frequent type of exercise you perform each week, 2 the second most frequent, etc.

Walking_____

Running_____

Bicycling_____

Stepper_____

Aerobic Dance___

Other_____

Please complete the enclosed "Exercise Record" following the instructions included with the record.

I. Food and Beverage Intake Information

Please complete the enclosed "Food and Beverage Intake Record" following the instructions included with the record.

Are you on a special diet? _____ If yes, please describe.

_____

Has your diet changed in the last six months? _____

If yes, explain. _____

_____

Have you had a large increase or decrease in your weight over the last six months? _____ If yes, please record your weight gain or loss _____.

Alcohol Consumption

Please record your average weekly consumption of the following alcoholic beverages. If none, record zero.

_____ ounces Beer per week

_____ ounces Wine per week

_____ ounces of 80-100 proof spirits per week

Are you an abstainer or a usual drinker? _____

Has this pattern of consumption increased or decreased over the

last six to twelve months? _____ If yes, explain.

_____

K. Stress Patterns

Please complete the enclosed stress questionnaires following the instructions included with the questionnaires.

Appendix C

Food and Beverage Intake Record

FOOD AND BEVERAGE INTAKE RECORD

ID Number: _____ Date: _____

Instructions:

You will need to keep an accurate recording of everything you eat or drink for four days, and then return the forms to researcher in the envelope provided. Your food and beverage intake will be analyzed using a computer program, and a copy of the results will be returned to you.

If you have any questions, PLEASE CALL **LAURA BRAATEN** (Graduate Nurse Research Student).

* It is very important that you do not change your usual eating and drinking patterns, and that you record everything! This will contribute to the accuracy of our research data, and provide you with a more accurate picture of the content of your diet.

* List the name brands of your food and beverage products as often as you can. Be very specific as to the type of food item.

* Use a separate sheet to record each day's intake.

TO ESTIMATE YOUR PORTION SIZES:

A. Beverages can be measured in ounces or cups (1/4, 1/3, 1/2, 3/4, 1).
B. Fats (butter, margarine, salad dressing, oils, mayonnaise) and spreads (jams, jellies) can be measured in teaspoons or tablespoons.
C. Fruits, vegetables, if frozen, canned or cooked and rice, pastas (cooked) be measured in tablespoons, or cups (1/4, 1/3, 1/2, 3/4, 1).
D. Fruits, vegetables if fresh or raw, can be estimated as small, medium, or large with a measurement of diameter or length. For example, 1 medium banana (7 inches long).
E. For amount record food and drink in measures such as: Teaspoon, tablespoon, cup, slice, piece, each, ounces, pounds, grams.

FOOD AND BEVERAGE INTAKE RECORD

Date/Time	Food Item (Indicate fresh, canned, frozen, method of cooking)	Homemade (H) or Purchased (P) (Brand name)	Amount (Indicate ounces, cups, tsp., etc.)

Appendix D

Exercise Record

EXERCISE RECORD

ID Number: _____ Date: _____

Instructions:

You will need to keep an accurate recording of your exercise program for one full week.

* It is very important that you do not change your usual exercise pattern, and that you record your minutes of exercise and heart rate accurately.

* To record the "exercise type" use the codes listed at the bottom of the record.

* When taking your maximum heart rate, take a 10 second pulse count and multiply by six.

PHYSICAL ACTIVITY RECORD

		MINUTES			HEART RATE		
DATE	Exercise Type	Warm-up	Exercise	Cool-down	Resting	Maximum	Comments

EXERCISE CODES:

W	Walking	TM	Treadmill
R	Running	ST	Stepper
B	Bicycling	CC	Cross Country Ski Machine
SB	Stationary Bicycling	O	Other (Please describe)

PERCEIVED EXERTION SCALE

Weak	2	Strong	5
Moderate	3		6
Somewhat Strong	4	Very Strong	7

Appendix E

Hassles Scale

The Hassles Scale

Directions: Hassles are irritants that can range from minor annoyances to fairly major pressures, problems, or difficulties. They can occur few or many times.

Listed in the center of the following pages are a number of ways in which a person can feel hassled. First, circle the hassles that have happened to you in the past month. Then look at the numbers on the right of the items you circled. Indicate by circling a 1, 2, or 3 how SEVERE each of the circled hassles has been for you in the past month. If a hassle did not occur in the last month do NOT circle it.

	HASSLES	SEVERITY 1. Somewhat severe 2. Moderately severe 3. Extremely severe		
(1)	Misplacing or losing things.....	1	2	3
(2)	Troublesome neighbors.....	1	2	3
(3)	Social obligations.....	1	2	3
(4)	Inconsiderate smokers.....	1	2	3
(5)	Troubling thoughts about your future.....	1	2	3
(6)	Thoughts about a death.....	1	2	3
(7)	Health of a family member.....	1	2	3
(8)	Not enough money for clothing.....	1	2	3
(9)	Not enough money for housing.....	1	2	3
(10)	Concerns about owing money.....	1	2	3
(11)	Concerns about getting credit.....	1	2	3
(12)	Concerns about money for emergencies.....	1	2	3

HASSLES SCALE

	HASSLES	SEVERITY (1. Somewhat severe 2. Moderately severe 3. Extremely severe)		
(13)	Someone owes you money.....	1	2	3
(14)	Financial responsibility for someone who doesn't live with you.....	1	2	3
(15)	Cutting down on electricity, water, etc..	1	2	3
(16)	Smoking too much.....	1	2	3
(17)	Use of alcohol.....	1	2	3
(18)	Personal use of drugs.....	1	2	3
(19)	Too many responsibilities.....	1	2	3
(20)	Decisions about having children.....	1	2	3
(21)	Non-family members living in your house..	1	2	3
(22)	Care for pet.....	1	2	3
(23)	Planning meals.....	1	2	3
(24)	Concerned about the meaning of life.....	1	2	3
(25)	Trouble relaxing.....	1	2	3
(26)	Trouble making decisions.....	1	2	3
(27)	Problems getting along with fellow workers	1	2	3
(28)	Customers or clients give you a hard time	1	2	3
(29)	Home maintenance (inside).....	1	2	3
(30)	Concerns about job security.....	1	2	3
(31)	Concerns about retirement.....	1	2	3
(32)	Laid-off or out of work.....	1	2	3
(33)	Don't like current work duties.....	1	2	3
(34)	Don't like fellow workers.....	1	2	3
(35)	Not enough money for basic necessities...	1	2	3

HASSLES SCALE

HASSLES	SEVERITY 1. Somewhat severe 2. Moderately severe 3. Extremely severe		
(36) Not enough money for food.....	1	2	3
(37) Too many interruptions.....	1	2	3
(38) Unexpected company.....	1	2	3
(39) Too much time on hands.....	1	2	3
(40) Having to wait.....	1	2	3
(41) Concerns about accidents.....	1	2	3
(42) Being lonely.....	1	2	3
(43) Not enough money for health care.....	1	2	3
(44) Fear of confrontation.....	1	2	3
(45) Financial security.....	1	2	3
(46) Silly practical mistakes.....	1	2	3
(47) Inability to express yourself.....	1	2	3
(48) Physical illness.....	1	2	3
(49) Side effects of medications.....	1	2	3
(50) Concerns about medical treatment.....	1	2	3
(51) Physical appearance.....	1	2	3
(52) Fear of rejection.....	1	2	3
(53) Difficulties with getting pregnant.....	1	2	3
(54) Sexual problems that result from physical problems.....	1	2	3
(55) Sexual problems other than those resulting from physical problems.....	1	2	3
(56) Concerns about health in general.....	1	2	3

HASSLES SCALE

	HASSLES	SEVERITY 1. Somewhat severe 2. Moderately severe 3. Extremely severe		
(57)	Not seeing enough people	1	2	3
(58)	Friends or relatives too far away	1	2	3
(59)	Preparing for meals	1	2	3
(60)	Wasting time	1	2	3
(61)	Auto maintenance	1	2	3
(62)	Filling out forms	1	2	3
(63)	Neighborhood deterioration	1	2	3
(64)	Financing children's education	1	2	3
(65)	Problems with employees	1	2	3
(66)	Problems on job due to being a woman or man	1	2	3
(67)	Declining physical abilities	1	2	3
(68)	Being exploited	1	2	3
(69)	Concerns about bodily functions	1	2	3
(70)	Rising prices of common goods	1	2	3
(71)	Not getting enough rest	1	2	3
(72)	Not getting enough sleep	1	2	3
(73)	Problems with aging parents	1	2	3
(74)	Problems with your children	1	2	3
(75)	Problems with persons younger than yourself	1	2	3
(76)	Problems with your lover	1	2	3
(77)	Difficulties with your hearing	1	2	3
(78)	Overloaded with family responsibilities	1	2	3
(79)	Too many things to do	1	2	3

HASSLES SCALE

	HASSLES	SEVERITY 1. Somewhat severe 2. Moderately severe 3. Extremely severe		
(102)	Hassles from boss or supervisor.....	1	2	3
(103)	Difficulties with friends.....	1	2	3
(104)	Not enough time for family.....	1	2	3
(105)	Transportation problems.....	1	2	3
(106)	Not enough money for transportation.....	1	2	3
(107)	Not enough money for entertainment and recreation.....	1	2	3
(108)	Shopping.....	1	2	3
(109)	Prejudice and discrimination from others.	1	2	3
(110)	Property, investments or taxes.....	1	2	3
(111)	Not enough time for entertainment and recreation.....	1	2	3
(112)	Yardwork or outside home maintenance.....	1	2	3
(113)	Concerns about news events.....	1	2	3
(114)	Noise.....	1	2	3
(115)	Crime.....	1	2	3
(116)	Traffic.....	1	2	3
(117)	Pollution.....	1	2	3

HAVE WE MISSED ANY OF YOUR HASSLES? IF SO WRITE THEM IN BELOW:

(118) ---------- 1 2 3

ONE MORE THING: HAS THERE BEEN A CHANGE IN YOUR LIFE THAT AFFECTED HOW YOU ANSWERED THIS SCALE? IF SO, TELL US WHAT IT WAS:

Appendix F

Job Stress Scale

Subject Identification_____

Job Stress Scale

For each numbered item below, mark the appropriate response

A = Almost Always
F = Frequently
O = Occasionally
R = Rarely

1. The immediate supervisor respects my judgment. . . . . A F O R
2. My knowledge is respected by co-workers. . . . . A F O R
3. I feel as if I am used to fill an empty slot. . . . . A F O R
4. My unit does not have the equipment needed for the patients. . . . . A F O R
5. My unit is noisy. . . . . A F O R
6. I can give quality patient care under pressure. . . . . A F O R
7. I have time to give quality patient care. . . . . A F O R
8. I feel comfortable making patient care decisions. . . . . A F O R
9. Time prevents me from giving emotional support to the families of patients. . . . . A F O R
10. Caring for dying patients is upsetting for me. . . . . A F O R
11. Opportunities for job advancement are available to people in my job categories. . . A F O R
12. I am capable of giving my patient quality physical nursing care. . . . . A F O R
13. Counseling helps a person remain concerned for patients. . . . . A F O R
14. My clinical judgments are questioned by co-workers. . . . . A F O R
15. A feeling of team spirit exists on my shift. . . . . A F O R
16. I am distressed when patients have major setbacks or die. . . . . A F O R
17. Patients' equipment is maintained for my ready use. . . . . A F O R
18. Group or individual counseling is available to staff at work. . . . . A F O R
19. Organizing my daily work requires too much time. . . . . A F O R
20. I feel confident in my abilities. . . . . A F O R
21. Adequate relief is regularly provided for lunch, coffee breaks. . . . . A F O R

Subject Identification_____

22. I cover my anxiety about a patient with a smile. . . . . A F O R

23. My judgments are respected by physicians. . . . . A F O R

24. I feel like taking a "mental health day" after a patient does poorly. . . . . A F O R

25. The work won't get done if I don't do it personally. . . . . A F O R

26. Physicians consider my judgment during emergencies. . . . . A F O R

27. I feel that my knowledge is current. . . . . A F O R

28. My patient care is interrupted by paper work. . . . . A F O R

29. New staff are not well oriented before being assigned to give care on my unit. . . . . A F O R

30. I am able to keep up with technological advances. . . . . A F O R

31. The unnecessary prolongation of life distresses me. . . . . A F O R

32. Time prevents me from giving emotional support to patients. . . . . A F O R

33. There is adequate staffing on the unit. . . . . A F O R

34. My knowledge is respected by the immediate supervisor. . . . . A F O R

35. Nursing care supplies are available when needed. . . . . A F O R

36. Staff need support from others to cope with the job. . . . . A F O R

37. Patients' needs can be met according to priority in this unit. . . . . A F O R

38. I feel comfortable giving other workers directions for nursing care. . . . . A F O R

39. Some staff participate in group or individual counseling at work. . . . . A F O R

40. I am able to express my real feelings about patients in serious sitations. . . . . A F O R

41. I am able to cope with job distress. . . . . A F O R

42. Physicians respect my knowledge. . . . . A F O R

43. A lack of work space distresses me. . . . . A F O R

44. Staffing permits me to work a satisfying schedule. . . . . A F O R

45. I have sufficient preparation to operate the specialized equipment used on units where I work. . . . . A F O R

Subject Identification_____

46. I am able to provide the nursing care that I want to during the length of my work shift. . . . . A F O R

47. My work schedule is stressful. . . . . A F O R

48 It doesn't help to talk over work stresses with my friends outside the health field. A F O R

49. Staffing allows me to attend continuing education events. . . . . A F O R

Appendix G

Consent Form

OREGON HEALTH SCIENCES UNIVERSITY CONSENT FORM

Title:
The Relationship Between Aerobic Exercise Habit and Plasma Lipoprotein Levels in Female Nurses: A Follow-Up Study

Investigator:
Laura Braaten, Graduate Nursing Student.

Purpose of the study:
The purpose of this follow-up study is to determine the effect of aerobic physical activity on the metabolism of plasma lipids. The expected duration of participation in the study will be approximately five weeks.

Procedures:
You will be asked to do the following activities as a subject in this research project:

- Complete a brief health history questionnaire which will include a medical history; family history; medication use, including prescription drugs, over-the-counter drugs and vitamin and mineral supplements; and reproductive history including menstrual cycle patterns.

- Complete a 4-day diet and beverage intake record, including alcohol intake, to be analyzed by the investigator using a nutrition software program.

- Have 5 milliliters of venous blood drawn on two separate dates for a total of 10 milliliters. The blood will be collected during two separate menstrual cycles and after a 12-hour fast to evaluate your lipid profile (total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides).

- Complete a 7-day aerobic exercise diary.

- Complete two stress questionnaires.

- Have two blood pressure readings taken on two separate dates with a blood pressure cuff.

- Have skin fold measurements taken to determine your body composition.

Risks and Discomforts:
Blood drawing may cause some pain and carries the risk of bleeding and/or bruising at the puncture site. The tightness of the blood pressure cuff may cause brief discomfort. There may be a slight inconvenience with maintaining the food intake and exercise records.

Benefits:
As a result of participating in this study, the information acquired about your activity level, eating habits and stress levels may help you identify potentially modifiable risk factors for coronary heart disease. Increasing your knowledge of cholesterol levels may encourage you to offer similar information when counseling patients' in your nursing practice. Data obtained from this study will add to previous research on the effect of aerobic physical activity on the metabolism of plasma lipids.

Compensation for this study will be a fitness audio cassette tape. You will receive a copy of your dietary analysis and lipid profile results.

Confidentiality:
All information identifying or concerning you will be kept confidential. Neither your name nor your identity will be used for publication or publicity purposes. All information will be coded by number. Results of the study will be presented in group form and the anonymity of participants preserved. Records may be reviewed by funding or regulating federal agencies.

Costs:
Any and all costs of this study will be the responsibility of the investigator and will not be charged to you.

Liability:
The Oregon Health Sciences University, as an agency of the State, is covered by the State Liability Fund. If you suffer any injury from the research project, compensation would be available to you only if you establish that the injury occurred through the fault of the University, its officers, or employees. If you have further questions, please call Dr. Michael Baird at (503) 494-8014.

Other:

Laura Braaten has offered to answer any questions you might have. Feel free to contact her through OHSU School of Nursing, Graduate Studies.

Your participation in this study is voluntary. You may refuse to participate, or you may withdraw from this study at any time without affecting your relationship with or treatment at the Oregon Health Sciences University. Your participation in this study may be terminated if you fail to meet the criteria for the study, become ill during the actual testing period, or fail to complete the study. You will receive a copy of this consent form.

Your signature below indicates that you have read the above material and that you are willing to participate in this study.

Signature of Participant **Date**

Signature of Witness **Date**

ABSTRACT

Title: The Relationship Between Aerobic Exercise Habit and Plasma Lipoprotein Levels in Female Nurses: A Follow-Up Study

Author: Laura Braaten, RN, BSN

Approved [redacted]
Advisor

This study compared the fasting plasma lipid profiles of female nurses who maintained a regular aerobic exercise habit with female nurses who did not exercise regularly. Total cholesterol (TC), high density lipoprotein (HDL) cholesterol, very low density lipoprotein (VLDL), low density lipoprotein (LDL) and TC/HDL ratios were measured in 7 exercisers and 4 non-exercisers. Non-parametric statistical data analyses determined HDL levels were significantly higher in the exercisers compared to non-exercisers ($p=0.02$). The exercise group reported a mean exercise intensity of 76% of their maximal heart rate. Dietary analysis demonstrated the exercise group consumed less sugar ($p=0.04$), but there were no differences in the intake of other nutrients. Each subject completed a one-week prospective exercise diary, 4-day food and beverage intake records, health history questionnaires, and had two blood pressure measurements taken. There was a trend towards a higher systolic blood pressure ($p=0.07$) of the 4 subjects in the non-exercise group. This investigator found that regular exercise is associated with high HDL cholesterol levels in healthy female nurses. Further research is warranted to determine the intensity of exercise needed to raise HDL levels in women.