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ABSTRACT

The purpose of this investigation was to compare physical activity, aerobic fitness, and selected coronary heart disease risk factors in 27 male and 21 female university faculty members. Results of t-tests indicate that the males had significantly greater values for physical activity index, systolic blood pressure, aerobic fitness (V02 max), and LDL-C/HDL-C. The females had significantly higher percent body fat and higher resting heart rates. No significant differences were found between males and females on the following variables: age, smoking, drinks per day, T-CHO, LDL-C, VLDL-C/HDL-C, HDL-C, and Tg. HDL-C was significantly related to less body fat, lower resting heart rates, and higher aerobic fitness in both males and females. While females tend to possess plasma lipoprotein profiles that suggest less risk of coronary heart disease, the more active males exhibited plasma lipoprotein profiles that resembled those of less active females. (Author)

PHYSICAL FITNESS OF UNIVERSITY FACULTY MEMBERS

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Physical Fitness of University Faculty Members

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Abstract

The purpose of this investigation was to compare physical activity, aerobic fitness, and selected coronary heart disease risk factors in 27 male and 21 female university faculty members. Results of t-tests indicate that the males had significantly greater values for physical activity index, systolic blood pressure, aerobic fitness (VO_2max), and LDL-C/HDL-C. The females had significantly higher percent body fat and higher resting heart rates. No significant differences were found between males and females on the following variables: age, smoking, drinks per day, T-CHO, LDL-C, VLDL-C/HDL-C, HDL-C, and Tg. HDL-C was significantly related to less body fat, lower resting heart rates, and higher aerobic fitness in both males and females. While females tend to possess plasma lipoprotein profiles that suggest less risk of coronary heart disease, the more active males exhibited plasma lipoprotein profiles that resembled those of less active females.

Key words: Physical fitness, Coronary risk factors, Plasma lipoproteins

Introduction

In 1981, cardiovascular diseases accounted for nearly 50% of all deaths in the United States and heart attacks caused 559,000 of these deaths (1). Premature death from heart disease ranks high among both men and women and often occurs at the most productive periods of life. Diseases of the heart are our most costly health problem in terms of deaths, dollars, and disability (2). Emphasis has been placed upon the identification of risk factors which precede coronary heart disease. The Framingham and other epidemiological studies have shown that a prediction of the likelihood of developing coronary heart disease can be made in advance of the appearance of symptoms (3). By identifying coronary risk factors and comparing the individual values to norms based upon age and sex, predictions of developing coronary heart disease can be made.

The role that physical activity plays in relation to coronary heart disease has gained in attention during the last 30 years. Since 1953, investigators have attempted to determine the relationship between physical activity and coronary heart disease. In a review of the relationships between physical activity and health, Thomas (4) found that epidemiologic and clinical studies conducted during the last 30 years have shown that regular physical exercise appears to offer some degree of protection against coronary heart disease, but there is still no definitive proof of a casual relationship (5).

Inverse relationships have been found between physical fitness categories and coronary heart disease for both men (6,7.8,9) and women (10). Greater emphasis has been placed upon the identification of relationships of physical activity to coronary heart disease risk factors in men rather than in women. The purpose of this investigation was to compare physical activity, aerobic fitness, and selected coronary risk factors in a rather homogeneous population of male and female university faculty members.

Methods

Twenty-seven male and twenty-one female university faculty members volunteered to take part in the study. The subjects were faculty members at Auburn University at Montgomery, Montgomery, Alabama. Prior to initiation of the study each faculty member was required to sign an informed consent statement. Permission to use human subjects was granted by the Institutional Review Board for the Protection of Human Subjects and their guidelines were followed.

After completing a questionnaire on demographic information and answering questions relating to health behaviors and medical and family history, clinical data was obtained. Body height and weight were measured on a standard physicians scale. Body density was determined from skinfold measures. Skinfolds were measured to the nearest .10 mm and all measures were taken on the right side of the body. The sites measured were the chest, abdomen, and thigh

for males and tricep, iliac crest, and thigh for females. The equation of Jackson and Pollock (11) was used to predict body density for males and the equation of Jackson, Pollock, and Ward (12) was employed for females. The Siri (13) equation was used to predict percent body fat from body density.

Resting blood pressure was evaluated by the standard ascultatory method. Heart rates were calculated from electrocardiagram traces during rest and exercise. A progressive multistage cycle ergometer test was conducted to evaluate aerobic fitness. A Monark bicycle ergometer was pedalled at a rate of 50 revolutions/min. The subject pedalled for nine minutes with the work load being increased after each three minute period. The work load was increased until the subject reached a heart rate of 85% of maximum predicted heart rate. Max VO_2 was predicted by extrapolating the heart rate-workload relationship to a maximum heart rate and calculating the predicted oxygen consumption requirement for that particular workload.

Alcohol consumption was recorded from the subjects replies to a Center for Disease Control Health Risk Appraisal (CDCHRA) (14). The CDCHRA asked for the number of bottles of beer, glasses of wine, and/or mixed drinks or shots of liquor per week. Smoking was also evaluated from the CDCHRA. The number of cigarettes smoked per day was recorded. A Physical Activity Index (PAI) (15) questionnaire was employed to determine levels of physical activity. The subjects

answered questions relating to the frequency, intensity, and duration of physical activity. A total score was calculated which corresponded to one of the following categories: high very active, high active and healthy, medium acceptable, low not good enough, and low sedentary.

A venous blood sample was drawn after a 12 hour fast. Total cholesterol (T-CHO) was analyzed by an enzymatic procedure using cholesterol esterase, cholesterol oxidase and peroxidase coupled with the phenol/4-amino-antipyrine indicator system (Baker-Instruments Corporation). Triglycerides (Tg) were determined by an enzymatic procedure using liver esterase combined with lipase from Rhizopus Arrhizus (Boehringer Mannheim Corporation). Tg and T-CHO analysis were performed on a Baush & Lomb Spectronic 21 DV Spectrophometer. High density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), and very low density lipoprotein cholesterol (VLDL-C) were determined following electrophoretic seperation utilizing the same enzymatic system that was used for T-CHO determination (Helena Laboratories). Following the cholesterol enzymatic reaction the results were quantified using a Gelman ACD-18 scanning densitometer. Between-run coefficients of variation were 3.8% (Tg), 3.1% (T-CHO), 2.6% (HDL-C), 2.1% (LDL-C), and 2.1% (VLDL-C).

Means and standard deviations were computed for each variable. T-tests were calculated to determine the differences between the means of variables of males and females. Correlation coefficients were calculated to determine the relationships between variables.

Results and Discussion

Table 1 shows the means, standard deviations, and results of t-tests comparing males and females on the measured variables. The males had significantly higher weight, height, diastolic blood pressure, aerobic fitness, T-CHO/HDL-C, and PAI. The females had significantly higher percent body fat and resting heart rates.

Insert Table 1

It has long been established that the average male is taller and weighs more than the average female. The mean heights for the males and females were very similar to the theoretical model for reference man and woman established by Behnke (16). Reference heights for men are 173.99 cm and 163.83 cm for women. The present sample had respective heights of 176.76 cm and 163.83 cm for men and women. The U.S. Public Health Service and Nutrition Survey reported mean weights of 67.74 kg for females and 78.64 kg for males at the reference heights (17). The present sample had weights of 63.43 kg for females and 81.14 kg for males.

Females generally have significantly higher mean percent body fat values than males. The percent body fat value for the reference male is 15% and 27% for the reference female (16). The present sample had body fat values of 19.4% for males and 25.7% for females.

The males had a significantly higher PAI which indicates that the males were more active in their exercise habits than the females.

A mean score of 48 placed the males in the acceptable medium category and a mean score of 27 placed the females in the low not good enough category.

The mean aerobic fitness values were 37.14 ($ml \cdot kg^{-1} \cdot min^{-1}$) for males and 30.21 ($ml \cdot kg^{-1} \cdot min^{-1}$) for females. Since males are larger they are expected to have a higher VO_2max than females. Sparling (18) found that women have an aerobic fitness value that is about 80% of mens. The present sample had a similar ratio with the females aerobic fitness 81% of the males.

The females mean resting heart rates were higher than the males. Women have a smaller heart and stroke volume and a faster heart rate is needed to compensate for the smaller heart and stroke volume (19). The diastolic blood pressure of the females was significantly lower than the males, but there was not a significant difference in the mean systolic blood pressure values.

All of the blood chemistry values with the exception of HDL-C were lower for the females than the males. The only significant difference ($p. < .05$) was found in the ratio of T-CHO/HDL-C. The Framingham Heart Institute has established the T-CHO/HDL-C ratio as a predictor of coronary heart disease (20). The T-CHO/HDL-C ratio has been found to be sex dependent with females having lower values than males. When the T-CHO/HDL-C ratio was evaluated based upon sex dependent norms from the Framingham Institute there was little difference in the risk of coronary heart disease for the present sample of males compared to the females.

Heiss et al.(21) reported that throughout their adult life women have higher plasma HDL-C and lower Tg concentrations than men and women usually have lower T-CHO and LDL-C than men until after menopause when the T-CHO and LDL-C plasma levels match or exceed those of men. The present sample of females had mean Tg values almost identical to the males (males, 124.59 mg/dl, and females 124.43 mg/dl). The females had slightly higher mean HDL-C values than the males but there was not a significant difference between the two values. HDL-C has proven to be one of the most accurate predicators of coronary heart disease risk (22), and diet and exercise can raise HDL-C levels. Diet was not evaluated but physical activity was higher in the males than in the females. One possible mechanism for the similar HDL-C could be related to the higher physical activity levels of the males. Since HDL-C is related to physical activity an active male would have a HDL-C value that resembles the less active female.

Insert Table 2

Table 2 shows the associations between physical activity, aerobic fitness, and selected variables. For males the variables that significantly correlated with physical activity were percent body fat ($p. < .01$) and resting heart rate ($p. < .01$) negatively and aerobic fitness ($p. < .05$) and HDL-C ($p < .01$) positively.

For females physical activity correlated significantly with percent body fat ($p < .01$), systolic blood pressure ($p < .01$), and diastolic blood pressure ($p < .01$) all negatively, and aerobic fitness ($p < .05$) and VLDL-C ($p < .05$) positively. For males aerobic fitness correlated significantly with age ($p < .05$), resting heart rate ($p < .01$), and VLDL-C all negatively, and physical activity ($p < .05$) positively. For females aerobic fitness correlated significantly with age ($p < .05$), weight ($p < .01$), percent body fat ($p < .01$), and resting heart rate ($p < .01$) all negatively and physical activity ($p < .05$) positively.

One unexpected finding was the significant positive relationship between physical activity and VLDL-C for females. A negative relationship was expected since other investigations have shown that female athletes tend to have lower VLDL-C values than sedentary controls (23). One problem that obscures the relationship between VLDL-C and exercise is that in most exercise studies VLDL-C levels were estimated from total plasma Tg values (Tg/5=VLDL-C) rather than directly measured. Few studies have evaluated VLDL-C levels in relation to physical activity in females. The exact mechanism for the significant positive correlation between VLDL-C and physical activity in the present sample of females is not clear. One possible explanation may be that in the present sample of fairly inactive females an increase in physical activity may be related to an increased caloric intake and higher VLDL-C, however

an analysis of the relationship between Tg and physical activity was not significant. Another possible explanation could be the use of synthetic hormone preparations. Higher VLDL-C values have been reported in women ages 20-25 years who use synthetic hormones (21). No evaluation of hormone use was made.

For males there was a significant negative relationship between aerobic fitness and VLDL-C. This was expected since other investigations have reported active male office workers (8) have lower VLDL-C levels than inactive office workers and significant negative relationships have been reported between VLDL-C and male athletes (24,25).

There was a significant positive relationship between physical activity and HDL-C for males. There is considerable evidence to relate higher HDL-C levels to higher levels of physical activity in men (8, 26, 27, 28). For females there was not a significant relationship between HDL-C and physical activity or aerobic fitness. Haskell et al. (29) also reported no significant association between aerobic fitness and HDL-C in women. However, when a questionnaire was used to evaluate physical activity they did report a significant association between physical activity and HDL-C. Other investigations have also reported strong associations between HDL-C and physical fitness in women (30), and female athletes have been reported to possess higher HDL-C levels than sedentary women (30, 31, 32, 33). The lack of correlation between HDL-C and physical activity and aerobic fitness could be related

to the low activity levels of the females. The majority of females evaluated were inactive and did not participate in regular physical activity.

For females significant negative correlations were found between aerobic fitness and the following variables: age, weight, and percent body fat. In a study of 1700 females Gibbons et al. (10) also found that less fit women were heavier, fatter, and older. There were a significant negative correlation between resting heart rates and physical activity and aerobic fitness for both males and females. While the resting heart rate has not been established as a coronary heart disease risk factor it has long been demonstrated that training lowers resting heart rates (34). For females systolic blood pressure correlated significantly negatively with physical activity and aerobic fitness. Diastolic blood pressure correlated significantly negatively with physical activity. Several investigations have shown that blood pressure decreases with regular exercise (26, 10). Changes in weight and salt intake may also influence blood pressure values.

Mean smoking and alcohol consumption values were fairly low for both males and females. There were no significant relationships found between physical activity and either alcohol consumption or smoking. Heavy smoking would be expected to decrease exercise performance.

In the present sample of a rather homogeneous group of male and female university faculty members the males were more active based upon their replies to a physical activity index. While females are expected to have plasma lipoprotein profiles that suggest less risk of coronary heart disease, the more active males had values that were not significantly different from the less active females with the exception of T-CHO/HDL. Physical activity was significantly related to HDL-C in males which suggests less risk of coronary heart disease with higher levels of physical activity. Lower blood pressure values were related to physical activity levels for females but not males. When the more active males were compared to less ac e females, the males exhibited a plasma lipoprotein profile resembling that of less active females.

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Table 1

COMPARISON OF MALES AND FEMALES ON SELECTED VARIABLES

VARIABLE	MALES		FEMALES		
	Mean	SD	Mean	SD	
Age (years)	41.81	6.25	39.95	10.32	NS
Weight (kg)	81.14	10.35	63.43	11.27	0.01
Height (cm)	176.76	10.66	163.88	31.14	0.01
Percent body fat (%)	19.43	4.88	24.74	6.48	0.01
Smoking (cigarettes/day)	2.78	6.56	6.29	12.27	NS
Drinks (drinks/day)	0.56	0.75	0.24	0.43	NS
Physical Activity Index (PAI)	48.07	34.70	27.38	32.66	0.05
Resting heart rate (bpm)	74.22	12.50	85.10	14.64	0.01
Systolic blood pressure (mmHg)	117.22	11.53	114.33	14.71	NS
Diastolic blood pressure (mmHg)	32.11	7.30	73.24	9.36	0.01
Aerobic Fitness (VO_2max ml/kg·min)	37.14	9.84	30.21	8.69	0.01
T-CHO (mg/dl)	192.44	38.50	184.14	36.44	NS
LDL-C (mg/dl)	118.15	29.99	110.81	30.55	NS
HDL-C (mg/dl)	56.00	8.47	59.81	8.94	NS
VLDL-C (mg/dl)	17.30	8.11	13.24	6.91	NS
T-CHO/HDL-C (mg/dl)	3.45	0.54	3.10	0.53	0.05
LDL-C/HDL-C (mg/dl)	2.11	0.46	1.87	0.50	NS
Tg (mg/dl)	124.59	25.49	124.43	19.56	NS

TABLE 2

CORRELATIONS OF PHYSICAL ACTIVITY INDEX AND AEROBIC FITNESS WITH SELECTED VARIABLES FOR MALES AND FEMALES

Variable	Physical Activity (PAI)		Aerobic Fitness (VO_2max)	
	Males	Females	Males	Females
Age (years)	-.03	-.30	-.41*	-.46*
Weight (kg)	.18	-.33	.13	-.61**
Height (cm)	.25	.06	-.07	.07
Percent body fat (%)	-.50**	-.48**	-.22	-.72**
Smoking (cigarettes/day)	-.24	.18	.00	.03
Drinks (drinks/day)	.01	.24	-.10	.19
Physical Activity Index (PAI)			.41*	.46*
Resting heart rate (bpm)	-.57**	-.66**	-.45**	-.58**
Systolic blood pressure (mmHg)	.01	-.51**	-.19	-.37
Diastolic blood pressure (mmHg)	-.15	-.61**	-.26	-.29
Aerobic Fitness (VO_2max ml/kg·min)	.41*	.46**		
T-CHO (mg/dl)	.15	-.12	.13	-.17
LDL-C (mg/dl)	.08	-.20	.22	-.26
HDL-C (mg/dl)	.24**	.11	.27	.03
VLDL-C (mg/dl)	.04	.42*	-.47**	.30
T-CHO/HDL-C (mg/dl)	-.05	-.03	.07	-.17
LDL-C/HDL-C (mg/dl)	-.09	.13	.11	-.26
Tg (mg/dl)	.09	.00	-.05	.23

*$p < 0.05$
**$p < 0.01$

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