A STUDY OF PHYSICAL ACTIVITY AND PLASMA CHOLESTEROL IN GHANAIAN MALES USING A SINGLE QUESTION

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SUMMARY

Sixty-four adult males aged 31-40years, provided responses to the question "Are you involved in any form of regular exercise aimed at improving your physical fitness?" The aim of the study was to utilize a single question as a tool to investigate the exercise status of a sample male population by evaluating its association with some key parameters known to be linked with physical exercise, namely HDL-cholesterol, LDL-cholesterol, total cholesterol and body mass index (BMI). Fasting blood was drawn for plasma cholesterol determinations, and BMI calculated as body weight (Kg) divided by height (m) squared, i.e. Kg/m^2. The study showed that respondents involved in regular, moderately vigorous exercise (intensity level of 8-12 METs) had a significantly lower mean plasma LDL-cholesterol ($p<0.05$), a lower BMI ($p< 0.05$), and a higher HDL-cholesterol ($p<0.05$) than respondents who did not participate in any form of exercise. Mean total plasma cholesterol was however not different between exercising and non-exercising subjects ($p>0.10$). The present study validates the use of exercise questionnaires as a tool to generate exercise information and suggests its use in large-scale epidemiological studies.

Keywords: Physical activity, plasma cholesterol, Ghanaian males, single question.

INTRODUCTION

An increase in physical activity has been recommended as a desirable alternative or adjunct to drug therapy against conditions associated with chronic inactivity. Recent reports have implicated low levels of physical activity in urbanized societies both as a cause and as a consequence of weight gain and obesity[1,2]. The sum effect of low physical activity, over-consumption of fats, obesity and high cholesterol levels, is an increase in the risk of developing cardiovascular disease[2,3,4]. Evidence from the medical literature indicate that a significant increase in one's physical activity lower the level of plasma total cholesterol, while increasing that of plasma high-density lipoprotein (HDL) cholesterol. While excess total cholesterol helps trigger arterial plaque build-up, HDL cholesterol helps to slow the latter process by removing excess cholesterol from blood and tissue cells, thus reducing the risk of cardiovascular disease[5,6].

Studies comparing endurance-trained athletes or subjects engaged in regular vigorous exercise and untrained or active (sedentary) subjects show that physically trained subjects have plasma lipid and lipoprotein levels that place them at low risk for developing cardiovascular disease[7,8,9]. Moreover, elite marathon runners are known to have exceptionally high plasma HDL cholesterol, and relatively low total cholesterol and low LDL (low-density lipoprotein) cholesterol[10,11,12]. These findings seem to indicate that individuals who participate in regular strenuous exercise achieve alterations in plasma lipids and lipoproteins that lower the risk of cardiovascular risk. Other evidence exist to show that regular aerobic exercise at moderate intensity results in improved plasma cholesterol and lipoprotein levels[13,14]. However, results of other studies showed no significant changes in plasma lipids and lipoproteins in subjects participating in prolonged moderate aerobic exercise programs[15].

Since previous studies have relied on expensive and complex equipment to measure physical activity, the present study was designed to investigate the association of physical activity with risk factors for cardiovascular disease and obesity, using a simple, easily obtained measure of activity, in the form of responses to a single question. Such an approach has previously been utilized and validated for the assessment of exercise behaviour[16,17].

It is the aim of this study to discuss the use of a single question in the evaluation of a possible link

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between regular physical activity and plasma total cholesterol, total/HDL-cholesterol, and the body mass index (BMI), the widely accepted overweight index.

The question posed in this study was "Are you involved in any form of regular exercise aimed at improving your physical fitness?"

SUBJECTS AND METHOD

Sixty-four male subjects, aged between 31-40 years provided responses to the question designed for the study. The subjects comprised of office and laboratory workers drawn from Korle-Bu Hospital and its immediate environs in Accra, Ghana.

Responses of "Yes" or "No" were provided by subjects to the study question, i.e. "Are you involved in any form of regular exercise aimed at improving your physical fitness?"

Inclusion Criteria for Selection

All volunteers were male, and between the ages of 31-40years. "Yes" responses were accepted on condition that the exercise activity was held daily, was on-going, and aimed at maintaining fitness. However, no limitation was placed on duration, time of day, or the type and level of intensity of exercise. "Yes" respondents reported participation in one or more of the following forms of exercise: jogging, recreational football, rope skipping, weight lifting, aerobics, swimming and distance walking.

A total of 103 males were interviewed to determine their suitability for the present study. Within this number, 64 were found to meet the criteria for inclusion in the study, out of which 29(45%) reported regular participation in one form of physical exercise or the other mentioned above and 35 volunteers (55%) did not engage in any form of physical exercise.

The remaining 39 out of the 103 males interviewed, although they reported participation in some forms of exercises, were not included in the study because the frequency, regularity and reasons for engaging in exercise did not meet the inclusion criteria for the study.

Subjects in the study were also required to state whether they were on any special diet or medication, in which case such were excluded from the study to minimize potential confounding factors. No subjects were included who were engaged in vigorous competitive sports up to 6months before the study and also during the study.

All subjects were on regular Ghanaian diet consisting of high carbohydrate (60-65% of total calories) and low-fat (15-20% of total calories). Subjects commonly reported taking kenkey and fish, rice/yam and stew, banku and okro soup, fufu and soup, koko and bread. "No" respondents in the study were not engaged in any form of voluntary physical exercise.

After the objectives and methodology of the study were explained to the volunteer, they signed consent forms as willing participants in the study.

Assays

Fasting morning blood samples were obtained daily in random batches from all selected subjects. Each subject provided 10 mililitres of blood drawn from the antecubital vein and drained into sterile tubes containing EDTA, a chelator and anticoagulant. Plasma was separated by centrifugation and samples assayed for cholesterol and triglyceride immediately. All assays were done in duplicate. Total cholesterol was assayed by enzymatic procedures involving cholesterol esterase and oxidase reactions[18], and the HDL – cholesterol fraction was determined by the phosphotungstate/magnesium chloride precipitation method[18]. LDL-cholesterol fractions were calculated by means of Friedwald's equation[19], using measured triglyceride values. Coefficient of interassay variation in cholesterol assays was within 3%. Assays were standardized and controlled by the use of commercial reagents (Randox) with known values. Body fat composition, in terms of BMI (body mass index) was calculated as body weight in kilograms divided by the square of the height in meters (kg/m^2). The BMI correlates closely with body fat content, more so than other anthropometric measures of body composition and overweight[20].

Statistical Analysis

Values were expressed as mean ± standard deviation. The level of statistical significance of differences in the mean values of total cholesterol, LDL-cholesterol, HDL-cholesterol and BMI between the two respondent groups was determined by the unpaired independent student *t* test (significance level of $P < 0.05$) .

RESULTS

Table 1 presents the types of exercise and the proportion of "Yes" respondents who were engaged in them. More than 50% of exercisers were involved in jogging and recreational football, both relatively vigorous types of exercise which required the most

amount of energy expenditure to undertake. Data on energy expenditure is presented in terms of the metabolic equivalent or MET. One MET is a unit of resting oxygen uptake (3.5 ml of 0_2 per kilogram of body weight per minute (ml. kg^{-1}. min^{-1}), and rather than determining each person's true resting oxygen uptake, the MET is the standard widely used. The estimated MET values for various activities are already known[21].

Table 1 Distribution and intensity of exercise type among active participants

	% of Active Participants	Intensity Level (multiples of MET)*
Jogging	28	10-11
Recreational football	24	8-9
Distance walking	14	5-6
Rope skipping	10	11-12
Aerobics and floor exercises	10	5-6
Lifting weights	7	6-7
Swimming	7	5-6

*1 MET (metabolic equivalent) is equal to energy expended per minute in sitting, resting state

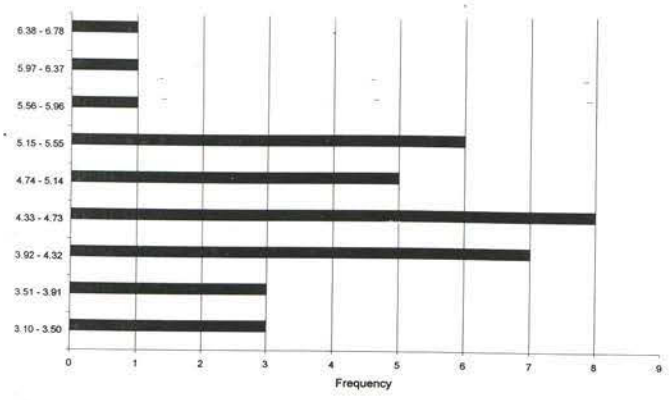

Figure 1 Total cholesterol distribution (mmol l)

Figure 1 shows a normal frequency distribution of cholesterol values obtained from sedentary (non-exercising) subjects. Over half of subjects (54%) fell within 4.33 and 5.55mmol/l, 37% within 3.11 and 4.32 mmol/l, and 9% within 5.56 and 6.78 mmol/l.

Table 2 provides data summarizing the results of the single-question study. The table shows that for the age group studied, the mean plasma total cholesterol for sedentary, non-exercising adults was 4.57+-0.79 mmol/l, whereas volunteers reporting regular participation in exercise had a mean plasma total cholesterol of 4.44 mmol/l +- 0.84 ($p>0.05$).

Exercising participants however has a significantly lower mean plasma LDL-cholesterol (13% lower, $p<0.05$), a higher HDL-cholesterol (11.4% higher, $p<0.05$), and a lower BMI (3.4% lower, $p<0.05$) than those volunteers who did not participate in any form of exercise.

Table 2 Differences in plasma lipid and BMI between participants*

	Exercisers	Non-Exercisers	P value
Total cholesterol (mmol/l)	4.44 (SD 0.84)	4.57 (SD 079)	0.191
LDL cholesterol (mmol/l)	2.77 (SD 0.70)	3.19 (SD 0.81)	0.013
HDL cholesterol (mmol/l)	1.36 (SD 0.26)	1.22 (SD 0.23)	0.038
Body mass index (Kg/m^2)	22.80 (SD 1.50)	23.60 (SD 1.91)	0.029

*n = 29(Exercisers), n=35 (Non-exercisers)

DISCUSSION

The value for the mean plasma total cholesterol level for sedentary male adults, 4.57+-0.79mmol/l, obtained in the present study, lies above the mean value of 4.21+-0.92 mmol/l reported in male subjects from Ghana in 1971[22], but below the mean of 5.17+-0.51 mmol/l reported in Nigerian male government workers in 1996[23]. More recently, Nyarko et al (1994)[24] and Asibey-Berko and Avorkliyah (1999)[25] have respectively reported mean serum cholesterol values of 4.3+-1.0 mmol/l and 4.3+-0.9 mmol/l in normal Ghanaian adult males. The value reported in this paper is derived from fasting plasma of subjects aged 31-40, whereas mean values from the other Ghanaian studies derive from data using serum from subjects aged 18-55. Sample size and sampling technique in different studies, and the sensitivity of methods employed in these assays are conceivable sources of variance in reported values.

A study of 400,000 men screened for the Multiple Risk Factor Intervention Trail (MRFIT) reported an unequivocal relation between base-line serum cholesterol levels and mortality from cardiovascular disease during a 6-year period. An increased risk was associated with total serum cholesterol levels of 4.68 mmol/l, and the risk increased progressively with higher cholesterol levels[26], a finding that has been subsequently demonstrated in younger men[27], women[28], African Americans[29], and elderly subjects[30].

The U.S. National Cholesterol Education Program (NCEP) recommends to reduce serum cholesterol in adults to less than 5.18mmol/l (<200mg/dL), within which context the data obtained in this study reveals some disturbing trends. A frequency distribution of total blood cholesterol in our study (Figure 1) shows 23% of sedentary subjects with levels above the NCEP cut-off. Although this proportion is 17% in exercising subjects (5 out of a total of 29 subjects), the difference is not statistically significant.. However, HDL-cholesterol values are significantly higher in exercisers, suggesting that regular, moderately vigorous recreational exercise may confer cardiovascular benefits.

The aim of the present study was to utilize a single question as a tool to investigate the voluntary physical activity status of a sample population by evaluating its association with a number of physiological parameters known to be associated with physical activity, namely HDL-cholesterol, LDL-cholesterol, total blood cholesterol and body mass index (BMI). The results indicate that among participants in this study, regular exercise activity is significantly associated with an increase in HDL-cholesterol, and decreases in LDL-cholesterol and the BMI. There was no decrease in plasma total cholesterol in exercising respondents, a finding not inconsistent with previous studies[4,15]. More sweeping reductions in plasma lipid levels have been achieved in subjects exercising at intensity levels sufficient to cause major changes in both the BMI[13] and oxygen capacity or VO_{2max}[31]. Our work does not directly measure VO_{2max} in participating volunteers, but a 3% lower body mass index, therefore a lower average body weight, in our exercising group, is associated with lower LDL-cholesterol and a higher HDL-cholesterol. The significance of our results is that, a simple exercise question may serve as a significant alternative to sophisticated instruments often used in generating exercising information in epidemiological studies.

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