

Original Contribution

The effect of maximal vs submaximal exertion on postprandial lipid levels in individuals with and without coronary heart disease

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KEYWORDS:

Coronary heart disease (CHD);
Combined fat and physical load;
Physical work capacity;
Apolipoproteins AI and B

BACKGROUND: Decisions about fat consumption and levels of physical activity are among the everyday choices we make in life and risk of coronary heart disease (CHD) can be affected by those choices.

OBJECTIVE: The purpose of this study was to investigate the influence of a standard fat load combined with physical exertion of different intensities on the plasma lipid profile of CHD patients and CHD-free individuals.

METHODS: This study looked at the influence of different intensities of physical exercise on postprandial lipid metabolism in 20 healthy men and 36 men with diagnosis of CHD. Venous blood samples were obtained after overnight fasting, 3 hours after standard fat load (before the physical load), and immediately after maximal or submaximal physical exercise on bicycle ergometer.

RESULTS: After fat load total cholesterol (TC) concentration did not change in either group. However, after the addition of maximal exercise, TC, triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and apolipoprotein (Apo) B increased significantly ($P < .01$) in both groups. After fat load and maximal exercise, there was no change in high-density lipoprotein cholesterol (HDL-C) in healthy men, but in men with CHD, HDL-C fell significantly ($P < .01$); and Apo AI rose in healthy men ($P < .01$) but dropped significantly ($P < .01$) in men with CHD. Submaximal physical exercise (60% of max VO_2 load for 40 minutes) after fat load decreased TG level in CHD patients ($P < .01$) and improved other lipid parameters in both groups significantly (\downarrow LDL-C, \uparrow HDL-C, \uparrow Apo AI, \downarrow Apo B, $P < .01$). We observed a worsening of physical work capacity in men with CHD (significant reduction of duration and total amount of work performed, maximal VO_2 , oxygen pulse), during maximal stress test performed 3 hours after fat load. There was a doubling of the number of abnormal stress test results ($P < .01$). Healthy persons showed an increase in respiratory parameters (ventilation, CO_2 production, maximal VO_2 , and oxygen pulse), but no significant change was found in work capacity. Thus, maximal physical exercise produced atherogenic blood lipid changes (increased TC, increased LDL-C, increased TG, increased Apo B, $P < .01$) in men with CHD and in healthy men;

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Submitted July 20, 2016. Accepted for publication January 7, 2017.

however, individuals with CHD also demonstrated a significant decrease in HDL-C and Apo AI ($P < .01$). In contrast, the submaximal physical load improved postprandial lipid changes in both healthy men and men with CHD.

CONCLUSIONS: This study demonstrates that moderate exercise is beneficial in improving postprandial lipid abnormalities in both CHD and CHD-free subjects after fatty meal preload. In addition, maximal exercise demonstrated evidence of increase of lipid abnormalities in both CHD and CHD-free individuals under similar conditions of fatty meal preload.

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Introduction

Decisions about fat consumption and levels of physical activity are among the everyday choices we make in life and risk of coronary heart disease (CHD) can clearly be affected by those choices. Dietary factors, especially cholesterol and saturated fat consumption, have been demonstrated to be associated with increased risk of CHD.^{1–3} Evidence suggests that not only the long-term effect of dietary habits affect CHD risk, but even the fatty content of a single meal may affect risk.^{4,5} Zilversmit⁶ has advanced the hypothesis of «postprandial phenomena», according to which the postprandial triglyceride (TG)-rich chylomicrons play an important role in atherogenesis. It is widely appreciated that regular occupational and recreational physical activity may reduce the risk of CHD. However, in prescribing physical activity, especially to CHD patients, it is advisable to specify the intensity of activity because there are data suggesting that very strenuous occupational or leisure-time physical effort is associated with a higher risk of CHD.^{7–9} The purpose of this study was to investigate the influence of a standard fat load combined with physical exertion of different intensities on the plasma lipid profile of CHD patients and CHD-free individuals.

Materials and methods

Study participants

Fifty-six untrained adult men ranging in age from 33 to 56 years were enrolled in the study. There were two groups. Group I was comprised of 20 CHD-free men with a mean age of 43 ± 1.2 years and no evidence of CHD after selective coronary angiography (performed because of suspicion of CHD), maximal bicycle stress test, and clinical examination. Group II was made up of 36 CHD patients with a mean age of 47 ± 2.1 years and a functional class I after the same type of evaluation.

In our study, the Canadian Cardiovascular Society grading of angina pectoris (sometimes referred to as the CCS Functional Classification of Angina)^{10,11} was used to grade the severity of angina pectoris.

Individuals in group II had demonstrated evidence of stenosis on coronary angiograms or 2 mm or more of ischemic type depression of S-T segment during maximal bicycle stress test with or without angina pain. Only 9 of 25 patients of the group II had stenosis (<50% of diameter; non-left main coronary artery). Ischemic changes in electrocardiogram (ECG) were seen on the peak of maximal stress test, according to the age.¹² It is commonly accepted that these patients do not need any type revascularization (as there are no anatomic or physiologic criteria for revascularization).¹³ Patients with diabetes mellitus, or having Quetelet body mass index >29, liver, kidney, or bronchopulmonary dysfunction were excluded from the study. All subjects were free of any medication.

The study was conducted in accordance with the Helsinki Declaration and informed consent was obtained from the study participants. The study was approved by the ethics committees of the National Research Center for Preventive Medicine, Moscow, and Institute for Atherosclerosis, Moscow, Russian Federation.

Analyzed parameters

Standard fat load

The standard fat load consisted of emulsified 20% milk cream (65 g of fat for 1 m² of body surface, 639 ± 7 mL) and 50 g of wheat bread as described by Patsch et al¹⁴ This breakfast contained an average 510 mg of cholesterol, 130 g of fat (saturated fat 77.6 g [59.7%]) and 23.4 g of carbohydrates for approximately total 1300 kcal.

Stress tests

- (1) The maximal stress test was a continuous gradual step-wise bicycle exercise in a sitting position. At the first stage, the load was 300 kg/min. Each successive load was increased by this value. Each work load was sustained for 3 minutes. The interruption criteria included the attainment of full fatigue, or maximal heart rate, blood pressure increase to $\geq 230/120$ mm Hg, provocation of angina pectoris, ischemic ST segment displacement ≥ 2 mm. Mean duration of maximal stress test was 582 ± 20 seconds for group I and

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