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Inverse association of legume consumption and dyslipidemia: Isfahan Healthy Heart Program

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BACKGROUND: Dietary intervention for improving serum lipids emphasizes on dietary fiber, plant protein, and flavonoids. This study was performed to examine whether regular legume consumption could alter serum lipids level and prevalence of dyslipidemia.

MATERIALS AND METHODS: This cross-sectional study was performed among 9660 randomly selected Iranian adults in 3 districts in the central part of Iran, using data collected in the Isfahan Healthy Heart Program in 2007. Dietary behavior including frequency of legume consumption was assessed by 48-item food frequency questionnaire. Fasting serum lipids were measured by standard enzymatic methods. We applied analysis covariance test to compare adjusted mean of serum lipids across legume consumption quartile and logistic regression test was used to determine odds ratio 95% confidence interval of dyslipidemia based on legume consumption in unadjusted and 4-adjusted models.

RESULTS: Adjusted mean triglyceride significantly reduced and high-density lipoprotein cholesterol (HDL-C) enhanced by increasing legume consumption ($P = .04$). The frequency of legume consumption associated with occurrence of all kinds of dyslipidemia except for hypercholesterolemia, especially for those who had consumed legume more than 1 time per day in adjusted models (hypertriglyceridemia: 0.82 [0.68–0.98]; high low-density lipoprotein [LDL-C]: 0.76 [0.60–0.97], and low HDL-C: 0.81 [0.71–0.92]).

CONCLUSION: We found an inverse dose-response association between the frequency of legume consumption and the risk of hypertriglyceridemia, high LDL-C, and low HDL-C. Therefore it is suggested that increasing legume intake may be an important part of a dietary approach for primary prevention of cardiovascular disease.

Cardiovascular diseases (CVDs) are the main causes of disability and death worldwide, with a rapid increase in developing countries.[1] Lipid profiles modification by dietary intervention may prevent and control CVD risks.[2] The effect of dietary behavior on serum lipids was identified as the core of diet-heart theory several years ago.[3] Epidemiologic and experimental studies imply an inverse association between dietary fiber consumption and serum lipid concentration.[4] Moreover consuming plant protein instead animal proteins is 1 of the key components of a healthy diet.[5] Legumes, which are a source of plant protein and dietary soluble fiber, can reduce serum lipids.[6] They are low in sodium and high in potassium, calcium, and

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magnesium.[7] Furthermore thousands of phytochemicals including plant sterols and isoflavones have been discovered in legume.[8] Therefore, legumes are inexpensive and high-quality and high-quantity protein sources.[9] The Iranian population has traditionally consumed legumes instead of animal proteins.[10] Legumes have been categorized into 2 groups: high-fat legumes such as soybeans and peanuts and low-fat ones including common beans, cowpeas, fava beans, lima beans, lentils, common peas, chickpeas, and soy protein. Although there are studies on the effects of various types of legumes on serum lipids,[11] many studies showed that soy protein could reduce serum lipids.[12] Because dietary intervention for improving serum lipids emphasizes dietary fiber, plant protein and flavonoids, dry beans, and legumes may potentially be a major dietary approach for hyperlipidemia management.[11]

Because to our knowledge, there is no published data on Iranian populations on plausible association between legume intake and serum lipids, this study was performed to examine whether regular legume consumption could improve serum lipids and prevent hyperlipidemia.

Materials and methods

Sampling

Data from the Isfahan Healthy Heart Program (IHHP) were used in this study. IHHP was a comprehensive integrated program conducted in 3 districts in the central part of Iran done between 2001 and 2007 in 3 phases. IHHP's design was published previously.[13,14] Multistage random sampling was conducted to stratify the study populations according to the regional population distribution. This cross-sectional survey was performed in 9660 randomly selected adults aged ≥19 years based on gender, age, and settlement distributions in each community. Among each household, single age-eligible subjects, if Iranian, mentally competent and not pregnant, were selected randomly from 6 specific age groups (19–24, 25–34, 35–44, 45–54, 55–64, and >65). Sampling was presented in details elsewhere.[13,14] The study was approved by the Research Council of the Isfahan Cardiovascular Research Center (ICRC).

Data collection

Trained health professionals performed about 30-minute home interview from eligible individuals. Gathered data consisted of socioeconomic and demographic characteristics and dietary, smoking, and physical activity behaviors.[15] Furthermore medical and drug history including dyslipidemia, diabetes, and hypertension were obtained by well-trained physicians.

Legume consumption including lentils, peas, beans, mung beans, and soy protein (excluding peanuts, which was not consumed commonly in Iranian population) was assessed through 2 separate questions in a validated 48-item food frequency questionnaire (FFQ).[16] The Spearman correlation coefficient between frequency consumption of legume estimated by the FFQ and legume consumption calculated based on the mean of legume consumption through 3 24-hour dietary recall as a reference method was .473.[16] The mean frequency legume consumption was presented per week.

Measurements

Trained nurses collected participants' blood samples by venipuncture from the left antecubital vein after 12–14 hours of fasting. All blood samples frozen at −20°C to be assayed within 72 hours at the central laboratory of ICRC, which meets the criteria of the National Reference Laboratory (a World Health Organization–collaborating center). Serum total cholesterol (TC) and triglycerides (TG) were determined by the standard enzymatic method using an auto-analyzer.[13] High-density lipoprotein cholesterol (HDL-C) was measured enzymatically after precipitating the other lipoproteins with dextran sulphate magnesium chloride.[17] Low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formula. Direct measurement of LDL-C was performed with a turbidimetric method for those with TG ≥400 mg/dL.[18] Abnormal serum lipid profiles were defined based on the National Cholesterol Education Panel Adult Treatment Panel III as TC ≥240 mg/dL; TG ≥200 mg/dl; HDL-C <40 mg/dL for males and <50 mg/dL for females; and/or LDL-C ≥160 mg/dL or taken hypolipidemic medications.[19]

Trained medical staff measured weight by Seca scale with minimum necessary clothing, and recorded to the nearest 0.5 kg. Height was measured in a standing position, without shoes to the nearest 0.5 cm using a no elastic meter, while shoulders were in the normal position. Body mass index (BMI) was calculated as weight in kilograms divided by height square in meters.[20]

Statistical analysis

Statistical analysis was performed using SPSS for Windows software (version 15; SPSS, Chicago, IL). The legume consumption was presented based on quartiles. The means of basic characteristics according to the quartiles of legume consumption were compared by analysis of variance test. Comparison of the prevalence of basic characteristics was conducted by chi-squared test. Analysis of covariance test was used to compare the means of lipid profiles according to the frequency of legume consumption with adjustment for age groups (19–24/25–34/35–44/45–54/55–64/>65), gender (male/female), BMI, smoking status (nonsmoker/current smoker), physical activity status (MET minute/week), diabetes (yes/no), hypertension (yes/no), and weekly intake of refined grains, red meat, processed meat, hydrogenated oil, liquid oil, butter, sweets, whole dairy products, and fruits and