LIPID CARDIOVASCULAR RISK MARKERS AND NUTRITION
LIPIDOVÉ MARKERY KARDIOVASKULÁRNEHO RIZIKA A VÝŽIVA

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Súhrn
Vek je hlavným rizikovým faktorom mnohých degeneratívnych ochorení. Biomarkery ako predurčovatelia ochorení môžu slúžiť na včasné odhalenie rizika vyvíjajúceho sa s vekom asociovaného ochorenia. Starnutie patrí k hlavným rizikovým faktorom tiež vo výskyte a vývoji kardiovaskulárneho ochorenia. Okrem genetických faktorov environmentálne faktory vrátane výživy môžu ovplyvniť mieru rizika s vekom spojených ochorení. Cieľom štúdie bolo vyhodnotiť vybrané kardiovaskulárne rizikové markery v dvoch skupinách osôb s rozdielnym nutričným režimom a v spojitosti s vekom. Boli merané koncentrácie celkového cholesterolu, HDL-cholesterolu a triacylglycerolov a vypočítané hodnoty LDL-cholesterolu a aterogenného indexu u 270 dlhodobých vegetariánov (lakto-ovo) a 278 osôb všeobecnej populácie na tradičnej zmiešanej strave (subjektívne zdravé, neobézne, nefajčiace, psychicky pracujúce osoby veku 21-70 rokov). Výsledky boli vyhodnotené tiež vo vzťahu ku vekovým dekádam. Vegetariánske vz nevegetariánske koncentrácie celkového cholesterolu a LDL-cholesterolu ako aj hodnoty aterogenného indexu boli významne redukované vo všetkých vekových dekádach. Koncentrácie triacylglycerolov boli u vegetariánov významne nižšie od 4. vekovej dekády. Vegetariánske priemerné dekádové hodnoty sú v referenčnom rozpätí. U nevegetariánov sa našli rizikové hodnoty celkového cholesterolu (> 5,2 mmol.l^{-1}) v 5. až 7. dekáde, LDL-cholesterolu (> 3,4 mmol.l^{-1}) v 7. dekáde a aterogenného indexu (> 4) v 6. a 7. dekáde. U vegetariánov vz nevegetariáni boli zaznamenané priemerné dekádové hodnoty pre celkový cholesterol 4,01-4,59 vz 4,48-5,67 mmol.l^{-1}, pre triacylglyceroly 1,00-1,33 vz 1,13-1,74 mmol.l^{-1}, pre LDL-cholesterol 2,03-2,58 vz 2,43-3,49 mmol.l^{-1} a pre aterogenný index 2,72-3,31 vz 3,05-4,21. Na základe sklonu priamky lineárnej regresie medzi markermi a vekom sa ukázalo, že vekové zmeny markerov sú menej výrazné u vegetariánov. Výsledky signifikantne redukovaných lipidových kardiovaskulárnych rizikových markerov vo všetkých 5 vekových dekádach a menšie zmeny markerov medzi dekádami v porovnaní s nevegetariánmi dokumentujú ochranný efekt vegetariánskej výživy v prevencii kardiovaskulárneho ochorenia v každom veku.
Kľúčové slová: celkový cholesterol, LDL-cholesterol, vegetariánska výživa, vek

INTRODUCTION

Ageing is a complex process that negatively impacts the development of the different systems. On the other hand, the rate of ageing in humans is not uniform, due to genetic heterogeneity and the influence of environmental factors including nutrition (Vasto et al., 2010). Age-related changes in body function or composition that could serve as a measure of biological age and predict the onset of age-related diseases or residual lifetime are termed biomarkers of ageing. Age is a major risk factor in many degenerative diseases and biomarkers could be subsequently used to identity individuals at high risk of developing age-associated diseases or disabilities (Vasto et al., 2010; Simm et al., 2008).

Ageing belongs to main risk factors in development and incidence also of cardiovascular disease. Cardiovascular diseases are very frequent diagnoses in subjects of older age (Graham, 2007). Gradual prolongation of life (Ginter, 2009) requires an adequate health care in older or old age including the health life style, appropriate physical activity but also correct nutrition.

The main goal of this study was to assess the selected cardiovascular risk parameters in two groups of subjects with different nutritional regimen in relation to age.

SUBJECTS AND METHODS

Randomly selected group of 548 apparently healthy adult non-obese non-smoking subjects aged 21-70 years were divided into two groups in dependence to nutritional habit: vegetarian group consisted of 270 lacto-ovo-vegetarians (111 men, 159 women) who consumed plant food, dairy products and eggs and non-vegetarian (control group) of 278 persons of general population on traditional mixed diet (105 men, 173 women). Vegetarian group: average age 42.6 ± 0.9 (SEM) years, BMI 22.6 ± 0.2 $kg.m^{-2}$, duration of vegetarianism 10.6 ± 0.4 years; non-vegetarian group: average age 42.3 ± 0.8 years, BMI 23.9 ± 0.2 $kg.m^{-2}$ ($P < 0.001$). From view of evaluation of age dependence of risk cardiovascular markers, all probands were divided into age decades. Characteristic of groups is introduced in Tab.1. The volunteers selected according to age, gender, nutritional habit, BMI < 30 $kg.m^{-2}$, no smoking, no supplementation were workers and students of Slovak medical university and other universities in Bratislava as well as subjects selected from data base of previous research university projects. They had approximately a similar physical activity (psychic work, no sports).

Blood was sampled after an overnight fasting by a standard procedure. Serum concentrations of total cholesterol, HDL-cholesterol and triacylglycerols were measured using standard laboratory methods. Values of LDL-cholesterol were calculated in according with the Friedewald formula (LDL-cholesterol = total cholesterol – triacylglycerols/2.2 – HDL-cholesterol). The atherogenic index was expressed as a ratio of total cholesterol and HDL-cholesterol. The intake of vitamins, mineral and trace elements in natural form only was allowed (no supplementation). The study was realized in spring (April, May) at condition of the same amounts of vegetarian and non-vegetarian subjects in each week according to age decades. The Student t-test and linear regression analysis were used for final evaluation.

RESULTS AND DISCUSSION

The nutrition knowledge from experimental and human studies suggests that consumption of saturated fat (animal sources) is associated with hypercholesterolemia, while unsaturated fats (plant oils, oil seeds, nuts, oil spreads) were reported to have a cholesterol lowering effect. Consumption of food high in dietary fiber (fruit, vegetables, legumes, whole grain products, nuts, seeds) is associated with a lower risk of cardiovascular disease because of the ability of soluble and insoluble fibers to reduce plasma total and LDL cholesterol. The hypocholesterolemic effect of fiber is due to an increase in bile-acid binding and fecal sterol excretion. Fermentation of soluble fiber are produced short-chain fatty acids that inhibit hepatic cholesterol synthesis. In addition to unsaturated fat and fiber, there are other plant components with reduction of cardiovascular risk (saponins in legumes, plant proteins, antioxidant nutrients, selenium, polyphenols, flavonoids (Caroll a Kurowska, 1995; Krajcovicova-Kudlackova et al., 2005; Key et al., 2006; Erkkila et al., 2008; Krajčovičová-Kudláčková et al., 2008). Previously, the dietary recommendations to reducing cardiovascular risk were aimed at decreasing total and saturated fat intake from meat consumption. Actually, this alone may not be sufficient. The inclusion of a variety of plant foods into nutritional regimen is necessary to favourable modify lipid and lipoprotein profile (Rajaram a Sabaté, 2000).

Cardiovascular risk can be decreased by plant protein consumption. Experimental studies described, that animal proteins with higher content of essential amino acids in comparison to plant proteins induce an elevation of plasma total and LDL cholesterol concentrations that can be prevented by a plant protein consumption (Caroll a Kurowska, 1995). Composition of dietary proteins has the potential to influence the balance of glucagon and insulin activity (McCarty, 1999). Plant proteins are higher in non-essential amino acids in comparison to reference protein and other animal proteins (Krajcovicova-Kudlackova et al., 2005). Glucagon promotes (and insulin inhibits) cAMP-dependent mechanisms that down-regulate lipogenic enzymes and cholesterol synthesis, while up-regulating hepatic LDL receptors. Essential amino acids are relatively more effective for releasing insulin, whereas non-essential amino acids (arginine and pyruvigenic amino acids) are effective in glucagon secretion. The effect of a chronic increase in glucagon activity by regular and sufficient intake of plant proteins means a reduction in lipogenesis, cholesterol and triacylglycerol synthesis. The higher intake of methionine and lysine from animal proteins has an unfavourable effect on phospholipid metabolism (Krajcovicova-Kudlackova et al., 2005).

Table 1 Group characteristics, lipid profile and insulin resistance

age decades	3	4	5	6	7
age span (y)	21-30	31-40	41-50	51-60	61-70
Non-vegetarians					
n (m + w)	73(26 + 47)	62(24 + 38)	55(21 + 34)	52(20 + 32)	36(14 + 22)
average age (y)	25.6 ± 0.3	35.2 ± 0.3	45.0 ± 0.4	55.7 ± 0.4	64.9 ± 0.5
BMI ($kg.m^{-2}$)	22.3 ± 0.3	23.8 ± 0.4	24.3 ± 0.4	25.1 ± 0.4	25.3 ± 0.3
> 25	12 %	27 %	29 %	35 %	36 %
> 30	0	0	0	0	0
total cholesterol	4.48 ± 0.08	5.11 ± 0.11	5.24 ± 0.11	5.45 ± 0.14	5.67 ± 0.13
triacylglycerols	1.13 ± 0.06	1.44 ± 0.14	1.61 ± 0.12	1.65 ± 0.11	1.74 ± 0.12
HDL-cholesterol	1.54 ± 0.04	1.48 ± 0.05	1.45 ± 0.05	1.41 ± 0.04	1.39 ± 0.04
LDL-cholesterol	2.43 ± 0.07	2.98 ± 0.10	3.07 ± 0.11	3.31 ± 0.12	3.49 ± 0.14
atherogenic index	3.05 ± 0.09	3.73 ± 0.18	3.84 ± 0.16	4.07 ± 0.14	4.21 ± 0.18
Vegetarians					
n (m + w)	68(26 + 42)	59(23 + 36)	52(24 + 28)	53(24 + 29)	38(14 + 24)
average age (y)	25.4 ± 0.3	35.2 ± 0.4	45.4 ± 0.4	55.4 ± 0.5	64.1 ± 0.5
BMI ($kg.m^{-2}$)	21.0 ± 0.3 ^	22.4 ± 0.3 ^	23.1 ± 0.4 °	23.5 ± 0.3 *	23.6 ± 0.3 *
> 25	3 %	8 %	19 %	19 %	13 %
> 30	0	0	0	0	0
duration of veget.(y)	8.4 ± 0.6	10.9 ± 0.7	12.0 ± 0.7	12.9 ± 0.9	9.4 ± 0.8
total cholesterol	4.01 ± 0.06 *	4.39 ± 0.08 *	4.50 ± 0.10 *	4.56 ± 0.08 *	4.59 ± 0.08 *
triacylglycerols	1.00 ± 0.05	1.07 ± 0.05 °	1.27 ± 0.08 °	1.30 ± 0.08 ^	1.33 ± 0.08 ^
HDL-cholesterol	1.49 ± 0.03	1.51 ± 0.04	1.52 ± 0.05	1.50 ± 0.05	1.44 ± 0.06
LDL-cholesterol	2.03 ± 0.05 *	2.40 ± 0.07 *	2.48 ± 0.10 *	2.54 ± 0.08 *	2.58 ± 0.07 *
atherogenic index	2.72 ± 0.06 ^	3.06 ± 0.10 ^	3.17 ± 0.14 ^	3.27 ± 0.13 *	3.31 ± 0.11 *

The results are expressed as mean ± SEM ;
The values of lipid parameters are expressed in $mmol.l^{-1}$;

° P < 0.05; ^ P < 0.01; * P < 0.001

Concentrations of total cholesterol, LDL-cholesterol and values of atherogenic index are in vegetarians vs. non-vegetarians significantly reduced in all age decades (Table 1). Vegetarian vs. non-vegetarian triacylglycerol concentrations are significantly reduced from 4. to 7. decade. Vegetarian average decade values of all lipid parameters are in reference range. In non-vegetarian group, the risk average values of total cholesterol (> 5.2 mmol.l^{-1}) were found from 5. to 7. decade, LDL-cholesterol (> 3.4 mmol.l^{-1}) in 7. decade and atherogenic index (> 4) in 6. and 7. decade. In healthy non-obese vegetarians vs. non-vegetarians were noted the average decade values for total cholesterol in range 4.01-4.59 vs. 4.48-5.67 mmol.l^{-1}, for triacylglycerols 1.00-1.33 vs. 1.13-1.74 mmol.l^{-1}, for LDL-cholesterol 2.03-2.58 vs. 2.43-3.49 mmol.l^{-1} and for atherogenic index 2.72-3.31 vs. 3.05-4.21 (Table 1).

The similar findings were described by Richter and co-workers (Richter et al. 2004). The authors investigated 10 550 subjects of general population (3816 men, 6734 women) aged 18-93 years and these subjects compared with 417 vegetarians (148 men, 269 women; lacto-, lacto-ovo- and vegans). The mean total cholesterol and non-HDL-cholesterol concentration and the total:HDL-cholesterol ratio showed the expected age dependence with maximum values within the decade 60-70 years. Vegetarians showed lower total and non-HDL cholesterol concentration in comparison with the general population. Furthermore, the age dependent increase of these parameters is less pronounced under the condition of vegetarian nutrition. The calculated linear equations of lipid markers in dependence to age in our presented study showed according to the slope of straight lines that age dependent changes of lipid markers are less pronounced also in our vegetarians (linear equations in vegetarians: total cholesterol = 0.0135 age + 3.8036, r = 0.302; LDL-cholesterol = 0.0136 age + 1.7983, r = 0.321; atherogenic index = 0.0125 age + 2.5001, r = 0.238; linear equations in non-vegetarians: total cholesterol = 0.0303 age + 3.8234, r = 0.472; LDL-cholesterol = 0.0276 age + 1.8268, r = 0.455; atherogenic index = 0.0290 age + 2.4651, r = 0.351).

CONCLUSION

The favourable mean age decade values of lipid cardiovascular risk markers of adult vegetarians aged 21-70 years in all five age decades (significantly reduced and with smaller changes between decades in comparison to non-vegetarians) document a protective effect of vegetarian nutrition in prevention of cardiovascular disease.

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