

Low serum leptin concentration in vegetarian prepubertal children

Ambroszkiewicz J¹, Laskowska-Klita T¹, Klemarczyk W²

¹ Department of Biochemistry, Warsaw, Poland

² Department of Nutrition, Institute of Mother and Child, Warsaw, Poland

Abstract

Purpose: Vegetarian diet may play a positive role in reducing risk of several chronic diseases such as diabetes, coronary heart disease and some types of cancer. There are different vegetarian dietary patterns, some of which are nutritionally adequate for children, whereas other may lack some essential nutrients. Leptin, a hormone from adipose tissue plays a key role in the control of body fat stores and energy expenditure. Higher leptin levels were observed in obese subjects and lower in anorectic patients. Recent studies support that diet may be a factor which influences leptin levels. The aim of this study was to investigate serum concentrations of leptin, lipids and apolipoproteins in prepubertal children with two different nutritional habits: vegetarian and omnivorous diet.

Material and methods: We examined 22 vegetarians and 13 omnivores in age 2-10 years. Serum leptin concentration was determined by immunoenzyme assay (ELISA) and serum lipids were measured by enzymatic and immunoturbidimetric methods.

Results: Average daily dietary energy intake and the percentage of energy from protein, fat and carbohydrates were similar for both groups of children. We observed that in vegetarian diet there is a high rate of fiber nearly twice as high as in omnivorous diet. Vegetarians had lower total cholesterol and HDL- and LDL-cholesterol concentrations than children on traditional mixed diet. There is no significant differences in triglyceride concentration between studied groups. The apolipoproteins levels in vegetarian children were significantly below that of omnivores. The

serum concentration of leptin was lower in vegetarians (3.0 ± 1.1 ng/mL) than in nonvegetarians (5.1 ± 2.0 ng/mL) ($p < 0.01$).

Conclusions: Our results suggest that vegetarian diet may be accompanied by lower serum leptin concentration. Further studies on large group of children are needed for understanding this problem better.

Key words: leptin, lipids, vegetarian diet, prepubertal children.

Introduction

Leptin, a product of the *ob* gene, is synthesized and secreted mainly from adipose tissue. In humans this hormone regulates feeding behavior, metabolic rate and body energy balance and plays a key role in the control of body fat stores [1,2]. Apart from the function of leptin in the central nervous system on the regulation of energy expenditure it may be one of the hormonal factors, which signal the brain at what time the body is ready for maturation and reproduction [3]. Leptin levels correlate with adiposity, decrease acutely with caloric restriction, and increase with refeeding. Higher circulating levels of leptin were observed in obese subjects and lower in anorectic patients [4-6]. Leptin is important in energy balance, however its role in the metabolism of lipids is still not clear. Recent studies support the concept that other factors such as a diet rich in polyunsaturated fatty acids may influence leptin levels independently on changes in body mass index (BMI) [7].

The principal difference among various vegetarian diets is the extent to which animal products are avoided. Some vegetarian diets provide less fat and fewer calories than typical omnivorous diets and have a higher content of fruits, vegetables, and whole-grain products [8]. There is a wide range of vegetarian dietary patterns, some of which are nutritionally adequate for children, whereas other may lack some essential nutrition. Generally this kind of diet has low caloric density and is very rich in fiber [9].

ADDRESS FOR CORRESPONDENCE:

Jadwiga Ambroszkiewicz
Department of Biochemistry
Institute of Mother and Child, ul. Kasprzaka 17a
01-211 Warsaw, Poland
e-mail: biochem@imid.med.pl

Table 1. Serum lipids concentration in prepubertal vegetarian and omnivores children

	Vegetarian children n=22	Omnivores children n=13	p value
TC (mg/dL)	146.6 ± 23.3	172.4 ± 22.9	p=0.003
HDL-C (mg/dL)	49.3 ± 13.1	60.4 ± 13.9	p=0.027
LDL-C (mg/dL)	80.0 ± 18.5	94.8 ± 15.0	p=0.012
TG (mg/dL)	66.4 ± 22.9	63.6 ± 22.3	NS
Apo A-I (mg/dL)	167.3 ± 23.9	180.2 ± 16.8	p=0.048
Apo B (mg/dL)	69.4 ± 14.1	81.4 ± 18.4	p=0.024

Data are shown as mean ± SD; NS – not significant

However lacto-ovo-vegetarians include dairy and eggs, lacto-vegetarians only dairy, while vegans exclude all animal products. Thus, the choice of vegetarian diet determines the nutritional status and the health of an individual, especially a child.

In the present study we investigated two groups of children with different dietary habits (vegetarians and omnivores) in order to determine the influence of vegetarian lifestyle on leptin and lipids status.

Material and methods

We examined 35 children who had been referred to Pediatric Clinic at the Institute of Mother and Child (Warsaw). Study group consisted of 22 children (11 girls, 11 boys; mean age 5.7 ± 2.9 years) on vegetarian diet. The reasons for the children being seen at Department of Nutrition were dietary consultation. In this group there were 13 children on lacto-ovo-vegetarian diet, 2 on lacto-vegetarian diet and 7 on vegan diet.

As a control group, 13 healthy children (7 girls, 6 boys; mean age 4.5 ± 2.1 years) with normal lipids profile on omnivorous diet were recruited from subjects being under temporary medical supervision (after 2 years of early constipation treatment).

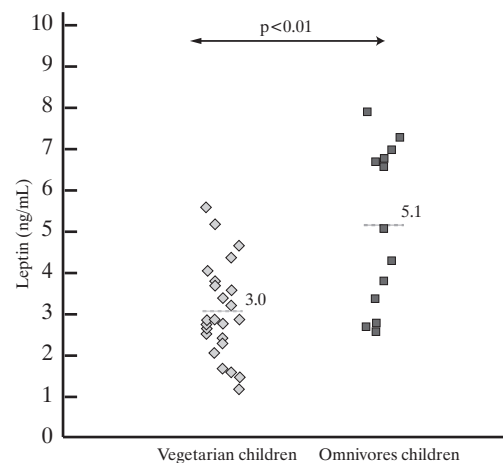
The studies were approved by the institutional review board. Informed consent was obtained from parents of examined children.

We collected main daily diet components and anthropometrical data (weight, height) of all subjects. Dietary constituents were analyzed using nutritional programme „Dietetyk2®“ (National Food and Nutrition Institute, Warsaw) and completed with supplementation data. Body mass index was calculated by the formula: body weight (kg) × height (m²).

Venous blood samples were obtained after a 12-hour overnight fast. Serum was prepared by centrifugation at 1000xg, at 4°C. Total cholesterol (TC), high-density lipoprotein HDL (HDL-C), low-density lipoprotein LDL (LDL-C), and triglycerides (TG) concentrations were determined enzymatically with commercially available kits from Bio-Merieux (France) by Cobas Mira analyzer. Serum apolipoproteins A-I (apo A-I) and B (apo B) were measured using immunoturbidimetric methods with kits from Hoffman-La Roche (Switzerland). Serum leptin concentration was determined by immunoassay (ELISA) using kits from BioVendor Laboratory Medicine, Inc. (Czech Republic).

All data were reported as mean ± standard deviation of the means and compared by Student's t-test. Differences were regarded as statistically significant at $p < 0.05$.

Figure 1. Serum leptin concentration in vegetarian and omnivores children



Results

Children consuming vegetarian diet were slightly older (5.7 ± 2.9 years) compared with their omnivorous diet counterparts (4.5 ± 2.1 years). Vegetarian children had slightly higher weight and height, but BMI in both groups was nearly the same: 15.7 ± 1.7 kg/m² in vegetarian versus 16.0 ± 1.3 kg/m² in omnivores. Average daily dietary energy intake was similar for both groups of children. In vegetarian diet the percentage of energy from protein was: 15.9 ± 3.2 ; from fat 27.5 ± 6.9 ; from carbohydrates 56.6 ± 6.9 whereas in the control group it was: 15.6 ± 3.7 ; 30.2 ± 8.5 and 54.2 ± 9.7 , respectively. Vegetarian diets consisted of 20.7 g of fiber and omnivorous – 11.8 g/day ($p < 0.01$).

The results presented in Tab. 1 indicate that vegetarian children had lower total cholesterol and HDL- and LDL-cholesterol in fractions than meat eaters did. There is no significant difference in TG concentration between the two groups (66.4 ± 22.9 mg/dL in vegetarian and 63.6 ± 22.3 mg/dL in omnivores). The apolipoproteins levels in vegetarian children were significantly below that of nonvegetarians: Apo A-I concentration was 167.3 ± 23.9 mg/dL versus 180.2 ± 16.8 mg/dL ($p < 0.05$) and Apo B was 69.4 ± 14.1 mg/dL versus 81.4 ± 18.4 mg/dL ($p < 0.05$). The mean serum leptin concentration in vegetarian children was significantly lower: 3.0 ± 1.1 ng/mL as compared with the omnivores: 5.1 ± 2.0 ng/mL, ($p < 0.01$) (Fig. 1). The

vegetarian children in our study were on different kind of diets, therefore leptin levels for the 13 children on a lacto-ovo vegetarian diet versus the 7 vegans were compared. Mean values of leptin was 3.17 ± 1.1 ng/mL in lacto-ovo vegetarians and slightly lower: 2.9 ± 0.9 ng/mL in vegans (no significant).

Discussion

Winnicki et al. [7] examined leptin levels in two African populations. In one of them the major dietary component was fishes, whereas in the other it was vegetables. Authors stated that diet rich in fish resulted in lower leptin levels in comparison to one in the manner independent on body mass index. Our results in prepubertal children suggest also that vegetarian diet rich in olive oil may be accompanied by lower leptin levels. It seems that diet may influence serum leptin concentrations.

Conclusions

This is the first observation on serum leptin levels in prepubertal children on vegetarian diet and larger studies are needed for better understanding this problem.

References

1. Ahima RS, Flier JS. Leptin. *Ann Rev Physiol* 2000; 62: 413-37.
2. Coleman RA, Herrmann TS. Nutritional regulation of leptin in humans. *Diabetologia* 1999; 42: 639-46.
3. Kiess W, Reich A, Meyer K, Glasow A, Deutscher J, Klammt J, Yang Y, Muller G, Kratzsch J. A role for leptin in sexual maturation and puberty? *Horm Res* 1999; 51(suppl 3): 55-63.
4. Considine RV, Sinha MK, Heiman ML, Kriauciunas A, Stephens, TW, Nyce MR, Ohannesian JP, Marco CC, McKee LJ, Bauer TL. Serum immunoreactive-leptin concentrations in normal-weight and obese humans. *N Engl J Med* 1996; 334: 292-5.
5. Gutin B, Ramsey L, Barbeau P, Cannady W, Ferguson M, Litaiker M, Owens S. Plasma leptin concentrations in obese children: changes during 4-mo periods with and without physical training. *Am J Clin Nutr* 1999; 69: 388-94.
6. Heer M, Mika C, Grzella I, Drummer C, Herpertz-Dahlmann B. Changes in bone turnover in patients with Anorexia Nervosa during eleven weeks of inpatient dietary treatment. *Clin Chem* 2002, 48(5): 754-60.
7. Winnicki M, Somers VK, Accurso V, Phillips BG, Puato M, Palatini P, Pualetto P. Fish-rich diet, leptin, and body mass. *Circulation* 2002; 106: 289-91.
8. Rajaram S, Sabate J. Health benefits of vegetarian diet. *Nutrition* 2000; 16 (7/8): 531-3.
9. Dwyer JT. Dietary fiber for children: How much? *Pediatrics* 1995; 96(5): 1019-22.