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NUTRITIONAL STATUS AND BLOOD SERUM LEVELS OF GLUCOSE AND SELECTED PEPTIDE HORMONES IN YOUNG ADULTS

Grzegorz Galiński[1], Jan Gawęcki[1], Dawid Szczepankiewicz[2], Joanna Bajerska[1], Krzysztof W. Nowak[2], Jan Jeszka[1]

[1]Department of Human Nutrition and Hygiene, [2]Department of Animal Physiology and Biochemistry; The August Cieszkowski Agricultural University, Poznań

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The aim of this study was to assess the variation in levels of glucose and selected peptide hormones (insulin, leptin and ghrelin) in blood serum of young adults, depending on their nutritional status. Investigations were conducted with the participation of 18 persons, which were divided into three groups characterised by different nutritional status – BMI: <20 kg/m^2, 20–25 kg/m^2 and >25 kg/m^2. Blood samples were collected from each examined person before they have eaten and next blood serum levels were determined for glucose, insulin, leptin, active and total ghrelin.

Significant ($p<0.05$) inter-group differences were shown in leptin concentration, with the highest values of this parameter shown in the group of overweight persons (31.68±23.29 ng/cm^3), while the lowest for individuals with BMI<20 kg/m^2 (5.81±4.57 ng/cm^3). Statistically significant correlations were found between BMI and leptin level ($r=0.56$, $p<0.05$), the share of fat mass and levels of insulin ($r=0.52$, $p<0.05$) and leptin ($r=0.81$, $p<0.001$), as well as the mean skinfolds thickness and the concentration of insulin ($r=0.47$, $p<0.05$) and leptin ($r=0.63$, $p<0.01$).

INTRODUCTION

In recent years the number of overweight and obese people has considerably increased, which results mainly from the discrepancy between the amount of consumed food and energy expenditure. Important factors regulating food consumption and energy balance include metabolic and hormonal signals, participating in the sensation of hunger and satiety. Apart from the relatively well-known and described signals, such as blood glucose and insulin levels, at present the focus is on two peptide hormones: ghrelin and leptin [Broberger, 2005]. Elevated blood ghrelin level is connected with increased food consumption, while during food consumption a rapid decrease is observed in the concentration of this peptide [Ariyasu *et al.*, 2001]. In turn, a high leptin level is correlated with a reduction in the amount of consumed food and a decrease in its blood concentration causes hyperphagia, which leads to increased body weight [Elmquist *et al.*, 1999; Friedman & Halaas, 1998; Mantzoros, 1999; Schwartz *et al.*, 2000]. These hormones act antagonistically to one another and according to the reports by Barazzoni *et al.* [2003] and Tschöp *et al.* [2001], blood plasma ghrelin concentration on an empty stomach is negatively correlated with leptin level and the percentage of fat mass.

The aim of the study was to assess the variation in levels of glucose and selected peptide hormones (insulin, leptin and ghrelin) in blood serum of young adults, depending on their nutritional status.

MATERIALS AND METHODS

Investigations were conducted with the participation of 18 young adults, 9 women and 9 men. Examined individuals were divided into three groups characterised by different nutritional status, defined using the body mass index (BMI), body compositions (performed by bioelectric impedance technique using BIA 101S AKERN – RJL bioanalyser) and the mean skinfolds thickness, which were measured by a Harpenden skinfold caliper (Switzerland), with pressure of 10 g/mm^2 at the following sites: chin, cheek, biceps, triceps, subscapular, chest, abdominal, hip, thigh, knee, and calf.

The first group consisted of underweight individuals with BMI<20 kg/m^2 (18.5±0.6 kg/m^2), the second – persons with proper body weight, for whom BMI was 20–25 kg/m^2 (22.4±0.9 kg/m^2), while the third group – overweight individuals with BMI>25 kg/m^2 (27.4±2.7 kg/m^2) [WHO, 1988]. Each group consisted of 3 women and 3 men. Characteristics of the analysed groups are presented in Table 1. Blood samples were collected from each examined individual before they have eaten (after at least 12 h fast) and next glucose level was assayed in blood serum using the enzymatic method [Burrin & Price, 1985], while concentrations of insulin, leptin, active and total ghrelin were analysed using radioimmunoassay kits by Linco (HI-14HK, HL-81HK, GHRA-88HK and GHRT-89HK, respectively).

Results were verified statistically using a one-way analysis of variance, the Scheffe test and correlation and regression analyses [Stanisz, 1998]. All calculations were performed using the STATISTICA PL ver.7.1 software package.

Author's address for correspondence: dr inż. Grzegorz Galiński, Department of Human Nutrition and Hygiene, The August Cieszkowski Agricultural University, ul. Wojska Polskiego 31, 60-624 Poznań, Poland; tel.: (48 61) 848 73 33; fax: (48 61) 848 73 32; e-mail: gregoryg@au.poznan.pl

TABLE 1. Characteristics of the examined groups (mean±SD).

Group	Age (years)	Weight (kg)	Height (m)	BMI (kg/m^2)	FM (kg)	FM (%)	Mean skinfolds thickness (mm)
BMI<20 kg/m^2	21.2±1.5	54.8±5.0	1.72±0.08	18.5±0.6	11.3±2.6	21.0±5.7	8.9±2.6
BMI 20-25 kg/m^2	21.7±1.0	74.6±9.0	1.77±0.10	22.4±0.9	22.4±4.3	30.2±5.8	14.4±4.1
BMI>25 kg/m^2	22.2±2.0	88.7±21.1	1.74±0.15	27.4±2.7	31.0±8.7	35.1±6.7	19.3±4.9

BMI – body mass index, FM – fat mass

TABLE 2. Concentration of glucose and selected peptide hormones in blood serum of the examined individuals depending on their nutritional status (mean±SD).

Parameter	BMI			ANOVA p
	<20 kg/m^2	20-25 kg/m^2	>25 kg/m^2	
Glucose concentration (mg/dL)	89.7±7.7^a	84.2±6.2^a	91.0±3.7^a	p=0.137
Insulin concentration (μU/cm^3)	7.65±3.69^a	12.13±11.34^a	13.28±3.90^a	p=0.388
Leptin concentration (ng/cm^3)	5.81±4.57^a	12.18±8.71^{ab}	31.68±23.29^b	p=0.020
Total ghrelin concentration (pg/cm^3)	1264±366^a	1254±238^a	913±399^a	p=0.162
Active ghrelin concentration (pg/cm^3)	34.9±10.2^a	31.1±7.0^a	30.8±4.1^a	p=0.584

TABLE 3. Coefficients of correlation between anthropometric parameters and concentration of glucose and selected peptide hormones in blood serum of the examined individuals (n=18).

Parameter	BMI	FM (kg)	FM (%)	Mean skinfolds thickness
Glucose concentration	0.06	-0.05	-0.08	-0.04
Insulin concentration	0.35	0.50*	0.52*	0.47*
Leptin concentration	0.56*	0.61**	0.81***	0.63**
Total ghrelin concentration	-0.29	-0.17	-0.05	-0.20
Active ghrelin concentration	-0.34	-0.09	0.20	0.07

BMI – body mass index; FM – fat mass; significance level: * - p<0.05; ** - p<0.01; *** - p<0.001

RESULTS AND DISCUSSION

Table 2 presents blood serum levels of glucose and selected peptide hormones for the examined persons, with blood samples taken before they have eaten. Significant (p<0.05) differences were shown between groups in blood serum leptin concentrations in the examined individuals, with the highest values of this parameter recorded in the group of overweight individuals (31.68±23.29 ng cm^3), while the lowest in individuals with BMI<20 kg/m^2 (5.81±4.57 ng/cm^3). Results confirm earlier reports [Gromadzka-Ostrowska, 2004] that obese persons have considerably elevated blood plasma leptin levels, even by over 300% in comparison to individuals with proper body weight. In the case of the other analysed parameters (levels of glucose, insulin and ghrelin) no statistically significant differences were shown between the analysed groups, although a trend was evident for blood serum ghrelin level to decrease and insulin level to increase with an increase of BMI and fat mass of the examined individuals.

As it results from Table 3, a significant relationship was found between the body mass index of the examined individuals and blood serum leptin level (r=0.56; p<0.05). Moreover, a statistically characteristic interdependence was found between the share of fat mass of the examined persons and levels of insulin (r=0.52; p<0.05) and leptin (r=0.81; p<0.001). The correlation between mean skinfolds thickness and blood serum concentrations of insulin (r=0.47; p<0.05) and leptin (r=0.63; p<0.01) turned out to be statistically significant. Also in studies conducted by Lyousii *et al.* [2005] a positive correlation was shown between blood leptin concentration and BMI. In contrast, Ng *et al.* [2005], in studies on term and preterm newborns did not show significant interdependencies between anthropometric parameters and blood serum ghrelin level.

CONCLUSIONS

1. The nutritional status has a significant effect on blood serum leptin concentration, while overweight individuals exhibited an above two times higher level of this hormone in comparison to individuals with normal body weight.

2. Blood serum levels of leptin and insulin in young adults is positively correlated with fat mass and the mean skinfolds thickness, while in the case of leptin it is also correlated with body mass index (BMI).

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STAN ODŻYWIENIA ORGANIZMU A POZIOM GLUKOZY I WYBRANYCH HORMONÓW PEPTYDOWYCH W SUROWICY KRWI OSÓB MŁODYCH

Grzegorz Galiński[1], Jan Gawęcki[1], Dawid Szczepankiewicz[2], Joanna Bajerska[1], Krzysztof W. Nowak[2], Jan Jeszka[1]

[1]Katedra Higieny Żywienia Człowieka, [2]Katedra Fizjologii i Biochemii Zwierząt; Akademia Rolnicza im. A. Cieszkowskiego w Poznaniu

Celem pracy była ocena zróżnicowania poziomu glukozy i wybranych hormonów peptydowych (insulina, leptyna i grelina) w surowicy krwi osób młodych, zależnie od ich stanu odżywienia.

Badania realizowano z udziałem 18 osób, w tym 9 kobiet i 9 mężczyzn. Badane osoby podzielono na trzy grupy charakteryzujące się różnym stanem odżywienia: BMI<20 kg/m^2 (18,5±0,6 kg/m^2), BMI 20–25 kg/m^2 (22,4±0,9 kg/m^2) i BMI>25 kg/m^2 (27,4±2,7 kg/m^2). Każdej badanej osobie pobierano na czczo krew, a następnie oznaczano w surowicy poziom glukozy oraz stężenie insuliny, leptyny oraz greliny aktywnej i całkowitej.

Wykazano istotne ($p<0,05$) różnice międzygrupowe stężeń leptyny w surowicy krwi badanych osób, przy czym najwyższe wartości tego parametru stwierdzono w grupie osób z nadwagą (31,68±23,29 ng/cm^3), a najniższe wśród osób charakteryzujących się BMI<20 kg/m^2 (5,81±4,57 ng/cm^3). Stwierdzono istotny związek pomiędzy wskaźnikiem masy ciała badanych osób a poziomem leptyny w surowicy krwi ($r=0,56$; $p<0,05$). Ponadto wykazano znamienną statystycznie współzależność pomiędzy udziałem tkanki tłuszczowej w ciele badanych osób a poziomem insuliny ($r=0,52$; $p<0,05$) i leptyny ($r=0,81$; $p<0,001$). Istotna statystycznie okazała się również korelacja pomiędzy średnią grubością fałdów tłuszczowo-skórnych a stężeniem w surowicy krwi insuliny ($r=0,47$; $p<0,05$) i leptyny ($r=0,63$; $p<0,01$).