



# Relationship of serum adipocytokine levels with glucolipid metabolism and micro-inflammatory state in obese children

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## ABSTRACT

**Objective:** To analyze the relationship of serum adipocytokine levels with glucolipid metabolism and micro-inflammatory state in obese children. **Methods:** A total of 299 obese children and 264 normal children were included in the study, fasting peripheral venous blood was extracted to determine serum levels of adipocytokines, glucolipid metabolism and micro-inflammation-related indexes, and the correlation between the levels of adipocytokines and the levels of glucolipid metabolism and micro-inflammation-related indexes was further analyzed.

**Results:** Serum leptin and Vaspin levels of observation group were higher than those of control group, and APN level was lower than that of control group ( $P < 0.05$ ); serum FINS, C-P, Cor, TG and LDL-C levels were higher than those of control group, and HDL-C level was lower than that of control group ( $P < 0.05$ ); serum hs-CRP, IL-8, IL-6 and TNF- $\alpha$  levels were higher than those of control group ( $P < 0.05$ ); serum Leptin, APN and Vaspin levels were directly correlated with the levels of above glucolipid metabolism and micro-micro-inflammatory state indexes. **Conclusions:** There are high expression levels of inflammatory factors and glucolipid metabolism disorder in obese children, and excessively expressed adipocytokines may be the important factors of persist and worsened obesity.

## 1. Introduction

Obesity is characterized by chronic inflammation, changes in gene expression, immune disorders, etc., and is closely associated with diabetes and cardiovascular diseases. Obese population shows younger-age trend in China, and survey shows that the percentage of obese population in children less than 15 years old is increasing year by year, and the probability of this part of children developing to obesity in adult is extremely high[1,2]. Glucolipid metabolism disorder and micro-inflammation in obese children have been clinically recognized, and are also the important means to judge the obesity severity of children. The latest research shows that a series of protein molecules abnormally expressed by adipocytes in obese patients are the upstream factors leading to metabolic disorders,

intervening with them can improve the severity of obesity, but this view still needs the support of related clinical data[3]. Leptin, adiponectin (APN) and vaspin are the typical proteins secreted by adipocytes, the expression levels of adipocytokines, glucolipid metabolism indexes, inflammatory factors and so on were analyzed in the study, and the correlation between the levels of adipocytokines and the levels of glucolipid metabolism indexes and inflammatory factors was mainly stated.

## 2. Materials and methods

### 2.1. Case information

A total of 319 obese children were treated in our hospital between July 2010 and July, 2015. Inclusion criteria were as follows: 1) the body mass index (BMI) was greater than the 95th percentile of the children with same age; 2) fasting blood glucose  $< 100$  mg/dL, triglycerides  $< 150$  mg/dL; 3) with 3-year history of obesity; 4) families signed informed consent. Exclusion criteria

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were as follows: 1) associated with metabolic syndrome; 2) with hypertension; 3) taking drugs leading to obesity for a long time; 4) associated with mental illness and couldn't cooperate research; 5) those whose data was incomplete.

Among 319 obese children, 12 patients with metabolic syndrome and 8 patients whose families refused to sign the informed consent were ruled out, and a total of 299 obese children were included in the observation group of the study, there were 159 male cases and 140 female cases, they were 7-13 years old, and the average age was  $(9.62\pm 3.19)$  years. All 264 children who got vaccinated in our hospital during the same period and whose weight was in the normal range were selected as normal control group, there were 141 male cases and 123 female cases, they were 6-14 years old, and the average age was  $(9.47\pm 3.38)$  years. The research process conformed to the requirements of the hospital ethics committee, the included children showed no statistically significant difference in gender and age distribution ( $P>0.05$ ), and they were comparable.

## 2.2. Detection indexes

A total of 2 mL of fasting venous blood was extracted from two groups and centrifuged at room temperature and low speed, supernatant was collected and cryopreserved in  $-80^{\circ}\text{C}$  refrigerator for detection, and enzyme-linked immunosorbent assay was used to detect the following indexes: 1) adipocytokines: leptin, adiponectin (APN) and vaspin; 2) glucolipid metabolism-related indexes: fasting insulin (FINS), C-P, Cor, TG, low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C); 3) micro-inflammation indexes: hypersensitive C-reactive protein (hs-CRP), interleukin-8 (IL-8), interleukin-6 (IL-6) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ).

## 2.3. Statistical methods

SPSS23.0 software was used to input and analyze data, measurement data comparison between groups was performed by *t* test, count data was by *chi*-square test and  $P<0.05$  indicated statistical significant differences.

**Table 1**

Comparison of serum adipocytokine levels.

Groups	Case No.	Leptin ( $\mu\text{g/L}$ )	APN (pg/L)	Vaspin ( $\mu\text{g/L}$ )
Observation group	299	$17.39\pm 2.15$	$23.27\pm 3.02$	$1.51\pm 0.19$
Control group	264	$6.49\pm 0.71$	$61.53\pm 0.75$	$0.83\pm 0.09$
<i>t</i>		7.384	9.374	5.273
<i>P</i>		$<0.05$	$<0.05$	$<0.05$

## 3. Results

### 3.1. Serum adipocytokines

Serum leptin and Vaspin levels of observation group were

significantly higher than those of control group, APN level was significantly lower than that of control group ( $P<0.05$ ), as shown in Table 1.

### 3.2. Glucolipid metabolism-related indexes

Serum TG and LDL-C levels of observation group were significantly higher than those of control group, and HDL-C level was significantly lower than that of control group ( $P<0.05$ ), as shown in Table 2.

### 3.3. Micro-inflammation indexes

Serum hs-CRP, IL-8, IL-6 and TNF- $\alpha$  levels of observation group were significantly higher than those of control group ( $P<0.05$ ), as shown in Table 3.

### 3.4. Correlations of adipocytokines with glucolipid metabolism and micro-inflammatory state

Serum leptin and Vaspin levels in obese children were positively correlated with FINS, C-P, Cor, TG, LDL-C, hs-CRP, IL-8, IL-6 and TNF- $\alpha$  levels, and negatively correlated with HDL-C ( $P<0.05$ ); serum APN level was negatively correlated with FINS, C-P, Cor, TG, LDL-C, hs-CRP, IL-8, IL-6 and TNF- $\alpha$  levels, and positively correlated with HDL-C ( $P<0.05$ ), shown in Table 4.

## 4. Discussion

Investigation shows that the proportion of obese children in the population is rising, and many severely obese children are even threatened by cardiovascular diseases in adult. How to reduce obese children and avoid their development to obese adults is the clinical focus at present, and many studies have confirmed that the specific proteins secreted by adipose tissue are the core factors causing persistent obesity and the occurrence of cardiovascular complications[4,5]. Leptin, APN and vaspin are three adipocyte secretion markers, and domestic study has found abnormally secreted leptin, APN and vaspin in obese rat models, indicating that abnormal expression of adipocytokines is directly involved in the occurrence of obesity[6]. Previous studies about the causes, risk, *etc* of obesity are mostly focused on obese adults, fewer clinical studies are about adipocytokines in obese children, so leptin, APN and vaspin were selected as the research cores of adipocytokines in the study, and the relationship of their expression levels in obese children with glucolipid metabolism, inflammatory state, *etc* was mainly analyzed.

It was found in the study that compared with normal-weight peers, obese children were with higher serum levels of leptin and Vaspin and lower level of APN, and it is mainly due to the different total

fat and fat distribution in two groups. Leptin plays an important role in appetite control and weight management; APN is abundantly expressed in white adipose tissue, and is an important factor to resist body weight gain and reduce cardiovascular risk; Vaspin is an insulin-sensitizing adipocytokine secreted by adipocytes, and may be directly related to the degree of obesity and insulin resistance[7,8]. Study has confirmed that there is leptin and vaspin resistance in the obese, and the study results are consistent with it, further show the change in APN expression, indicate that the changes of adipocytokine levels in obese children in the "obesity-promoting" direction are due to increased fat content in obese children and also the important factors that increase childhood obesity degree[9].

Glucolipid metabolism disorder is the symbolic metabolism change in obese people, and the study of Liu *et al*[10] shows that the degree of glucolipid metabolism disorder is different in children with different obesity degree, and as obesity increases, the glucose and lipid metabolism disorders intensifies. The study results showed that serum glucolipid indexes FINS, C-P, Cor, TG and LDL-C levels of observation group were higher while the level of HDL-C that could reduce cholesterol levels was lower, which is consistent with the results of literature reports and shows that there is significant

metabolic disorder in obese children, including hyperglycemia, insulin resistance, hyperlipidemia, *etc*[11]. Some scholars[12] believe that the state of high sugar and high fat formed in glucolipid metabolism disorder can further stimulate adipocytes to secrete related factors, and lead to the further microenvironment disorder in obese patients and sharply increased incidence of obesity-related cardiovascular diseases. Recent studies have shown that adipose tissue is not only a passive energy storage portion, but also have important endocrine function, can secrete a variety of inflammatory cytokines including IL-8, CRP, TNF- $\alpha$ , *etc*, involved in maintaining various physiological functions stability. This study has tested two children's serum micro-inflammatory cytokines levels, found that observation group children's hs-CRP, IL-8, IL-6, TNF- $\alpha$  levels were higher. TNF- $\alpha$ , IL-8 are important immune and inflammatory responses regulators, can reflect overall body inflammation state. hs-CRP is the most sensitive indicator reflecting the body's inflammatory response, which can increase proinflammatory cytokine IL-6 secretion. These results confirm the presence of micro-inflammation in obese children, consistent with the results of foreign research reports.

There have been many studies about the role of obesity cytokines

**Table 2**

Comparison of glucolipid metabolism-related index levels.

Groups	Case No.	Glucose metabolism indexes			Lipid metabolism indexes (mmol/L)		
		FINS (mU/L)	C-P (pmol/L)	Cor (ng/mL)	TG	LDL-C	HDL-C
Observation group	299	16.72±2.41	0.71±0.08	201.27±24.74	1.53±0.21	3.15±0.43	1.12±0.17
Control group	264	7.69±0.91	0.34±0.04	157.37±18.32	0.82±0.09	1.94±0.26	1.87±0.23
<i>t</i>		8.935	5.127	9.384	5.783	6.182	6.042
<i>P</i>		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

**Table 3**

Comparison of serum micro-inflammation index levels.

Groups	Case No.	hs-CRP (mg/dL)	IL-8 (pg/mL)	IL-6 (ng/mL)	TNF- $\alpha$ (ng/mL)
Observation group	299	6.71±0.75	1.16±0.13	24.48±3.12	1.62±0.21
Control group	264	4.52±0.59	0.42±0.05	9.57±1.02	0.93±0.09
<i>t</i>		7.203	5.382	9.283	5.372
<i>P</i>		<0.05	<0.05	<0.05	<0.05

**Table 4**

Correlations of adipocytokines with glucolipid metabolism and micro-inflammatory state.

Indexes	Leptin		APN		Vaspin	
	Determination coefficient <i>r</i>	<i>P</i>	Determination coefficient <i>r</i>	<i>P</i>	Determination coefficient <i>r</i>	<i>P</i>
FINS	0.783	<0.05	-0.694	<0.05	0.812	<0.05
C-P	0.788	<0.05	-0.742	<0.05	0.793	<0.05
Cor	0.809	<0.05	-0.821	<0.05	0.784	<0.05
TG	0.704	<0.05	-0.769	<0.05	0.812	<0.05
LDL-C	0.811	<0.05	-0.758	<0.05	0.803	<0.05
HDL-C	-0.773	<0.05	0.812	<0.05	-0.782	<0.05
hs-CRP	0.821	<0.05	-0.773	<0.05	0.785	<0.05
IL-8	0.741	<0.05	-0.805	<0.05	0.779	<0.05
IL-6	0.764	<0.05	-0.713	<0.05	0.751	<0.05
TNF- $\alpha$	0.831	<0.05	-0.745	<0.05	0.773	<0.05

in the occurrence and development of obesity, but they are less used as the means of obesity intervention, and the most common clinical ways for obese patients are lipid regulation, blood glucose control, insulin sensitization, *etc*[13,14]. In the study, the correlation between the levels of obesity cytokines and the levels of glucolipid metabolism and inflammation-related indexes was further analyzed, and it was found that serum leptin, APN and Vaspin levels were directly correlated with the levels of glucolipid metabolism and inflammation indexes, indicating that changes of leptin, APN and Vaspin levels are the important factors causing glucolipid metabolism disorder and micro-inflammatory state in obese children, and the intervention of adipocytokine levels will directly lead to the changes in patients' glucolipid metabolism and micro-inflammatory state[15,16]. Thus, it can be believed that abnormal secretion of adipocytokines can directly promote the occurrence and development of obesity, and the intervention of the secretion of adipocytes can be used as new targets for obesity treatment.

To sum up, abnormal secretion of adipocytokines in obese children may be the key elements causing glucolipid metabolism disorder and micro-inflammatory state, and the intervention on adipocytokines is expected to become the new targets for childhood obesity treatment.

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