



The Relationship of Leptin, Exercise and Dietary Habits of Overweight and Obese Children

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ABSTRACT

Purpose The goal of the study is to clarify the relationship among Leptin, exercise habits and dietary habits in overweight and obese children. **Methods** The exercise data included the amount of exercise, the amount of effective exercise, the effective exercise duration and the effective exercise times. A self-designed questionnaire was used for the survey of dietary habits, which including the frequency of the intake of vegetables, the meat and poultry, the fruits and other kinds of the foods in the recent week, as well as the time that they spent on meals. **Results** There were forty-one subjects including thirty boys and eleven girls from three primary schools. The average age was ten years old and the mean Body Mass Index was 23.1kg/m². Both Leptin and Leptin Receptor were skewed distributions and the median were 4.3ng/ml and 3.1ng/ml. Leptin had negative relations with the amount of exercise, the amount of effective exercise, the effective exercise duration and the effective exercise times significantly. However, Leptin Receptor was not significantly correlated with all of the exercise data. Afterwards, multi-variable linear regression analysis was carried out. The remaining explanatory variables were the amount of effective exercise and the time that they spent on meals. 82.2% of the variation of Leptin could be explained by the two variables above. **Conclusion** Children who had lower levels of Leptin tended to take more effective exercise and take the longer time of the meal. Leptin was closely related to dietary and exercise habits.

CCS CONCEPTS

• **Social and professional topics** → Professional topics; Computing and business; Economic impact.

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KEYWORDS

Leptin, Exercise Habits, Dietary Habits, Overweight, Obese

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1 INTRODUCTION

The obesity has been nearly tripled since 1975 worldwide. The prevalence of the overweight and the obesity among children and adolescents aged 5-19 has been risen rapidly from 4% in 1975 to over 18% in 2016. Over 340 million children and adolescents aged 5-19 were the overweight or the obese in 2016 [1]. The rate of overweight among children and adolescents aged 6-17 in China was 9.6% and the rate of obesity was 6.4% in 2012 [2].

Obese subjects have significantly higher Leptin due to increased adipose tissue [3]. Leptin is mainly produced by fat cells and the dominant action is a 'starvation signal' [4]. The paradox of raised levels of Leptin in obesity may be explained by the resistance of Leptin partly [5]. Abnormal level of Leptin not only promotes insulin resistance, high blood pressure, but also relates to an increased risk of cardiovascular diseases [6]. Studies have showed that unique dietary pattern also related to Leptin [7]. Several studies have refined the relationships between the food types and Leptin [8, 9]. On the other hand, some studies showed that aerobic exercise significantly reduced Leptin compared to the control group [10, 11]. But some experimental studies showed conflicting results. It was pointed out that resistance training successfully reduces the Leptin level of middle-aged or older obese people [12].

The goal of the study was to assess the relationships among Leptin, Leptin Receptor, exercise habits and dietary habits in obese children.

2 METHODS

The subjects were the overweight and the obese children from three primary schools in Jiaying of Zhejiang Province. The parents of the participants signed the informed consent after the researchers

Table 1: Characteristics of study participants

	$\bar{x} \pm s$	Min	Max
Age(years)	10 \pm 1.0	8.0	12.0
Body Mass Index(kg/m ²)	23.1 \pm 1.8	20.0	27.0
Leptin(ng/ml)	4.3 [*]	1.4	41.2
Leptin Receptor(ng/ml)	3.1 [*]	1.6	29.3
The amount of exercise(Kcal)	508.3 \pm 163.4	205.0	825.0
The amount of effective exercise(Kcal)	197.0 \pm 81.3	35.0	373.0
The effective exercise/The amount of exercise(%)	37.5 \pm 10.4	17.0	58.0
The effective exercise duration(minutes)	45.3 \pm 21.1	8.0	99.0
The effective exercise times(times)	4.5 \pm 1.9	1.0	8.0

*: The median was used for the data of skewed distribution.

Table 2: The correlation of Leptin, Leptin Receptor and the exercise data

	Leptin	Leptin Receptor	The amount of exercise	The amount of effective exercise	The effective exercise/The amount of exercise(%)	The effective exercise duration
Leptin Receptor	0.663	***				
The amount of exercise	-0.469	*	-0.157			
The amount of effective exercise	-0.530	**	-0.032	0.817	***	
The effective exercise/The amount of exercise	-0.367		0.144	0.163	0.641	***
The effective exercise duration	-0.456	*	0.040	0.677	0.943	0.669
The effective exercise times	-0.467	*	-0.048	0.716	0.870	0.556

* P<0.05 ** P<0.01 *** P<0.001

explained the programme. The subjects were classified to be the overweight or the obese according to the body mass index [13]. The secondary obesity caused by endocrine, genetic metabolic diseases or drugs were not found.

Leptin and Leptin Receptor were measured by ELISA. The kits were produced by R&D company in the United States. The exercise data were collected by the pedometer produced by Beijing Yao-HuaKangYe technology and development company. It included the amount of exercise, the amount of effective exercise, the effective exercise duration and the effective exercise times. A self-designed questionnaire was carried out for the survey of dietary habits. It included the frequency of intake of vegetables, fruits, meat and poultry, aquatic product, eggs, beans, milk and milk product, snacks, midnight snacks, eating out in the recent week, as well as the time that they spent on meals.

3 RESULTS

There were forty-one subjects including thirty boys and eleven girls. The characteristics of the subjects were shown as table 1. The average ages of boys and girls were ten years old and the mean Body Mass Index was 23.1kg/m². Both Leptin and Leptin Receptor were skewed distributions and the logarithmic transformation was performed. The median of Leptin was 4.3ng/ml and that of Leptin Receptor was 3.1ng/ml.

According to the time that they spent on meals, 26.1% of the students answered 5-10 minutes, while 52.2% answered 10-20 minutes. 21.7% of them spent 20-30 minutes and 23% spent more than 30minutes.

Concerning to the correlation of Leptin, Leptin Receptor and exercise data. The results were showed in table 2. Leptin had negative relations with the amount of exercise($r=-0.469$, $P<0.05$), the amount of effective exercise($r=-0.530$, $P<0.01$), the effective exercise duration($r=-0.456$, $P<0.05$), and the effective exercise times($r=-0.467$, $P<0.05$) significantly. However, Leptin Receptor and all of the exercise data were not significantly correlated.

Afterwards, multi-variable linear regression analysis was carried out and the stepwise method was adopted. The results were showed in table 3. Leptin was used as the dependent variable while the independent variables were exercise and dietary data. The remaining explanatory variables were the amount of effective exercise ($\beta = -0.005$, $P<0.001$) and the time that they spent on meals($\beta = -0.270$, $P=0.027$). 82.2% of the variation of Leptin could be explained by the two variables above.

The dependent variable: Leptin.

The independent variables: All of the exercise and dietary data.

Table 3: The Results of the the linear regression analysis.

Model	Unstandardized Coefficients		Standardized Coefficients	P	95% CI of β	
	β	SE				
	2.058	0.240		<0.001	(1.524,	2.591)
The amount of effective exercise	-0.005	0.001	-0.837	<0.001	(-0.006,	-0.003)
The time that they spent on meals	-0.270	0.104	-0.346	0.027	(-0.501,	-0.038)

4 DISCUSSION

Leptin regulates food intake and energy storage. Some of the studies have shown that Leptin is associated with the dietary pattern and specific foods [7]. The concentration of Leptin progressively increases as the overnutrition continues [14]. It has been reported that unhealthy dietary habits can also lead to a rise in Leptin. The pediatric binge and loss of control eating are the prospective risk factors for higher fasting Leptin in youth. It may predict the development of metabolic abnormalities [15]. It was reported that the excessive intake of the saturated fatty acids may cause Leptin resistance in obesity [4]. Several studies have showed that Leptin relates to specific foods [8, 9].

Prospective studies on whether diet affects Leptin are limited to animal studies. Exposure to a high-fat diet resulted in obesity in wild-type and ob-norm animals, the Leptin levels in these two groups were different. The wild-type animals became markedly hyper-leptinemic as they became obese, whereas the plasma Leptin levels of obnorm animals on a high-fat diet were the same as low-fat diet fed group [16]. Mice fed oat or wheat bran fiber exhibited lower body weight, as well as insulin and Leptin levels. The two cereal fibers potentially increased the protein expressions of Leptin Receptor in the adipose tissue. Furthermore, the cereal fiber can improve Leptin resistance and sensitivity [17, 18].

Concerning to exercise, we found that Leptin had negative relations with all of the exercise data, especially the amount of effective exercise. The result of the systematic review and the meta-analysis of the randomized controlled trials of the effectiveness of exercise on Leptin in obese individuals showed that the exercise significantly reduced Leptin compared to no exercise group [10, 11].

But some experimental studies have shown conflicting results. It has been reported that training intervention, especially resistance training successfully reduces the Leptin level of the middle-aged or the older, obese people. It was pointed out that the resistance training appears to be more efficient in reducing the Leptin level than the aerobic training alone [12].

In the end, we realized that there are some defects in our study. For example: we collected a small study sample, especially lack of girls. Prospective studies are required to elucidate which kind of exercise or better dietary habits promote greater function of Leptin. In short, it is suggested that modifications in dietary habits and physical activity can induce Leptin in obesity. However, it needs to be confirmed by further intervention trails whether the

improvement on exercise and dietary habits can affect Leptin in obese children.

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