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ASSESSMENT OF THE RESULTS OF PREVENTIVE INTERVENTION TO CHANGE LIFESTYLE IN OVERWEIGHT AND OBESE CHILDREN

G.A.Mamatkhujaeva[1] A.Sh.Arzikulov[1]

1. Andijan State Medical Institute, Andijan, Uzbekistan.

Correspondence: *Andijan State Medical Institute, 170127, Uzbekistan, Andijan, Yu. Atabekova Street, 1.*

Correspondence author: Gulhayo A. Mamatkhujayeva, Assistant of the Department of pediatrics for the medical faculty, Andijan State Medical Institute, Andijan, Uzbekistan.
e-mail: dr_mgulhayo94@mail.ru.

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Abstract.

Obesity is associated with serious health problems in children and is a major and early risk factor for morbidity and mortality in adults. The direct health effects of obesity include hyperlipidemia, hypertension, and glucose tolerance. **Purpose of the study:** assessment of leptin and adiponectin levels before and after lifestyle changes in children with obesity and overweight and determining their role as biomarkers. **Material and methods:** One hundred and four overweight and obese children (51 boys and 53 girls) were included in this study and constituted the main group. Fifty-four children with normal body weight without endocrine, cardiovascular, gastrointestinal, or liver diseases constituted the study's control group. Of the first 104 children, 48 returned for re-examination after a year of lifestyle changes. Anthropometric indicators were assessed in these children at the initial stage, as well as after one year. Lifestyle intervention is included in the educational program, which includes changes in nutrition and physical activity. Children and their parents are advised to switch to a normal calorie diet based on a balanced distribution of carbohydrates (55%), proteins (15%), and lipids (total 30%, saturated fats less than 10%). When changing the form of physical activity, it is recommended to perform aerobic exercises three to five times a week for no less than 45-60 minutes. **Results**: Clinical and biochemical characteristics were determined in children with obesity and excess body weight (group A, n=104) at the initial stage compared to the control group (group B, n=54), at the initial stage (group C, n=48) and after 1 year of intervention (group D, n=48). After 1 year of preventive intervention, 48 children were re-examined. Children with unchanged body weight and those who lost weight were compared. Children with obesity and excess weight did not have statistical differences in many parameters, including insulin levels, HOMA-IR, and adiponectin levels, compared to children who lost weight and had normal weight, which once again indicates the positive effect of lifestyle changes on children. However, the level of leptin was still higher in children with obesity and excess body weight than in children with normal weight, which allows us to assume that, despite the "normalization" of metabolic status, leptin did not change in accordance with these positive changes. **Conclusions**: our study confirms the positive effect of simple dietary recommendations and physical activity on metabolic and clinical parameters in children with obesity and excess body weight. The level of leptin was significantly increased in children who did not lose weight, but in children who actually lost weight, there were no significant changes compared to the baseline level, which allows us to assume that leptin is not directly related to the change in body weight. Adiponectin is the best and simplest marker for assessing the positive results of prevention and treatment of obesity and excess weight in children, monitoring metabolic changes, and their detection.

Key words: overweight; obesity; body mass index; leptin; adiponectin.

Introduction

A number of adipokines, including TNF-α, IL-6, leptin, and adiponectin, affect insulin sensitivity by modulating insulin signals [2,5,7,10]. Adiponectin, in particular, enhances the effect of insulin, improves insulin sensitivity in peripheral tissues, and is inversely related to insulin resistance, the level of which is low in obesity, type II diabetes mellitus, and metabolic syndrome . Adiponectin levels are negatively corrected by fat and insulin sensitivity in the body and predict type II diabetes in children with obesity[5,7].

It is believed that serum leptin also plays an important role in obesity. Several studies show a correlation between physical activity and leptin in energy balance in children with obesity. However, the results are unreliable: after physical exercises or dietary interventions, leptin levels decrease or remain unchanged [4,7]. Lifestyle interventions with changes in physical activity and eating habits are an important measure in combating excess body weight in childhood and adolescence [3,7,8,9,11,12].

Simple anthropometric parameters, such as body mass index (BMI) or weight, may not reveal all the positive changes associated with lifestyle. The exercise program reduces insulin resistance, measured using the euglycemic-hyperinsulinemic clamp test, independent

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of changes in body weight or composition [1,6]. If circulating adipokines are associated with changes in insulin sensitivity, then they can also be very simple and alternative biomarkers of positive outcomes.

Purpose of the study: assessment of leptin and adiponectin levels before and after lifestyle changes in children with obesity and excess body weight, determining the possibility of using adiponectin or leptin as biomarkers that improve insulin sensitivity.

Material and methods: one hundred and four overweight and obese children (51 boys and 53 girls) were included in this study and constituted the main group. Fifty-four children with normal body weight without endocrine, cardiovascular, gastrointestinal, or liver diseases constituted the study's control group. Of the first 104 children, 48 returned for re-examination after a year of lifestyle changes. Anthropometric indicators were assessed in these children at the initial stage, as well as after one year.

Lifestyle intervention is included in the educational program, which includes changes in nutrition and physical activity. Children and their parents are advised to switch to a normal calorie diet based on a balanced distribution of carbohydrates (55%), proteins (15%), and lipids (total 30%, saturated fats less than 10%).

When changing the form of physical activity, it is recommended to perform aerobic exercises three to five times a week for no less than 45-60 minutes. At the same time, children are advised not to spend more than 2 hours a day (mainly in front of gadgets, TV, and computer). All children were examined together with their parents 6 months and one year after the start of the program. After 6 months, the children's weight and height were assessed, and their compliance with lifestyle recommendations was checked.

In all children with obesity and excess body weight, the levels of glycemia, insulin, total cholesterol, HDL and LDL cholesterol, triglycerides, adiponectin, and leptin were measured. After a year of lifestyle intervention, the same parameters were checked. In children with normal body weight, the above-mentioned parameters were measured at the initial stage.

If the children's weight changed from obesity to excess weight or normal weight, or from excess weight to normal weight, it was classified as weight loss.

Results: Clinical and biochemical characteristics were determined in children with obesity and excess body weight (group A, n=104) at the initial stage compared to the control group (group B, n=54), at the initial stage (group C, n=48) and after 1 year of intervention (group D, n=48). Table 1.

Table 1. Comparison of clinical and biochemical parameters of obese and overweight children one year after intervention in the lifestyle.

Indicators	Group A1 (n=104)	Group B2 (n=54)	P1-2	Group C3 1 year before (n=48)	Group D4, 1 year later (n=48)	P3-4
Age	10,7±3,2	10,6±3,6	>0,05	10,5±2,9	11,5±2,8	
Gender boy/ girl	51/53	27/27	>0,05	51/53	26/22	
Body mass (overweight/ obesity/ normal)	69/35/0	0/0/54		43/5/0	16/1/31	<0,01
Prepubertal/ pubertal period	62/42	32/22	>0,05	28/20	19/29	>0,05
BMI (kg/m2)	27,7±4,5	17,3±2,4	<0,001	27,2±3,7	25,5±3,6	<0,01
Glucosa (mg/ dl)	90,5±5,3	87,6±7,9	<0,01	90,7±5,3	88,5±6,3	<0,05
Insulin (μU/ ml)	19,5±9,5	10,4±4,6	<0,001	19,4±10	16±6,5	<0,05
Homa-IR	4,2±2,3	2,2±1	<0,001	4,4±2,4	3,5±1,5	<0,05
Total cholesterol (mg/dL)	167±29,4	166,7±27,3	>0,05	166±30,0	161,4±30	>0,05
HDL (mg/dL)	47,8±10,8	62,4±12.	<0,001	48,8±11,6	51,1±13,1	>0,05

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LDL (mg/dL)	107±23,7	96±24,3	<0,01	105,3±21,6	100,2±25,8	>0,05
Triglycerides (mg/dl)	60,4±30,4	41,4±29,2	<0,001	58,7±29,4	50±25,5	>0,05
Adiponectin (μg/ml)	5,7±3,7	18,2±8,0	<0,001	5,9±4	14,7±9,2	<0,001
Leptin (ng/ml)	19,7±14,1	6,8±7,1	<0,001	18,4±14,3	23,4±14,7	<0,05

The data is like the average sum ±standard variation or proportion.

After 1 year of preventive intervention, 48 children were re-examined. Children with unchanged body weight and those who lost weight were compared.

Table 2. Indicators of metabolic parameters between children who lost weight after one year and children with unchanged weight

Indicators	Children who lost weight (n=16)	Children with unchanged weight status (n=31)	P
Blood glucose (mg/dL)	−5±7	−0,8±5,5	<0,05
Insulin (μU/ml)	−4,2±9,7	−3,2±9,5	>0,05
HOMA-IR	−1,1±2,4	-0,81±2,2	>0,05
Total cholesterol, mg/dL	−12,6±20,9	2,9±25,3	<0,04
HDL (mg/dL)	1,9±11,2	2,5±7,4	>0,05
LDL (mg/dL)	−11,3±16,5	1,5±19,8	<0,05
Triglycerides (mg/dL)	−16,4±25,9	−4,6±34,7	>0,05
Adiponectin (μg/ml)	9,3±11,5	8,4±8	>0,05
Leptin (ng/ml)	−1,6±10,8	8,1±14,4	<0,05

Data are expressed as mean differences compared to the baseline level ±standard deviation.

Discussion: Compared to the stage of puberty, high values of HOMA-IR (3.7±1.7 versus 5±2.8; p<0.004) and insulinemia (16.8±6.8 versus 23.6±11.4; p<0.001) were observed in children of pubertal age. In children of prepubertal age, the level of adiponectin was higher than in children of pubertal age (4.9±3.2 versus 6.3±3.8; p<0.049), the level of leptin in the serum was significantly lower (15.8±11.5; p<0.001). In the pubertal period, high values of HOMA-IR (3.7±1.7 versus 5±2.8; p<0.004) and insulin (16.8±6.8 versus 23.6±11.4; p<0.001) were observed in children. In children of prepubertal age, the level of adiponectin was elevated (4.9±3.2 versus 6.3±3.8; P<0.049) serum leptin was significantly lower than in children of pubertal age (15.8±11.5 versus 26±15.7; p<0.001).

Children with obesity, as well as insulinemia (21.2±10.6 versus 15.9±5.2; p<0.008), had a significantly higher HOMA-IR indicator (3.4±1.2 versus 4.6±2.6; p<0.022) compared to children with excess body weight, despite their puberty.

In subsequent observations, despite the results by body weight, the average plasma glucose level (p<0.024), insulin (p<0.018), and HOMA-IR (p<0.013) were significantly lower than the initial results (Table 1). No significant changes in lipid parameters were observed.

The level of adiponectin showed a significant increase compared to the baseline level: from 5.9±4.0 to 14.7±9.2 (p<0.001). An independent relationship was shown between adiponectin levels and changes in adipose mass, while multiple linear regression analysis was used to study this relationship in the presence of other risk factors, which, as is known, can affect adiponectin levels, including changes in HOMA-IR, weight, and Tanner stage. Unlike expected, the leptin level increased from 18.4±14.3 to 23.4±14.7 years after the intervention (p<0.025). In the analysis of differences in the initial level of metabolic parameters between children who lost weight and without changes in weight status, we observed a significant decrease in glycemia (p<0.031), total cholesterol and LDL cholesterol (p<0.04), and leptin (p<0.031) in children who lost weight, while no significant differences were observed in the initial level of HOMA-IR and insulin (Table 2).

Finally, after one year, no differences in adiponectin levels were found between the children of the two groups (Table 2). Thus, regardless of a significant change in body weight, the levels of insulin, HOMA-IR, and adiponectin in children increased, which indicates that a

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change in lifestyle can lead to an improvement in metabolic status in our population.

To confirm these observations, children who returned to observation after one year were compared with children with normal weight, regardless of whether they had a positive result in weight status (Table 2). In subsequent observations, the level of adiponectin in children with obesity was similar to that of children with normal body weight (18.2±8 versus 14.7±9.2), and the average level of blood glucose, total cholesterol, LDL, and triglycerides in subjects with normal body weight was also the same. However, significant differences were observed in the levels of insulin, HOMA-IR, and leptin ($p<0.001$).

Children with obesity and excess weight did not have statistical differences in many parameters, including insulin levels, HOMA-IR, and adiponectin levels, compared to children who lost weight and had normal weight, which once again indicates the positive effect of lifestyle changes on children (Table 2). However, the level of leptin was still higher in children with obesity and excess body weight than in children with normal weight, which allows us to assume that, despite the "normalization" of metabolic status, leptin did not change in accordance with these positive changes.

Conclusions: our study confirms the positive effect of simple dietary recommendations and physical activity on metabolic and clinical parameters in children with obesity and excess body weight. Leptin levels remained high in obese and overweight children even after a year. The level of leptin was significantly increased in children who did not lose weight, but in children who actually lost weight, there were no significant changes compared to the baseline level, which allows us to assume that leptin is not directly related to the change in body weight. Adiponectin is the best and simplest marker for assessing the positive results of prevention and treatment of obesity and excess weight in children, monitoring metabolic changes, and their detection. Further studies should confirm the effectiveness of periodic measurements of adiponectin levels for monitoring the assessment of the results of prevention and treatment of obesity and overweight in children.

ABOUT THE AUTHORS:

Gulhayo A. Mamatkhujayeva, ORCID ID:0009-0008-2707-2625, e-mail: dr_mgulhayo94@mail.ru, Assistant of the Department of pediatrics for the medical faculty, Andijan State Medical Institute, Uzbekistan, 170127, Andijan, Yu. Atabekov St., Children's hospital.

Abduraym Sh. Arzikulov, ORCID: 0000-0001-6726-4244, D.M.Sc., professor, e-mail: pediatr60@mail.ru, Professor of the Department of pediatrics for the medical faculty Andijan State Medical Institute, Uzbekistan, 170127, Andijan, Yu. Atabekov St., Children's hospital.

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