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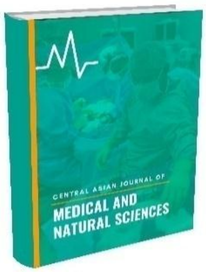

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EVALUATING THE RESULTS OF OBESITY IN CHILDREN AGED 8 TO 14 YEARS ACCORDING TO MAGNESIUM LEVELS

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Abstract: Background In developed countries, it is a public health problem that affects both adults and children. Objective: This study aimed to assess health outcomes related to children with obese according to magnesium levels. Patients and method 120 samples were recruited, and clinical data were collected from one year, from January 2022 to February 2023. All examinations and laboratory tests were performed on the children, which included two groups, the first of which included children suffering from obesity and the second group of children of normal weight. Magnesium levels were assessed based on the degree of obesity and defined for children for all levels of obesity for both groups. Also, the general health of children was evaluated based on the quality-of-life scale. Results This study measured the levels of several biochemical markers in morbidly obese children. The recorded values were as follows: serum magnesium (1.6 ± 0.41), total cholesterol (188.46 ± 26.32), LDL-cholesterol (141.3 ± 27.11), triglycerides (108.46 ± 16.28), HDL-cholesterol (50.66±8.3).

In contrast, this research discovered that the biochemical rates of children with a healthy weight exhibited Serum magnesium levels of 2.5 ± 0.2, Total cholesterol levels of 131.60 ± 29.7, Triglyceride levels of 93.42 ± 23.60, and HDL-cholesterol levels of 58.72 ± 12.84. The blood pressure readings showed notable disparities between the two groups. In the group of morbidly obese children, the average Systolic Blood Pressure (BP) was 57.60 ± 12.3, and the average Diastolic BP was 61.86 ± 9.86. In contrast, the group of normal-weight children had an average Systolic BP of 46.33 ± 8.5 and an average Diastolic BP of 58.2 ± 11.6. Conclusion Most of obese children had a considerable drop in magnesium levels.

Key words: Obesity; Children; Serum magnesium levels; and quality of life.

Introduction

Obesity is the most widespread metabolic disease in the world; its prevalence has increased dramatically in the last two decades, both in developed and non-developed countries [1]. In the United States, childhood obesity has increased significantly: 28 to 36% in all children and adolescents, but, specifically, between the ages of 6-11, overweight has increased by 55% and severe obesity up to 97% in the middle east. The same trend has been found in countries such as the United Kingdom, Japan, and Canada. [2-6]

Until recently, in most countries of the world, pediatricians hardly cared about the problems related to childhood obesity. Obesity was rare and was often associated with hereditary diseases or appeared because of severe brain injuries caused during childbirth [7,8]. In addition, culturally, the fat child was synonymous with a healthy child. The situation has completely changed due to the extraordinary growth in the prevalence of obesity in pediatric age around the world, and, currently, obesity in developed countries, such as the USA, is considered the epidemic of the XXI century. [9]

As for the developing countries in Latin America and Central America, the prevalence of obesity and overweight in women and children <5 years has been increasing [10]; of 12 Latin American countries that had complete information on overweight and obesity, just over a third exceeded 20% in both situations. In most of the countries, an increase was observed in recent years; 72% of the countries had an increase in overweight and 66% of obesity. [11,12]

Heredity plays an important role: children of obese parents are more likely to be obese than children of non-obese parents 10:1 [13]. These genetic factors are influenced by other external aspects, such as the intake of foods with high caloric density and a sedentary lifestyle for prolonged periods, which are triggering factors in the appearance of overweight and obesity [14]. Urbanization and economic development lead to changes in the lifestyle of individuals, in which they cause modifications in eating and physical activity patterns, especially in children and adolescents who spend many hours in front of the television and reduce the time they should devote to physical activity. in addition, some mass media of social communication stimulate the consumption of fast foods and high-calorie sweets [15-17]. Although an overweight and obese child will not always be an obese adult, obesity in childhood and adolescence is associated with a high risk of persistence in adulthood (44 – 74%); the age of onset, the degree of obesity, and its duration are determining factors. [18]

The importance of childhood obesity lies in the fact that it is a risk factor in adulthood for the maintenance of obesity and for the development of chronic non-communicable diseases such as arterial hypertension, type II diabetes, atherosclerosis, coronary artery disease, among others, important causes of morbidity and mortality, lost workdays, disability, and high health costs for society [19, 20]. In children, obesity triggers multiple alterations: the advance of bone maturation, the advance of sexual maturation, emotional disturbances, hyperlipidemia, increased cardiac output, fatty liver, hyperinsulinism, -orthopedic problems, sleep apnea, pseudotumor cerebri, cholelithiasis, and arterial hypertension. [21]

Patients and methods

A cross-sectional study was presented in different hospitals in Iraq over the course of a year, from January 2022 to February 2023. One hundred twenty candidate samples were recorded in this data, as the first group included 60 children suffering from excessive obesity, and the second group represented children who did not have obesity and were in ideal health and included 60 children. All samples required for both groups were matched in age (8-14) years and gender as well.

This study determined the demographic data of the samples collected in this study, which were determined by age, gender, dietary level, family history, as well as the educational and economic aspects of the parents. In addition, the family's nutritional and medical history was determined through a questionnaire given to the family to check the children's diet.

Clinical examinations, including anthropometric and blood pressure measurements, were performed. Moreover, a comprehensive assessment of the weight status and degree of obesity was performed for all children. Weight measures for children were based on measuring height and weight to calculate the body mass index, which was applied to all children to determine the weight specific to the child's age.

Using a mercury sphygmomanometer, this study measured specific blood pressures for both diastolic blood pressure and systolic blood pressure performed on both groups through a mercury sphygmomanometer that is inserted into the right arm while sitting and lasts for five minutes. In addition, biochemical examinations were conducted for the children by obtaining a blood sample after fasting for approximately 12 hours to determine and measure all test parameters, which include serum magnesium, total cholesterol, HDL, LDL cholesterol, triglycerides, and other measurements.

Magnesium levels were evaluated based on the degree of obesity determined for children for all levels of obesity for both groups, matching the same ages determined in the clinical data. Also, the general and specific health of pediatric patients was evaluated for the samples collected for both groups on the basis of the quality-of-life scale, where 100 represents the best quality of life for children, and 0 represents the worst quality of life for children within the following criteria, which included each of physical health - psychosocial health - emotional functioning - performance. Social - school performance.

This study excluded all children who had comorbidities or chronic medical conditions, had a history of prior surgery, or had genetic diseases that could cause hypomagnesemia. The children's collected data were analyzed, and the patients' quality of life was assessed through SPSS version 22.0.

Results

Table 1: Basics demographic characteristics of children in this study.

Variables	**Obesity Children [60]**	**Healthy Children [60]**	**P-value**
Age [years], mean ± SD	11.2 ± 2.8	11.3 ± 2.7	0.418
Gender, N [%]			< 0.001
Males	37 [61.67%]	40 [66.67%]	
Females	23 [38.33%]	20 [33.33%]	
BMI [kg/m2], mean ± SD	28.62 ± 1.24	16.35 ± 2.77	< 0.001
Family history of obesity, N [%]	16 [26.67%]	4 [6.67%]	
Waist circumference (cm), mean ± SD	93.23 ± 11.52	64.78 ± 14.5	< 0.001
Eating food rich in magnesium N [%]	17 [28.33%]	8 [13.33%]	0.058
Education level of parents, N [%]			0.305
Primary school	14 [23.33%]	16 [26.67%]	
Secondary school	12 [20%]	13 [21.67%]	
Under graduated college	8 [13.33%]	9 [15%]	
Post graduated college	26 [43.33%]	22 [36.67%]	

Income Level of parents, $			0.686
400 – 600	16 [26.67%]	15 [25%]	
601 – 800	18 [30%]	20 [33.33%]	
801 – 1000	26 [43.33%]	25 [41.67%]	

Table 2: Determine the biochemical outcomes of participants.

Variables	**Obesity Children [60]**	**Healthy Children [60]**	**P-value**
Serum magnesium	1.6 ± 0.41	2.5 ± 0.2	0.0024
Total cholesterol	188.46 ± 26.32	131.60 ± 29.7	0.0055
LDL-cholesterol	141.3 ± 27.11	90.70 ± 18.89	0.0011
Triglycerides	108.46 ± 16.28	93.42 ±23.60	0.0026
HDL-cholesterol	50.66 ± 8.3	58.72 ± 12.84	0.0021
Systolic BP percentiles (mm Hg)	57.60 ± 12.3	46.33 ± 8.5	0.00142
Diastolic BP percentiles (mm Hg)	61.86 ± 9.86	58.2 ± 11.6	0.036
HgA1c	5.4 ± 0.25	5.14 ± 0.47	0.128
TSH	2.0 ± 2.4	2.4 ± 1.7	0.4021

T4	15.1 ± 1.42	13.23 ± 1.7	0.416
Vitamin D	1.57 ± 0.25	43.89 ± 29.70	0.0015
Phosphorus	4.13 ± 0.47	1.48 ± 0.24	0.0012
Sodium	41.50 ± 20.87	138.42 ± 3.41	0.00153

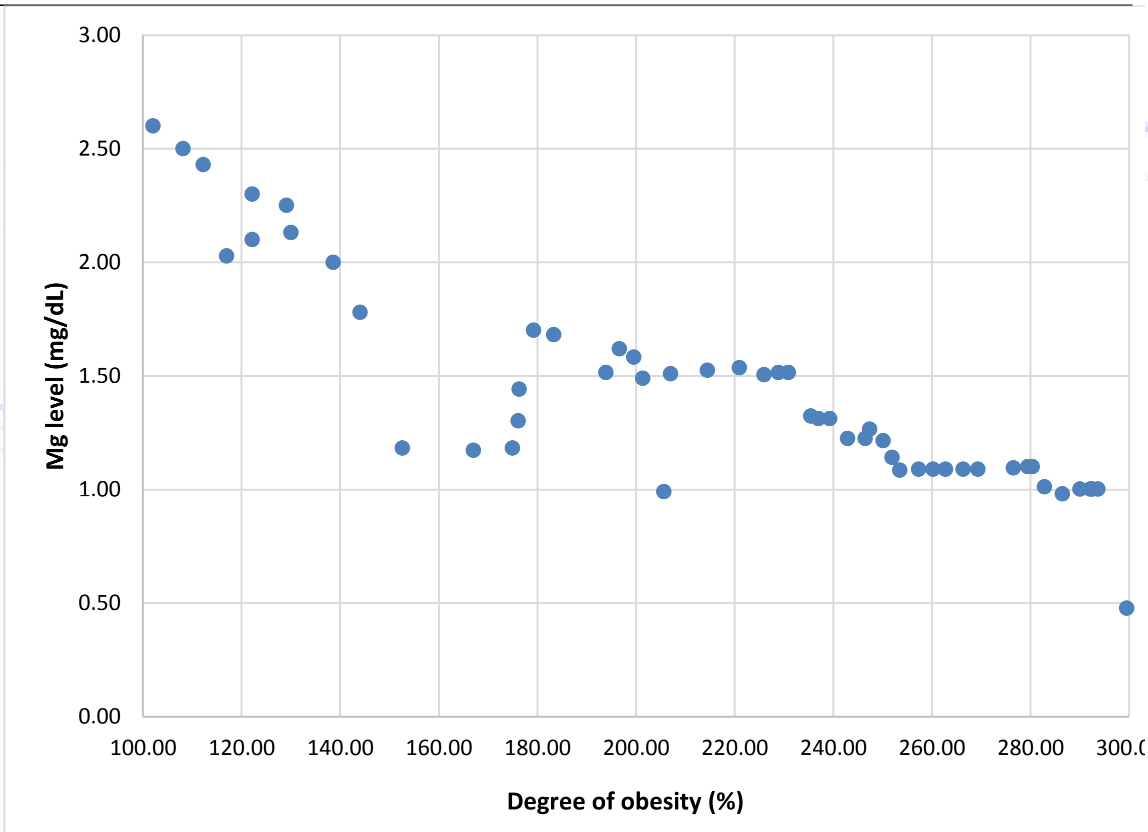

Figure 1: Determine Serum Magnesium Levels in correlation with the degree of obesity (%).

Table 3: Assessment of quality of life for children with obese and healthy.

Variables	Obesity Children [60]	Healthy Children [60]	P-value

Physical health	70.41 ± 7.1	84.20 ± 12.10	0.028
Psychosocial health	62.33 ± 13.28	82.46 ± 14.77	< 0.001
Emotional functioning	62.68 ± 19.86	81.78 ± 13.55	< 0.001
Social functioning	65.76 ± 23.66	86.40 ±11.2	< 0.001
School functioning	62.33 ± 21.56	79.21 ± 19.88	< 0.001

Table 4: Determine the correlation between Serum Magnesium Levels and obesity of children.

Lipid profile (mg/dL)	***Serum Mg (mg/dL)***		***Degree of obesity (%)***	
	Correlation coefficient (r)	P-value	Correlation coefficient (r)	P-value
Total cholesterol	- 0.411	0.002	0.330	0.018
LDL-cholesterol	- 3102	0.026	0.325	0.020
Triglycerides	- 0.066	0.640	0.120	0.410
HDL-cholesterol	- 0.052	0.702	- 0.005	0.963

Discussion

The current study recorded that the rates of obesity for males (37 children) were higher than those for females (23 children), and the body mass index (BMI) was (28.62 ± 1.24) for obese children, while for children with normal weight (16.35 ± 2.77). Based on family medical history, this study found that 16 cases were overweight due to genetic factors, and 17 had a dietary level rich in magnesium. Regarding biochemical tests and examinations, this study recorded the biochemical rates of morbidly obese children as serum magnesium (1.6 ± 0.41), total cholesterol (188.46 ± 26.32), LDL-cholesterol (141.3 ± 27.11), triglycerides (108.46 ± 16.28), HDL-cholesterol (50.66±8.3). On the contrary, this study found that the biochemical rates of normal-weight children showed Serum magnesium (2.5 ± 0.2), Total cholesterol (131.60 ± 29.7), Triglycerides (93.42 ± 23.60), and HDL-cholesterol (58.72 ± 12.84).

Blood pressure measurements showed significant differences between both groups. As for the group of morbidly obese children, the Systolic BP was (57.60 ± 12.3), the Diastolic BP was (61.86 ±

9.86), while the group of normal-weight children showed the Systolic BP was 46.33 ± 8.5 and the Diastolic BP was 58.2 ± 11.6. Moreover, other rates were found where HgA1c was 5.4 ± 0.25 for the group of obese children and 5.14 ± 0.47 for the group of children with normal weight. Vitamin D results were found to be 1.57 ± 0.25 for the group of obese children and 43.89 ± 29.70 for the group of children. Of normal weight.

This study noticed that the obese group has been shown to have lower levels of magnesium in their blood, even if they consume a lot of magnesium-rich meals. This might be because their bodies are not absorbing magnesium from the intestines as effectively or because they are excreting more magnesium. Both of these explanations are possible. Some studies showed that it is established that heightened consumption of fat or calcium in instances of extreme obesity hinders the absorption of magnesium [22]. Consuming dairy products and soft drinks that are high in phosphorus may hinder the absorption of magnesium, while coffee can enhance the excretion of magnesium via the kidneys. [23]

This study evaluated the quality of life of pediatric patients in comparison between the two groups, as both physical health and social functioning showed the most efficient rates in the quality of life of pediatric patients for both groups. Physical health score was 70.41 ± 7.1 for the group of obese children and 84.20 ± 12.10 for the group of children with normal weight. Social functioning was 65.76 ± 23.66 for the group of obese children and 86.40 ± 11.2 for the group of children with normal weight.

Prior study has shown that individuals with obesity have a notable reduction in blood magnesium levels, and this decline is strongly correlated with the severity of obesity. Interestingly, despite consuming magnesium-rich meals in large quantities, the observed association did not approach statistical significance. The findings of this study align with last studies which also observed notably decreased levels of magnesium in the blood and a negative correlation between blood magnesium levels and BMI in overweight children. Reports on dietary consumption of magnesium are subject to debate [24,25]. A study conducted in the United States revealed a substantial decrease in obese children. [26]

Obese individuals, as compared to those of normal weight, had notably reduced levels of blood magnesium and HDL cholesterol, as well as considerably elevated levels of LDL cholesterol, total cholesterol, triglycerides, as well as both diastolic and systolic blood pressure [27]. The serum magnesium levels exhibited a notable and robust negative correlation with the extent of obesity, as well as a substantial and moderate negative correlation with both total cholesterols along with LDL cholesterol p [28]. There was no significant correlation between triglycerides and HDL cholesterol. The level of obesity had a noteworthy and moderate positive correlation with both total cholesterol and LDL cholesterol while demonstrating no significant link with triglycerides and HDL cholesterol. [29]

The psychological ramifications of juvenile overweight and obesity are significant, resulting in adverse self-perception, dissatisfaction with one's body, and social exclusion, which ultimately contribute to a diminished quality of life and overall health. This study found that children seeking treatment for obesity who had the most severe levels of obesity had the greatest impact on their Health-associated Quality of Life (HRQoL), particularly in terms of physical and psychological aspects associated to their parents. The results were also of clinical significance, as obese children and adolescents exhibited substantially poorer ratings in health-related quality of life (HRQoL) compared to children and adolescents with a normal weight. [30]

Conclusion

This study enrolled the presence of negative and inverse indicators in magnesium levels in overweight children, where it was noted that the dietary intake associated with magnesium appears higher in most children suffering from magnesium deficiency. This study showed that the majority of obese children suffer from a significant decrease in the rate of magnesium levels in children. Although high blood pressure and total cholesterol, magnesium shows its presence as an early biomarker for the identification of all obesity-related diseases.

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