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Children in Zakho City with Normal Weight or Obesity and Their Serum Magnesium Levels

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Abstract

Backgrounds: Obesity among children is a global health issue, with a significant increase in prevalence over the past three decades. Over 379 million children and adolescents globally are overweight or obese. Magnesium is fourth among the most abundant cations after calcium, sodium, and potassium. Magnesium is essential for biological functions. It can lead to deadly outcomes such as vasospasm of cardiac arteries, arrhythmias, and even unexpected death. Methodology: A cross-sectional case-control research design was used to evaluate data from 100 children 50 boys, and 50 girls, aged 2-14 years at Zakho General Hospital in Iraq. The sample was obtained between April 1st, 2022, and April 1st, 2023. Demographic data, blood collection, and anthropometric measurements were used. Serum magnesium levels were measured and body mass index (BMI) was calculated. Ethical approval was obtained from the College of Medicine/University of Zakho. Statistical analysis included Chi-square and independent t-tests. Results: The study found that the majority of obese children are 5-10 years old, with males dominating. The mean serum magnesium level for all participants was 2.082 ±0.190 mg/dl which is a bit higher in the obese than normal-weight children with no significant difference. Conclusion: The serum magnesium level is not significantly related to body weight in children. Further studies are recommended focusing on the dietary intake and physical activity that are the main confounders for this association.

1. Introduction

Obesity among children is a serious health problem over the world in the 21st century. It is a multifactorial problem and a phenotype of many pathologies [1]. Throughout the past three decades, there has been a significant increase in the prevalence of childhood overweight and obesity. From 1990 to 2010, it increased from 4.2% to 6.7% [2]. Currently, 16–31% of children are obese, with the Middle East having the greatest prevalence—up to 45% in certain locations [3]. Over 379 million children and adolescents globally are overweight or obese [2].

Children who are obese or overweight are likely to be obese adults and are likely to have serious health problems like dyslipidemia, diabetes, hypertension, and diseases of the cardiovascular system at a young age [1,4]. Hypomagnesemia is inversely related to the level of blood glucose. It can also lead to resistance to insulin [5].

Various micronutrient deficiencies like B complex, fat-soluble vitamins, vitamin C, and ions such as magnesium and calcium may be related to high body mass index (BMI). Such micronutrients play a pivotal role in different nutrients' metabolism and help regulate hunger and its controlling hormones [6].

Magnesium is fourth among the most abundant cations after calcium, sodium, and potassium. Magnesium is essential for biological functions. It can lead to deadly outcomes such as vasospasm of cardiac arteries, arrhythmias, and even unexpected death [7]. Magnesium is considered the second most plentiful intracellular cation and helps greatly in regulating the uptake of glucose mediated by insulin. There is a negative correlation between its serum levels and the homeostasis model of resistance to insulin [8].

Serum magnesium is correlated with obesity in several studies. Hypomagnesemia is found in metabolically obese children [9]. Serum magnesium level in overweight children is significantly lower than that of the normal weight group. In addition, serum magnesium levels are inversely related to systolic and diastolic blood pressure, body mass index, fasting level of insulin as well as waist circumference [9]. To our knowledge, no studies in Zakho have assessed the relationship between serum magnesium levels and childhood obesity. This study aims to determine the mean serum magnesium level in obese children and compare it to normal weight controls to assess its relationship with obesity.

2. Materials and Methods

2.1. Ethical Approval

The College of Medicine/University of Zakho, Kurdistan Region, Iraq, ethics committee authorized the study proposal. Before collecting samples, legal guardians of children were contacted for permission to participate in the study and informed written agreements were obtained from all participants. Participants and their guardians were fully informed about the purpose and procedures of the study, and participation was voluntary, with the right to withdraw at any time without any repercussions.

2.2. Selection of Subjects

A cross-sectional case-control research design was used to evaluate data from a sample of 100 children, 50 boys, and 50 girls, aged 2-14 years attended an outpatient clinic at Zakho General Hospital in Zakho City, Kurdistan region of Iraq. The sample was obtained between April 1st, 2022, and April 1st, 2023.

2.3. Exclusion Criteria

Children with obesity due to genetic, syndromic, or endocrine causes, children with diabetes mellitus, chronic renal disease, chronic liver diseases, and children taking medications predisposing to hypomagnesemia like diuretics and amphotericin.

2.4. Patient Information and Blood Collection

Demographic data like age and gender were collected. We took history and performed examinations for the participants. Investigations like complete blood pictures, random blood sugar, renal function tests, chest X-rays, and liver function tests were sent to rule out other diseases. In the early morning and on an empty stomach, Serum magnesium levels of both were measured for the participants using a Hitachi -192 serum analyzer (Hitachi, Japan).

2.5. Anthropometric Measures

Anthropometric weight measures were obtained. The subjects were dressed in light clothes, and their weight was recorded to the nearest "100 g" without shoes. The scale was a Health O Meter Digital Scale, produced in the United States of America, that reads to the nearest hundred grams. Every participant weighed themselves using the same scale. This scale was calibrated daily, and zero was assured before each student's weight was recorded.

2.6. Definition of Variable

The body mass index (BMI), which may be calculated for each research participant, is the product of height in square meters and weight in kilograms (kg/m^2). The CDC's BMI growth charts for boys and girls show that any score over the 95th percentile is considered obese [10]. The normal values for the Serum magnesium concentration are 1.5 - 2.3 mg/dL [11].

2.7. Statistical Analysis

SPSS vs. 26 software was used for statistical analysis. The descriptive statistics of the individuals were described using frequencies and percentages. Chi-square and independent t-tests were used to investigate the relationship between serum Magnesium and different variables. To determine the difference between the two groups, a p-value of 0.05 or less was considered statistically significant.

3. Results

As shown in Table (1), the predominant age group in both normal weight and obese children is 5-10 years but generally, there were no significant differences. Males predominated among the obese children contrary to the normal weight group where females were predominant but without significant differences.

Table (1): Age and Gender distribution of participants.

Age	Normal	Obese	p Values
Less than 5 years	12 (24%)	6 (12%)	0.294
Between 5 – 10 years	22 (44%)	25 (50%)	
More than 10 years	16 (32%)	19 (38%)	
Gender			
Male	24(48%)	26 (52%)	0.689
Female	26(52%)	24 (48%)	

The body mass index of all participants was 21.1+/-.876 but it was much higher among obese children as compared to normal children with significant differences as shown in Table (2).

Table (2): BMI distribution of participants.

	Normal	Obese	Total	t-test
BMI (mean ±SD)	16.58 ± 2.16	26.13 ± 4.30	21.351 ± 5.876	0.001

The mean serum magnesium level of the participants was 2.082 ± 0.190 mg/dl, but this level was a bit higher in the obese than normal-weight children with no significant difference as shown in Table (3). The serum magnesium level by BMI of both groups is presented graphically in Figure (1).

Table (3): Mean serum Mg level.

S. Mg level	Normal	Obese	Total	t-test
Mean ± SD	2.068 ±0.175	2.096 ± 0.204	2.082 ±0.190	0.862

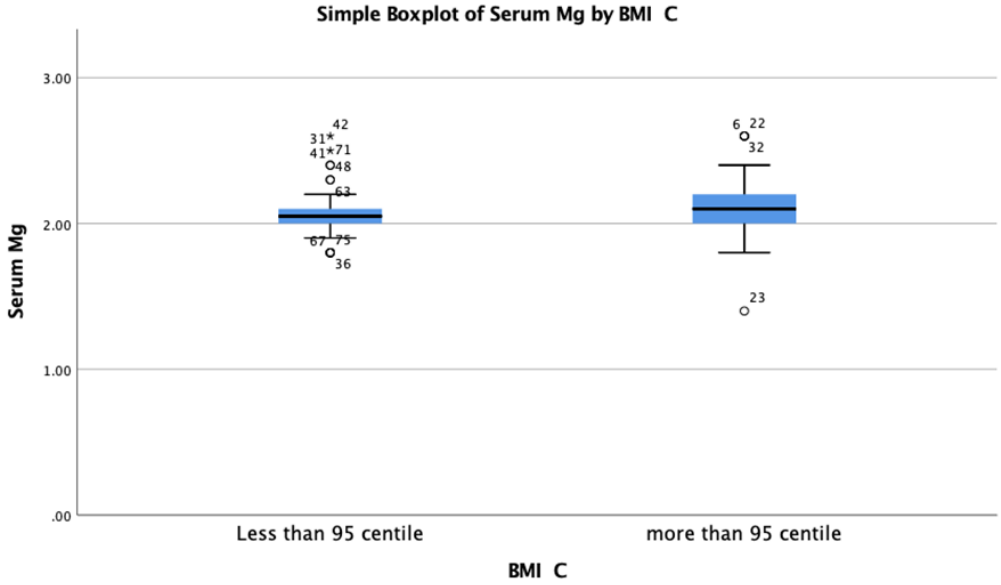

Figure (1): Serum magnesium level by BMI.

4. Discussion

The pathophysiology of obesity is complex and multifactorial. It is a pandemic all over the world. Magnesium has been postulated as an important micronutrient playing a major role in regulation of the glucose metabolism and enzymatic processes as well as the determination of body weight [12].

Overweight persons have a smaller amount of magnesium in serum and intracellular spaces as compared to normal adults. In the pediatric population, there is very limited data internationally, and in Iraq especially in the Kurdistan region, no study has been done on the association of serum magnesium levels with obesity [13].

Studies achieved in various health facilities found low serum magnesium levels and a diet low in magnesium in obese children. Huerta, et al. concluded that obese children had a lower calorie-adjusted magnesium intake by comparison with normal-weight children [1]. Jose B, et al. found that overweight children have lower levels of serum magnesium (2.12 ± 0.33) as compared to normal-weight children (2.56 ± 0.24) [14].

It is still debatable whether supplementation of magnesium can help in preventing or curing obesity. Rodríguez-Moran M conducted a randomized double-blind placebo-controlled trial on obese children and proved evident improvements in the metabolic profiles and blood pressures of obese individuals after magnesium supplementation [15].

This study shows that overweight and obesity are not associated with low serum magnesium levels. Similarly, Guerrero-Rumero also found no direct relationship between hypomagnesemia and obesity but postulated that both hyperglycemia and poor intake of magnesium lead to hypomagnesemia irrespective of obesity [16]. A similar result was also found by Bertinato who found that serum magnesium was not significantly related to obesity in males [17].

Hypomagnesemia commonly has been related to decreased dietary intake of magnesium and/or increased loss of magnesium [18]. To control these confounders in our study, we excluded the well-known conditions to cause loss of magnesium like malnutrition, extreme exercise, liver, and renal diseases, the use of diuretics, and chronic diarrhea in the study participants.

Our results are in contrast to other studies that show a significant relation between hypomagnesemia and overweight and obesity [6-8,19-21]. The explanation for this difference in the results can be based on dietary intake and physical activity being the most important predisposing factors to obesity thereby overweighing the effect of hypomagnesemia.

The main limitation of our study was the lack of assessing the latter two. The lack of physical activity spending most of the time the child in electronic games and consuming high-calorie fast foods in large amounts can best explain why the children are obese despite normal serum magnesium levels. Another possible explanation can be the high dietary magnesium intake by most children in our locality through frequent eating of dark chocolate-based desserts, nuts, legumes, tahini (sesame seed paste), bananas, and leafy greens that can raise serum magnesium levels in normal-weight as well as overweight and obese children.

5. Conclusions

The serum magnesium level is not significantly related to the body weight in children. Further studies are recommended with more focus on dietary intake and physical activity which are the main confounders for this association.

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this research project. We have no financial or personal relationships that could potentially bias our work or influence the interpretation of the results.

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