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Assessment of serum magnesium in overweight children at a tertiary care hospital of Bihar

Dr. Rita Chaudhary[1], Dr. Amit Kumar[2], Dr. Ram Binay Sinha[3]
[1] Assistant Professor, Department of Biochemistry, Patna Medical College, Patna, Bihar, India
[2] Assistant Professor, Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India
[3] Professor & HOD, Department of Biochemistry, Patna Medical College, Patna, Bihar, India

Abstract
The association between a low magnesium (Mg) status, insulin resistance and metabolic syndrome has been shown repeatedly in adults, and higher Mg intakes have been shown to have a protective role. Magnesium is a cofactor in many enzymes involved in Carbohydrate metabolism. Thus its deficiency can theoretically explain abnormality of carbohydrate metabolism, Glucose intolerance and Insulin resistance. The base of obesity is laid down very much since childhood, further tracking into adulthood. It would be interesting to find out whether Magnesium deficiency also starts since childhood, so that we can ascertain etiological and therapeutic role of Magnesium in childhood Obesity, which can further prevent adulthood obesity and other metabolic syndromes.
The objectives of the study were to determine whether serum Magnesium and dietary intake of Magnesium were lower in overweight children compared to normal weight children and to assess the correlation of serum magnesium with parameters of metabolic syndrome.
The study was planned in Department of Biochemistry, Patna Medical College, Patna with the help of Department of Pediatrics, PMCH, Patna. Children were divided in 2 groups. Group 1 had 25 overweight children (BMI >85th centile for age and gender as per Agarwal's growth charts for Indian children) and group 2 had 25 normal weight children. The age group of the patients were from 5 years to 14 years.
Serum Magnesium was found to be significantly lower in overweight children in comparison to normal children.
Hence from the above findings it can be concluded that presence of lower serum magnesium levels in children with higher BMI, systolic and diastolic BP, Waist Circumference and serum insulin level in our study suggests that the origin of the association of insulin resistant state with low serum magnesium starts in childhood itself.

Keywords: magnesium, metabolic syndrome, overweight

Introduction
Childhood obesity is one of the most serious public health challenges of the 21st century. The problem is global and is steadily affecting many low- and middle-income countries, particularly in urban settings. The prevalence has increased at an alarming rate. Overweight and obese children are likely to stay obese into adulthood and more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age. Overweight and obesity, as well as their related diseases, are largely preventable. Prevention of childhood obesity therefore needs high priority.
The WHO Member States in the 66th World Health Assembly have agreed on a voluntary global NCD target to halt the rise in diabetes and obesity.
Childhood obesity is a condition where excess body fat negatively affects a child's health or well-being. As methods to determine body fat directly are difficult, the diagnosis of obesity is often based on Body Mass Index (BMI). Due to the rising prevalence of obesity in children and its many adverse health effects it is being recognized as a serious public health concern [1]. The term overweight rather than obese is often used in children as it is less stigmatizing [2]. Body mass index (BMI) is acceptable for determining obesity for children two years of age and older [3]. It is determined by the ratio of weight to height [4].
The normal range for BMI in children varies with age and sex. While a BMI above the 85th percentile is defined as overweight, a BMI greater than or equal to the 95th percentile is defined as obesity by Centres for Disease Control and Prevention. It has published tables for determining this in children [5]. BMI may mistakenly rule out some children who do have excess adipose tissue. It is therefore beneficial to supplement the reliability of a BMI diagnosis with additional screening tools such as adipose tissue or skin fold measurements [6].
The association between low magnesium (Mg) status, and insulin resistance and the metabolic syndrome has been shown repeatedly in adults, and higher Mg intakes have been shown to have a protective role. This leads to the possibility of a mechanistic involvement of Mg in weight gain and insulin resistance through its critical role as a cofactor in several enzymes in carbohydrate metabolism. Furthermore, reverse causality is also possible: diabetes is known to increase renal Mg excretion, and insulin resistance decreases Mg uptake. Therefore, the theoretical framework that links low Mg status to obesity and insulin resistance is not simple [7].

Magnesium acts as a cofactor in many enzymes, especially linked with carbohydrate metabolism. Hypomagnesemia is generally defined as serum magnesium <1.8 mg/dl. Most clinical laboratories determine the serum magnesium concentration by colorimetric methods. Mostly automated analyzers having chromophore magon are used.

The objectives of the study were to determine whether serum magnesium and dietary intake of magnesium were lower in overweight children compared to normal weight and to assess the correlation of serum magnesium with parameters of metabolic syndrome.

Methodology

The study was planned in department of Biochemistry, Patna medical College, Patna with the help of department of Pediatrics. Study period was from 1st July 2016 to 30th June 2017. 25 overweight children (BMI >85th centile for age and gender as per Agarwal's growth charts for Indian children) and 25 normal weight children were selected in two different groups. The age group of the patients was from 5 years to 14 years. The patients visited to Out Patient Department (OPD) and in-patient department (IPD) of a tertiary care hospital, PMCH, Patna. All the patients were informed about the study protocol and consents taken. Exclusion Criteria: Children with genetic/endocrine/syndromic causes of obesity, diabetes mellitus, medical conditions predisposing to hypomagnesemia (gastroenteritis, chronic kidney disease and chronic liver disease) or on medications predisposing to hypomagnesemia (e.g. diuretics, amphotericin B) Proper and detailed history was taken from patients in each group using a questionnaire based method. Dietary history including approximate Magnesium intake was also estimated. Detailed anthropometry, Blood pressure, SMR, etc were recorded using proper techniques. 2 ml of venous blood sample in sterile plain vial was taken from all the patients after overnight fasting. Serum Magnesium was estimated using flame atomic absorption spectrometer. Blood was also analyzed for other markers like glucose, insulin, lipid profile etc.

Metabolic syndrome was defined as abdominal obesity and presence of (2 or more) hypertriglyceridemia, BP>130 mm hg systolic, fasting glucose > 100 mg/dl.

Results & Discussion

The data from the 50 case study patients were collected and is presented here. Table 1 gives the information about the different characteristic of the overweight and normal patients.

Table 1: Comparison of Different Characteristics (Mean+- SD)

Characteristic	Normal weight	Overweight
Total Cases	25	25
Age (years)	6- 14	5 -13
SMR stage		
Tanner 1 (males)	12 (7)	13 (9)
Tanner 2,3 (males)	10(7)	9(6)
>Tanner 4 (males)	3 (2)	3 (3)
BMI (kg/m^2)	13.2 ± 2.6	23.5 ± 4.5
Waist circumference (cm)	57.2 ± 4.6	84 ± 5.3
Systolic BP (mm Hg)	104 ± 11	120 ± 14
Diastolic BP (mm Hg)	65 ± 8	75 ± 10
Total cholesterol (mg/dL)	129 ± 16	132 ± 12
Triglycerides (mg/dL)	93 ± 14	106 ± 19
Serum insulin (µIU/mL)	4.5 ± 2.5	7.2 ± 3.2

The baseline parameters of the two groups show more increase in the BMI, waist circumference, blood pressure, cholesterol level, triglyceride level and serum insulin in overweight children.

Table 2: Comparison of Magnesium Levels

Variable	Normal weight	Overweight	P value
Total Cases	25	25	
Serum Mg (mg/dL)			
5 - 8 years	2.65 – 3.21	1.85 – 2.49	<0.001
8 – 12 years	2.85 – 2.99	1.76 – 2. 35	<0.001
12 – 16 years	2.47 – 2.79	1.73 – 2.25	<0.001

The serum magnesium levels in the overweight patients are seen on lower side as compared to normal weight children's. Statistical analysis was done using student`s t-test. It showed serum Magnesium values to be significantly lower in overweight children (p value <0.001) in all age groups. We speculate that the lower serum magnesium levels further aggravate the insulin resistant state in overweight children and predispose them to type 2 diabetes and cardiovascular diseases in adulthood.

Human and animal studies suggest that supplementation with magnesium improves insulin-mediated glucose disposal and insulin secretion [8-10]. In one small (n=25) pediatric study by Huerta, *et al.* [11], overweight children had lower serum levels as well as lower calorie-adjusted intake of magnesium compared to normal weight children. However, we found the unadjusted as well as calorie-adjusted dietary intake of magnesium to be higher in the overweight group, which was even greater than the RDA for magnesium (140-290 mg/day).

We postulate that the lower serum levels of magnesium in our overweight group in spite of a higher dietary intake might be due to either decreased absorption or increased excretion of magnesium. Increased fractional excretion of magnesium in urine in patients with type 2 DM, hypertension and obesity has been previously reported in adults [12].

Conclusion

Hence from the above findings it can be concluded that there is association of lower serum magnesium levels with higher BMI, higher systolic and diastolic BP, higher WC and increased serum insulin levels. It can also be postulated that the origin of the association of insulin resistant state with low serum magnesium starts in childhood itself.

References

1. Kopelman Peter G. Clinical obesity in adults and children: In Adults and Children. Blackwell Publishing, 2005, p. 493. ISBN 978-1-4051-1672-5.
2. Bessesen DH. Update on obesity. J. Clin. Endocrinol. Metab. 2008; 93(6):2027-34. doi:10.1210/jc.2008-0520. PMID 18539769.
3. Deurenberg P, Weststrate JA, Seidell JC. Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. Br. J. Nutr. 1991; 65(2):105-14. doi: 10.1079/BJN19910073. PMID 2043597.
4. Berger Kathleen Stassen. Invitation to the Life Span, Second Edition. New York: Worth Publishers, 2014, p. 247. ISBN 1464172056.
5. Healthy Weight: Assessing Your Weight: BMI: About BMI for Children and Teens. CDC.
6. Javed A, Jumean M, Murad MH, Okorodudu D, Kumar S, Somers VK, Sochor O, Lopez-Jimenez F. Diagnostic performance of body mass index to identify obesity as defined by body adiposity in children and adolescents: a systematic review and meta-analysis". Pediatric Obesity. 2015, 10(3):234-244. doi:10.1111/ijpo.242. PMID 24961794.
7. Anura Kurpad V, Isabelle Aeberli. Low Serum Magnesium and Obesity – Causal Role or Diet Biomarker? Indian Pediatrics. 2012; 49:16.
8. Saris NE, Mervaala E, Karppanen H, Khawaja JA, Lewenstam A. Magnesium: an update on physiological, clinical and analytical aspects. Clin Chim Acta. 2000; 294:1-26.
9. Balon TW, Gu JL, Tokuyama Y, Jasman AP, Nadler JL. Magnesium supplementation reduces development of diabetes in a rat model of spontaneous NIDDM. Am J Physiol, 1995; 269:E745-52.
10. He K, Liu K, Daviglus ML, Morris SJ, Loria CM, Van HL, *et al*. Magnesium intake and incidence of metabolic syndrome among young adults. Circulation. 2006; 113:1675-82.
11. Huerta MG, Roemmich JN, Kington ML, Bovbjerg VE, Weltman AC, Holmes F. Magnesium deficiency is associated with insulin resistance in obese children. Diabetes Care. 2005; 28:1175-81.
12. Sjogren A, Floren CH, Nilsson A. Magnesium, potassium and zinc deficiency in subjects with type II diabetes mellitus. Acta Med Scand. 1988; 224:461-6.