Original Research Article

Assessment of serum magnesium level in obese young adults

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Abstract

Background: Obesity is a metabolic disorder with excessive accumulation of fat that has adverse effects on health. It increases the risk of health complications such as Hypertension, Diabetes mellitus-II, Metabolic syndrome, Cardiovascular diseases, Stroke, Cancers, Infertility, and also micronutrient deficiency. Magnesium is a cofactor of the enzyme systems that regulate various biochemical reactions in the body. **Aim:** To assess the serum magnesium level in obese young adults. **Materials and methods**: 60 participants, of which 30 obese and 30 healthy subjects with normal BMI, in the age group of 18 to 35 years were recruited from the Non-Communicable Disease Outpatient. Body Mass Index (BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) were the obesity indices used to assess the obesity. Serum magnesium level was estimated in them. **Results**: The data was analysed using Statistical Package for Social Sciences (SPSS) version 20. The study group were with the mean age of 22.87 $\pm$ 3.76 years, mean BMI of 29.16 $\pm$ 2.14, mean WC of 96.84 $\pm$ 6.96, mean WHR of 0.9 $\pm$ 0.03, mean serum magnesium level of 1.39 $\pm$ 0.26. Among the study group 70 %(n=21) of the participants had serum magnesium level less than 1.7 mg/dl and 30 % (n=9) had normal serum magnesium level with range of 1.8 to 2.4 mg /dl. Negative correlation was observed between serum magnesium level and all the obesity indices. **Conclusion:** Serum magnesium level was reduced in obese individuals and was inversely related to the obesity indices. Hence early diagnosis and appropriate interventions may prevent the complications of magnesium deficiency in obese individuals.

Key words: diabetes, hypertension, hypomagnesemia, obesity

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Introduction

Obesity is the abnormal or excessive accumulation of body fat, that increases the morbidity and mortality. Obesity is a result of an imbalance between energy intake and expenditure, but it is not merely an effect of overeating and lack of physical activity. It is known to be strongly related to hypertension, hypercholesterolemia, diabetes, coronary heart disease, and thus with higher risk of morbidity and mortality.[1] According to World Health Organisation(WHO) in 2016, about 39% of adults aged 18 years and above were overweight (39% of men, 40% of women) and 13% of adults aged 18 years and above were obese (11% men,15% women).[2]

Obese individuals in spite of overeating, there is deficiency of essential micronutrients such as zinc, copper, chromium,magnesium and iron.[3,4] Magnesium (Mg) is primarily an intracellular cation. Approximately one half of the body's magnesium is present in bones, then remaining in the soft tissue and very little in plasma. It is an essential co factor in more than 300 enzyme systems that regulate the protein synthesis, muscle and nerve transmission, neuromuscular conduction, signal transduction, blood glucose control, and blood pressure regulation.[5,6]It is required for DNA and RNA synthesis,aerobic and anaerobic energy production—oxidative phosphorylation and glycolysis. Magnesium also mediatesthe active transport of calcium and potassium ions into the cell.[7]

Low magnesium status occurs in obesity due to poor dietary intake of whole grains, nuts , legumes and green leafy vegetables. Subclinical magnesium deficiency is a predisposing factor for chronic inflammatory stress that increases the risk for chronic diseases such as cardiovascular disease and diabetes.[8,9] Higher Mg intake and maintaining optimal serum magnesium level may decrease the risk of developing insulin resistance and type 2 diabetes among the obese.[10]

Several studies have shown that the magnesium deficiency is associated with chronic inflammatory stress, cardiovascular disease, metabolic syndrome, and diabetes.[11]Previous studies had shown magnesium deficiency among the children and diabetics, but there were only few studies as evidence to show hypomagnesemia among the obese individuals of younger age group. Hence this study was conducted to assess the magnesium status among the young obese adults and intervention at the earliest to avoid the complications of severe magnesium deficiency in later life.

Aim and objectives

1. To assess the serum magnesium level inobese adults.

2. To measure the Waist Circumference (WC) and to calculate Body Mass Index (BMI), Waist Hip Ratio (WHR) in the obese adults.

3. To correlate the serum magnesium level with obesity indices.

Materials and methods

This is an analytical cross-sectional study conducted after obtaining Institutional Ethical committee clearance, Stanley Medical College, Chennai. 60 participants in the age group of 18 to 35 years were recruited from Non communicable disease outpatient Department, Stanley Medical College and Hospital, Chennai. This study was conducted for a period of 6 months. 30 subjects of both genders with BMI > 25, based on revised consensus guidelines for India, were recruited as obese group. Blood pressures were measured using mercury sphygmomanometer of appropriate cuff size for obese individuals.

Obese subjects with the known history of the Diabetes, Hypertension, Coronary artery disease, Neurological disorders, chronic inflammatory diseases (Rheumatoid arthritis, SLE), Thyroid dysfunction, chronic medications for any other illness, those with adverse habits such as smoking, tobacco and alcohol abuse, and women with history of PCOS, who were pregnant were excluded from the study. 30 subjects apparently healthy, age and gender matched with normal weight were the control group.

All the subjects were explained about the study and written informed consent was obtained. History was taken and clinical examination was done. The height was measured in meter (m) on barefoot using stadiometer and weight in kilograms by using a standardized weighing machine for all the participants. Body Mass

Index was calculated using Quetelet's Index (Weight / Height^2). Their Waist Circumference was measured in centimeters at the level of umbilicus or midway between the lower ribcage and pubic symphysis. Hip circumference was measured as widest circumference at the level of greater trochanter using inch tape. Then the Waist-Hip Ratio was calculated. Revised consensus guidelines for India, Normal weight - BMI 18 - 22.9, Overweight - BMI 23 - 24.9, Obese - BMI > 25.[12]

Estimation of serum magnesium levels

Under strict aseptic precautions after 12 hours of fasting, by antecubitalveni puncture, 2 ml of blood wascollected in a test tube and centrifuged;serum was separated for all the participants. Serum Magnesium was estimated byXylidyl blue method using EM 360 Fully Automated Chemistry analyzer in the Department of Biochemistry in Stanley Medical College, Chennai. Reference values of Serum magnesium level - 1.7 to 2.4 mg/ dl .

Statistical analysis

The data obtained was analysed using software SPSS version 20. Independent Students t- test was used and p value < 0.05 was considered to be statistically significant. Pearson's test was used to find out the correlation between the obesity indices and serum magnesium.

Results

Of the total 60 study participants, 30 were clinically healthy subjects, 30 obese individuals . Data are represented as mean ± standard deviation. Table- 1 depicts the comparison of age, blood pressure, obesity indices, serum magnesium in the control and study group. The mean age of the control group and obese group were 23.15 years and 22.87years. Both the groups were age and gender matched.

Table -1 : Demographic characteristics, obesity indices and serum magnesium in study population.

Parameter	Control group n=30	Study group (Obese) n=30	P -value
Age (years)	23.15 ± 3.86	22.87 ± 3.76	0.5
Sex	Males n=14 Females n=16	Males n=16 Females n=14	
SBP (mm of Hg)	116.4 ± 6.31	124.9 ± 7.69	0.43
DBP (mm of Hg)	74.16 ± 7.33	79.25 ± 6.54	0.78
Height (m)	1.66 ± 0.07	1.71 ± 0.11	0.14
Weight (kg)	61.01 ± 5.69	85.16 ± 8.27	0.62
BMI (kg/m^2)	21.33 ±1.06	29.16 ± 2.14	0.042*
WC (cm)	77.32 ± 3.55	96.84 ± 6.96	0.036 *
WHR	0.83 ± 0.45	0.9 ± 0.03	0.054*
Serum Magnesium level (mg/dl)	1.87 ± 0.17	1.39 ± 0.26	0.04 *

*p value < 0.05 significant

Correlation between serum magnesium level and all the obesity indices among the study group is given in the table -2.

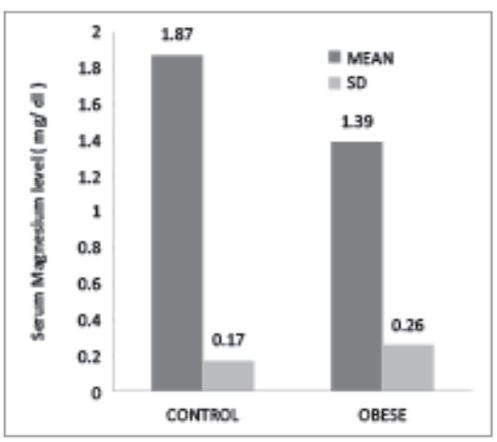
Table -2 : Correlation between Obesity Indices and Serum Magnesium level in the study group

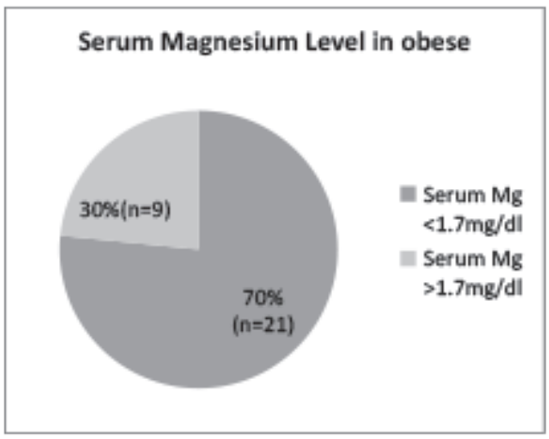
Obesity indices	Correlation co- efficient
BMI	r = -0.06, p=0.96
WC	r = -0.08, p=0.82
WHR	r = -0.09, p= 0.74

BMI- Body mass index, WC- Waist circumference, WHR- Waist Hip Ratio

There was significant difference (p value <0.05) in mean BMI, WC,WHR between the control and the obese group. The serum magnesium was found to be lower in the study group than the control group which was statistically significant (p value <0.05). Negative correlation was observed between the obesity indices BMI, WC, WHR and serum magnesium, indicating that as the obesity indices increases the serum magnesium level decreases. Comparison of serum magnesium level among the control group and the study group is shown in figure-1. The mean serum magnesiumlevel among the control group was 1.87 $\pm$ 0.17 and in obese group was 1.39 $\pm$ 0.26. Percentage distribution of Serum magnesium levelamong the study group is shown in figure-2. Among the 30 obese subjects, 21 subjects (70 %) were found to have serum magnesium less than 1.7 mg/ dl , 30 % were found to have normal serum magnesium levels >1.7 mg/dl upto 2.4 mg/dl.

Figure -1 : Comparison of Serum Magnesium level among the control group and study group.





Discussion

Obesity is a major health problem with increasing morbidity and mortality in all age groups. Our study showed that hypomagnesemia was observed in male and female obese individuals of age group 18 to 35 years. Similar results were obtained in the study conducted by Son GC et al which showed that the reduced plasma levels of serum magnesium was associated with increase in BMI.[13]Snedeker et al study showed hypomagnesemia among the obese in the age group of 20 to 70 years (mean age 47-48 years) and also showed that hypomagnesemia was more common among male than in females.[14] However few study showed that the obese women revealed higher percentage of magnesium deficiency when compared to normal weight women.[15]

Though our study group excluded hypertensives, the SBP and DBP was found to be slightly higher than the control group. The probable cause might be due to hypomagnesemia in obese individuals. The deleterious effects of a magnesium intake below 200 mg/day worsens hypertension among the obese.[16] The dietary history and personal history obtained from the subjects, which revealed that most of the obese individuals had the history of high carbohydrate, high fatty diet, reduced consumption of whole grains, green leafy vegetables.

In our study hypomagnesemia was observed among obese, 70% (n=21) of them were found to have serum magnesium levels less than 1.7mg/dl which was statistically significant ($p < 0.05$).Similar results were obtained in Guerrero et al, which showed low magnesium levels in non-diabetic, non-hypertensive obese individuals.[17] Few studies have demonstrated that hypomagnesemia is associated with metabolic syndrome.[18] Yakinci et al revealed the prevalence of magnesium deficiency among overweight and obese children.[19] The probable cause for low magnesium status in obese could be due to low dietary intake.

Magnesium deficiency due to low dietary intake causes increased oxidation of lipoproteins and membrane phospholipid, increases the catecholamines, increases the stress response, increases phagocyte priming, release of systemic inflammatory mediators like TNF – α, IL- 6, IL-1, thereby increasing the release of reactive oxygen species and reducing the antioxidant enzymes. As the consequence, low magnesium increases the inflammatory markers especially CRP and increase the oxidative stress. Since obesity is an state of chronic low grade inflammation with increased circulatory levels of inflammatory mediators like TNF – α, IL- 6, IL-1, CRP, leptin, adiponectin, etc hypomagnesemia aggravates the oxidative stress in obesity leading to vicious cycle.[20,21]

Another probable reason suggested by Kolisec et al study, an antioxidant protien PARK 7/ DJ-1 is involved in magnesium efflux system. Over expression of this protein occurs in obesity, which leads to increased cellular oxidative stress leads to modulation of intracellular magnesium concentration promoting efflux of magnesium.[22] This could be another probable reason for hypomagnesemia in obese .

Previous studies demonstrated hypomagnesemia among diabetics, obese children, obese women, obese of middle age group, but our study was conducted among young adult obese and could assess the prevalence of hypomagnesemia in them. Hence early interventions to treat hypomagnesemia by increasing dietary intake of magnesium rich foods, along with life style modifications and increasing the physical activity will decrease the comorbidities of magnesium deficiency among the obese young adults.

Conclusion

Our study concludes that the obese individuals have low serum magnesium level due to inadequate dietary intake of magnesium rich foods. Hypomagnesemia potentially increases and aggravates the ongoing inflammatory process occurring in obesity. Hence estimation of serum magnesium can be done as a routine blood investigation among the obese to prevent the late complications of severe hypomagnesemia.

Limitations

Our present study was conducted with a smaller sample size in the age group of 18-35 years. In future studies, wide range of age group shall be included .The inflammatory markers which indicate the severity of ongoing inflammatory process were not assessed in our study, which could be done in future studies.

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Conflict of interest Nil

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