Research Article

Magnesium Deficiency and its Correlation with Insulin Resistance in Obese Females in Majmaah

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ABSTRACT

The aim of this study is deficiency of Magnesium is related to development of insulin resistance that later increases the risk of type 2 diabetes. This study was designed to find whether serum magnesium is exhibited in obese female and its relation with insulin resistance. We selected 50 non-diabetic females (BMI> 30) calculated their BMI and measured serum magnesium and glucose using kits. Serum magnesium was found significantly lower in obese females (0.640 + 0.015 mmol/l, means + SE) compared with the lean control females (0.821 + 0.012 mmol/l). It was found that serum magnesium was inversely correlated with insulin (rs = – 0.36 [95% CI –0.59 to –0.08]; P = 0.011). The association between magnesium deficiency and insulin resistance is present in obese females. Serum magnesium deficiency in obese females may be secondary to decreased dietary magnesium intake. Magnesium supplementation or increased intake of magnesium- rich foods may be an important tool in the prevention of type 2 diabetes in obese females.

Keywords: Magnesium, Deficiency, Obesity, Insulin resistance.

INTRODUCTION

Obesity is often defined as multi-faceted disorder associated with an increase in number of diseases like hypertension, diabetes mellitus, arthritis, gout, coronary heart diseases and gall bladder [1, 2]. The rapid social and cultural change that has taken place in Arabian and Gulf countries after the discovery of oil during 1970s and 1980s increased obesity at an alarming rate in these countries [3, 4, 5]. Many studies show that obesity is a major risk factor for chronic diseases and plays an important role in the "insulin resistance" or "metabolic" syndrome, which includes much disease like hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease. The metabolic syndrome is a common pathophysiologic condition with implications for the development of many chronic diseases. Obesity beginning in childhood often precedes the hyperinsulinemia state [15]. The developing countries are observing increasing incidence of childhood obesity as a result of this new cases of metabolic syndrome among children are increasing, which in turn is likely to create an enormous socioeconomic and public health burden for nations with large number of young population like KSA in the near future[16]. However, little is known about the prevalence of childhood obesity and the pediatric metabolic syndrome because of the limited number of studies, the various definitions used, and the different age groups studied, which makes comparisons difficult. Many studies conducted in kingdom of Saudi Arabia (KSA) revealed that a major change in dietary habits has taken place. Fat consumption and fast food consumption increased as well as processed food has become a major part of everyday meal [6].

Magnesium is fourth abundant material in body and an important cofactor for enzymes involved in Carbohydrate metabolism. Many studies show a strong relation between magnesium and insulin action and a low serum and intercellular magnesium are associated with insulin resistance [7] impaired glucose tolerances and decreased insulin secretion [8]. The present study was designed to study whether serum magnesium is exhibited in obese and its relation with insulin resistance.

MATERIALS AND METHODS

We selected 30 non-diabetic females (BMI>25) age between 20 to 25 years. 20 lean females (BMI<25) matched for sex and stage of pubertal development. Female students were recruited with written informed consent obtained from both parents and students. On arrival, a questionnaire was provided to fill all necessary information and weight was measured using a calibrated digital scale. Height was measured in triplicate to the nearest millimeter using a calibrated stadiometer. BMI scores were calculated using equation provided by Centre for diseases control and prevention (CDC).

Laboratory Tests

Blood samples were obtained for glucose and serum magnesium. Serum glucose were measured using glucose liquicolour kit (Human) which is an enzymatic colorimetric method. The optimum density (OD) was measured at 500nm. Serum magnesium was measured using magnesium measuring kit (Human) which is also enzymatic colorimetric method. The optimum density (OD) was measured at 470nm.

Statistical analysis

Difference between obese and lean female students were examined for serum glucose and serum magnesium. *P* values for these comparisons were calculated via ANOVA. Weight status (lean, obese) served as independent factors of the ANOVA model. Statistical significance was set at $\alpha < 0.05$.

RESULTS AND DISCUSSION

Serum Magnesium

Serum magnesium concentration was significantly lower in obese females compared with lean females 0.472 ± 0.015 vs lean 0.903 ± 0.012 mmol/l; *P* = 0.02.

Serum Glucose

Serum glucose concentration was significantly high in obese females compared with lean females 0.726 ± 0.011 vs lean 0.387 ± 0.015 mmol/l; *P* = 0.03.

Table 1: Characteristics and metabolic parameters of the study subjects

Parameter	Obese females	Lean females	*P values
n (number of subjects)	30	20	----
BMI (kg/m^2)	30.5 ± 2.1; 28.4 (24.5 – 35)	22.5 ± 0.6; 21.4 (20 – 24.5)	<0.001
Fasting glucose (mmol/l)	5.80 ± 0.11; 5.69 (5.6 – 6.8)	5.16 ± 0.015; 5.15 (4.8 – 5.5)	0.782
Serum magnesium(mmol/l)	0.472 ± 0.015; 0.467 (0.402 – 0.653)	0.93 ± 0.012; 0.891 (0.732 – 1.01)	0.005

*By ANOVA for continuous variables and by exact test for categorical variables.

Serum Magnesium and Glucose

Serum magnesium was found inversely proportional to fasting serum glucose level in obese female students.

CONCLUSION

Our studies found that low serum magnesium concentrations are associated with hyperinsulinemia, decreased insulin-mediated glucose disposal, and the metabolic syndrome[9]. In the Atherosclerosis Risk in Communities study, low serum magnesium had a two fold increase in incidence of type 2 diabetes compared with those having a normal magnesium concentration[10]. Magnesium supplementation in subjects with IR and type 2 diabetes resulted in improvement of insulin sensitivity[11] and cell response to glucose[12]. In an animal model of the metabolic syndrome, increased magnesium intake reduced the rate of development of type 2 diabetes[13, 14]. These results suggest a potential role of magnesium in the prevention of type 2 diabetes. It will be important to test in future interventional studies whether increasing magnesium intake will improve insulin sensitivity and reduce the risk of type 2 diabetes in obese females.

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