EVALUATION OF SERUM MAGNESIUM IN OBESE CHILDREN

Thesis

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Dedication

- *To my great parents:*

  For their continuous support to me.

- *To my dear sisters and to the soul of my brother.*

List of Abbreviations

AAP: American Academy of Pediatrics.
ACTH: Adreno Corticotropic Hormone.
B.P.: Blood Pressure.
BMI: Body Mass Index.
CDC: Centers for Disease Control and Prevention.
DEXA: Dual Energy X-ray Absorptiometry.
DM: Diabetes Mellitus.
H.R: Heart Rate.
HTN: Hypertension.
IU: International Unit.
LMBBS: Laurence-Moon-Bardet-Biedl-Syndrome.
MAOIs: Mono Amine Oxidase Inhibitors.
NASH: Non Alcoholic Steatosis Hepatitis.
NIDDM: Non-Insulin- Dependent Diabetes Mellitus.
OSAS: Obstructive Sleep Apnea Syndrome.
PCOs: Poly Cystic Ovary Syndrome.
PMS: Laurence Moon Syndrome.
PTH: Para Thormone Hormone.
PWS: Prader Willi Syndrome.
R.R.: Respiratory Rate.

Introduction

There are many facts that make it necessary to have a thorough look at the subject of childhood obesity. First, there is a dramatic rise in the prevalence of obesity among Egyptian children that has reached alarming levels **(Galal, 2006).**

Second, childhood obesity is linked to obesity in adulthood and furthermore it is associated with increased mortality, coronary heart disease, hypertension, dyslipidemia and diabetes mellitus. Thus, the importance of achieving a reliable and accurate estimate fat mass is essential not only for the prevention but also for the treatment of obesity in children and adolescents **(Kaufer and Ariza, 1998).**

There has been no agreement with the definition and classification of obesity in childhood . However, there is lack of simple accurate method to measure fat mass in children, and also there is lack of cutoffs of fat mass for children to identify individuals at moderate or high cardiovascular or metabolic risk **(Flodmark et al., 2006).**

Assessment of obesity in children can be done using different methods such as BMI, skin fold thickness, waist circumference and waist hip ratio; however none of them is ideal to assess fat mass in pediatric age group **(Waehre, 2009) .**

BMI is a simple method to measure the percentage body fat would be of considerable value, both in clinical practice and for research. Skin fold caliper has been the most frequently used method of measuring subcutaneous adipose tissue thickness. However, it has been

demonstrated that different caliper types may affect skin fold estimates **(Waehre, 2009) .**

BMI is probably the best choice among available measures, BMI can be easily assessed at low cost, and has a strong association with body fatness and health risks **(Nowicka ,2005).**

BMI better reflect the amount of body fat composed with the amount of muscle or bone and is used for the proxy for measurement of body fat mass in adults in absence of laboratory and radiographic determination **(Nowicka ,2005).**

BMI has a good specificity as it exclude subjects not overweight, but has poor sensitivity as it misses some who are obese, and provide a higher value than would be accurate in stunted children suggesting better nutritional status than actually the case **(Nowicka ,2005).**

Most professionals use published guidelines based on the body mass index (BMI), or a modified BMI for age and sex, to measure obesity in children, Although BMI has been used to evaluate overweight and obesity in adults for many years, it has only recently been recommended for screening children and adolescents **(Waehre, 2009).**

The advantages of using modified BMI for age are (1) it can be used continuously from age 2 years through adulthood. (2) allow significant changes in growth patterns to recognized and addressed before children become severely overweight ,it also facilitates anticipatory guidance for children and adolescents at risk of overweight or for those who are underweight **(Nowicka ,2005).**

Children with a modified BMI between the 85th and 95th percentile are considered overweight, and above the 95th percentile are considered obese individuals **(Waehre, 2009).**

Magnesium a divalent ion, is widespread throughout the mammalian organism **(Briscore, 1966).** The physiological role of magnesium is achieved through its ability to form chelates with important intracellular ligands especially ATP **(Altura et al, 2004).** Magnesium is therefore essential for the synthesis of nucleic acids and proteins, for intermediary metabolism and for specific actions in different organs such as neuromuscular and cardiovascular system **(Elin et al, 2004).**

Magnesium deficiency can be divided to primary and secondary deficiency. Primary magnesium deficiency is entirely due to reduced dietary intake and secondary magnesium deficiency is a result of increased gastrointestinal or renal loss of magnesium **(Katieen , 2004 and Nadler ,1995).** Multiple studies linked obesity with low serum magnesium. Obesity is characterized by a high risk for glucose intolerance, cardiovascular disease, dyslipidaemia and insulin resistance . It is speculated that one of the causes for the a fore mentioned disorders in obese individuals, is magnesium deficiency **(De leeuw etal, 1992).** Several studies have identified low serum magnesium in obesity (**Huerta et al, 2005 and Song et al, 2004)** found a negative correlation between serum magnesium and modified BMI in healthy children and adults($P<0.05$). In some of studies low serum and intracellular magnesium has been reported in obesity **(Resnick et al, 1990 and shills et al, 2006).**

On the other hand, if magnesium deficiency is detected, it should be treated because non treated hypomagnesaemia can lead to chronic

disease as atherosclerosis, myocardial infarction, hypertension and renal calculi **(Nadler et al, 1992).**

Aim of the work

The aim of this study was to determine whether obese children and adolescents have lower serum concentration of magnesium compared to those with normal weight or not.

Childhood Obesity

Definition:

Childhood obesity in general means an excess of body fat. However, Centers for Disease Control and Prevention (CDC) defines childhood obesity as at or above the 95th percentile of BMI for age and sex and overweight as between 85th to 95th percentile of BMI for age and sex **(Centers of Disease Control and Prevention, 2012)**.

BMI is calculated using a child's weight and height. BMI does not measure body fat directly, but it is a reasonable indicator of body fatness for most children and teens **(Centers of Disease Control and Prevention, 2012)**.

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. Globally, in 2010 the number of overweight children under the age of five is estimated to be over 42 million. Close to 35 million of these are living in developing countries **(WHO, 2012)**.

Prevalence:

There is a dramatic rise in the prevalence of obesity among Egyptian children that has reached alarming levels **(Aboul Ella et al., 2010)**.

In 2010, 43 million children (35 million in developing countries) were estimated to be overweight and obese; 92 million were at risk of being overweight. The worldwide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010. This trend is expected to reach 9.1%, or ≈60 million, in 2020. The estimated prevalence of childhood overweight and obesity in Africa in 2010 was 8.5% and is expected to reach 12.7% in 2020. The prevalence is lower in Asia than in Africa (4.9% in 2010), but the number of affected children (18 million) is higher in Asia **(Burros and Marian, 2010).**

Risk factors:

The onset of obesity may occur at any age, and is triggered by factors such as early weaning, eating disorders and problems related to family relationship, especially during growth spurts **(Giugliano and Carneiro , 2004).**

1. Maternal weight:

Children whose mothers were obese before pregnancy are at a greater risk of becoming overweight than children whose mothers had normal BMI. Additive interaction between maternal pre pregnancy obesity and lack of breast-feeding was detected, such that children whose mothers were obese and who were never breast-fed had the greatest risk of becoming overweight **(Li et al., 2005).**

2. ***Maternal education:***

The importance of education, especially maternal education, is shown by the higher occurrence of overweight and obesity in students whose mothers had a lower educational level, which suggests that maternal education is a risk factor for childhood obesity. This was not observed in paternal education **(Giugliano and Carneiro, 2004).**

3. Birth weight:

More than two dozen studies have addressed the association between birth weight and attained BMI. Most have measured the outcome in childhood, but several have examined adult BMI. Almost all of the studies have found direct associations, i.e., that higher birth weight is associated with higher attained BMI. Some of the smaller studies have found no association; none has found an inverse association **(Oken and Gillman , 2003).**

4. psychological factors:

psychological factors can cause compensatory overeating in children as in adults**.** Emotional, physical or social values are essential for a child growth and development. Being deprived of any one of these, may bring on obesity. Also, the child who is socially isolated may resort to over-eating as a solution to his inner turmoil**(Giugliano and Carneiro, 2004).**

5. ***Social factors***:

Single child, single parent are associated with obesity in young children. The prevalence of large families amongst the older children suggest that it is only in later childhood that these children become obese **(Giugliano and Carneiro, 2004).**

6. *socio economic status:*

A negative relationship between socioeconomic status (e.g., parental income, parental education, occupation status) and being overweight or obese has been well established **(sobal and stunkard,2010).**

A number of studies find that socioeconomic status is negatively correlated with children being overweight or obese **(strauss and knight, 2010).**

7. Breast feeding:-

Both physiological and behavioral mechanisms raise the possibility that breast feeding during infancy could reduce the risk of overweight in later childhood and adolescence. Some epidemiologic studies suggest a protective effect in the first 6 years of life, but few reliable data exist for older ages. During the second year of life, for example, children who had been breastfed for at least 12 months have lower weight for age values than those breastfed for shorter durations **(Gillman et al., 2001).**

A recent study postulated that breast feeding may promote healthier eating habits because breast fed infants may eat until satiated, whereas bottle fed babies may be encouraged to eat until they have consumed all of the formula. Breast feeding also may expose babies to more variability in terms of nutrition and tastes since formula fed infants have experience with only single flavor, whereas breast fed infants are exposed to variety of flavors from the maternal diet that are transmitted through the milk **(Bonuk, 2010).**

Etiology:

Obesity is a complex multifactorial disease which is independently related to Genetic and environmental causes ,Genetics alone does not cause obesity. Obesity will occur only when a child eats more calories than he or she uses **(Stoppler, 2010).**

Leptin and Leptin Receptor Deficiency :

Leptin is a cytokine secreted by adipocytes in proportion to body's fat content. It binds to receptors in two different specific populations of neurons of the arcuate nucleus of the hypothalamus. Pathogenic mutations in both leptin (LEP) and its receptor (LEPR) in extreme forms of early-onset obesity were identified **(Montague et al., 1997)**.

patients with congenital leptin deficiency exhibit normal weight at birth but gain weight rapidly in the early postnatal period. Leptin deficiency is associated with marked hyperphagia, impaired satiety, and excessive fat deposition in the trunk and limbs **(Montague et al., 1997)**.

A- Enviromental factors:-

1- Dietary habits:-

Children's dietary habits have shifted away from healthy foods (such as fruits, vegetables, and whole grains) to a much greater reliance on fast food, processed snack foods, and sugary drinks, These foods tend to be high in fat and/or calories and low in many other nutrients. Patterns associated with obesity are eating when not hungry and eating while watching TV. **(James and William, 2010)**

Children who regularly consume more calories than they use will gain weight. If this is not reversed, the child will become obese over time. Many different factors contribute to this imbalance between calorie intake and consumption. **(James and William, 2010)**

2- Sedentary behavior:-

In the last decades, children have become less active as a result of their easy access to technological advances. The fact that the number of hours of sleep may favor a decrease in body fat shows that sleep may act positively towards maintaining body composition in children and should therefore be encouraged, especially in overweight and obese ones **(Giugliano and Carneiro , 2004).**

Factors contributing to inactivity have included the decrease in physical education programs in the school system and the increase in the use of automobiles and buses to transport school children **(Nicklas et al., 2011).**

Time spent watching Television is positively associated with risk of obesity and type 2 diabetes. Independent of exercise levels, sedentary behavior, especially TV watching, is associated with significantly elevated risk of obesity and type 2 diabetes **(Giugliano and Carneiro , 2004).**

A Television in the child's bed room is an even stronger marker of increased risk of being overweight. Because most children watch TV by age 2 years, educational efforts about limiting child TV/video viewing and keeping the TV out of the child's bed room need to begin **(Batch and Baur , 2005).**

Television viewing exposes children to food marketing, increases opportunities for snacking on high-energy foods and drinks, decreases