The Egyptian Journal of Medical Human Genetics (2016) 17, 63–70

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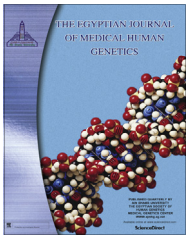

ORIGINAL ARTICLE

Magnesium supplementation in children with attention deficit hyperactivity disorder

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Received 20 May 2015; accepted 27 May 2015
Available online 7 July 2015

KEYWORDS

ADHD;
Magnesium;
Supplementation;
Treatment

Abstract *Background:* Attention deficit hyperactivity disorder (ADHD) is a common neurodevelopmental disorder with associated mineral deficiency.

Aim: To assess magnesium level in ADHD children and compare it to the normal levels in children. Then, to detect the effect of magnesium supplementation as an add on therapy, on magnesium deficient patients.

Methods: The study was conducted on 25 patients with ADHD and 25 controls. All subjects had magnesium estimation in serum and hair. ADHD children were further assessed by Wechsler intelligence scale for children, Conners' parent rating scale, and Wisconsin card sorting test. Then magnesium deficient patients were assigned into 2 groups, those who received magnesium, and those who did not. The difference between the studied groups was assessed by Conners' parents rating scale and Wisconsin card sorting test.

Results: Magnesium deficiency was found in 18 (72%) of ADHD children. The magnesium supplemented group improved as regards cognitive functions as measured by the Wisconsin card sorting test and Conners' rating scale. The patients reported minor side effects from magnesium supplementation.

Conclusion: Magnesium supplementation in ADHD, proves its value and safety.

1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a common, early-onset and enduring neuropsychiatric disorder characterized by developmentally inappropriate deficits in attention, hyperactivity, increased impulsivity and emotional deregulation, resulting in impairments in multiple domains of personal and professional life [1].

Evidence for dietary/nutritional treatments of attention-def icit/hyperactivity disorder (ADHD) varies widely; however recommended daily allowance of minerals and essential fatty acids is an ADHD-specific intervention [2].

Magnesium is the fourth most abundant mineral in the body and is essential for good health [3]. Its biological importance evolves from being an essential trace mineral involved in over 300 metabolic reactions including cellular

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Peer review under responsibility of Ain Shams University.

http://dx.doi.org/10.1016/j.ejmhg.2015.05.008

energy generation, nucleic acid production (DNA, RNA), and protein synthesis. Magnesium (Mg^{+2}) is, also, the most abundant intracellular divalent cation [4].

The mineral magnesium is necessary for sufficient brain energy and aids smooth transmission of communications through the central nervous system, calms the central nervous system and is an important component in the making of serotonin [5].

Magnesium deficiency is typified by a number of reductions in cognitive ability and processes, and in particular a reduced attention span along with increased instances of aggression, fatigue and lack of concentration [6]. Other common symptoms of magnesium deficiency include becoming easily irritated, nervousness, fatigue and mood swings [6].

Given the nature of these symptoms and the significant amount of overlap that they share with ADHD, this led many experts involved in the treatment and care of ADHD to hypothesize that children who suffer from ADHD also have magnesium deficiency as well.

In the current study, magnesium level in children with attention deficit hyperactivity disorder (ADHD) will be compared to normal children, in both serum and hair. Then, the effects of magnesium supplementation in magnesium deficient patients will be assessed.

2. Subjects and methods

This study is a case-control prospective interventional comparative study. It was conducted on 25 patients with ADHD and 25 age and sex matched controls.

2.1. Participants

Patients were considered ineligible for the study, if they fulfilled criteria of ADHD according to DSMIV, their age range was between 6 and 16 years and their IQ above 70. Ineligibility for the study included presence of other medical conditions as significant anemia, chronic illness, hearing or vision impairment, medication side effects which may result in hyperactivity and impaired sleep rhythm.

Twenty five healthy children recruited from the sibs of the ADHD group were included in the study as a control group.

Both patients and healthy controls were recruited from Children's hospital and institute of psychiatry, Ain Shams University, Cairo, Egypt. The work has been carried out in accordance with the code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

2.2. Study design

Patients were recruited from the clinic randomly. After explaining the purpose of the study, written consents from parents and the acceptance of the ethics committee of Ain Shams University were obtained. Data were collected through the administration of the predesigned questionnaires to the parents.

Each patient in this study was subjected to the following; Full detailed medical history including presence of organic or psychological diseases, perinatal and developmental history, family history of similar cases, and the previous treatment which was received.

Clinical Examination included; body measurements, physical examination and neurological examination.

2.3. Investigations

Serum magnesium level was assayed by auto analyzer [7].

Hair magnesium level (Fresh, clean hair sample) was subjected to Inductively Coupled Mass Spectroscopy (ICP-MS) which has been cited as currently the most sensitive and comprehensive technique available for multi-element analysis of trace elements to measure hair magnesium in both cases and controls [8].

2.4. Scales

DSM (IV) to confirm the diagnosis of ADHD in cases and to exclude concomitant psychiatric disease [9].

Conners' parent rating scales using an Arabic version for detection of the severity of ADHD [10]. Items are scored on 14 subscales but in our study we used only the hyperactivity, inattention, oppositional and impulsivity scores.

Wisconsin's card sorting test (WCST) is a neuropsychological test of "set-shifting", i.e. the ability to display flexibility in the face of changing schedules of reinforcement. It's a measure of executive function. We used computerized versions of the task (Microsoft Windows-compatible version 4.0). It has the advantage of automatically scoring the test, which was quite complex in the manual version [11].

Wechsler intelligence scale for children (WISC) using the Arabic version for IQ assessment [11].

We compared the ADHD group (25 patients) with the matched control group (25 children) as regards different variables mainly the hair and serum magnesium. The ROC Curve (Receiver Operating Characteristics) was used for the diagnosis of decreased magnesium level in hair among ADHD children as there is no available reference in Egypt for hair Magnesium in this age group. Using ROC Curve,

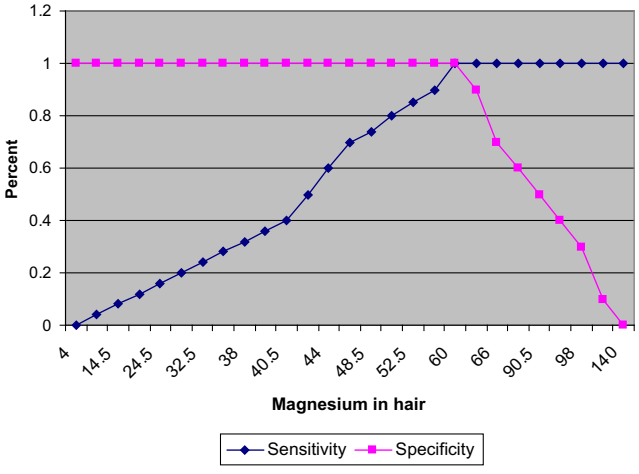

Figure 1 Using ROC Curve the cut off value for deficient magnesium level in hair was equal or less than 60.