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Relationship between Serum Levelsof Zinc, Iron Andvitamin D in Children with Attention Deficithyperactivity Disorder

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ABSTRACT: Background: Attention-deficit/hyperactivity disorder(ADHD) is a neurodevelopmental disorder. Children with ADHD may have reduced levels of zinc, iron, ferritin and vitamin D. These nutrients have important roles in neurologic function, cognition and neurotransmitter synthesis.

Objectives: The aim of this study was to determine relationship between serum levels of zinc, iron, vitamin D in children with attention deficit hyperactivity disorder.

Methods:

Study design: Case control study

Statistical analysis: SPSS (version 20) used for statistical analysis. Statistical tests like chi- square and t- test were applied to find out the test of significance.

The study was conducted in 38 children with ADHD and 76 controls aged 3-18 years.The health status of children was assessed by symptoms and clinical presentation, family history ,Diagnostic and Statistical Manual of Mental Disorders 5th edition(DSM-V) and laboratory investigations,including serum level of zinc, iron, ferritin, 25-Hydroxy vitamin D.

Results:Mean age (SD in years) for ADHD and control children was (7.24 ± 1.79 vs 7.94 ± 1.89). There were statistically significant differences between ADHD vs control children for serum zinc(34.26±12.85vs82.57±26.21 µg/dL),serumiron(49.07±25.27vs89.25±32.90 µg/dL), serum ferritin (19.76 ± 18.26 vs 96.8 ± 22.91 ng/ml) and serum 25-Hydroxy vitamin D (22.18 ± 4.67 vs 30.78 ± 6.22ng/ml).

Conclusion: This study indicates that zinc, iron, ferritin, vitamin D deficiency may be related to the pathophysiology of ADHD.This may suggest alternative therapeutic approach (zinc, iron & vitamin D supplementation) in prevention and treatment of ADHD.

Keywords: ADHD, Zinc, Iron, Vitamin D

I. INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder.

It is one of the most prevalent mental health disorders that affect ~5.3–7.1% of children and adolescents[1]. Attention deficiency, hyperactivity, and impulsivity are three main symptoms that help diagnose the disorder before the age of 12 years[2]. There are three major subtypes of the disorder: predominantly inattentive (ADHD-PI or ADHD-I), predominantly hyperactive impulsive (ADHD-HI or ADHD-H), or a combination of these two subtypes (ADHD-C)[3]. Despite being one of the most studied psychiatric disorders, the exact cause of ADHD is still unknown; both genetic and environmental risk factors contribute to the development of ADHD[4].Dopamine is one of the most important factors in the pathophysiology of ADHD and the hormone melatonin has an important role in the regulation of dopamine. Because zinc is necessary in the metabolism of melatonin, it can be assumed that zinc is a very important factor in the treatment of attention deficit and hyperactivity disorder (ADHD),so its deficiency has an important role in the pathogenesis of ADHD [5]. Zinc is an important cofactor for metabolism relevant to neurotransmitters, prostaglandins, and melatonin, and indirectly affects dopamine metabolism [6]. It mediates the release of neurotransmitters like gamma amino butyric acid [GABA] and glutamate. This indicates that it may be a key modulator of neuronal excitability [7]. Also, zinc is an important cofactor for more than 300 other nutrients. So, zinc deficiency may create functional deficiency of these other nutrients [8]. These functions have been shown to be affected by moderate zinc deficiencies in humans [9]. It, also, seems likely that zinc supplementation in zinc-deficient ADHD patients improves the binding status of the dopamine transporter [10]

Iron deficiency is considered a potent cause of poor cognitive impairment, learning disabilities, and psychomotor instability[11], which also supports the hypothesis that iron deficiency may play a role in the pathophysiology of

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ADHD[12]. The most useful single laboratory value for the diagnosis of iron deficiency may be plasma ferritin[13]. Recent studies have reported a significant relationship between ADHD and low serum ferritin levels[14]. Vitamin D is essential for the brain as it promotes normal brain development[15]. Studies demonstrate that vitamin D deficiency could be a risk factor for developing ADHD[16].

Objectives:

The aim of this study was to determine relationship between serum levels of zinc, iron, vitamin D in children with attention deficit hyperactivity disorder.

Methods:

This study was carried in Pediatric Department, Hi-Tech Medical College and Hospital, Bhubaneswar,Odisha.It follows the ethical standards of our institution. Informed consents from all subjects were obtained from the period of Nov 2019 till November 2020. This study was carried on 114 patients. They were classified into the following groups.

Group I included 38 patients with ADHD. Group II included 76matched healthy individuals, excluding children with seizures, mental retardation, and children with chronic systemic diseases.

All participants underwent full history taking and thorough clinical examination and laboratory investigations, which included the following: (a)serum zinc (b) serum iron, (c) serum ferritin, and (d) serum 25-hydroxy vitamin D [25(OH) D].

Specimen collection and preparation were done under sterile aseptic techniques. Venous blood samples were collected, and serum separated and stored at −70°C until analysis. Blood tests were carried out for the patient group and the control group.

Statistical analysis

The data collected were tabulated and analyzed by Statistical Package for the Social Science Software, version 20 .The patient and control groups were compared using the chi-square test for categorical variables and independent sample t-test for the analysis of parametric numerical data. P value of <0.05 was considered statistically significant.

II. RESULTS

Mean age (SD in years) for ADHD and control children was (7.24 ± 1.79 vs 7.94 ± 1.89). There were statistically significant differences between ADHD vs control children for serum zinc(34.26±12.85vs82.57±26.21µg/dL),serumiron(49.07±25.27vs89.25±32.90µg/dL), serum ferritin (19.76 ± 18.26 vs 96.8 ± 22.91 ng/ml) and serum 25-Hydroxy vitamin D (22.18 ± 4.67 vs 30.78 ± 6.22ng/ml).

Table 1. The Results of Laboratory Tests in the Case and Control Groups[a]

Variable	ADHD	Control	P Value[b]
Zinc, µg/dL	34.26 ± 12.85	82.57 ± 26.21	0.032
Iron, µg/dL	49.07 ± 25.27	89.25 ± 32.90	0.022
Ferritin, ng/mL	19.76 ± 18.26	96.8 ± 22.91	0.045
25 OH Vitamin D, ng/mL	22.18 ± 4.67	30.78± 6.22	0.015

[a]Values are expressed as mean ± SD.
[b]Independent samples t-test was used and P values of less than 0.05 were considered significant.

III. DISCUSSION

In our study ADHD patients were deficient in zinc ,iron,ferritin, and vitamin D in serum samples. The levels of these elements in serum were significantly lower than both laboratory reference ranges and levels in normal controls .Regarding the serum level of zinc, our results revealed that there was a significant statistical difference (P value of less than 0.05) between ADHD group and control as mean values of zinc

were34.26 ±12.85µg/dland 82.57 ± 26.21µg/dl among ADHD group and control children, respectively . it was similar to the results obtained by Bekarogluet et al [17]. in Turkey and Arnold et al [18].

Our results also revealed that there was a significant statistical difference (P value of less than 0.05) between ADHD group and control group regarding iron and ferritin levels, as mean values of iron were49.07 ± 25.27µg/dl and89.25 ± 32.90µg/dl among ADHD group and control children, respectively, and also regarding ferritin mean values, which were19.76 ± 18.26 ng/ml and 96.8 ± 22.91ng/ml in ADHD group and control children, respectively. This result was in agreement with Mahmoud et al.[19] **and** Beneret al[20], who revealed that there was a significant statistical difference between ADHD and control groups regarding iron and ferritin levels.

Regarding serum vitamin D level, our result revealed that there was a significant statistical difference (P value of less than 0.05) between patient group and control regarding vitamin D level, as mean values of vitamin D were22.18 ± 4.67 ng/ml in ADHD group and 30.78± 6.22 ng/ml in the control children. This is in agreement with Sharif et al.[21].

IV. CONCLUSION

This study indicates that zinc, iron, ferritin, vitamin D deficiency may be related to the pathophysiology of ADHD So serum analysis of iron, ferritin, and vitamin D could be considered in the workup of ADHD, and this may suggest alternative therapeutic approach (zinc, iron & vitamin D supplementation) in prevention and treatment of ADHD.

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