Study of some toxic metal pollution in autistic patients in Thi-Qar Governorate

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ABSTRACT

Background. Autism-spectrum disorders (ASDs) are a group of chronic neurodevelopmental conditions characterized by difficulties in social interaction and communication, as well as rigid thinking and behaviour.

Aim of this study. This study aimed to examine the potential impact of trace metals, specifically copper, iron, and zinc, in the development of autism spectrum disease.

Materials and Method. A total of 100 blood samples were collected from patients diagnosed with autism, while an additional 100 samples were taken from healthy individuals serving as a control group. The individuals separated into three distinct groups: Group A (control) consisted of one hundred healthy participants aged 3-14 years. Group B consisted of one hundred patients diagnosed with autism, ranging in age from 3 to 14 years old.

The results. The findings demonstrated a substantial elevation in the levels of lead (Pb), selenium (Se), cadmium (Cd), nickel (Ni), and chromium (Cr) in all groups of patients as compared to the control group.

Conclusion. Study the relationship between trace elements and autism. It was observed that the concentration of lead (Pb) and chromium (Cr) was significantly higher in women who did not consume folic acid compared to those who did. On the other hand, the level of nickel (Ni) was significantly lower in women who did not consume folic acid compared to those who did.

Keywords: Autism, autism spectrum disorder, Trace Elements, Cadmium (Cd), Nickel (Ni), Selenium (Se), Chromium (Cr), and Lead (Pb).

Introduction

Autism, also referred to as autism spectrum disorder (ASD), is widely acknowledged as one of the most widespread neurodevelopmental disorders [1]. These issues pertain to communication, social interaction, and conduct. Currently, there is still a significant lack of understanding on the meaning of ASD. Consequently, ASD is frequently perceived in a negative light, with a considerable number of individuals even classifying it as an illness. They frequently exhibit aberrant conduct [2]. Lead (Pb) is a naturally occurring heavy metal element that is not magnetic and is present in the earth's crust. Although Pb is highly dangerous, it has been widely utilized in different industries and consumer products globally because of its malleability and resistance to corrosion [3]. Selenium exerts various biological effects, including the modulation of the arachidonic acid cascade and the promotion of apo A-I expression by influencing PPARγ and NF-κB. Selenium shortage is linked to increased inflammation and enhances the production of seleno-proteins, which play a role in antioxidant defense mechanisms [4]. Cadmium (Cd) is a well-known hazardous metal mostly originating from industrial and agricultural sources [5]. In 2010, the global production of cadmium reached 22,000 tons, whereas the estimated global reserves of this metal are 660,000 tons [6]. Chromium (Cr) exists in two oxidation states: +3 and +6. Cr (+3) is the sole necessary trace element that has a significant impact on the metabolism of glucose and cholesterol [7]. Nickel is a resilient, malleable, lustrous transition metal that is widely available in nature. Nickel can exist in various oxidative states ranging from -1 to +4. However, the most common oxidative state in both the environment and biological systems is Ni2+ in the +2-oxidation state [8].

Material and Method

Sample collection

This study conducted at Autism Center in Nasiriyah, Thi-Qar Governorate from Biochemistry Laboratory in College of Science, at the period between from December 2022 to June 2023. It included (200) cases, (100) control and (110) patients.

Table 1: Data of Controls and Patients Groups

Groups	No.	Groups
Controls	100	Controls
Patients	100	Patients

This study comprised a total of 100 male and female volunteers, both control and patients with trace elements, who were between the ages of 3 and 14 and had autism spectrum disorder (ASD). They split into two factions as follows:

Control: The study consisted of one hundred (100) participants who were in good health and ranged in age from 3 to 14 years old.

Autistic patients: The study included a total of one hundred (100) patient volunteers aged between three (3) and fourteen (14) years old.

Collection of Blood Samples

Four milliliter blood samples were collected from both autistic patients and controls. The samples were then left to clot in empty disposable tubes at room temperature. Afterward, the samples were separated using a centrifuge operating at a speed of 3000 revolutions per minute (rpm) for a duration of 10 minutes. The serum samples were isolated and preserved at a temperature of -20 ℃ for subsequent analysis of biochemical characteristics, unless they were utilized immediately. The flame atomic absorption spectrophotometer was used to test the trace elements Cadmium (Cd), Nickel (Ni), Selenium (Se), Chromium (Cr), and Lead (Pb).

Quantification of Cadmium (Cd) in Serum: Take 0.5 cc of the standards, samples (serum), and quality control specimens and dilute them 4.5 times with distilled water (HPLC). Ensure thorough mixing. A flame atomic absorption spectrophotometer was used to analyze the sample after creating a calibration curve at a wavelength of 288.80 nm (Osselton & Widdop, 2011). The analysis of selenium, nickel, chromium, and lead was conducted using the same methodology.

Digestion of samples: The serum samples underwent digestion by combining 2 mL of concentrated nitric acid and 1 mL of concentrated perchloric acid with 0.5 mL of serum in a Pyrex tube. The mixture samples were subjected to heating at a temperature of 160 ℃ for a duration of 1 hour using an oil bath. Afterward, they were chilled. The volume was augmented to 10 mL by using 0.5 mL of hydrochloric acid.

Results

Table 2 presents the current results of the investigation on the concentration of all heavy metals examined in this study. The concentrations of all heavy metals showed a significant rise ($p < 0.05$) in individuals with autism compared to the control group, as illustrated in figures 1, 2, 3, 4, and 5.

Table 2: The concentration of heavy elements in autism patients and control group

Trace elements	Autism Patients No. 100	Control group No. 100	p. value
	Mean ± SD		

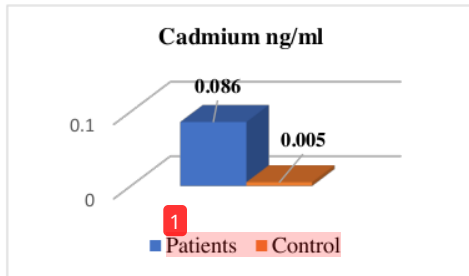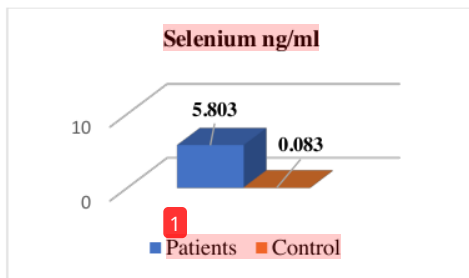|			
Cd	0.086±0.0400	0.005±.0.010	< 0.001 **
Se	5.803±1.8270	0.083±0.0110	< 0.001 **
Pb	0.203±0.0660	0.033±0.0080	< 0.001 **
Ni	0.082±0.0330	0.0005±0.0001	< 0.001 **
Cr	0.297±0.0990	0.001±0.0009	< 0.001 **

Figure 1: Cd level in autism-patients and control group

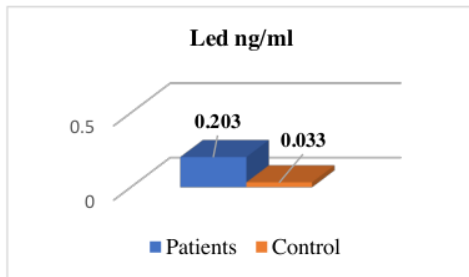**Figure 2:** Se level in autism-patients and control group

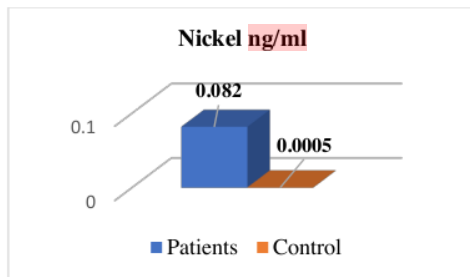**Figure 3:** Pb level in autism-patients and control group

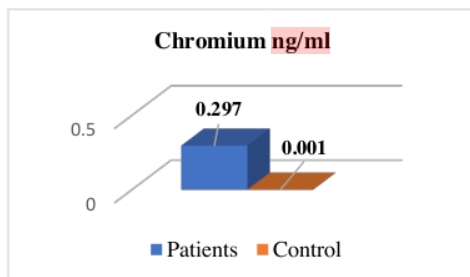**Figure 4:** Ni level in autism-patients and control group

Figure 5: Cr level in autism-patients and control group

Discussion

Metals are considered a potential modifiable risk factor in ASD. Women of reproductive age in the United States are commonly exposed to metals in their surroundings, and pregnant women tend to have greater levels of metal concentrations compared to non-pregnant women [9,10]. Crucial neurodevelopmental processes take place during pregnancy [11], exposure to environmental factors, namely metals, is believed to play a role in the development of autism spectrum disorder (ASD) [12-14]. Children diagnosed with ASD have been found to have elevated blood levels of arsenic compared to control groups [15], mercury [16-18], lead [19-21], and cadmium [22], Have been witnessed. Although these findings show that exposure to metals was detected after the diagnosis of ASD [23]. Furthermore, it has been demonstrated that Cd can trigger an immunological response [24], How often this effect manifests in the brain is unclear. Exposure to potentially harmful substances is one environmental variable that has been linked to an increase in the incidence of autism spectrum disorder [25].

Conclusion

It was observed that the concentration of lead (Pb) and chromium (Cr) was significantly higher in women who did not consume folic acid compared to those who did. On the other hand, the level of nickel (Ni) was significantly lower in women who did not consume folic acid compared to those who did.

Disclosure

None

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