

Comparative Study of Serum Copper and Zinc in Schizophrenia Subjects, (SCZ).

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Abstract

Background: Schizophrenia is a severe mental disorder. For normal metabolism, trace elements are essential. It is suggested that trace elements alterations are associated with schizophrenia. **Aims and objectives:** This study was conducted to evaluate the association between schizophrenia risk and serum levels of copper and zinc.

Materials and Methods: The study was conducted in the Department of Biochemistry laboratory of SRG Hospital, Jhalawar Medical College, Jhalawar (Rajasthan). The present study comprised of 100 subjects among them 50 normal healthy controls without any clinical symptoms or disease and 50 Schizophrenia diseases. The statistical analysis was performed by using in SPSS version 12.0 and Microsoft excels 2007.

Results: There was a statistically significant increase in serum copper level in schizophrenia subjects (cases) as compared to healthy control groups ($p < 0.0001$). The percentage of low, high, normal and overall distribution of copper in schizophrenia subjects (cases) were L= 0.0%, H= 94.0%, N= 6.0% and T= 100% respectively and the percentage of low, high, normal, and overall, in healthy (control) groups were L= 2.0%, H= 10.0%, N= 88.0% and T= 100% respectively and total percentage respectively L= 1.0%, H= 52.0%, N= 47.0% and T= 100.0%, which indicates high significance in schizophrenia subjects and low in healthy control groups. We have also found that there was a statistically significant decrease in zinc level in schizophrenia subjects (cases) as compared to healthy control groups ($p < 0.0001$).

Conclusion: In our study, we observed that brain function was altered in schizophrenia disease patients that subsequently lead to trace element dysfunction and we concluded that monitoring of trace elements may be beneficial to Schizophrenia patients.

Keywords: Copper, Zinc, Schizophrenia.

Introduction

Schizophrenia is a major mental illness characterized by symptoms including psychosis, apathy, social withdrawal, and cognitive impairment.¹ A trace element is defined as one that makes up less than 0.01% of the body's mass. For numerous metabolic and physiological processes in the human body, a complex balance of trace elements is vital for the maintenance of physical and mental health.² Many biological processes may be adversely affected by imbalance in the optimum levels of these elements and are associated with many psychiatric diseases including schizophrenia.³

In many diseases, including autoimmune, neurologic, and psychiatric disorders, Copper (Cu) and (Zn) levels have been studied, and zinc levels are found to be deficient whereas copper levels tend to be accumulated.⁴

In several metalloenzymes linked to dopamine synthesis like in biological pathways involving either antagonism of dopamine production or catalysis of its breakdown, copper is an important component, so its homeostasis may be particularly relevant in the development of schizophrenia: an excess of copper may be correlated with this disease.⁵

For the structural integrity and/or catalysis of more than 200 enzymes involved in nucleic acid and protein synthesis, Zinc is required.⁶

It is very important to know the level of trace elements so that we could prevent complications in Schizophrenia patients.

In the present study, analysis of serum copper and zinc level was done in the patients coming to O.P.D and psychiatric ward of S.R.G Hospital and Jhalawar Medical College, Jhalawar.

MATERIALS AND METHODS

Serum copper and zinc levels, in 100 subjects among them 50 normal healthy controls without any clinical symptoms or disease and 50 Schizophrenia diseases (SCZ), were studied under this study.

This study was conducted in the Department of Biochemistry and Department of Psychiatry, S.R.G hospital (tertiary care hospital), and Jhalawar Medical College, Jhalawar (Raj.). The present study was conducted between March 2019 to October 2019.

The study was approved by the Ethical Committee of Jhalawar Medical College and patients agreed to be included in the study. Signed informed written consent was obtained from all the subjects involved in the study.

INCLUSION CRITERIA:

CASE:-

1) Patient with history and physical or neurological (mental status) findings of Schizophrenia disease.

- 2) Biochemical analysis suggestive of schizophrenia disease.
- 3) Both male and female above 20 years of age and upper age (older).

CONTROL: Healthy male and female above 20 years of age.

EXCLUSION CRITERIA:

- 1) History of anti-thyroid drugs.
- 2) Prolonged use of medicine (e.g. steroids, anti-cancer drugs).
- 3) Pregnancy.
- 4) Any major medical illness.

Serum copper and zinc levels in venous blood of subjects of control group I and case group II were tested for by flame atomic absorption spectrophotometer.

The standard solutions were determined for copper and zinc. The graph of absorbance against concentration was plotted to show the Beer-Lambert law.

PRINCIPLE OF ATOMIC ABSORPTION SPECTROPHOTOMETER⁷:-

The sample is subjected to a high-energy thermal environment to produce excited-state atoms. This environment can be provided by a flame or, more recently, a plasma. The “ground state”. As the number of atoms in the light path increases, the amount of light absorbed also increases. By measuring the amount of light absorbed, a quantitative determination of the amount of analysis can be made. The use of special light sources and careful selection of wavelengths allows the specific determination of individual elements.

NORMAL RANGE:-

SERUM COPPER (Cu) = 12-25 μ mol./liter or (0.76-1.58 ppm).

SERUM ZINC (Zn) = 10-22 μ mol./liter or (0.65-1.43 ppm).

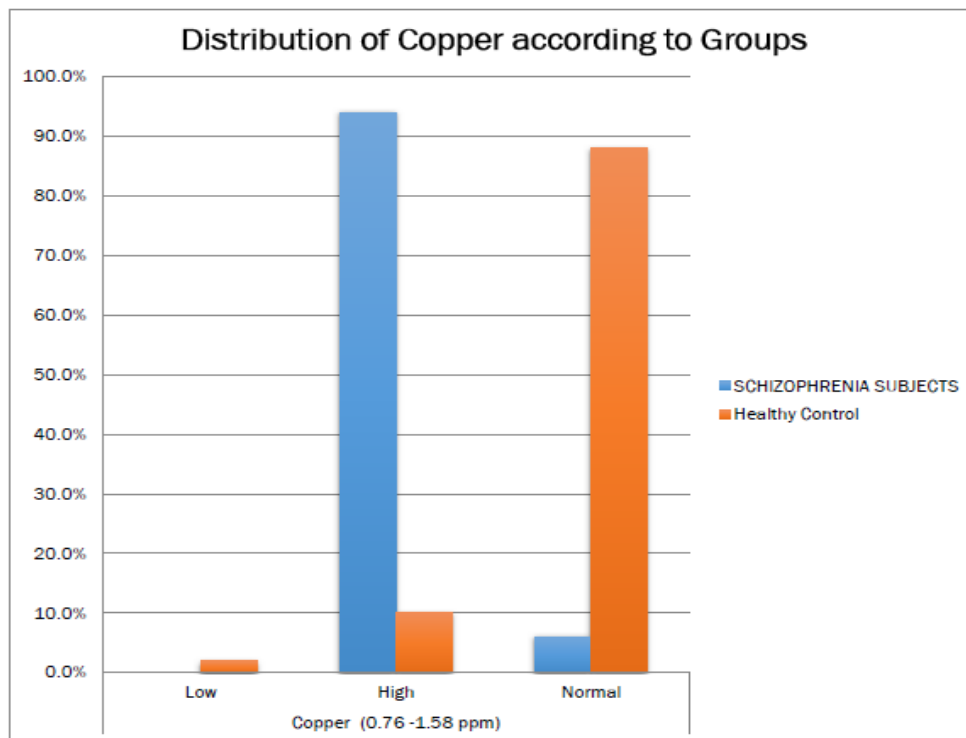
RESULTS

In the present study, 50 cases of known schizophrenia disease and 50 healthy subjects were studied. The statistical data in our study were expressed as mean \pm SD. $P < 0.05$ was considered statistically significant.

Table 1 and graph 1 show the distribution of copper according to their level as low, high, and normal percentage in both schizophrenia subjects and healthy control groups. The percentage of low, high, normal and overall distribution of copper in schizophrenia subjects (cases) were L= 0.0%, H= 94.0%, N= 6.0% and T= 100% respectively and the percentage of low, high, normal, and overall, in healthy (control) groups were L= 2.0%, H= 10.0%, N= 88.0% and T= 100% respectively and total percentage respectively L= 1.0%, H= 52.0%, N= 47.0% and T= 100.0%, which indicates high significance in schizophrenia subjects and low in healthy control groups. It suggests that patients with schizophrenia disease have low, high, and normal serum copper as compared to healthy control group.

Table 1: Distribution of Copper (ppm) according to Group I (Control) and Group II (Cases) Patients

Biological reference value		Group		Total	P value
		Group I	Group II		
Copper (0.76 -1.58 ppm)	Low	1 (2.0%)	0 (0.0%)	1 (1.0%)	< 0.0001
	High	5 (10.0%)	47 (94.0%)	52 (52.0%)	
	Normal	44 (88.0%)	3 (6.0%)	47 (47.0%)	
Total		50 (100.0%)	50 (100.0%)	100 (100.0%)	

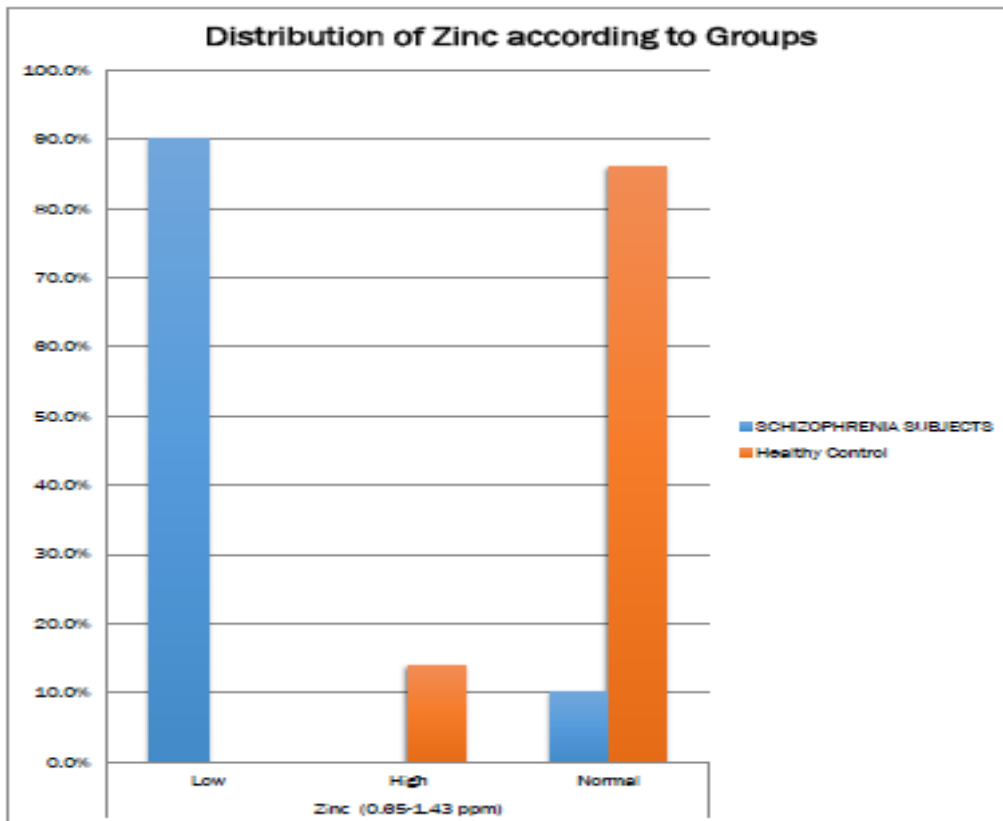


Graph 1: Distribution of Copper (ppm) according to Group I (Control) and Group II (Cases) Patients

Table 2 and graph 2 shows the distribution of zinc according to their level as low, high, and normal percentage in both schizophrenia subjects and healthy control groups. The present observation shows the percentage of low, high, normal and overall, in schizophrenia subjects (cases) were L= 90.0%, H= 0.0%, N= 10.0% and T= 100% respectively and the percentage of low, high, normal, and overall in healthy (control) groups were L= 0.0%, H= 14.0%, N= 86% and T= 100% respectively, total percentage respectively L= 45.0%, H= 7.0%, N= 48.0% and T= 100.0%. It suggests that patients with schizophrenia disease have low, high, and normal serum zinc levels as compared to healthy control group.

Table 2: Distribution of Zinc (ppm) according to Group I (Control) and Group II (Cases) Patients

Biological reference value		Group		Total	P value
		Group I	Group II		
Copper (0.65 -1.543 ppm)	Low	0 (0.0%)	45 (90.0%)	45 (45.0%)	< 0.0001
	High	7 (14.0%)	0 (0.0%)	7 (7.0%)	
	Normal	43 (86.0%)	5 (10.0%)	48 (48.0%)	
Total		50 (100.0%)	50 (100.0%)	100 (100.0%)	



Graph 2: Distribution of Zinc (ppm) according to Group I (Control) and Group II (Cases) Patient

DISCUSSION

Copper and zinc essential trace elements are neuroactive substances that can be synaptically released during neuronal activity. They have been implicated in diseases with neuropathological components like schizophrenia.⁸ Copper /Zinc superoxide dismutase coenzyme concentrations in post-mortem prefrontal cortical regions of the brain were significantly increased in patients with recurrent depressive disorder evidencing oxidative stress in the pathophysiology of depressive disorder.⁹

In our study, we found that there was a statistically significant increase in copper level in schizophrenia subjects (cases) as compared to healthy control groups (p<0.0001).

Similar findings were obtained by Tokedemir et al.,(2003)¹⁰ wolf et al.,(2006)¹¹; Rahman et al.,(2009)¹²demonstrating a significant increase in serum and hair concentration of Cu in schizophrenic patients than that of their levels in control groups.Vidovic et al.(2013)¹³also found that the copper levels were higher significantly in patients with schizophrenia than in the normal control.

The role of copper homeostasis in various psychopathology was found to be significant by Joe et al.,(2018)¹⁴.

But Herran et al.,(2000)¹⁵obtainedcontroversial findings of the status of trace elements in patients with schizophrenia. A decrease in serum copper concentration in schizophrenia females was observed bySuzuki et al.,(1992)¹⁶.

In this study, we have also found that there was a statistically significant decrease in zinc level schizophrenia subjects (cases) as compared to healthy control groups ($p < 0.0001$).

Zn is also found to be an essential trace element implicated in many diseases, including autoimmune, neurological, and psychiatric disorders by Cramer et al.,(1983)¹⁷.

Tokedemir et al.,(2003)¹⁰, Wolf et al.,(2006)¹¹, Rahman et al., (2009)¹²found similar results like a significant decrease in Zn in schizophrenic patients than that's of their levels in the control group. Levels of zinc were found to be lower in serum by Jun and Nancy et al.,(2000)¹⁸ studied that produce a variety of biochemical and psychological changes.

Findings obtained by Gillin J.; Carpenter W et al.,(1982)¹⁹ were not found to be in concordance with our study by not obtaining a significant deviation from normal in the concentration of serum Cu and Zn, while others found a decrease in serum Cu and Zn concentrations in female patients with chronic schizophrenia.

Conclusion:

In conclusion, schizophrenia is a very disabling psychiatric disorder.

Essential trace elements of the human body including copper (Cu) and zinc (Zn) account for only 0.02% of the total body weight, they play significant roles, e.g., as active centers of enzymes or as trace bioactive substances. Reduced activity of the concerned enzymes have been found to be a major outcome of trace element deficiencies.

In our study, we observed that brain function was altered in schizophrenia disease patients that subsequently lead to trace element dysfunction and we concluded that monitoring of trace elements may be beneficial to Schizophrenia patients. Based on the present study, it is suggested that all schizophrenia patients should be evaluated for serum levels of trace element copper and zinc levels.

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