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**Original Research Article**

# Assessment of Serum Zn and Cu Levels among Patients with Abnormal Results of Semen Fluid Analysis

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**Abstract: Background:** Zinc (Zn) and Copper (Cu) are essential minerals that are found in almost every cell in the body. They act as a key factor in making many parts of the reproductive system work properly. Evidence suggests that serum and seminal Zn and Cu have an important role in the physiologic functions of the sperm and that its reduced levels result in low seminal quality and subsequent chances of fertilization. **Objective:** To access the levels of Zn and Cu in serum among Sudanese male with an abnormal semen analysis. **Materials and methods:** This is a case-control study carried out at Banoon Fertility Center in the period from March to May 2018. We quantified the levels of Zn and Cu in serum samples from 50 patients of infertility and 50 healthy control people. These elements were determined using atomic absorption spectrophotometer. **Results:** According to the findings of this study, the mean of serum Zn and Cu were significantly lower in infertile men patients, (0.269±0.093 mg/l) (0.223±0.084 mg/l) when compared with control group, (0.579±0.224mg/l) (0.821±0.179 mg/l), respectively with P value (0.000). Of 50 infertile men, the age range of patients was 25-62years and their mean age was (41.9+ 9.4) and 50 control the range age 21-59 years and their mean age (40.9+8.7). There was no association between the Zn and Cu with age (R=-0.080, P= 0.579 (R=0.075, P=0.606). **Conclusion:** There is a low level of Zn and Cu in infertile men patients. The estimation of these trace elements could be a useful complementary test in diagnosis and monitoring male infertility.

**Keywords:** Zinc (Zn) and Copper (Cu), fertilization, patients.

## INTRODUCTION

Infertility is defined as the lack of ability to conceive within one year of unprotected intercourse with the same partner (Abarikwu, S.O. 2013). It is estimated that nearly 8–12% of couples are infertile, and approximately 30–40% of infertility cases are caused by malefactors· (Kumar, N., & Singh, A.K. 2015). Several risk factors are involved in the pathogenesis of infertility, some of which include alterations in spermatogenesis due to testicular diseases, aplasia of the germinal cells, varicocele, defects in the transport of sperm, or environmental factors as well as congenital anomalies, infectious diseases, alterations in the characteristics of semen such as a decrease in sperm motility and sperm count, the presence of anti-sperm antibodies (ASAs), and nutritional deficiency of trace elements such as Cu, selenium and Zn (Pourmasumi, S. *et al.*, 2017; Mahdi, B. M. *et al.*, 2011; Giahi, L. *et al.*, 2015; & Anchordoquy, J.P. *et al.*, 2019). Many different trace elements are involved in male fertility. Elements, such as Zn, magnesium, Cu, and calcium, are important for the maintenance of normal spermatogenesis, sperm maturation, DNA metabolism and repair, and gene expression in germ cells (Kasperczyk, A. *et al.*, 2016).

In humans, the concentration of Zn is high in the prostate compared to the other tissues and body fluids (Kolenko, V. *et al.*, 2013). Zn and citrate are excreted from the prostate gland as a low-molecular-weight complex; thus, it is estimated that the Zn levels in seminal plasma typically represent prostatic secretary function. After ejaculation, half of the quantity of this complex is redistributed and linked to medium- and high-molecular-weight compounds generated from the seminal vesicles (Kasperczyk, A. *et al.*, 2016). The decrease of Zn in the seminal plasma and serum may result from inadequate intake, reduced absorption, increased losses, or increased demand (Kolenko, V. *et al.*, 2013). Additionally, the commonest worldwide

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cause is inadequate intake as a result of a diet low in Zn or rich in phytate (Kolenko, V. *et al.*, 2013; Foresta, C. *et al.*, 2014). Furthermore, some studies have reported that a sharp decrease in Zn in the prostatic fluid results in a decreased Zn concentration in seminal plasma (Chu, D.S. 2018).

## MATERIALS AND METHODS

### Study Design and Study Area

Cross-Sectional - Case-control study conducted from June to November 2018 at Banoon Fertility Center.

### Study Population

One hundred (200) subjects were recruited for this study divided into two groups, 100 subjects, referred to the center for investigations of infertility, a study group and 100 healthy fertile men as a control group. Any participants under treatment with mineral supplements were excluded from the study as well as patients with chronic disease, such as DM, tuberculosis, and renal failure.

### Ethical Considerations

Permission of study obtained from the local scientific committee of Al-Neelain University, all participants were informed verbally by the aims of the study.

### Sampling Collection and Processing

Following aseptic techniques, 3.0 ml of venous blood collected from the groups of the study. Serum obtained by centrifugation and then kept at 20c until tested. The samples diluted with 1:5 of deionized water for Zn, and with an equal volume for Cu, then atomic absorption spectrophotometer used to determine the levels of both minerals. Semen fluid results were obtained from the records of the participants. Semen was tested for volume, count of sperm, motility, and morphology in each case as per the World Health Organization (WHO) criteria.

### Statistical Analysis

The data was analyzed using SPSS version 21**.** The results expressed as mean Standard deviation and percentage. Independent T-test obtained to compare the study parameters between the case and control. ANOVA test was used to compare between Zn and Cu concentration with seminal analysis result.

## RESULTS

The study included 200 subjects (100 as case and 100 as a control group), the age range of patients was 25-62 years with a mean of 41.9±9.4, and the range of control age 21-59 years with a mean of (40.9±8.7), (Table 1). The results of semen analysis indicated that, out of 100 male with abnormal results, 24 % were Azoozoospermic, 36 % Asthenozoospermic, 20 % Oligozoospermic, and 20 % Teratzoospermia, as shown in fig 1.

The results showed significant decrease in serum Zn and Cu in cases (0.269± 0.093) and (0.223± 0.084) as compared to control (0.579±0.224), (0.821±0.179), respectively, p.value (0.00).), (Table 2, fig 2).

ANOVA analysis showed no significant difference in the levels of Cu and Zn among the different types of abnormal sperm count, table 3.

According to the correlation analysis, there was no correlation between levels of Zn and Cu with age (R=-0.080, P= 0.579 (R=0.075, P=0.606), respectively, figure 3.

**Table (1) shows the age of the study groups.**

| Variables | Group | Minimum | Maximum | Mean±SD |
|---|---|---|---|---|
| Age (Years) | Case | 25.0 | 62.0 | 41.0±9.4 |
| | Control | 21.0 | 59.0 | 40.9±8.7 |

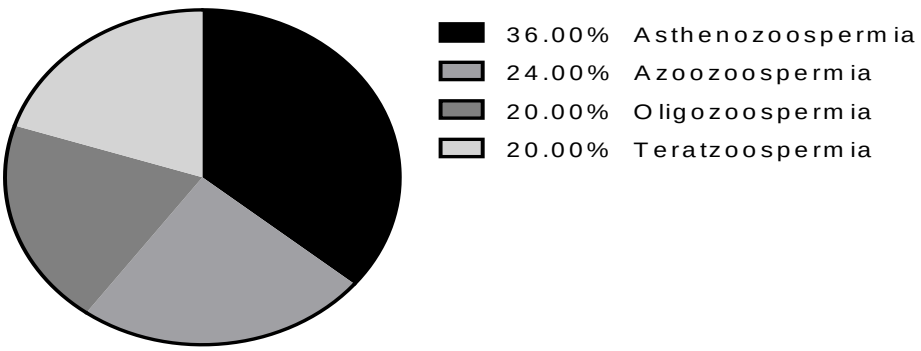


**Figure (1) distributions of patients according to semen result**

**Table (2) the mean concentration of measured elements in case and control**

| Parameters | Case (Mean±SD) | Control (Mean±SD) | *P-value* |
|---|---|---|---|
| **Zinc (mg/dI)** | 0.269±0.093 | 0.579±0.224 | 0.000 |
| **Copper (mg/dI)** | 0.223±0.084 | 0.821±0.179 | 0.000 |

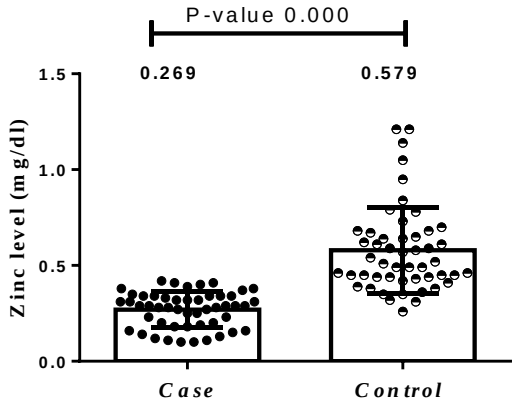


**Figure (2): mean concentration of Zn in the case and control**

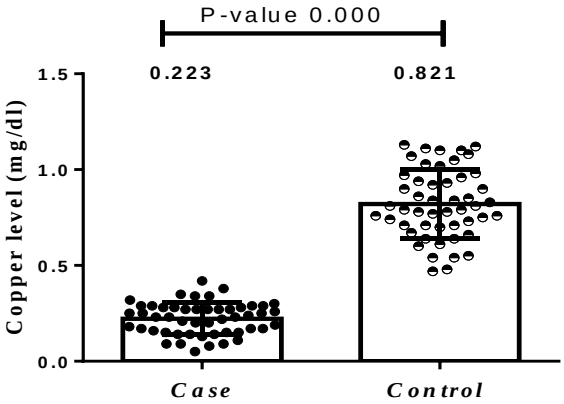


**Figure (3): mean concentration of Cu in case and control**

**Table (3): comparison between Zn and Cu levels with semen analysis results**

| Parameters | Mean±SD | *P-value* |
|---|---|---|
| **Zinc** | | |
| Azoozoospermia | 0.29±0.08 | 0.758 |
| Asthenozoospermia | 0.25±0.09 | |
| Oligozoospermia | 0.27±0.09 | |
| Teratzoospermia | 0.26±0.10 | |
| **Copper** | | |
| Azoozoospermia | 0.24±0.07 | 0.427 |
| Asthenozoospermia | 0.23±0.08 | |
| Oligozoospermia | 0.23±0.12 | |
| Teratzoospermia | 0.18±0.06 | |

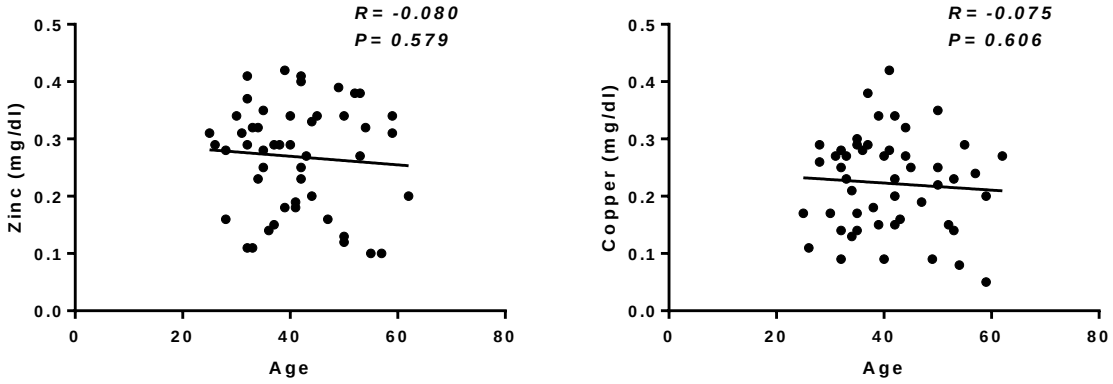


**Figure (4): show association between Zn and Cu with age**

## DISCUSSION

The role of trace elements in infertility is of great interest because many of them are co-factors in the reproductive system involving epididymis and prostate (Mirnamniha, M. *et al.*, 2019). An experimental study (Ogorek, M. *et al.*, 2017) showed that Cu and Zn deficiency could produce ejaculates of lower volume, lower sperm concentration, and poorer sperm motility and morphology.

In the current study, levels of Zn and Cu were low in the infertile male patient compared with normal group P-value (0.000), this finding is in agreement with a study done in National University of Singapore (Ogorek, M. *et al.*, 2017), also in accordance with other

study conducted in Sudan (Tabassomi, M., & Alavi-Shoushtari, S.M. 2013). The reduction in serum Zn levels may be related to multiple causes and consequences depending on the gender, sexual history, lifestyle and cultural background (Khadilkar, V., & Khadilkar, A. 2012).

In this study, we examined the trace element concentrations in serum, not in seminal fluid. Previous studies (Altaher, Y.M., & Abdrabo, A.A. 2015; Gurunath, S. *et al.,* 2011) have found that serum Zn and seminal Zn concentration was related to sperm quality and that among those with oligozoospermia, this is agreed with our results, we found decreased levels of both Cu and Zn in oligospermic men.

A positive correlation between serum and seminal plasma Zn levels was reported before (Ali, H. *et al.,* 2015), and Zn deficiency might account for a decrease in sperm quality.

The findings of this study confirmed that in infertile men there is no significant correlation between serum levels of Zn and Cu with spermatozoa count, this was also reported by Yuyan, who found that among 125 randomly selected semen samples, seminal and serum Cu had no statistical correlation with the number of spermatozoa or with their percentage of motility (Erdem, M. *et al.,* 2013).

Also, it seems that serum Cu level in teratozoospermia patients is lower than the others; this reduction did not achieve a statistically significant difference.

A previous study reported that a significant difference in serum and seminal Zn level in normospermic, oligospermic ($p<0.05$) and azoospermic ($p<0.005$) (Yuyan, L. *et al.,* 2008). Few older studies rejected the effects of Zn on sperm quality, suggested that measurement of the concentration Zn and Cu in seminal plasma or serum have little value in the investigation of infertility [(20)]. Many recent studies accept the relation between Zn and motility, morphology or sperm count. Perhaps one of the reasons for this correlation is the existence of Zn in the nucleus and tail of early sperm for chromatin condensation and motility. Others studies which are not similar to the present study showed higher mean concentration of plasma Cu than those of proven fertility, and seminal plasma Zn and Cu did not differ significantly between fertile and infertile men. But many recent studies confirm and accept the relationship between Zn and motility, morphology or sperm count. One of the reasons for this correlation is the existence of Zn in the nucleus and tail of early sperm for chromatin condensation and motility (Zhao, J. *et al.,* 2016; Fallah, A. *et al.,* 2018; & Mirnamniha, M. *et al.,* 2019).

The study is limited by factors, firstly, the study concern with the measurement of serum Zn and Cu, it is better to find the correlation between serum and the seminal fluid level of these elements. If there is a significant correlation, examining serum trace elements concentration would have a more practical significance because blood samples might be easier to collect than semen plasma. Secondly, we didn't study the correlation between the Cu/Zn ratio with sperms motility, studies reported that Cu/Zn ratio was higher in the group with abnormal motility (17).

## CONCLUSION:

Based on the finding of the present study, serum Zn and Cu levels were low in patients with abnormal seminal fluid results, so these tests should be considered as a useful tool in addition to other parameters in assessing male infertility.

## Conflict of Interest

No conflicts of interests.

## Acknowledgment

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