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# The relationship of zinc and magnesium in different male infertility cases

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**Abstract**

The present study is designed to investigate some variables in some types of trace elements such as zinc and magnesium in some different cases of infertility and lack of fertility in men in the northern governorates of Iraq. The study included (75) samples with ages ranging between (25-50) years, of which (60) samples suffered from infertility and lack of fertility, depending on the medical diagnosis made by infertility specialist consultants in Azadi Teaching Hospital in Kirkuk Governorate. The samples were distributed into five groups, each group included (15) sample agencies: the Azoospermia group), the Teratozospermia group, the Oligozoospermia group, the Asthenozoospermia group and the fifth group, which included (15) able healthy people On procreation, which is considered a control group. The study included measuring some biochemical variables for the study samples represented by measuring the level of zinc and magnesium in the blood serum.

The results indicated a significant decrease in the levels of trace elements zinc (Zn) and magnesium (Mg) in the experimental groups: Azoospermia group, Teratozospermia group, Oligozoospermia group, Asthenozoospermia group compared to Control group.

**Keywords:** zinc, magnesium, male infertility, fertility, biochemical

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## INTRODUCTION

Infertility is a disease that fails to establish a pregnancy after 12 months of regular, unprotected sexual intercourse, or because a person's ability to reproduce is impaired (Zegers-Hochschild et al., 2017). Between 12% and 15% of couples are infertile of all Sexually active couples, 50% can be determined from the male component at present (Machen and Sandlow., 2020).

### Trace elements

Trace elements (or trace minerals) are usually identified as minerals in quantities ranging from 1 to 100 mg/day by adults or constitute less than 0.01% of their total body weight. Ultra-rare minerals are generally defined as minerals that are needed in amounts of less than 1 microgram/day. (Tako., 2019; Kazemi, et al., 2018).

Minerals make up only 5% of a typical human diet, but they are essential for normal health and function. (Tako., 2019) Minerals usually fall into two general categories: major minerals and trace minerals. Minerals with an estimated average daily nutrient requirement of 100 milligrams or more and which represent more than 0.01% of the total human body mass are considered major minerals. Macrominerals (Medeiros and Wildman., 2019)

### Zinc

Various elements such as Calcium Ca, Magnesium Mg and Zn Zn are among the contents of human semen and are important elements for the normal function of the male reproductive system and sperm. Several studies have shown positive effects of zinc on semen quality and male factor sterility. Zinc is essential for testicular development and normal sperm generation and is also a major factor for DNA replication, DNA replication, protein synthesis, cell proliferation, cellular differentiation, and apoptosis, which are Key parts of sperm development (Harchegani et al., 2018; Sadeghi et al., 2020).

Zinc affects the immune system in many ways, from protecting the skin to gene expression for lymphocytes. Zinc acts as an antioxidant and helps stabilize cell membranes (Noorbakhsh., Et al, 2016). It also has many physiological roles in the growth and modification of the immune system. Zinc deficiency can cause infection, poor growth, and poor wound healing (Han et al., 2017).

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Zinc works as a catalyst for many Enzymes involved in immune function, growth, and tissue repair. Zinc increases the number of cells Pro-inflammatory (Mechie, et al., 2019; Powar, et al., 2019).

Magnesium Intracellular Mg2 + is the second most abundant cation and plays a major role in a wide range of cellular functions and total magnesium in the body depends on dietary intake. (Kieboom et al., 2016). Magnesium Mg2 + is a divalent cation necessary to regulate a set of metabolic pathways and cellular signaling and is considered the most abundant and widespread (de Baaij et al., 2015). In addition, direct association with Mg2 + enhances the structural integrity of key metabolites such as (ATP), proteins, and membranes. Fatty and nucleic acids (Chubanov et al., 2016).

Magnesium is necessary for sperm motility. Magnesium through its role with enzymes involved in energy release (ATP) and anaerobic glycolysis. An optimal concentration of magnesium is necessary for the survival of sperm, and magnesium is present in a lower concentration outside the sperm and larger inside it. (Valsa et al., 2012). Magnesium is an important component, its concentration and amount in the body, it has an important role in many vital systems, including the cardiovascular and skeletal muscle systems, as well as the effects of high blood pressure, stroke, migraine, diabetes, and other diseases. Magnesium is important for bone health, and nearly half of the body's magnesium is retained in the bones. (Smith & Zwart., 2015).

## MATERIALS AND METHODS

The study included (75) samples, of which (65) were a sample of infertile married persons, and it was distributed into different subgroups according to sperm concentration, movement, and sperm morphology. Each group included (15) samples represented by Azoospermia group, azoospermia, (15) samples representing Teratozoospermia, deformation of sperm, (15) samples representing Oligozoospermia, low number of sperms, (15) samples representing Asthenozoospermia, lack of sperm motility, and (15) samples. Represents healthy subjects with normal fertility as a control group. The ages of all samples ranged between (25-50) years, as the experimental sample was collected from the infertility treatment consultant at Azadi Teaching Hospital in Kirkuk Governorate, as well as from IVF and IVF centers in Kirkuk, Erbil, and Sulaymaniyah governorates. The control group was collected from the affiliated blood bank. For the Kirkuk Health Department, infertility was diagnosed in people by the specialists in the infertility consultant at Azadi Teaching Hospital, and a special form was organized for the people under study in which information about infertile and healthy people was recorded according to specific criteria.

10 ml of blood was withdrawn from the studied samples by medical syringes (10ml) and added to a tube (gel tube) and then using a centrifuge device to obtain blood serum and then dividing the serum into several small plastic tubes for laboratory tests under study and the data of the laboratory tests were recorded in The special form for each sample listed in Appendix (2). In this research, laboratory tests were performed using a (Cobas C 111 Analyzer) device.

### Principle of Mg (Magnesium) test

(Cobas c 111) Test principle Color method with Cholorophosphonazo III Chlorophosphonazo (CPZ III) binds to magnesium and causes an increase in absorption. EGTA (ethylene bis (oxyethylenenitrilo) tetra-acetic acid)] is used to inhibit calcium binding to CPZ III. $\mathrm{Mg + CPZ\ III} \xrightarrow{pH\ 7.5} \mathrm{Mg - CPZIII\ complex}$

Non-specific absorption interferences are reduced by the addition [EGTA (ethylenediaminetetraacetic acid)], which removes magnesium from the complex. Magnesium-CPZ III allows for accurate plank sample measurement.

$$\mathrm{Mg - CPZ\ III\ complex + EDTA} \xrightarrow{pH\ 7.5} \mathrm{Mg - EDTA + CPZ\ III}$$

The difference in absorption between the magnesium-CPZ III complex and the treated EDTA complex is the magnesium absorption alone.

Reagents solutions used :

1) R1 TES : 145 mmol / L, pH 7.5, chlorophosphonazo III: 0.2 mmol / L EGTA 10 mmol / L, non-reactive active surfaces, preservative.
2) R2 TES: 100 mmol / liter, pH 7.5, 16 mmol / liter, non-reactive active surfaces, preservative.
3) N-tris (hydroxymethyl) methyl-2-aminoethanesulfonic acid AccountsCobas c 111 The analyzer automatically calculates the analyzer pressure on each sample

Conversion factors mmol / L x 2.43 = mg / Dl
mval / L x 0.5 = mmol / L
mval / L x 1.22 = mg / Dl
mval / L x mEq / L

### Zinc testing

The zinc reacts with the chromium present in the detector, forming a colored compound that matches the color intensity with the zinc concentration in the sample.

### Prepare the reagents

1) Add 2 ml of Reagent B to Reagent A flask Measures
2) Type of endpoint analysis
3) Reading time is 5 minutes
4) Color stability 30 minutes
5) Wavelength 578nm (520-570)
6) The temperature is 20-25 degrees Celsius
7) Zero detectors are empty

Accounts Zn μg/dl = $\frac{A\ (sampple\ )}{A\ (standard)}$ × 200

**Table 1.** Reagents used to estimate the level of zinc in the blood

| | |
|---|---|
| A Detecto | Borate buffer 0.37 M pH 8.3 ;<br>Saliciladoxime 12.5 mM ;<br>Dimetilgioxime 1.25 mM ; surfactants and preservatives |
| B Detecto | NITRO-PAPS ; 0.4 mM , preservatives . |
| Standard | Zinc ion 200 µg/dl (30.6 µmol/l ); stabilizers and preservatives . |

**Table 2.** The steps of the method and its cells in the spectrophotometer

| REAGENTS | BLANK | STANDARD | SAMPLE |
|---|---|---|---|
| work reagent | 1 ml | 1 ml | **1 ml** |
| distilled wate | 50 µl | ----- | **-----** |
| stsndard | ----- | 50 µl | **-----** |
| sample | ----- | ---- | **50 µl** |
| **The absorption against the Planck is mixed and read at a wavelength of 578 nm. The color remains stable for 30 minutes** | | | |

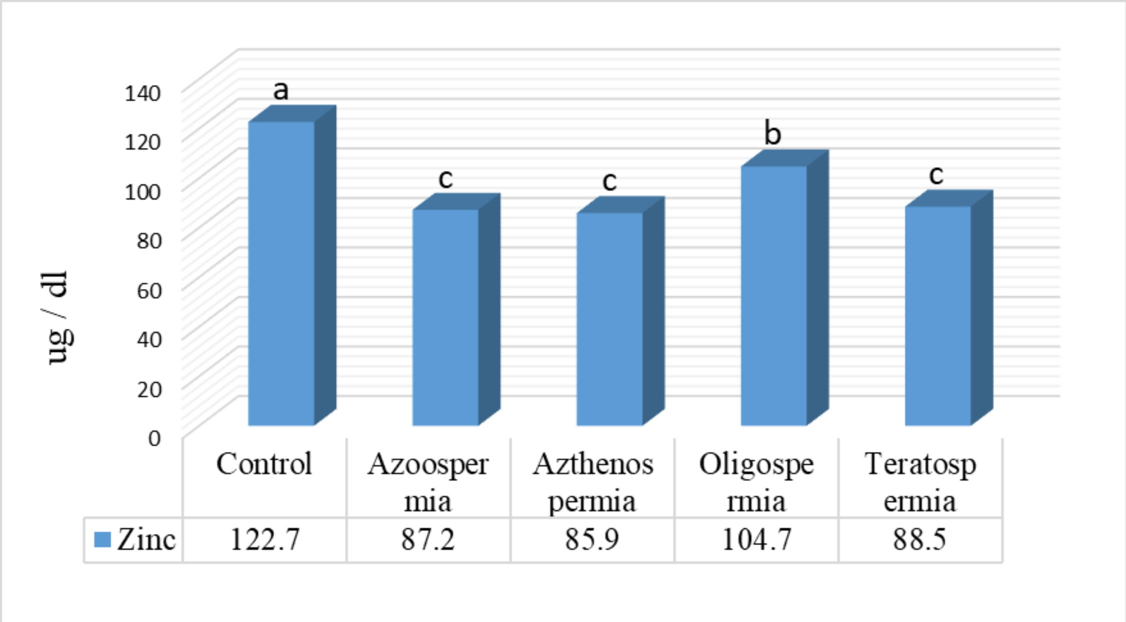


**Fig. 1.** The levels of zinc in the study groups

### Statistical analysis

The results were analyzed statistically according to the ANOVA one-way analysis of variance (ANOVA) program, using the IBM SPSS Statistics (Statistical Product and Service Solutions) program. "IBM SPSS Statistics 25.0.0.0 - Detailed System Requirements" represent the values in the tables (Mean ± SD) and the statistical values were at the acceptance level ($P \leq 0.05$) where the standard deviation and the arithmetic mean was calculated for the comparison between the totals.

## RESULTS AND DISCUSSION

The results of the current study showed significant differences ($P \leq 0.05$) in the levels of zinc and magnesium, as there was a significant decrease in each of the Azoospermia group (6.48 ± 87.2 ug / dl: 0.09 ± 1.94 mg / dl), respectively, and the Azthenospermia group: ug / dl 9.18 ± 85.9 0.12 ± 1.85 mg / dl) respectively and in the oligospermia group (: ug / dl 6.3 ± 104.7 0.06 ± 2.07 mg / dl) respectively and in the Teratospermia deformation group (5.7 ± 88.5 ug / dl: 0.05 ±) 2.03 mg / dl) respectively compared to the control group (ug / dl 11.24 ± 122.7: 0.18 ± 2.18 mg / dl), respectively, as shown in **Figs. 1** and **2**.

- **Similar lowercase letters mean no significant differences at ($P \leq 0.05$) level, while different small letters mean there are significant differences**
- **Similar lowercase letters mean no significant differences at ($P \leq 0.05$) level, while different small letters mean there are significant differences**

Trace elements are essential for testicular development and sperm generation. Zinc and magnesium play an important role in the development of the male reproductive system because they play a role in sperm production and/or viability, in preventing sperm degradation, and in stabilizing the sperm membrane. Where zinc deficiency leads to dysfunction of the gonads and reduces the weight of the testicle. The gonads are the body's fastest-growing tissues, and some vital enzymes involved in synthesizing nucleic acids and proteins are metal enzymes that need zinc and magnesium to function (Bedwell and Bahuguna; 1994).

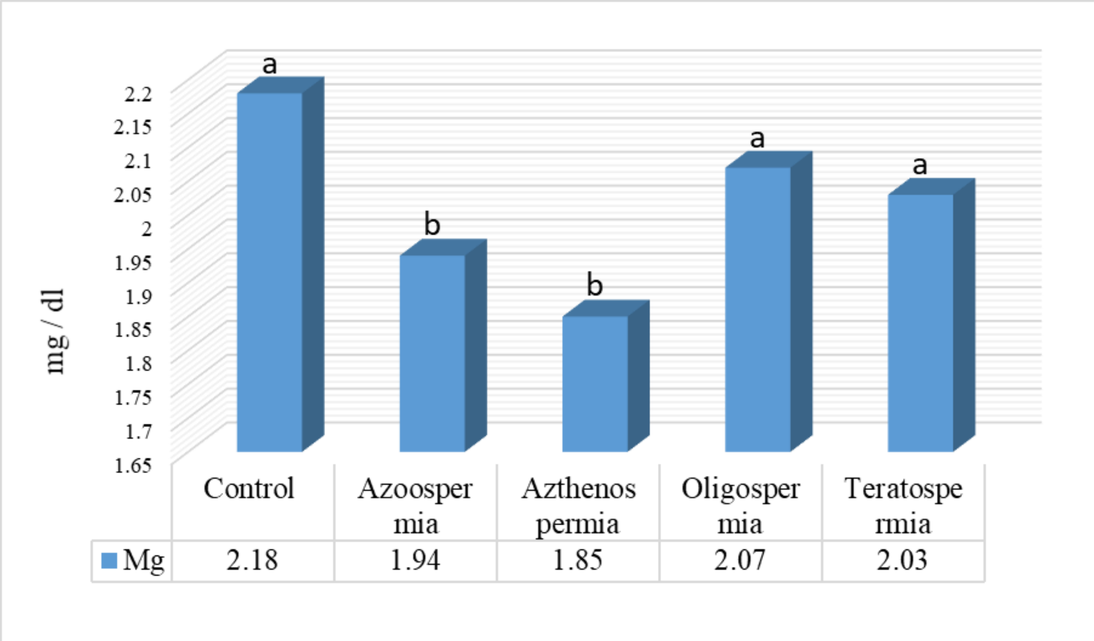


**Fig. 2.** The levels of magnesium in the study groups

The results of the present study showed significant differences (P≤0.05) in the levels of zinc and magnesium in all the study groups suffering from infertility compared to the control group. Zinc plays an important role in reproductive physiology, and zinc deficiency impairs male fertility because testosterone synthesis is dependent on the level of dietary zinc (Prasad; 1991), and because testosterone has an important role in sperm formation and promoting sexual maturity in puberty (Shaban; 2007) Therefore, zinc deficiency is characterized by low testosterone levels and low sperm count (Hunt et al; 1992). The results of the present study agreed with the findings of a study.

Ibrahim; (2013), which indicated that the average concentration of zinc in the blood showed a very significant decrease in all the infertile groups (the group with azoospermia, the group with azoospermia, the group with azoospermia, and the group with oligomenorrhea) when compared to the control group.

The results of the present study indicated that they are in agreement with a number of previous studies whose results indicated the presence of a significantly low concentration of zinc in the oligoasthenozoospermic males and the azoospermic infertile group when compared with the fertile group of males (Saleh et al; 2008). The results of the study also agreed with what Ali and his group observed in two different studies (2005) and (2007) significantly decreased zinc levels in males with oligoasthenozoospermic when compared with the fertile group of males. There is a positive correlation between sperm count and zinc concentration in seminal plasma. This component has been found to be extremely important for pregnancy, successful implantation, and pregnancy outcomes (Stephenson et al. 1999). The results of our study agreed with the findings (Ali et al. 2007). Which indicated that the low level of zinc in the plasma of subjects with oligozoospermia and males with azoospermia.

As for the role of magnesium in male fertility, Morisawa (1982) indicated that sperm motility requires the co-occurrence of cAMP and Mg ATP. It was found that the formation of ATP, as well as cAMP (Cyclic adenosine monophosphate), is a magnesium intensive process. The depletion of intracellular Mg2 + is known to affect all functions that depend on this ion, including glycolysis, protein synthesis, respiration, and reproduction (Wong et al. 2001). On the other hand, it was reported that the number of A spermatogonia, preleptotene spermatocytes, thickened mid pachytene, increased in animals treated with Mg2 +. It has also been reported that Mg2 + deficiency leads to morphological changes caused by up to 40% of total sperms (Asghari et al. 2016), and this agrees with the results of the current study that found low levels of magnesium in many cases of reduced and deformed sperm.

## CONCLUSIONS

A significant decrease in the levels of zinc and magnesium in the blood serum of the trial samples, which was associated with the levels of vitamin, sterility, and decreased effectiveness of antioxidant enzymes.

## RECOMMENDATIONS

Study of zinc and magnesium levels in the effectiveness of some important hormones and cellular enzymes.

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