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# STUDY ON SERUM LEVEL OF IRON AND ZINC IN TYPE 2 DIABETIC SUBJECTS

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## ABSTRACT

**Introduction**: Diabetes mellitus (DM), commonly known as diabetes is a group of metabolic disorders characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It causes death due to multi organ failure. Excess Iron is associated with DM, increased free radical production leading to oxidative damage to various tissue and organs. Zinc (Zn) helps in insulin secretion as it is a zinc dependents process This study was designed to evaluate the serum Iron and Zinc status in type2 diabetes mellitus patients. **Methods**: This cross sectional study was done among 60 diagnosed type 2 diabetic patients and 60 healthy people in the Department of Biochemistry, Mymensingh Medical College, Mymensingh over a period of one year from January 2015 to December 2015.Estimation of serum Iron and Zn level were done by colorimetric method by using test kit. All statistical analyses were performed by SPSS windows package, version 20. Significance of the difference between two groups was evaluated by using student's unpaired 't' test. **Results:** Study revealed that zinc levels were significantly decreased and iron levels were significantly increased in type2 diabetic patients. **Conclusion:** It can be concluded that the prevalence of decreased level of zinc and increased level of iron occurs in type2 diabetic patients. So in type 2 diabetic patient'szinc supplementation may be beneficial.

**KEYWORDS:** Iron, Zinc, Type 2 Diabetes Mellitus.

## INTRODUCTION

Diabetes mellitus is a heterogenous metabolic disorder characterized by chronic hyperglycemia resulting from defects in insulin secretion, resistance to insulin action or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. Diabetes can lead to heart disease, nerve damage, kidney disease and vision loss.[1]

The global prevalence of diabetes in adults (20-79 years old) according to a report published in 2013 by the IDF was 8.3% (382 million people) with 14 million more men than women(198 million men vs184 million women.[2]

In type-2 diabetes, insulin resistance increases the demand for insulin in insulin-target tissues. In addition to insulin resistance, the increased demand for insulin could not be met by the pancreatic beta cells due to defects in the function of these cells.[3] One of the global major health issues is iron defiency anemia (IDA).Up to 30% of diabetic patient present with coexisting anemia.[4]

Micronutrients play crucial roles in human nutrition, including the prevention and treatment of various diseases and conditions, as well as the optimization of physical and mental functioning. Understanding micronutrients is critical for anyone seeking to maintain or improve his or her health. Vitamins and minerals are the two types of micronutrients. While only needed in small amounts, they play important roles in human development and well-being, including the regulation of metabolism, heartbeat, cellular pH, and bone density. Lack of micronutrients can lead to increase risk for various diseases in adulthood. Without proper consumption of micronutrients, humans can suffer from diseases such as Diabetes, Rickets (lack of vitamin D), Scurvy (lack of vitamin C), and Osteoporosis (lack of calcium).[5]

Diabetes is a common worldwide health problem and the leading cause of high percentage of mortality and morbidity because it affects more than one system in the body. The tremendous growth of the incidence of type 2 diabetes is very high in adults.[6]

Disorders of mineral metabolism are sometimes passed from parents to their offspring through genes. Other conditions, such as starvation, diarrhoea,or alcoholism, can cause mineral metabolism problems. Minerals and trace elements may exert protective or scavenging effects, as well as being essential components of several key enzymes in intracellular antioxidant defense. Their deficiency, or excess, may contribute to derangement of

the pro-oxidant/anti-oxidant balance, and hence to the progressive appearance of secondary complications as the disease advances.[7]

**Iron (Fe)** has a significant role in the development of diabetes and its complications. Studies suggested that increased Fe stores tend to be associated with the development of diabetes mellitus. Excessive Fe, however, may be dangerous. It has been established in vitro that free Fe or Fe overload can cause free radical formation, lipid peroxidation, and neuronal damage. It is progressively more renowned that Fe influences glucose metabolism, even in the lack of essential Fe overload. In the general population, body Fe stores are positively associated with the development of glucose intolerance and T2DM.[8]

Modifications in the plasma concentrations of several trace elements have been suspected in diabetic patients and may be involved in some of the metabolic dysfunctions. Interconnecting systems of minerals accomplish the body's defense against oxidative stress. Diabetes mellitus is associated with altered iron homeostasis in human. Iron is capable of generating reactive oxygen species and contributes to diabetic nephropathy. Excess Fe has been implicated in the pathogenesis of diabetes and its complications.[9]

**Zinc** a trace element, is a component of many enzymes. The function of zinc in the body metabolism is based on its enzymatic affinity, way of a zinc enzyme complex or zinc metalloenzymes.[10]

Zinc serves as an essential co-factor for more than 200 enzymes, many of which regulate the metabolism of carbohydrates, lipids, and proteins. Insulin itself is believed to be stored in an inactive form of zinc crystals. Zinc ions in the secretory granules of cells are known to glue insulin β molecules, creating somatically stable hexamers. When the secretory granules open to the surface, the zinc ions pressure decreases rapidly and pH levels change from acid to physiological levels, which results in free insulin monomers and zinc ions will be released from the pancreas. Thus zinc is required for insulin synthesis and storage. There is accumulating evidence that the metabolism of zinc is altered in type 2 diabetes mellitus and that zinc might have specific roles in the pathogenesis and progress of this diseases.[11]

## METHODS

This case control study was carried out at the Department of Biochemistry, Mymensingh Medical College and the subjects were collected from the outpatient Department of Endocrinology, Mymensingh Medical College Hospital, and Mymensingh during the period of January 2015 to December 2015. A total of 120 subjects were studied. For both case and control group persons having no acute complications, serious co-morbid diseases and history of renal failure were selected.

With all aseptic precautions 6 ml of venous blood will be collected from the study subjects after overnight fasting by a disposable syringe from anticubital vein. The blood will be transferred to a dry screw capped sterile test tube immediately after removal of needle from the syringe with a gentle push to avoid hemolysis. Test tube will be kept in vertical position until clot formation and then will be centrifuged at 3000 rpm for 5 minutes. Clear serum will be taken out by micro pippet in a plain plastic eppendrop tube. Estimation of serum iron and zinc will be done as soon as possible. In case of any delay the sample will be stored at minus 20 degree Celcius. Serum iron was estimated by colorimetric method using test kit.

Serum zinc was estimated by colorimetric method using test kit. Serum glucose was estimated by enzymetric method by GOD PAP. All statistical analysis was done by using Statistical Package for social Science (SPSS) using version 20. Results were expressed as mean±SD. Statistical significance of reference between two groups were evaluated by using student's unpaired t test and 95% confidence limit was taken as level of significance.

## RESULTS

In this study, a total 120 subjects were enrolled out of which 60 were case and 60 were control. Blood glucose was done in all study subjects. Then serum iron and zinc levels were measured in fasting samples of both groups.

Serum iron and zinc level was expressed in µgm/dl while blood glucose level expressed in mmol/l.

In group 1 (case) mean±SD fasting blood glucose levels was 9.83±1.33 and two hours after blood glucose load was 15.62±3.76, while in group II (control) mean±SD fasting blood glucose levels was 4.51±0.48 and two hours after blood glucose load was 6.40±0.50 mmol/l respectively (Table I).

In diabetic subjects fasting and two hours after blood glucose load, serum glucose levels were significantly higher than control ($p<0.001$). The mean ±SD of serum iron levels in group I and group II were 128.35±31.69 and 97.37±37.05 µgm/dl respectively (Table II).

There was significantly increased ($p<0.002$) of iron in group I compared to that in group II.

The mean ±SD of serum zinc levels in group I and group II were 85.28±28.68 and 115.68±46.99 µgm/dl respectively (Table II). There was significantly decreased ($p<0.001$) of zinc in group I compared to that in group II.

**Table I: Blood glucose of the study subject.**

| Variables | Mean±SD Group 1(case) | Mean±SD Group 2 (control) | t value | p value |
|---|---|---|---|---|
| Fasting blood glucose (mmol/l) | 9.83±1.33 | 4.51±0.48 | 29.049 | P<0.001 |
| 2 hours after glucose load (mmol/l) | 15.62±3.76 | 6.40±0.50 | 18.842 | P<0.001 |

Unpaired student's *'t'* test, * Significant

**Table II: Serum iron and zinc levels of the study subjects.**

| Variables | Mean±SD Group 1(case) | Mean±SD Group 2 (control) | t value | p value |
|---|---|---|---|---|
| Iron (µgm/dl) | 128.35±31.69 | 97.37±37.05 | 4.923 | P<0.001 |
| Zinc (µ gm/dl) | 85.28±28.68 | 115.68±46.99 | 4.278 | P<0.001 |

Unpaired student's *'t'* test, * Significant

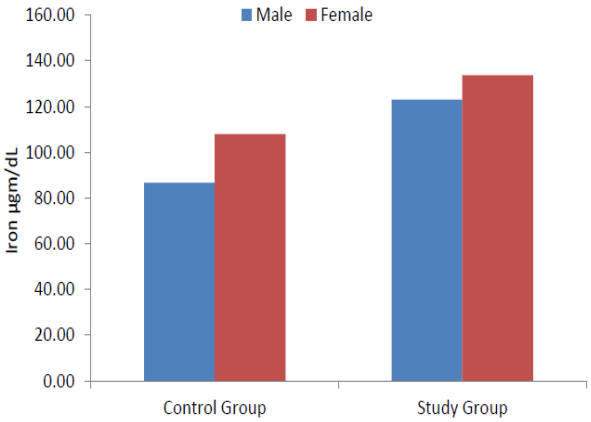


**Figure 1: Mean serum total Iron level comparing different subgroups.**
DM= Diabetic male
DF= Diabetic Female
NDM= Non Diabetic Male
NDF = Non Diabetic Female

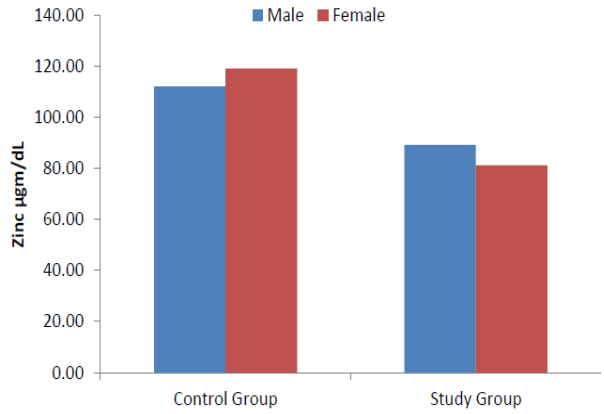


**Figure 2: Mean serum total Zinc level comparing different subgroups.**
DM= Diabetic male
DF= Diabetic Female
NDM= Non Diabetic Male
NDF = Non Diabetic Female

## DISCUSSION

Four hundred and fifteen million have diabetes and half of them are not yet confirmed. Ninety percent of them are exposed to bad outcomes, both those related to the large vessels or small vessels, which in turn reinforced the mental and impairment of function leading to worse healthcare budget. Regardless the social awareness about diabetic complications, and other disorders related to its occurrence, the percent of patients suffering from diabetes increase day by day.[12]

The concentration of several trace elements have been reported to be altered in type 2 diabetes mellitus and these elements might have specific roles in the pathogenesis and Progress of this disease.[13] Trace elements have important physiological effects when present at concentrations other than those associated with classical toxicity or with extreme deficiency. There is accumulating evidence that the metabolism of several trace elements is altered in diabetes mellitus.[14]

In the present study, the results showed that significant increase in iron level was observed in subjects with type 2 diabetes mellitus patients in comparison to control group. This finding was in agreement with the result of other researchers.[15]

The findings due to there is decrease in uptake of iron and increase circulatory pool of catalytic iron. Increased blood glucose in diabetes mellitus stimulates non enzymatic glycosylation of several proteins including hemoglobin. Glycosylation of hemoglobin also leads to increase in iron release from protein.[16]

Since, iron is a reactive metal ion which causes the damage of cellular macromolecules by production of highly reactive oxygen radical. Iron reduction from ferric state (Fe3+) to ferrous state (Fe2+) state plays a major role in lipid per oxidation process. As the concentration of iron increases, it finally accumulates in the liver. Ferritin, an iron storage protein may function as a source

of iron for promotion of superoxide-dependent lipid per oxidation (SJ et al. 2001).[17]

Zinc shown a significant difference between case group and control group (p-value=< 0.001) where the mean concentration in the case group was lower than the control group. Our results are in agreement with previous researches who mentioned that Zn level was significantly decreased in diabetic patients as compared to controls.[18]

Many other researchers confirm decrease level of Zn in patients with type2 diabetes compared to that of the control group. This hypozincemia is attributed to loss of zinc in urine.[19]

It is now becoming clear that the predominant effect on Zn homeostasis of diabetes is hypozincemia, which may be the result of hyperzincuria or decreased gastrointestinal absorption of Zn, or both.[20]

## LIMITATION

This was a case control study. The population size was small. Other physical and biochemical parameters were not evaluated. The contents of this study are open to criticism. Further studies with large number of subjects, with the application of modern sophisticated technology are required to give a conclusive decision.

## CONCLUSION

In this study we found that serum iron level was significantly increased and serum zinc level was significantly decreased in type 2 diabetes patient. As a result it may be recommended that all type 2 diabetic patients should undergo regular checkup of serum iron and zinc level as routine test. Supplementation of zinc may be given in type 2 diabetic patient

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