Evaluation of random blood sugar, alkaline phosphatase and zinc levels in type 2 diabetes mellitus subjects

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Abstract
Objective: The purpose of present study was to evaluate the RBS, ALP, and zinc in the individuals having T2DM and to compare the study parameters with healthy controls of Bundelkhand region. The other aim was to analyze the association between study parameters in healthy control subjects group and T2DM subjects group.

Results: We observed an insignificant in age in the present study when compared between the two groups. Whereas, comparison between two groups, of parameters such as the values of RBS, ALP, and serum zinc we observed a significant difference. In the patient group, positive correlation was observed between ALP versus zinc and a negative correlation was observed between age and RBS; RBS and serum zinc. In the control group, we found positive correlation between ALP and zinc.

Conclusion: In conclusion, we have demonstrated as zinc depletion aggravates insulin resistance and may result in increased loss through urine, it may be advisable to periodically monitor zinc concentrations in T2DM subjects.

Keywords: Type 2 Diabetes mellitus, Alkaline phosphatase, Hyperglycemia, Zinc.

Introduction
There are many etiologic hypotheses for hyperglycemia in Type 2 Diabetes Mellitus (T2DM), such as genetic defect¹, loss of insulin sensitivity², HDLc defect³, oxidative stress⁴, glucose toxicity⁵, low concentrations of chromium⁶, zinc⁷, and melatonin⁸. It is possible that several of these hypotheses, e.g., trace element deficiencies⁸, mitochondrial defect⁸, and oxidative stress², may interact as pathogenetic mechanisms for insulin resistance in T2DM. Bioavailability of minerals is especially vulnerable to free radical damage which is reported to be high during hyperglycemia might change the oxidation state of minerals, making it to excrete through urine⁹. Loss of minerals may lead to decrease in its bodily content and such loss might affect the concentrations of minerals like zinc.

Extensive studies of all the metabolic abnormalities under taken so far have not been able to provide an insight into all the pathophysiologic alterations in diabetes. New areas of problems keep surfacing as a result of the complex interactions among the various factors. A few published reports of both in vitro and in vivo studies on the interactions of Alkaline Phosphatase (ALP) enzyme activity and glucose
drew attention to their alterations in diabetic states. In one study, ALP activity was increased in the plasma of diabetic rats. In another study, in contrast to T2DM, starvation is associated with a decrease in ALP activity which is reversed by refeeding. However, the level of ALP has not been evaluated in case of T2DM subjects in this specific region.

Zinc is a necessary as a co-factor for several enzymes that play a vital role in glucose metabolism. Studies have demonstrated lower zinc level as a common feature in patients with T2DM, although diabetes can induce lower zinc levels, zinc deficiency has also been proposed as a risk factor for T2DM. Studies on models demonstrated that zinc has a negative effect on the signaling process of insulin. Similarly, some studies revealed that zinc administration has a beneficial effect on insulin action and glucose metabolism. In a study, found an inverse correlation between zinc intake and risk of T2DM. Moreover, zinc depletion has a negative impact on glucose homeostasis and insulin sensitivity in patients with T2DM, as well as on the evolution of complications such as retinopathy, thrombosis and hypertension. Interestingly, a study showed lower serum zinc is a strong independent predictor of the development of T2DM. Several studies have shown lower serum zinc concentrations in T2DM compared to healthy controls. However, there is no clear indication or hypothesis to trace whether zinc deficiency occurs first or development of T2DM.

Although low serum zinc concentrations in diabetics have also been found in the above mentioned studies, there are no reported data for diabetics living in Bundelkhand region. Therefore, the purpose of present study was to evaluate the RBS, ALP, and zinc in the individuals having T2DM and to compare the study parameters with healthy controls of Bundelkhand region. The other aim was to analyze the association between study parameters in healthy control subjects group and T2DM subjects group.
compare the means of variables between two groups. Pearson correlation was used to find the association between two variables. P < 0.05 was considered significant.

Results
Figure 1 shows age, RBS, ALP, and zinc mean values observed in T2DM subjects and control subjects respectively. We observed an insignificant in age in the present study when compared between the two groups. Whereas, comparison between two groups, of parameters such as the values of RBS, ALP, and serum zinc we observed a significant difference (P<0.001).

In the patient group (Table 1) positive correlation was observed between ALP versus zinc (R=0.2814, P=0.002) and a negative correlation was observed between age and RBS (R=0.2264, P=0.003); RBS and serum zinc (R=-0.3132, P=0.034). In the control group, we found positive correlation between ALP and zinc (R=0.1251, P=0.01).

Figure 1: Findings of age, RBS, ALP, and Zinc in T2DM and control groups

Table 1: Pearson correlation in healthy control group and T2DM group

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control subjects</th>
<th>T2DM subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age versus RBS</td>
<td>R=-0.0584</td>
<td>R= -0.2264</td>
</tr>
<tr>
<td>Age versus ALP</td>
<td>R=0.0248</td>
<td>R=0.0172</td>
</tr>
<tr>
<td>Age versus Zinc</td>
<td>R=-0.1142</td>
<td>R=-0.0960</td>
</tr>
<tr>
<td>RBS versus ALP</td>
<td>R=0.3458</td>
<td>R=0.0391</td>
</tr>
<tr>
<td>RBS versus Zinc</td>
<td>R=0.2461</td>
<td>R=-0.3132</td>
</tr>
<tr>
<td>ALP versus Zinc</td>
<td>R=0.1251</td>
<td>R=0.2814</td>
</tr>
</tbody>
</table>

Discussion
Aims in this study were to compare the plasma RBS, serum ALP, and serum zinc levels of patients with T2DM and healthy controls in Bundelkhand region and also to know the association between the study parameters in respective groups.

The T2DM group subjects showed altered RBS, ALP, and zinc when compared with healthy control group subjects. Insignificant difference was observed in the age parameter when compared between the two groups.

In the present study pertaining to T2DM group subjects, an inverse correlation between age and RBS was observed, but not in healthy controls. This finding suggests that increased blood sugar in T2DM group may be caused by increase age in the subjects[2,3]. Literature related to T2DM
reveals that T2DM is one of the aging diseases in the present world and our finding also infers the concerns with age in T2DM subjects\textsuperscript{1,5}. Studies reported that individuals above 40 years of age are more susceptible to develop T2DM\textsuperscript{7,10}. Interesting point is that no correlation was observed in the control group when compared between age and blood sugar, however, we observed insignificant difference in age when compared between T2DM and controls. Keeping in view of this finding, suggests that people who have predisposition to T2DM, are prominently driven towards the initiation of the disease rather than the people who has little predisposition. Moreover, because older adults have the highest prevalence of diabetes, such individuals have traditionally not been included in some studies that involve research on diabetes\textsuperscript{12,13}. For the normal functioning of ALP, zinc is an essential component for the enzyme ALP. It is interesting that a correlation between age and ALP and zinc was positive in the control group and in the T2DM as well. We also observed a negative correlation was observed between age and RBS in T2DM subjects group. At first it seems contradictory, but possible explanation could be that the oxidative stress increases with increased glucose concentration and decrease in zinc is compensatory to the increase in age and the free radical production. Many studies have shown that people with T2DM tend to have higher oxidative stress compared to healthy controls compared with same age group individuals\textsuperscript{2-5}. Though the present did not estimate free radicals but it is clear through the literature that oxidative stress is increased in T2DM patients and also in aged controls\textsuperscript{7-11}. Thus we observed lower ALP levels in T2DM subjects when compared with healthy control subjects. Zinc is a necessary as a co-factor for several enzymes that play a vital role in glucose metabolism\textsuperscript{14}. Studies have demonstrated lower zinc level as a common feature in patients with T2DM\textsuperscript{15}, although diabetes can induce lower zinc levels, zinc deficiency has also been proposed as a risk factor for T2DM\textsuperscript{16}. Studies on models demonstrated that zinc has a negative effect on the signaling process of insulin\textsuperscript{19-24}. Similarly, some studies\textsuperscript{17,18} revealed that zinc administration has a beneficial effect on insulin action and glucose metabolism. In a study\textsuperscript{21,22}, found an inverse correlation between zinc intake and risk of T2DM. Moreover, zinc depletion has a negative impact on glucose homeostasis and insulin sensitivity in patients with T2DM\textsuperscript{23,24}, as well as on the evolution of complications such as retinopathy, thrombosis and hypertension\textsuperscript{28-31}. Interestingly, a study showed lower serum zinc is a strong independent predictor of the development of T2DM\textsuperscript{25}. Several studies have shown lower serum zinc concentrations in T2DM compared to healthy controls\textsuperscript{26,27}. However, there is no clear indication or hypothesis to trace whether zinc deficiency occurs first or development of T2DM. We observed significant lower zinc levels in T2DM group subjects when compared to control group subjects and an inverse correlation between serum RBS and serum zinc in T2DM group. The lower level was due to hyperglycemia present in T2DM subjects. Osmotic diuresis is seen in T2DM subjects, cause frequent urination and during this process loss of zinc can occur as suggested by the studies\textsuperscript{28-30}. Similar finding has been shown in studies performed with T2DM subjects\textsuperscript{9}. **Conclusion** In conclusion, we have demonstrated that lower zinc levels in T2DM individuals in the Bundelkhand region. As zinc depletion aggravates insulin resistance and may result in increased loss through urine, it may be advisable to periodically monitor zinc concentrations in T2DM subjects. Moreover, further research is imminent to understand the deeper insights into the association of zinc and ALP with T2DM prior to the initiation or after initiation of T2DM. **Conflict of Interest:** None Declared
References


