Determination of random blood sugar, alkaline phosphatase and zinc levels in individuals with leprosy

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Abstract:

Objective: The current study aimed to compare the levels of zinc, alkaline phosphatase, and random blood sugar in people with leprosy to those in healthy controls from the Bundelkhand area. The second objective was to compare the correlation between study parameters in the leprosy group and the healthy control group. **Material & methods:** The research was carried out in the Department of Biochemistry at Maharani Laxmi Bai Medical College (MLBMC) in Jhansi. In the healthy control group, forty human beings with normal glycemic status were age and gender matched. The leprosy patient group contained forty leprosy patients who were receiving treatment. Leprosy disease was diagnosed in accordance with the world health organization guidelines. **Results:** Age difference between the two groups was not statistically significant in the present investigation. Whereas, we found a statistically significant contrast between the two sets of data we analyzed, including RBS, ALP, and serum zinc levels. Leprosy patients showed a positive link between ALP and zinc, and a negative correlation between age and RBS; RBS and serum zinc. A positive connection between ALP and zinc was seen in the control group. We conclude that periodic monitoring of zinc concentrations in leprosy people may be prudent since zinc deficiency worsens insulin resistance and may lead to greater loss through urine.

Key words: Leprosy, Alkaline phosphatase, Hyperglycemia, Zinc

Introduction:

There are numerous potential causes of hyperglycemia, including genetic abnormality [1], loss of insulin sensitivity [2], high density lipoprotein deficiency [3], oxidative stress [4], glucose toxicity [2,4,5], low levels of chromium [4], zinc [6], and melatonin [7], to name a few. Multiple hypotheses, such as trace element deficits [4,6], mitochondrial malfunction [8], and oxidative stress [9], may interact as pathogenetic pathways for insulin resistance. Mineral bioavailability is especially sensitive to free radical damage, which has been observed to be high during hyperglycemia [10,11]. Loss of minerals may result in a decrease in the body's mineral content, and this loss may impact the concentrations of minerals such as zinc [10-12].

Extensive studies of all metabolic abnormalities conducted thus far have failed to provide insight into all pathophysiologic modifications in leprosy. As a result of the complicated interactions among the many elements, new areas of concern continue to emerge. A few reports of in vitro and in vivo investigations on the interactions between Alkaline Phosphatase (ALP) enzyme activity and glucose brought attention to their changes in inflammatory situations [13-15]. In one investigation, ALP activity was found to be enhanced in inflammatory plasma [13]. In contrast, hunger is associated with a decrease in ALP activity that is reversed by refeeding [14]. However, the amount of ALP in leprosy patients in this location has not been assessed.

Zinc is required as a cofactor for various enzymes involved in glucose metabolism [6]. Lower zinc levels have been found to be a common feature in patients with a variety of inflammatory disorders [16-21]. While inflammation can cause lower zinc levels, zinc insufficiency has also been identified as a risk factor for pathological alterations [16,17]. Model studies have shown that zinc has a detrimental influence on insulin signaling [18-20]. A study [21,22] discovered an inverse relationship between zinc consumption and infection risk. Furthermore, zinc deficiency impairs glucose homeostasis and insulin sensitivity in leprosy patients [23,24], as well as the progression of comorbidities such as retinopathy, thrombosis, and hypertension [1-3]. A study found that decreased serum zinc levels are a strong independent predictor of the development of immune-mediated illnesses [19]. Several investigations have found that leprosy patients had lower serum zinc concentrations than healthy controls [19,25]. However, there is no definite indicator or theory to determine whether zinc deficiency or leprosy development happens first.

Although low serum zinc values in leprosy have been discovered in the research listed above, there is no data for leprosy patients living in this region. As a result, the goal of this study was to assess RBS, ALP, and zinc levels in leprosy patients and compare the results to healthy controls from the same region. Another goal was to examine the relationship between research parameters in healthy control volunteers and leprosy patients.

Materials & Methods:

The research was carried out in the Department of Biochemistry at Maharani Laxmi Bai Medical College (MLBMC) in Jhansi. In the healthy control group, forty human beings with normal

glycemic status were age and gender matched. The leprosy patient group contained forty leprosy patients who were receiving treatment. Leprosy disease was diagnosed in accordance with the world health organization guidelines. Leprosy group individuals were diagnosed by consultants from MLBMC's General Medicine department. Individuals with type 1 diabetes and type 2 diabetes and complications were excluded. Healthy controls had to be non-diabetic, not use supplements, and not have any other issues.

Sampling procedure:

After receiving informed written consent from all study group participants, 5ml of random venous blood was taken into gray and flat vials using a disposable syringe and needle under aseptic conditions. Blood was isolated from serum by centrifuging it at 3000 rpm for twenty minutes. Until analysis, samples were kept in aliquots at -20°C. Glucose levels in plasma were determined with the Glucose Oxidase and Peroxidase (DPEC – GOD/POD) kit acquired from Arkray Healthcare Pvt Ltd. The reagents were produced in accordance with the manual's instructions. Span Diagnostics' estimation of serum alkaline phosphatase using the King & King method. Serum Zinc measurement using the colometric technique of Coral Clinical Systems. Glassware was soaked in 1.6 mol/L nitric acid for 24 hours, then rinsed four times with water. Prior to use, micropipette tips were rinsed in 0.8 mol/L nitric acid, then rinsed three times with water, and allowed to dry on a non-contaminating absorbent paper.

Statistical analysis:

Excel was utilized to do statistical analysis. The unpaired t-test was used to compare the variable means of two groups. Pearson correlation was utilized to determine the relationship between two variables. $P < 0.05$ was judged statistically significant.

Results:

The average ages, RBS levels, ALP levels, and zinc concentrations of leprosy patients and healthy controls are shown in Figure 1. During our inquiry, we compared the ages of both groups and discovered that there was not a discernible gap between them. On the other hand, we discovered a statistically significant divide ($P < 0.001$) between the two groups we compared in terms of variables such as RBS, ALP, and serum zinc levels.

Table 1 shows in the patient group that there was a link between ALP and zinc that was positive ($R = 0.4572$, $P = 0.001$), yet there was a correlation between age and RBS that was negative ($R = -0.3452$, $P = 0.001$), and there was a correlation between RBS and serum zinc that was negative ($R = -0.0621$, $P = 0.034$). In the control group, we found that there was a significant positive correlation between ALP and zinc ($R = 0.4732$, $P = 0.01$).

Discussion:

The purpose of this study was to compare plasma RBS, serum ALP, and serum zinc levels between leprosy patients and healthy controls in the Bundelkhand region. In addition, the researchers desired to establish if there was a correlation between the study parameters in each group.

Comparing the leprosy group to the healthy control group, RBS, ALP, and zinc levels were shown to be abnormal in the leprosy group. Comparing the ages of the individuals in the two groups revealed no statistically significant differences.

In the present investigation involving persons with leprosy, an inverse association was found between age and RBS, but no such correlation was seen in the healthy control group. This finding suggests that an individual's advanced age may be the core cause of raised blood sugar levels [2,3] in the leprosy group. Leprosy is one of the bacterial diseases connected with immunity in the modern world, according to the research on the disease, and our study implies that there are age-related concerns among leprosy patients [26]. Several studies [26-28] indicate that persons with lower immunity level and genetic susceptibility have an increased chance of contracting leprosy. When we compared the ages of those with leprosy to those of the controls, we saw no significant difference. In contrast, there was no correlation between age and blood sugar levels in the control group. This discovery is intriguing. This research suggests that those with a high predisposition to leprosy are significantly more likely to develop the disease than those with a low inclination. This is in contrast to individuals with a reduced susceptibility to other ailments. In addition, older persons, who have the highest prevalence of leprosy, are often excluded from leprosy-related research studies [26-28]. This is because the danger of having leprosy is greater among the elderly and genetically susceptible individuals.

Zinc is an essential component for the ALP enzyme to complete its regular activity. It is noteworthy to note that a positive correlation was discovered between age and ALP and zinc levels in both the leprosy and control groups. Additionally, we observed an inverse association between the ages of leprosy patients and their RBS levels. This appears odd at first view; however, one potential explanation is that oxidative stress increases with growing glucose content and that the decrease in zinc is a compensatory response to aging and the increase in free radical generation. Numerous studies [216-18,29-31] have shown that leprosy patients tend to experience higher levels of oxidative stress than healthy controls and individuals of the same age. In spite of the fact that no attempt was made to assess the amounts of free radicals in this investigation, it is well-established that oxidative stress is higher in both leprosy patients and elderly controls [30-31]. As a result, we discovered that the levels of ALP in leprosy patients were lower than those in healthy controls.

Zinc is necessary in the body as a co-factor for a variety of glucose-metabolizing enzymes [14]. Despite the fact that immune-related diseases can reduce zinc levels, zinc deficiency has also

been identified as a risk factor for leprosy [16]. According to studies, a low zinc level is a prevalent characteristic of leprosy [15]. [19-24] Numerous investigations on animal models have demonstrated that zinc negatively affects the insulin signaling pathway. Similarly, a number of studies [17,18] have demonstrated that zinc ingestion positively affects both the action of insulin and the glucose metabolism. According to two distinct investigations [24,25], zinc consumption has a negative association with the incidence of leprosy. In addition, zinc deficiency has a negative impact on the glucose homeostasis and insulin sensitivity of leprosy patients [23,24]. It also hinders the growth of comorbidities such as retinopathy, thrombosis, and hypertension [28-31]. In a study published in [19,21], it was discovered that a low serum zinc level is a strong independent predictor of leprosy development. Multiple investigations comparing individuals with leprosy to healthy controls have revealed that patients with leprosy had lower serum zinc levels [19,20]. On the other hand, neither a conclusive signal nor a theory can determine which happens first: zinc deficiency or leprosy development. We discovered a significant inverse relationship between serum RBS and serum zinc in the leprosy group, as well as considerably lower zinc levels in leprosy participants compared to control people. The lower level was brought about by the hyperglycemia observed in leprosy patients. Leprosy patients have osmotic diuresis, resulting in an increase in the frequency with which they urinate. Zinc may be lost during this process, according to research [4].

Conclusion:

Finally, our findings indicate that patients with leprosy in the Bundelkhand region have decreased zinc levels. Testing zinc levels in persons with leprosy may be useful, as low zinc levels worsen insulin resistance and lead to increased zinc loss via urine. Zinc and ALP may have an effect on leprosy either before or after it develops, but further study is needed to determine this.

Conflict of interest:

None declared

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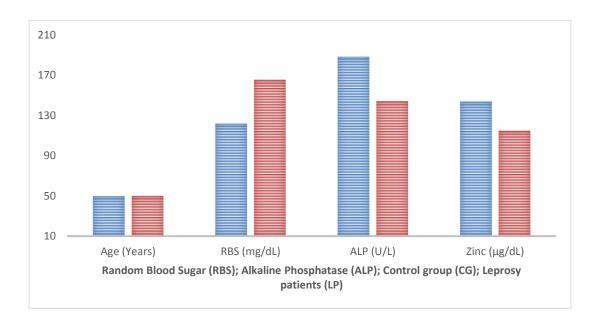
Figure 1: Findings of age, RBS, ALP, and Zinc in LEPROSY and control groups

Random Blood Sugar (RBS); Alkaline Phosphatase (ALP); Control group (CG); Leprosy patients (LP)

Variables	Control subjects	LEPROSY patients
RBS versus Age	R=-0.0324	R= -0.3452
ALP versus Age	R=0.0165	R=-0.0921
Zinc versus Age	R=-0.2431	R=-0.0621

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

ALP versus RBS	R=0.3785	R=0.0567
Zinc versus RBS	R=0.4679	R=-0.7893
Zinc versus ALP	R=0.4732	R=0.4572