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Research Article

Serum Mineral In Diabetes

Analysis of Serum Calcium, Serum Phosphorus, And Alkaline Phosphatase in Pre-Diabetes and Type-2 Diabetic Mellitus

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Abstract: "Diabetes mellitus" refers to a group of metabolic disorders that a wide range of causes may have brought on. The abnormalities in insulin production and action that characterize diabetes mellitus are distinctive. Pre-diabetes is a type of hyperglycemia that can be identified by glycemic indices that are higher than average but below the diabetes cut-off point. Pre-diabetes can be avoided by eating healthily and getting frequent exercise. This study aims to examine the association between bone markers (serum calcium, phosphorus, and alkaline phosphatase levels) and type 2 diabetes in individuals who are either currently diagnosed with type 2 diabetes mellitus or are at high risk of developing it. The Hyderabad, Telangana, India, location of the Aclin Clinical & Diagnostic Lab will be closed for maintenance beginning on January 1 and lasting through the end of the year. Comparisons were made between the serum levels of calcium, phosphorus, and alkaline phosphatase in 65 individuals with pre-diabetes and 65 people with type 2 diabetes. The comparison was performed using an automated technique. Compared to patients diagnosed with pre-diabetes, patients with type 2 diabetes had significantly lower serum calcium levels.On the other hand, those with diabetes showed significantly higher serum levels of both ALP and phosphorus compared to the prediabetic group (p0.001). Our study's findings imply that variations in serum mineral levels are related to pre-diabetes. These traits can be used to anticipate the onset of type II diabetes mellitus on their own, and getting a diagnosis as soon as is practical can serve to aid in the prevention of future problems.

Keywords: Calcium, phosphorus, type 2 diabetes, alkaline phosphatase, and pre-diabetes

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1. INTRODUCTION

Most people have diabetes. The distinction between type 1 and type 2 diabetes mellitus was made in 1936. More than 150 million people globally have diabetes. In 2030, 439 million persons will have diabetes, most of them type 2 [1,2]. Diabetes is a leading cause of death and illness in the US [3]. Diabetes mellitus is a metabolic illness with many etiologies characterized by chronic hyperglycemia and metabolic abnormalities generated by insulin synthesis and activity. Insulin is an anabolic hormone that affects glucose, lipid, and mineral metabolism. Low insulin production, decreased glucose utilization, and increased glucose synthesis contribute to hyperglycemia [4-6]. ICMR INDIAB estimates that India will have 101.2 million diabetics by 2030. The American Diabetes Association most typically classifies type 1 diabetes, type 2 diabetes, and gestational diabetes. Type 1 diabetes is characterized by inadequate insulin production, pancreatic cell loss, and ketoacidosis. The loss of pancreatic beta cells causes type 1 diabetes. It generates 80-90% of childhood diabetes [7-10]. Type 2 diabetes was the main component of metabolic syndrome in 1988. By 2030, 552 million people will have diabetes, up from 366 million in 2011. Type 2 diabetes is characterized by high blood glucose (hyperglycemia), insulin resistance, and insulin insufficiency. Type 2 diabetes mellitus, which affects 5.9% of adults worldwide and 8% of emerging countries, is characterized by insulin resistance and beta dysfunction. The American Diabetes Association uses the same IGT cut-off value (140 to 200 mg/dl) but a lower IFG value (100-125mg/dl) and haemoglobin A1C-based criteria for pre-diabetes at 5.7 to 6.4%. Pre-diabetes is high blood glucose [11-13]. The amount isn't high enough for diabetes. Type 2 diabetes can cause poor bone quality and bone loss, according to studies. Several investigations have revealed that serum calcium, serum phosphorus, and serum alkaline phosphate are bone indicator levels. Alkaline phosphate is found in the liver, bile duct, kidney, intestinal mucosa, and placenta. People with diabetes may have high serum alkaline phosphatase levels [of 14-16]. Calcium is a structural, metabolic component in bones and teeth. Calcium is essential for insulin-mediated intracellular activities in insulin-responsive tissues, including skeletal muscle and adipose tissue. However, insulin activity only changes in a narrow range. Changes in insulin target tissue calcium affect insulin activity. Adults should ingest 550-700 mg of phosphorus daily, with a maximum of 4000 mg per day. In recent years, phosphorus consumption has risen while type 2 diabetes has skyrocketed [17-20]. This study will evaluate serum calcium, phosphorus, and alkaline phosphatase (ALP) levels between type 2 diabetics and prediabetics. This study will also examine the link between these parameters and fasting plasma glucose and HbA1c.

2. MATERIALS AND METHODS

This study comprised a total of 130 patients, who were then split evenly between two different groups. Group I (Cases): This group included 65 patients who had been diagnosed with diabetes mellitus and received treatment at the medicine OPD or were admitted to the Aclin Clinical & Diagnostic Lab, Hyderabad, Telangana, India. Prediabetic individuals with fasting plasma glucose between 101 and 125 mg/dl and an HbA1c between 5.7 and 6.4% were included in Group II (controls), which had 65 participants.

2.2 Inclusion criteria

- Smokers
- Heavy alcoholics
- Chronic infection affecting bone
- Chronic renal failure
- Bone tumours
- Drugs that may affect bone metabolism

2.3 Exclusion Criteria

- Non Smokers
- Non-Alcoholics
- Drugs not affecting bone metabolism
- Non-renal failure

2.4 Ethical consideration

The Aclin Clinical & Diagnostic Lab approved to conduct this investigation. Upon completing the informed consent, which served as an agreement between the researchers and the responders, every participant was given information regarding the study's goals and assurances regarding the confidentiality and anonymity of the data.

3. STATISTICAL ANALYSIS

SPSS version 28.0 for data analysis Microsoft Word and Excel for graph development Statistical analysis SPSS version 28.0 for data analysis The mean and standard deviation were computed. A comparison was made with the student's t-test and Pearson's correlation coefficient (r-value). A p-value of less than 0.05 is considered significant in statistical analysis. A p-value that is lower than 0.001 is highly effective.

4. RESULTS

There were a total of 130 people who took part in this research, and they were divided into two groups: group I was made up of people who had pre-diabetes (n=65), with 42 (65%) males and 23 (35%) females. Group II was made up of people who had type 2 diabetes. These individuals' ages ranged from 30 to 60 years old, with the mean age being 43.72 and 7.39 years old. Group II consisted of people diagnosed with diabetes before the study. There were 65 participants, with 37 (58.33%) males and 28 (41.66%) females participating. Their ages ranged from 30 to 60 years old, with a mean age of 45.12 years old and a standard deviation of 5.90 years. Table 1 shows the data on pre-diabetes and diabetic groups' ages.

Table 1: Prediabetic and diabetic groups' ages

Sr. No.	Parameter	Prediabetic group (n = 65)	Patients Suffering from Diabetes Mellitus (n = 65)	p-value
1.	Age (year)	43.72±7.39	45.12±5.90	(p>0.05)

p Value - p>0.05 n=65

The independent Students t-test showed no statistically significant difference between the mean ages of patients suffering from diabetes mellitus and those of the control group. Table 2 Indicates the Gender comparison between prediabetic and diabetes patients.

Table 2: Gender comparison between prediabetic and diabetes patients

Parameter	Prediabetic group (n = 65)		Patients suffering from diabetes mellitus (n = 65)	
Gender	Male	Female	Male	Female
No of Individuals	42	23	37	28
Percentage	65%	35%	58.33%	41.66%

Patients who are diagnosed with diabetes mellitus are, on average, 58.33% male and 41.66% female. On average, patients diagnosed with pre-diabetes are 65% male and 35% female.

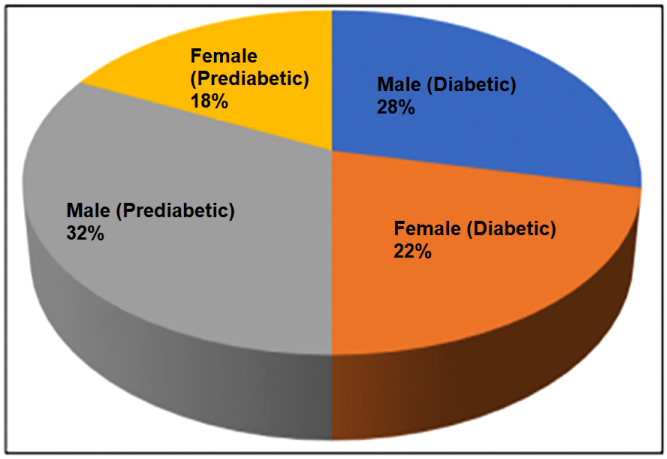

Fig 1: Gender distribution in pre-diabetes and diabetes patients irrespective with the female prediabetic at 18%, male at 28%, female diabetic at 22% and male prediabetic at 32%

In this study, 28% of diabetes mellitus patients were male, while only 22% of diabetes prediabetic patients were female. Additionally, 32% of prediabetic patients were male, while only 18% were female. Table 3 compares prediabetic serum phosphorus, ALP, and Ca.

Table 3: Comparing prediabetic serum phosphorus, ALP, and Ca

Parameter	Prediabetic group (n = 65)	Patients suffering from diabetes mellitus (n = 65)	p - Value
Serum Phosphorus (mg/dl)	3.80±1.37	4.51±1.36	0.004
Serum Alkaline Phosphatase (ALP) (U/L)	107.30±29.40	163.15±123.07	0.001
Serum Calcium (mg/dl)	8.53±0.84	7.98±0.91	0.001

p-value = 0.004, 0.001 and 0.001 n= 65

It was statistically significant that the mean value of serum phosphorus was significantly greater in patients diagnosed with diabetes (4.51.36 mg/dl) than in the prediabetic group (3.801.37 mg/dl). Individuals with diabetes mellitus were discovered to have a significantly greater serum phosphorus level, which was shown to be statistically very significant. This was found to be the case in the serum of these patients. ($p<0.004$). The prediabetic group and patients suffering from diabetes mellitus were found to have comparable levels of serum alkaline phosphatase (ALP). This finding was statistically found to be very significant. It was statistically significant that the mean value of serum alkaline phosphatase was greater in patients with diabetes mellitus (163.15123.07 IU/L) than it was in the prediabetic group (107.3029.40 IU/L), with the p-value being less than 0.001. Patients diagnosed with diabetes mellitus had significantly lower serum calcium levels than those in the prediabetic group. Significant (p 0.001) reductions in serum calcium were seen in people with diabetes mellitus as compared to healthy controls. It was statistically significant that the mean value of serum calcium was lower in diabetes mellitus patients (7.980.91 mg/dl) than in the prediabetic group (8.530.84 mg/dl), with the difference being 7.980.91 mg/dl versus 8.530.84 mg/dl.

5. DISCUSSION

A metabolic condition leads to diabetes mellitus. It is a group with varying degrees of impaired protein, lipid, and carbohydrate metabolism. Although diabetes mellitus can have many different causes and etiologies, abnormal insulin secretion and response are typically involved at some time during the course of the disease. The two most common kinds of diabetes mellitus are type 1 diabetes (autoimmune diabetes) and type 2 diabetes mellitus. Both are characterized by hyperglycemia, insulin resistance, and relative insulin deficiency. As a result, this study was conducted to evaluate the effects of bone markers (calcium, phosphorus, and alkaline phosphatase) on prediabetic and Type 2 diabetes mellitus patients. It also found a potential correlation between these bone markers, fasting blood sugar (FBS), and

HbA1c. In our study, the majority of participants were men. A higher prevalence of diabetes was observed in the age range of 30 to 60 years. Patients with diabetes mellitus who were Table 1 shows that the age groups of prediabetic and diabetic people were in the range of 30 to 60 years, with a mean of 43.727.39 for the prediabetic group and 45.125.90 for the diabetic group. The age range of prediabetic and diabetic individuals did not alter much. Table 2 shows the contrast of the gender percentages for the prediabetic group, where men made up 42 (60%), and women made up 23 (35%) and the diabetic group, where men made up 37 (58%) and women made up 28 (41%) in our study. Additionally, we evaluated the general gender distributions between the prediabetic and diabetic groups. In the prediabetic group, men made up 32%, and women made up 18%, while in the diabetic group, men made up 28%, and women made up 22%. Table 3 compares the serum calcium levels in patients with pre-diabetes and diabetes mellitus. When compared to patients with pre-diabetes (8.530.84 mg/dl), we discovered that the mean value of serum calcium in people with diabetes was considerably lower (7.980.91 mg/dl) (p0.001). When compared to the pre-diabetes group (3.801.37 mg/dl), we discovered that the mean value of serum phosphorus (4.511.36 mg/dl) in diabetic patients was considerably (p0.001). We discovered that the differences between pre-diabetes (107.30–29.40 IU/L) and those with diabetes mellitus (163.15–123.07 IU/L) were highly significant. Ruaha et al. showed elevated serum alkaline phosphatase levels in 2020, with a mean value of (90.3630.37 IU/L) compared to (78.7625.87 IU/L) healthy controls. In our investigation, we discovered that the mean serum alkaline phosphatase values were 107.3029.40 IU/L in the prediabetic group and 163.15123.07 IU/L in the diabetes mellitus group. From this study, we inferred that the level of ALP is greater in diabetic patients than in healthy or prediabetic persons [21-23]. According to Butola LK et al. in the year 2020 found that the level of serum calcium in diabetic patients (was 6.411.18 mg/dl) and in healthy individuals (9.260.59), and the level of serum phosphorus was (1.680.6) and (3.650.48) in type 2 diabetic group and normal healthy individuals, these studies showed a significant decrease in serum calcium and serum phosphorus level. We found from our study that the mean value of serum phosphorus (4.511.36) in diabetes patients was highly significantly (p0.001) increased in comparison to the pre-diabetes group (3.801.37), which is in line with the above finding that the mean value of serum calcium (7.980.91) in diabetic patients and (8.530.84) in prediabetics patients shows a significant decrease [24, 25]. M Krajnc et al. reported that HD and type 2 diabetes patients are at risk for coronary artery calcification (CAC). standard cardiovascular disease risk factors cannot fully explain CACS. CAC was assessed in 45 non-diabetic CKD patients on HD and 45 type two diabetic patients without nephropathy. Serum calcium, phosphate, 25-hydroxyvitamin D, alkaline phosphatase, intact parathyroid hormone, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides, and femoral neck bone mineral density were examined [2]. Raphael Enrique G et al. reported that millions of individuals worldwide have diabetes. Early detection and diagnosis of DM are critical to reducing its incidence and consequences. This study examined salivary glucose, amylase, calcium, and phosphorus as non-invasive DM indicators. Two groups of 80 were recruited (non-diabetics and diabetics). Blood and saliva were examined for glucose, amylase, calcium, and phosphorus [26]. Fares et al. studied 204 persons ages 18–65 with type 2 diabetes, pre-diabetes, and non-diabetic controls. Predesigned questionnaires were used to interview participants about socio-demographics, comorbidities, and drug therapy. Saliva and blood were tested. Mean salivary glucose was 23.40 12.755 mg/dl in the control group, 42.68 20.830 mg/dl in the prediabetic group, and 59.32 19.147 mg/dl in the diabetic group (P 0.001). Salivary glucose was strongly associated with FBS (r = 0.67, P <0.001 in the control group, r = 0.56, P 0.001 in the diabetes group, and r = 0.36, P 0.01). Salivary glucose may identify non-diabetics from people with diabetes (AUC: 0.928, P 0.001) with 94.2% sensitivity and 62% specificity [27]. Tiongco et al. reported the study aims to discover if salivary glucose can be used to screen, diagnose, and monitor type 2 diabetes (T2DM). Seventy-five participants were divided into 3 groups based on their FBG level: normal, impaired, and provisional DM. Each participant's blood and unstimulated saliva were analyzed using glucose oxidase-peroxidase [28]. Blood and salivary glucose had a substantial connection (r = 0.715, p0.001). Salivary glucose is 88.5% sensitive, 61.5% specific, and has a 45.8% positive and 97.1% negative predictive value. Naing and Mak, 2017, searched MEDLINE, EMBASE, Ovid, and Google Scholar for papers on salivary and serum glucose in type 1 diabetes. Following the review's inclusion criteria, we identified eligible studies. We did qualitative synthesis due to study heterogeneity. This evaluation comprised ten observational studies with 321 cases and 323 controls aged 3 to 61; 62% were male. Two studies involved kids under 17 years old. Six studies with 8 data sets found a significant difference between type 1 diabetes salivary glucose levels and controls. Five studies with seven datasets found salivary glucose and blood glucose correlations in diabetic individuals [29]. The mean values of serum phosphate were (4.20.4 mg/dl) and controls were (3.20.3 mg/dl), according to Raikou VD et al. observations from 2020, and the mean value of serum calcium was (9.50.6 mg/dl) and controls were (9.50.5 mg/dl). They identified the distinctions between diabetics and non-diabetics and noted elevated serum phosphate levels, and then they compared the controls and noted comparable serum calcium levels [30, 31].

6. CONCLUSION

Until early diagnostics are developed, diabetes will rise. Type and criterion are the best diagnostic criteria for pre-diabetes and diabetes. Pre-diabetes is hyperglycemia. Lifestyle modifications, dieting, and avoiding obesity can prevent diabetes. It affected diabetes. Calcium, P, and ALP were lower in people with diabetes. Pre-diabetes is unaffected. Early treatment can prevent complications from diabetes. Until early diagnostics are developed, diabetes will rise. Type and criterion are the best diagnostic criteria for pre-diabetes and diabetes. Pre-diabetes is hyperglycemia. Lifestyle modifications, dieting, and avoiding obesity can prevent diabetes. It affected diabetes. Calcium, P, and ALP were lower in people with diabetes. Pre-diabetes is unaffected. Early treatment can prevent complications from diabetes.

7. AUTHORS CONTRIBUTION STATEMENT

Dr Jaffar Shaik conceptualized and gathered the data about this work. Then, Dr Jaffar Shaik analyzed these data, and necessary inputs were given towards designing the manuscript. Finally, the author -- discussed the methodology and results and contributed to the final manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

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