

IMPORTANCE OF MINERAL DETERMINATION AND THEIR CORRELATION WITH HbA1c IN CHILDREN WITH TYPE 1 DIABETES MELLITUS



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BACKGROUND

Type 1 diabetes mellitus (T1DM) is caused by insulin deficiency resulting from the destruction of pancreatic β cells. Patients with T1DM often develop a hypoglycemia, hyperglycemia and diabetic ketoacidosis and number of electrolyte disorders.

Electrolytes play an important role in several body mechanisms, to name a few it helps maintain acid base balance, membrane potential, muscle contraction, nerve conduction and control body fluid.

Alterations in electrolytes homeostasis may lead to physiologic disorders. Insulin has been shown to activate $\text{Na}^+/\text{K}^+ - \text{ATPase}$ enzyme. Therefore, low serum insulin level reduces $\text{Na}^+/\text{K}^+ - \text{ATPase}$ activity with poor Na^+ and K^+ metabolism as a result and so transport across biomembranes as well as hindered monosaccharide uptake by intestinal epithelia occurs. In diabetes mellitus, hyperglycemia causes glucose induced osmotic diuresis with resultant loss of body fluids and electrolytes. [1]

Hyponatremia is associated with increased plasma glucose concentrations. Higher glucose concentration results in an osmotic force that draws water to the extracellular space. This dilutes extracellular sodium and leads to lower plasma sodium levels. This is why measured sodium levels need to be altered with a correctional factor during hyperglycemic crises. Sodium levels can fluctuate wildly during treatment of hyperglycemic crises due to osmotic diuresis and fluid intake, as well. Many medications commonly used in the management of diabetes result in hyponatremia as well. [2]

Calcium homeostasis plays major roles in insulin resistance and secretion [3]. Calcium homeostasis is impaired in diabetes and contributes to defective cell regulation in erythrocytes, cardiac muscles, platelets and skeletal muscles. The impaired homeostasis is concerning as it could be a significant contributory factor in the regulation of proper insulin secretion and action, also affecting various vascular complications independently [4, 5].

Chloride is an anion found predominantly in the extracellular fluid. The kidneys predominantly regulate serum chloride levels. Most of the chloride, which is filtered by the glomerulus, is reabsorbed by both proximal and distal tubules (majorly by proximal tubule) by both active and passive transport.

Hyperchloremia can occur due to gastrointestinal bicarbonate loss. Hypochloremia presents in gastrointestinal losses like vomiting or excess water gain like congestive heart failure. [6]

OBJECTIVE

The main focus of this study is to determine whether there is a statistically significant difference in mineral status in correlation with HbA1c in children with diagnosed T1DM compared to healthy children.

METHODS

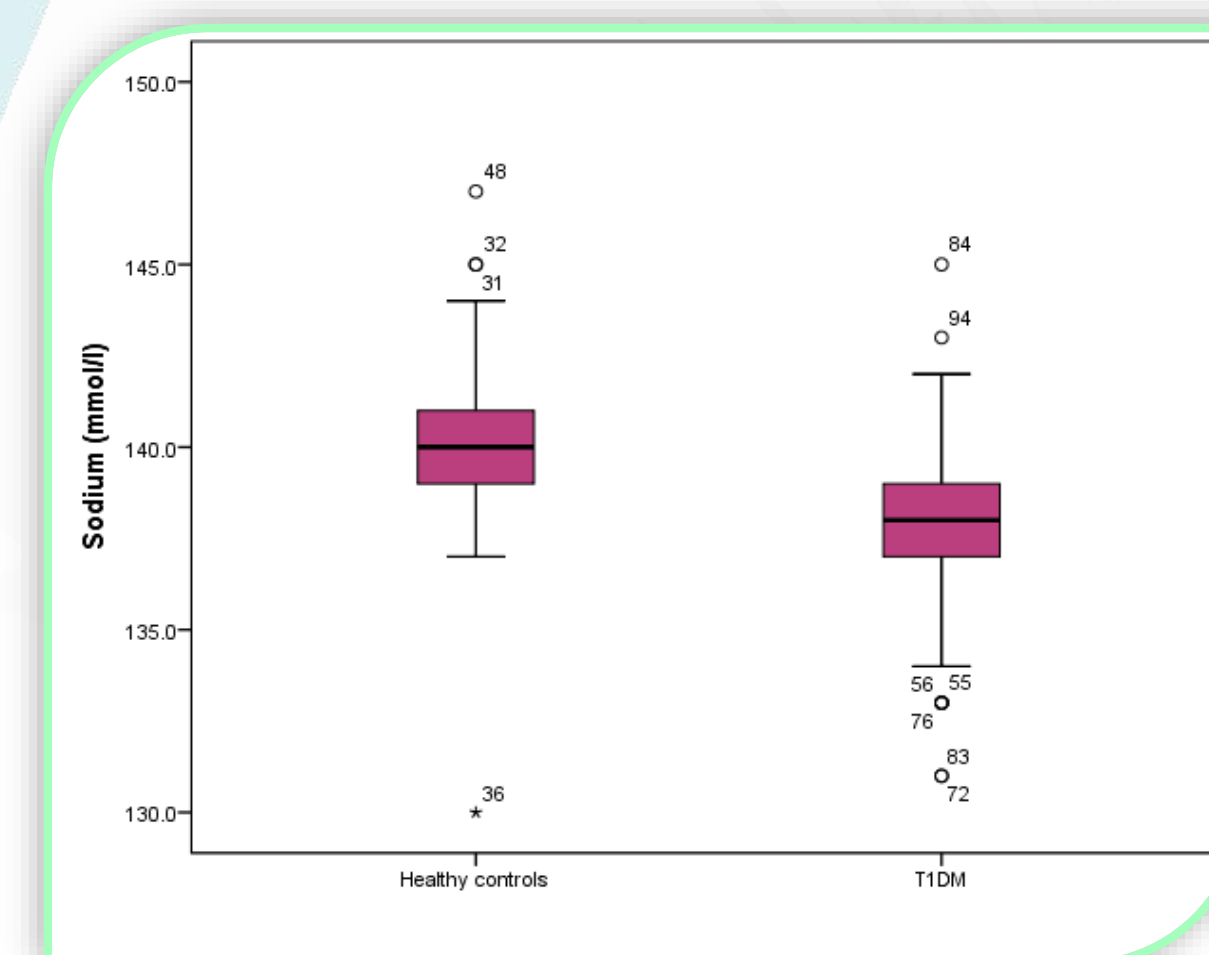
50 children diagnosed with T1DM for more than 6 months and 50 healthy controls, aged 1-10 years, without other underlying conditions were included in the research. Mineral concentrations were determined using indirect potentiometric method with ion-selective membrane electrodes. Total calcium concentrations were determined using the spectrophotometric method with ortho-cresol phthalein. HbA1c was determined by the immunoturbidimetric method. The results were edited with the program IBM SPSS Statistics, ver.23.

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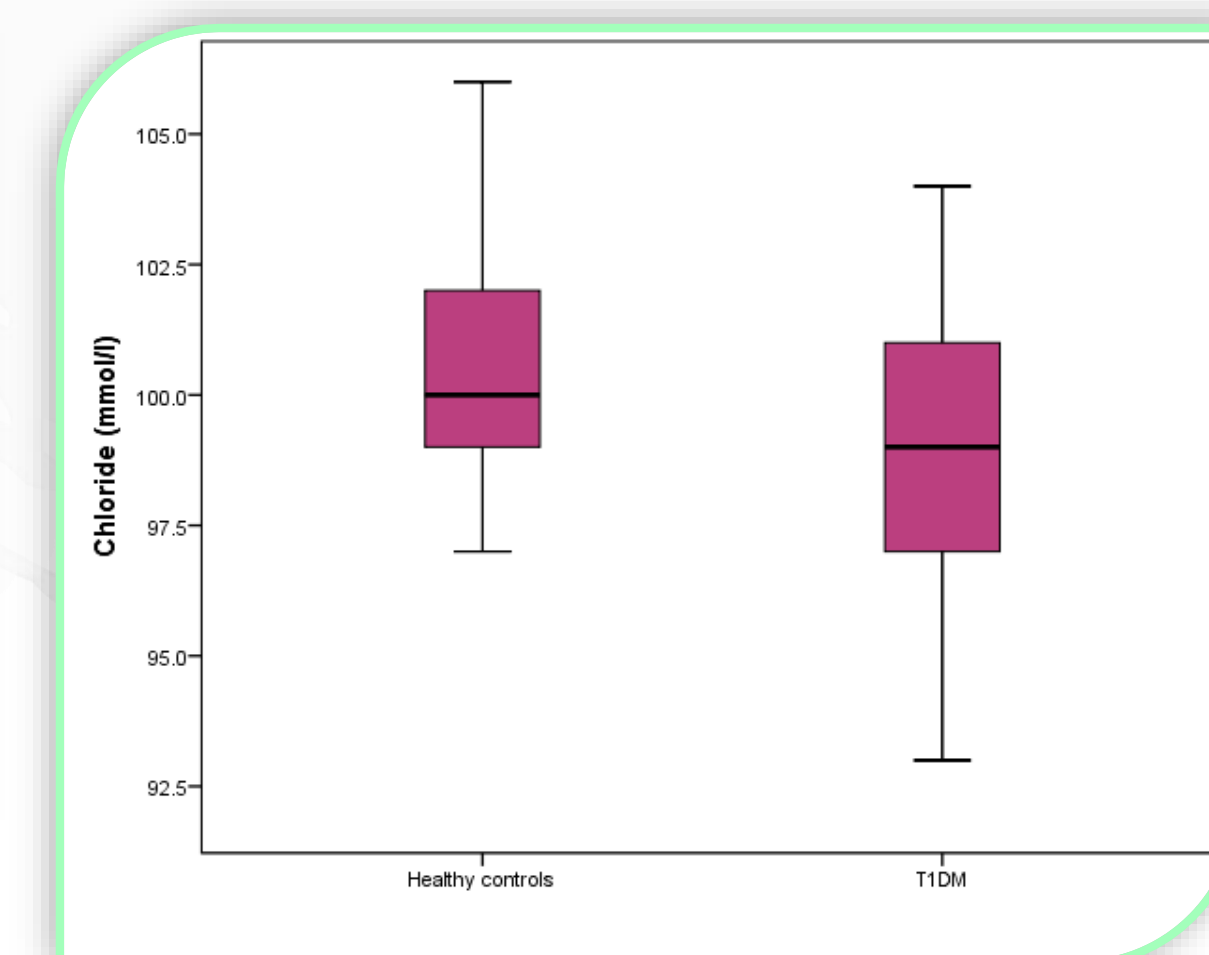
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RESULTS

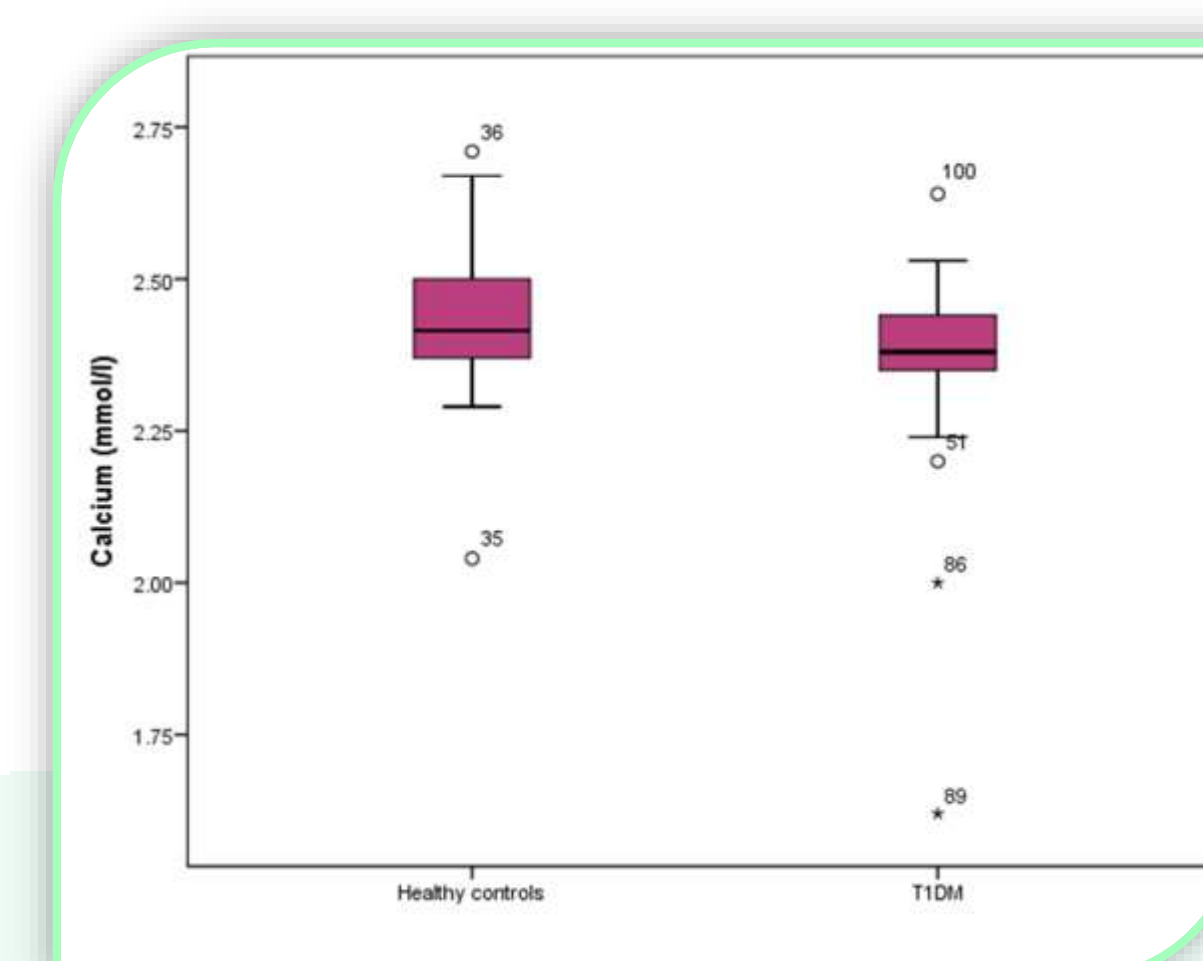
The results of our studies showed statistically lower values of sodium ($p < 0.001$) [Graph 1], chloride ($p = 0.002$) [Graph 2] and calcium ($p = 0.035$) [Graph 3] in patients with T1DM compared to healthy subjects.



Graph 1.



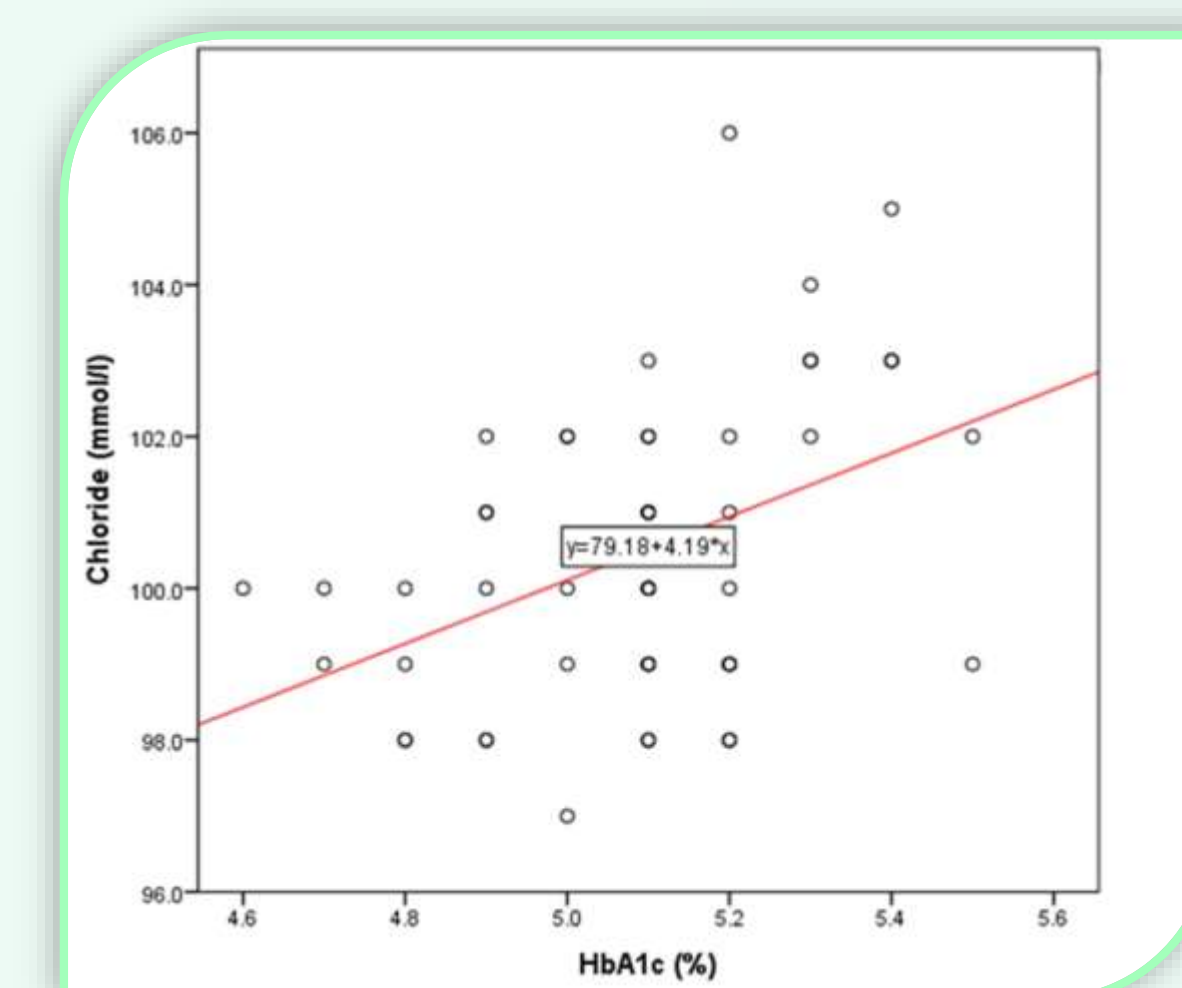
Graph 2.



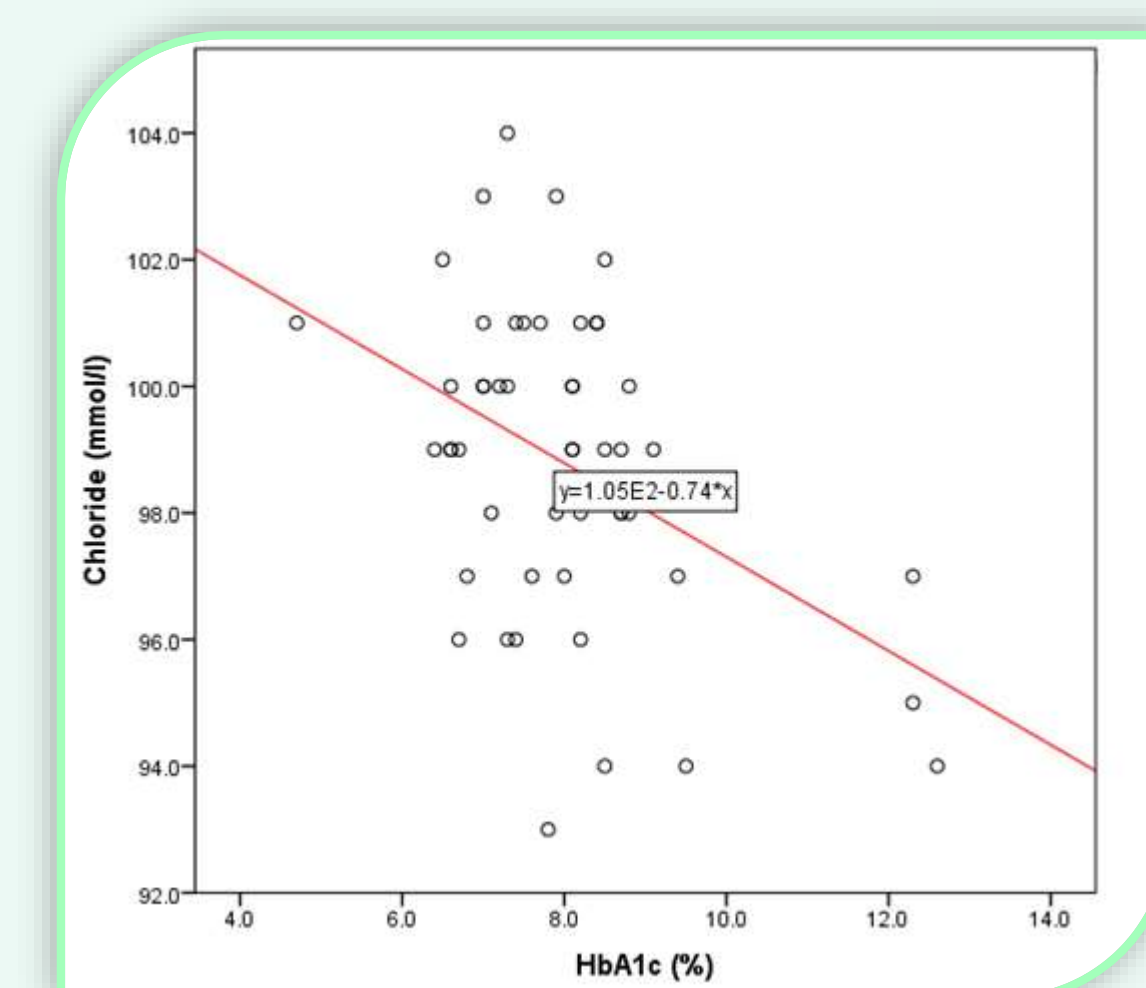
Graph 3.

Also, the correlation results indicated a significant positive correlation of HbA1c with chloride values ($p = 0.002$; $r = 0.423$) in the group of healthy patients. [Graph 4]

While in patients with T1DM the results indicated a negative significant correlation of HbA1c with chloride values ($p = 0.018$; $r = -0.334$). [Graph 5]



Graph 4.



Graph 5.

CONCLUSIONS

Our results indicate significant lower values of sodium, chloride and calcium in T1DM patients compared to healthy subjects of the same age, as well as correlation of chloride and HbA1c, which indicates the importance of monitoring this marker in relation to good control of T1DM in children aged 1-10 years.