

## IMPAIRED SERUM ELECTROLYTES ASSOCIATED WITH NON-ADHERENCE TO DIABETIC MEDICATION

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### ABSTRACT

**Objective:** To find out comparison between impaired electrolytes level and adherence to diabetic medication in diabetic patients. **Study design:** Cross-Sectional and Observational study. **Settings:** Fatima Memorial Hospital and Turab Hospital, Lahore. **Period:** 04-Months. **Material and Methods:** The data was gathered by applying convenient sampling technique from 74 diabetic patients from Fatima Memorial Hospital, Shadman, Lahore and Turab Hospital, Township Lahore, Pakistan. They were undergoing diabetic medication (loosely or strictly). All results of their serum glucose (random) levels, HbA1c levels, serum electrolytes included Na<sup>+</sup>, K<sup>+</sup>, and Cl<sup>-</sup>, clinical history and medical history were documented through a pre-designed proforma. Patients included in this research were, aged between 24 to 90 years, known case of diabetes mellitus whereas non-diabetic persons were excluded from this study. **Results:** Out of 74, 23 i.e., 31.1% patients were strictly adherent with medicine and have controlled diabetes and electrolyte levels, whereas 14 i.e., 18.9% patients were loosely adherent to their medications but 37 i.e., 50% were those who were non-adherent to their diabetic medicine and have uncontrolled diabetes and electrolytes levels. **Conclusion:** Electrolytes imbalance were a major problem in diabetic patients who didn't take diabetic medicines properly have life-threatening complications. It was statistically observed that low level of sodium and chloride significantly occurred whereas the level of potassium were significantly higher in them.

**Keywords:** Diabetes Mellitus, Diabetes Complications, Electrolyte Balance, Hyperglycemia, Medication Adherence.

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## INTRODUCTION

One of the most potentially serious issue of the twenty-first century is diabetes. The most indicating factor were observed in WHO Survey is that the amount of diabetes in Low- and Middle-income nations would rise by 67% from 2014 to 2030. Diabetes complications are the primary risk factor for premature death globally, with one death in every six seconds<sup>18</sup>. Hyperglycemia causes impairment of cellular function and growth factor activity and may the expression of genes that eventually increase the extracellular matrix which makes toxic compounds that can lead to cell damage and one of the toxic products

is increases transforming growth factor (TGF)- $\beta$ .14, it also inhibits the production of collagenase enzyme, which reduces extracellular matrix<sup>10</sup>. The second national diabetes survey of Pakistan (NDSP) was undertaken in all four provinces of Pakistan, throughout February 2016 till August 2017. According to this report, Diabetes was found in 28.3% of urbanites and 25.3% of rural population, respectively, whereas 14.4% of the population was affected in pre-diabetic state. In this study, it was observed that the risk factors for diabetes mellitus was high for age above 43, person having family history of diabetes, chronic hypertension, obesity, and dyslipidemia<sup>3</sup>. In 2019,

463 million of individuals (20-79 years) have diabetes worldwide; by 2045, this number will have risen to 700 million. In most nations, the number of persons with type 2 diabetes is rising. 1 in 5 individuals over 65 years old have diabetes, 1 in 2 (232 million) people with diabetes remain undiagnosed. Type 1 diabetes mainly affects more than 1.1 million children and adolescents<sup>16</sup>. Insulin activates the arginine-vasopressin-dependent expression of aquaporin-2 in the renal collecting duct, which may enhance the hydro-osmotic effect of vasopressin in response to other stimuli as circulating levels are increased. Insulin therapy may be the primary cause for the elevated level of potassium, because during therapy, potassium passes from cell membrane with glucose and remains inside the cell. Due to diffusion potassium from cells moves out and sodium moves inside the cells and may be triggered by electrical gradients, trans-membrane. By the use of  $\alpha$ -2-adrenergic receptors, insulin and catecholamine activates the pump which changes the concentration of potassium in serum<sup>2</sup>.

In diabetes mellitus, Hyponatremia caused by increased renal absorption and decreased renal excretion, serum elevation occurs and causes shifting of electrolytes from cells to extracellular fluid and its vice versa<sup>15</sup>, the hyponatremia in diabetic patients might be caused by osmotic diuresis<sup>11</sup>. Hyperkalemia can be categorized as mild, moderate, or severe depending on the quantity of potassium in the blood<sup>5</sup> and can cause critical medical conditions like muscular weakness, paralysis, and cardiac arrhythmias, as well as an increased risk of death<sup>13</sup>. Respectively, Chloride is a minor element that acts as a "passive partner" to sodium. Recent research shows that hyperchloremia might cause metabolic acidosis, which has been linked to negative consequences<sup>6</sup>. It is most common complications of diabetes regarding diabetic ketoacidosis (DKA)<sup>1</sup>. These disturbances are accompanied by dehydration and electrolyte abnormalities<sup>7</sup>. Hyperkalemia is a metabolic problem which results as electrophysiological disturbances with serious clinical consequences

which can be fatal<sup>4</sup>. In a recent retrospective research, patients with hyperkalemia had greater risks of hospitalization and mortality than those with hypokalemia. It also showed that the usage of Renin-angiotensin-aldosterone system (RAAS) inhibitors and the patients' initial GFR were linked to the development of hyperkalemia<sup>9</sup>.

In the comparison of Type 1 and Type 2 diabetes, 20 to 30 percent of diabetic patients have showed diabetic nephropathy. In diabetic patient with tight glycemic control (TGC), it was found to be advantageous in terms of better therapeutic success. TGC decreases the likelihood of problem in another organ in type-II DM patients<sup>12</sup>. One of the major causes of cardiovascular death is Diabetes Mellitus (DM) with inadequate glycemic control. The goal of treatment is to achieve a blood glucose level that is close to normal, as well as to control other co-morbid diseases including obesity, hypertension, and dyslipidemia<sup>12</sup>. This study was aimed to find out comparison between impaired electrolytes level and non-adherence to diabetic medication in diabetic patients.

## MATERIALS AND METHODS

It was cross-sectional and observational study conducted by collecting data of 74 random diabetic patients through convenient sampling technique, at Fatima Memorial Hospital and Turab Hospital, Lahore, who have been taking diabetic medication i.e., loosely or strictly. The duration of the research was 04 months. We have applied all basics Precautionary measures, due to pandemic of COVID-19 during our data collection period. we directly contacted with patients to take their interviews by using a study questionnaire, based on 20-questions, which were verbally or directly handed to patients by which their serum glucose Random, HbA1c level and serum electrolytes including Sodium  $\text{Na}^+$ , Potassium  $\text{K}^+$ , Chloride  $\text{Cl}^-$ , and medical history all these parameters have been recorded. Patients included in this research were 24 to 90 years old, known case of diabetes mellitus whereas non-diabetic persons were excluded in this study. The data was analyzed by using standard SPSS software version-25.0. Pearson correlation

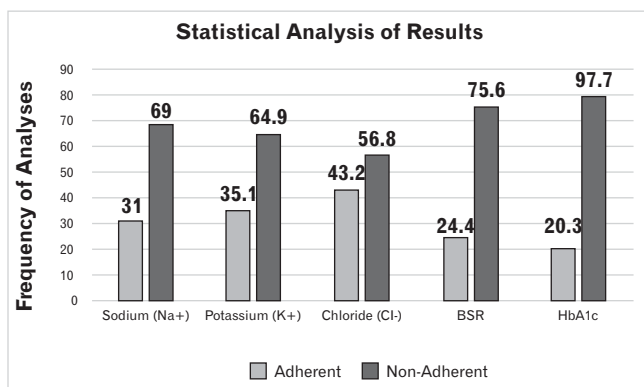
coefficients used to determine the relation between continuous variables. The p-value <0.05 was considered as statistically significant.

The informed consent i.e., verbal and written, was taken from each patient before taking their history and their recorded data was not shared with any staff. Patient's names and personal information was not collected as to maintain the confidentiality policies.

## RESULTS

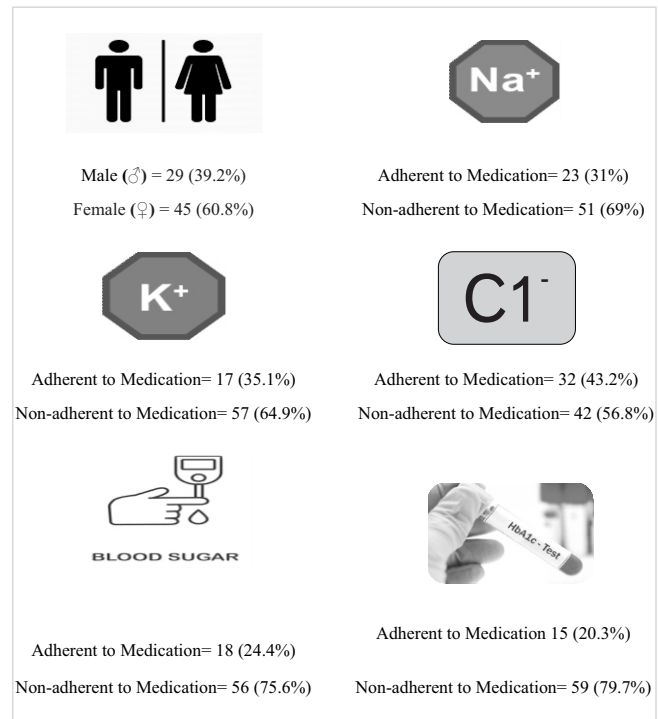
Out of 74 patients, 23 i.e., 31.1% were those strictly adherent with their medicine so they have controlled diabetes and electrolyte levels, whereas 14 i.e., 18.9% patients were loosely adherent to their medications but 37 i.e., 50% were non-adherent to their diabetic medicine and have uncontrolled diabetes and electrolytes level.

We assessed the dysregulation of serum electrolytes in diabetic patients with relation to their anti-diabetic medications. Among 74 patients, 23 i.e. 31% have controlled Sodium Na<sup>+</sup> level, 17 i.e. 35.1% have controlled Potassium K<sup>+</sup> level, 32 i.e. 43.2% have controlled Cl<sup>-</sup> level, 18 i.e. 24.4% have controlled random blood glucose level and 15 i.e. 20.3% have controlled HbA1c level who were strictly adherent to diabetic medication. On the other hand, 51 i.e. 69% have un-controlled Na<sup>+</sup> level, 57 i.e. 64.9% have uncontrolled K<sup>+</sup> level, 42 i.e. 56.8% have uncontrolled Cl<sup>-</sup> level, 56 i.e. 75.6% have uncontrolled blood sugar random



level and 59 i.e. 79.7% have uncontrolled HbA1c level which were non-adherent to diabetes medication. All of these indicators were considered because they deviate markedly i.e.,

high or low, in diabetes mellitus patients who do not adhere to their medications.



## DISCUSSION

In recent research, we observed a study in which, it was concluded that the sodium and chloride levels were significantly low in diabetic patients while potassium level were higher in diabetic patients<sup>14</sup>. Similarly, another research concluded that electrolyte imbalances in diabetics may have a lot of potential as a diagnostic tool in clinical practice<sup>8</sup>. Electrolyte imbalance increases the chance of acquiring a variety of illnesses. Furthermore, for the prevention and treatment of problems in diabetes mellitus, early diagnosis, excellent glycemic control, and dietary changes are typically sufficient. A correlation of diabetic patient with serum electrolytes imbalance occurs due to increase of blood sugar level with osmotic imbalance show significant result as its p-value is 0.05. So, it is showing that about 62.6% of patients have electrolytes imbalance due to hyperglycemia<sup>2</sup>. This study reveals that, if patient was non-adherent to diabetic medication, water moves outside of the cells into the extracellular spaces as a result of hyperglycemia (high blood sugar) and depleting sodium. The body eliminates the fluid by urinating more frequently,

causing other electrolytes like chloride and potassium to become imbalance. In some patients it was noticed that if they didn't follow proper diet plan for diabetes but they were adherent to their medicine consciously and also doing proper exercise (walk/cardio), it helped in normal blood sugar level and electrolyte balance.

## CONCLUSION

Electrolytes imbalance were a major problem in diabetic patients who didn't take diabetic medicines properly have life-threatening complications. It was statistically observed that low level of sodium and chloride significantly occurred whereas the level of potassium were significantly higher in them.

## Conflict of interest

There is no conflict of Interest to declare.

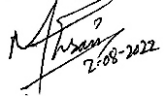


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**AUTHORSHIP AND CONTRIBUTION DECLARATION**

Sr. #	Author's Full Name	Contribution to the paper	Author's Signature
1	Muhammad Ahsan	Literature search, Concept, Data collection and Study Design	
2	Faraz Ahmed	Data collection, Study Design Sequencing and Drafting of Manuscript	
3	Abubakar Imran	Design of Questionnaire and concept of study	
4	Sajida Munir	Data analysis and interpretation	