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# Urea and electrolytes disorders in the blood of Zaria people, Nigeria

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**ABSTRACT**

Disorder of urea and electrolytes is a potential health hazard. However, the determination of these parameters in human blood was neglected by laboratories in many hospitals. Here, standard methods and procedures adopted by World Health Organization (WHO) were used to determine percentage disorders from the amount of urea and electrolytes obtained in human blood of patients attending department of chemical pathology, Ahmadu Bello University teaching hospital, Shika, Zaria. Out of one hundred and thirty (130) blood samples, 48(36.92%) were significantly positive. It was found that disorders increased with age, with percentage disorders of 30.76% among those aged 35-54 years. The disorder has no any gender difference but it varies significantly among patients with kidney and heart problems (29.92%). The determination for amount of urea and electrolytes in human blood using the standard methods adopted by WHO is therefore necessary for early diagnosis.



## Introduction

Urea or carbamide is an organic compound with the chemical formula $CO(NH_2)_2$. The molecule has two —$NH_2$ groups joined by a carbonyl (C=O) functional group. Urea serves an important role in the metabolism of nitrogen-containing compounds by animals and is the main nitrogen-containing substance in the urine of mammals. It is solid, colourless, and odourless (although the ammonia that it gives off in the presence of water, including water vapour in the air, has a strong odour). It is highly soluble in water and practically non-toxic (LD50 is 15 g/kg for rat). Dissolved in water, it is neither acidic nor alkaline. The body uses it in many processes, the most notable one being nitrogen excretion. Urea is widely used in fertilizers as a convenient source of nitrogen. Urea is also an important raw material for the chemical industry. The synthesis of this organic compound by Friedrich Wöhler in 1828 from an inorganic precursor was an important milestone in the development of organic chemistry, as it showed for the first time that a molecule found in living organisms could be synthesized in the lab without biological starting materials.

The normal whole blood urea throughout adult life increase with age, urea diffuses freely through all the body fluids and the same concentration is found in all body fluids. The plasma (or serum) urea level is about 8 percent higher than the blood urea nitrogen (BUN), the normal BUN being 7-20 mg/100ml and about half of urea is nitrogen (De fronze, 1982). It was reported that 356 patients out of 5000 patients with renal failure were found to have high level of urea in their blood serum and most of them were in the age group 30-40 years (WHO, 2000; 2003).

The handling of urea by the kidneys is a vital part of human metabolism. Besides its role as carrier of waste nitrogen, urea also plays a role in the counter current exchange system of the nephrons, that allows for re-absorption of water and critical ions from the excreted urine. Urea is reabsorbed in the inner medullary collecting ducts of the nephrons, thus raising the osmolarity in the medullary interstitium surrounding the thin ascending limb of the loop of Henle, which in turn causes water to be reabsorbed. By action of the urea transporter 2, some of this reabsorbed urea will eventually flow back into the thin ascending limb of the tubule, through the collecting ducts, and into the excreted urine (Marsh et al., 2005). This mechanism, which is controlled by the antidiuretic hormone, allows the body to create hyperosmotic urine, that has a higher concentration of dissolved substances than the blood plasma. This mechanism is important to prevent the loss of water, to maintain blood pressure, and to maintain a suitable concentration of sodium ions in the blood plasmas.

Chemically, electrolytes are substances that become ions in solutions and acquire the capacity to conduct electricity present in the body and the balance of electrolytes in our bodies is essential for normal function of our cell. Common electrolytes that are measured by laboratory scientist and researchers in medical laboratories include sodium, potassium, chloride and bicarbonate (Baron, 1993). De fronze (1982), described electrolytes as body fluid containing number of ions or electrically charged particles formed by the dissociation of electrolyte. An electrolyte can be defined as compound which dissociates in water or other ionize in solution to give ions (De fronze, 1982). Typically, test for electrolytes measures the levels of sodium, potassium, chloride and bicarbonate in the human blood.

In Ahmadu Bello University teaching hospital Zaria, Nigeria in general as in other developing countries, the high level of occurrence of kidney disorder and heart failure lead to the establishment of chemical pathology laboratory. It is among those available in each of the six geographical zones of Nigeria that help in early diagnosis of many blood disorders such as impaired nutrient absorption, malnutrition, dehydration and

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acute-myocardial infection. The long standing concern about kidney disorder and heart failure infections has over-shadowed the fact that other diseases particularly malnutrition, dehydration, acute myocardial infections and impaired nutrient absorption are cause by increase or decrease of urea and electrolytes level of blood components (Wamsley, 1984).

Electrolytes play a vital role in maintaining homeostasis within the body. They help to regulate myocardial and neurological function, fluid balance, oxygen delivery, acid-base balance and much more. Electrolyte imbalances can develop by the following mechanisms: excessive ingestion; diminished elimination of an electrolyte; diminished ingestion or excessive elimination of an electrolyte. The most common cause of electrolyte disturbances is renal failure.

The most serious electrolyte disturbances involve abnormalities in the levels of sodium, potassium, and/or calcium. Other electrolyte imbalances are less common, and often occur in conjunction with major electrolyte changes. Chronic laxative abuse or severe diarrhea or vomiting (Gastroenteritis) can lead to electrolyte disturbances along with dehydration. People suffering from bulimia or anorexia nervosa are at especially high risk for an electrolyte imbalance.

Electrolytes are important because they are what cells (especially nerve, heart, muscle) use to maintain voltages across their cell membranes and to carry electrical impulses (nerve impulses, muscle contractions) across themselves and to other cells. Kidneys work to keep the electrolyte concentrations in blood constant despite changes in your body. For example, during heavy exercise, electrolytes are lost in sweat, particularly sodium and potassium. These electrolytes must be replaced to keep the electrolyte concentrations of the body fluids constant.

This paper reports the percentage disorders from the amount of urea and electrolytes obtained in human blood, studied the basic information about other diseases caused by disorders of urea and electrolyte other than kidney and heart failure and also appreciate the importance and application of chemistry knowledge in human health determination.

**Experimental**

**Oral Data Collection and Blood Sampling**

Data was collected by oral interview and laboratory analysis. The oral interview method was chosen because it allows people to express their feelings which are helpful in drawing appropriate conclusions and recommendations. The random sampling method was used and the number of respondents includes people that have formal and non formal education (see Table 1). Blood samples were drawn from patients in the ward, members of family affected, co-workers and health students.

**Determination of Serum Urea**

Diacetyl monoxime method was used as reported by Silverton (2001) because it is accepted by WHO. The principle is that, when urea is heated in strongly acidic condition with substances such as diacetyl (containing two acetyl carbonyl groups) yellow condensation compounds are formed, the reaction is intensified by the presence of polyvalent ions such as ferric ions and then a red colored complex is formed which is more linear with concentration more than the yellow one. The intensity is proportional to the concentration of the urea in sample. The diacetyl monoxime method has usually been used because of its greater stability (Silverton, 2001).

**Determination of Serum $Na^+/K^+$**

Flame photometry method was used for the determination of both sodium and potassium serum as reported by Silverton (2001).

**Determination of Serum Chloride**

Titrimetric method was used for the determination of serum chloride as reported by Silverton (2001). It works on the principles that, when mercuric chloride reacts with the chloride in the serum solutions, mercuric chloride is formed on titration. At the end point, excess mercuric ion reacts with diphenyl carbozone (indicator) to give a violet blue colored complex.

**Determination of Serum Bicarbonate**

Back-titration was used to determine the amount of serum bicarbonate by the amount of sulphuric acid that neutralizes sodium hydroxide as reported by Silverton (2001).

**Results and discussion**

The results of the study are presented in Tables 2 to 8. Of the one hundred and thirty samples from patients' blood serum examined for urea and electrolytes, 48(36.9%) were significantly positive according to WHO standard.

The result as presented in Table 2 showed that the incident of disorders of urea and electrolytes has no much significant difference between males and females which indicates that there is no gender variation and that genetic structure of male and female has not contributed. The result shows that in males out of 87 males samples examined 30 are diagnosed positive rating 23% of disorders while in female out of 43 samples 18 diagnosed positive with 13% disorders, which indicated that out of 43 sample of female 25 are normal but in male 57 are normal. It could be observed that, people aged 35 years and above showed the highest level of disorders, majority of which are also married (Tables 3 and 5).

Results from Table 4, 6 and 8 revealed that, the people with high standard of living such as standard medical attention, well educated, high work employment, high socio-economic status and controlled diet among others were less exposed because they acquire more proper medical care and adequate medical facilities. Only 30 people out of 130 are well employed but 100 peoples are either manual skills or unemployed. The results also showed that people with low standard of living are more expose to the disorders due to improper medical attention, poor sanitation, lack of dietary control because they only need food in order to survive even their normal diet is a problem lack wise to control their diet and lack of education and employment which serve as a major problems that help to increase the rate of disorders.

Result from Table 7 shows that not only kidney and heart diseases are responsible of causing disorders of urea and electrolytes, but there are some diseases such as lipoma impaired nutrient absorption syndrome, dehydration and myocardial impaction this is because the samples collected from patients having such diseases in their clinical history but do not have kidney and heart problems shows positive result to urea and electrolytes disorders. It also shows that some of the sign and symptoms of the kidney and heart disorders occurred in some other diseases which caused significant increased in disorders of urea and electrolytes. The result also shows that out of one hundred and thirty (130) samples investigated, forty eight (48) were positive to disorders, of which 30 are males and 18 are females. Smith (2000) in his publication reported that diarrhoea and vomiting, myocardial infection and impaired nutrient absorption syndrome affect the amount of urea and electrolytes

in human blood. An increase in bicarbonates levels in blood is an indication of developing ulcer of the stomach and also an excessive increase in urea levels indicate kidney disease which leads to kidney damage while increase in electrolytes indicates heart disease which leads to the heart failure (Ama, 1968; Leonard, 2001; Henry, 2003; Walter, 2010).

The result of the investigation further shows that amount of urea and electrolytes can be determined in the blood serum, indicating that chemistry is a very wide subject that include every aspect and is useful in human health determination, it is also show that present of element and compound such as urea, potassium, chloride and bicarbonate in human body play a vital role in carrying out most of the chemical reaction in the body and also help to maintain certain changes that will cause health problems in the body such as acid-base balances. It also shows that, blood contain certain chemicals, element and compound and serve as a media of transporting them to various parts of the body (Black, 1966; Charles, 1966; Jackie and Thomas, 2007).

**Conclusion**

From the study, it was understood that people with low standard of living are at greater risk of disorder of urea and electrolytes than those with higher standard of living. There is also high rate of disorders with people having kidney, renal failure, heart failure and also high among other diseases such as diarrhoea and vomiting, impaired nutrient absorption syndrome, myocardial infection and lack of diet control also increase the rate of disorders. This is because people that controlled their diet properly especially excess protein and salt are more resistance and immune to the disease cause by urea and electrolytes disorders.

The outcome of the study further emphasized that, urea $(NH_2)_2CO$,and electrolytes ($Na^+$, $K^+$, $Cl^-$ and $HCO_3^-$) are essential for human life by playing important role in carrying out chemical change and reaction in the body fluids and also there is need to regulate their amount or content in human body for betterment of health. It was found that the disorder is high in old age and also occurred in male and female without any gender difference. It was also understood that the chemistry of urea and electrolytes is wide not only restricted in the fertilizer and other raw material but to the human life and human medicine. Similarly, in human blood there are many elements, ions, radicals and compounds deposited to carryout different functions. The blood as a sample serves as a media for transporting urea and electrolytes to their function unit area. Regular medical check-up, dietary control, early diagnoses among others will play an important role in decreasing the rate of disorders.

**References**

Amer. D.K. (1968). The symposium on urea. Cambridge university press, page 196-280.

Baron D.N (1993). (Department of chemical pathology Hospital school London) the clinical chemistry, cambridge university press, page 308-778.

Black A.K. (1966). Renal disease 2nd edition, published by scientific publication limited oxford, page 106 -126

Charles W. (1966) Renal Tubular Dysfunctions, volume 1, pages 230 -650.

De fronze A.J. (1982) the chemical analysis of disorder of hyper kalaemia annual medicine review, foundation Book new Delhi, page 82-96.

Henry A.J. (2003). Annual Review of medical science volume 1 page 80-105 published by manas siakia Global limited, Chennai

Jacki B. and Thomas, B. (2007). Manual of Dietetic Practice. Wiley-Blackwell. ISBN 1-4051-3525.

Leonard, J.V (2001) The nutritional management of urea cycle disorders. The Journal of Pediatrics, 138, 1, S40-S45.

Marsh, K. L., Sims, G. K.and Mulvaney, R. L. (2005). Availability of urea to autotrophic ammonia-oxidizing bacteria as related to the fate of 14C- and 15N-labeled urea added to soil. Biol. Fert. Soil. 42:137-145.

Silverton B. (2001). Introduction to medical laboratory technology page 5-178 published by Bounty Press Limited.

Smith W.E. (2000). Chemical disorder of hyperkalamia page 87-120 ISBN 81-7596-156-2 Paper Back

Walter F. B (2010). Medical Physiology: A Cellular And Molecular Approach. Elsevier/Saunders. ISBN 1-4160-2328-3, Page 837.

Wamsley J.(1984). Disorders of fluid and electrolytes balances volume 2 8o-92

World Health Organization (2000). The renal and heart disorders report

World Health organization (2003). Disease and control in Africa, volume 2, p 833-950.

**Table 1: Pattern of oral interview**

| S/no. | Area | Number of people interviewed |
|---|---|---|
| 1 | Out patients (attending) | 70 |
| 2 | In ward patients | 20 |
| 3 | Members of family affected | 20 |
| 4 | Co-workers | 10 |
| 5 | Health students | 10 |
| | Total | 130 |

**Table 2: Sex distribution of the respondents**

| S/no. | sex group | number of people examined | number of people with disorders | % of people with disorder |
|---|---|---|---|---|
| 1 | Male | 87 | 30 | 23.08% |
| 2 | Female | 43 | 18 | 13.85% |
| | Total | 130 | 48 | 36.92% |

**Table 3: Age patterns of the respondents**

| Age group | number of people examined | number of people with disorders | % of people with disorders |
|---|---|---|---|
| 20-24 | 8 | 3 | 2.31% |
| 25-29 | 7 | 2 | 1.54 % |
| 30-34 | 14 | 3 | 2.31 % |
| 35-39 | 20 | 9 | 6.92 % |
| 40-44 | 36 | 12 | 9.23 % |
| 45-49 | 29 | 11 | 8.46 % |
| 50-54 | 16 | 8 | 6.15 % |
| Total | 130 | 48 | 36.92% |

**Table 4: Occupational status of the various respondents**

| Group | number of people examined | number of people with disorders | % of people with disorders |
|---|---|---|---|
| Unemployed | 60 | 25 | 19.23% |
| Manual skill | 40 | 15 | 11.53% |
| Private workers | 20 | 5 | 3.84% |
| Civil servant | 10 | 3 | 2.30% |
| Total | 130 | 48 | 36.92% |

**Table 5: Marital status of the respondents**

| Group | number of people examined | number of people with disorders | %of people with disorders |
|---|---|---|---|
| Married | 80 | 35 | 26.92% |
| Divorced | 10 | 3 | 2.30% |
| Single | 20 | 5 | 3.84% |
| Widow | 20 | 5 | 3.84% |
| Total | 130 | 48 | 36.92% |

**Table 6: Educational status of the respondents**

| Group | number of people examined disorders | number of people with disorders | %people with disorders |
|---|---|---|---|
| No formal education | 60 | 20 | 15.38% |
| Primary | 40 | 15 | 11.53 |
| Secondary | 20 | 10 | 7.69% |
| Tertiary | 10 | 3 | 2.30% |
| Total | 130 | 48 | 36.9% |

**Table 7: Clinical history of the respondents**

| Group | number of people examined | number of people with disorders | %people with disorders |
|---|---|---|---|
| Renal disorders | 70 | 28 | 21.53% |
| Heart diseases | 30 | 10 | 7.69% |
| Diarrhoea and vomiting | 15 | 3 | 2.30% |
| Myocardial disorders | 10 | 3 | 2.53% |
| Emergency septic shock | 5 | 2 | 1.53% |
| Total | 130 | 48 | 36.92% |

**Table 8: Dietary consumption distribution pattern**

| Group | number of people examined | number of people with disorders | %of people with disorders |
|---|---|---|---|
| Normal diet | 80 | 40 | 30.76% |
| Controlled diet | 40 | 5 | 3.84% |
| Salt free | 10 | 3 | 2.30% |
| Total | 130 | 48 | 36.9% |