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Serological Evaluation of Staff Potassium Contents of Ogun State Polytechnic of Health and Allied Sciences, Nigeria

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Abstract:** Potassium inadequate and heart status with other diseases may present clinical indications from asymptomatic electrolyte disorder to heart-abnormal beating and heart attack. Blood K+ concentrations are within the limits of 3.5 to 5.5 mmol /L, but plasma concentrations are within 3.2-5.1 mmol/L. Clinical manifestations of mild to moderate hyperkalemia are usually non-specific and may include generalized weakness, paralysis, nausea, vomiting and diarrhea. Most studies solely examine a critically ill patient population, but it is of concern to know if such outcomes are present in the general population. This study aimed to evaluate the staff potassium contents of Ogun State Polytechnic of Health and Allied Sciences, Ilese- ijebu, Nigeria. Blood samples were collected from one hundred (100) staff into disposable sample bottles and then analyzed for potassium level. The study identify that the population has serum potassium concentration<3.5mmol/l. And, 66.7(66.7%) have serum potassium concentration between 3.5–5.5mmol/l with mean potassium values 4.825±3.69, however, 33.3(33.3%) of the study population have serum potassium concentration > 5.5mmol/l with mean value 6.256±1.48. The mean differences obtained were statistically significant (p<0.05).

***Keyword:** Blood, Clinical Manifestations, Hyperkalemia, and Potassium Concentration.*

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1. INTRODUCTION

Potassium cellular concentration is essential in controlling plasma membrane ability, cellular multitask and metabolic equilibrium [1], [2]. Blood potassium irregularities such as excess potassium or deficiency in potassium are usual clinical issues [3], [4], with occurrence as high as 48% of persons hospitalized [5]. Potassium inadequate and heart status with other diseases may present clinical indications from asymptomatic electrolyte disorder to heart-abnormal beating and heart attack [3].

The high amount of potassium from food is absorbed in the small intestine. Visceral potassium content is by the difference in dietary intake and renal excretion. Potassium is mainly passed- out through urination; the remaining is by faeces and rarely in sweat. According to Kovesdy [6], urinary potassium excretion determined by 24-h urine collection of adults in a population is considered a trusted biomarker.

Urso et al. [7] have shown the impact of potassium measures on patient outcomes and death rates. Krogager et al. [8] reported that hyperkalemia and hypokalemia are predominantly related to the high in-patient death rate in the general population. And patients with the heart-related disease, irregular admission blood potassium levels are associated with the raised threat of ventricular arrhythmias [9]

Potassium has a chemical element denoted letter K and atomic number 19, a soft metal with a silvery-white colour. It is reactive with an oxygen-forming flake of potassium peroxide in a flash of exposure and is primarily detected from ashes of plants and potash, as named [10]. As placed in the periodic table, potassium is an alkali metal with one electron valence on the outer electron shell, easy to bond with anions to form salts. Potassium exists only in ionic salts, strongly reactive with water, combusting with lilac shade flame, and producing enough heat that generates hydrogen. Sea water contains dissolved 0.04% potassium by weight [11]. K+ is about 2.4 % mass of the Earth's crust, an abundant and highly reactive alkali metal, with an atomic mass of 39.1 Da, and occurs only in one oxidation state. Potash is readily oxidized, a high reducing agent and is found as salts. Potassium compounds dissolve quickly in water [12]. There are three isotopes of potassium, stable isotope 39K, an abundance of 93.3%; 41K abundance of 6.7% and the radioactive isotope 40K, an abundance of 0.01%, with a half-life of $1.251 * 10^9$ years, responsible for most common radioactivity in the body [13], [14].

Potassium influences the regulation of acid-base equality [15]. The enzyme Na+/K+-ATPase is responsible for a rigid equilibrium control of plasma potassium concentrations. As such, K+ concentration within the cell is about 30 folds higher than the plasma and interstitial fluid. The potassium concentration gradient is crucial for the electrical activity transmittance in the nerve fibres; muscle cell has noted by Bailey et al., [16], [15], the concentration gradients in the cellular potassium levels have resultant effects on neural transmission, muscle contraction and vascular tone. Potassium movement through the endothelial cell membrane and vascular smooth muscle cells has impacted their contractile state, which may regulate endothelial performance, blood flow and pressure [17]. The kidney's excretion of sodium is by potassium concentration in its duct system, cell- membrane concentration regulation is a factor for both electrolytes and fluid homeostasis, as, blood pressure stability [16], [15].

Distinct K channels are responsible for some secretions, protein breakdown and uptake, carbohydrate breakdown and uptake, etc. Potassium has a co-factor in many enzymes, including glycerol dehydrogenase, ATPase's, pyruvate kinase, mitochondrial pyruvate carboxylase, etc. [18], [19].

The small intestine is where most dietary potassium is taken up through electrochemical gradient stimuli [20], [16] water-uptake sensitizes the movement of potassium through the intestinal mucosa. While in the ileum, the electrical potential difference of the epithelial creates the potassium movement. Potassium assimilation in the small intestine may be linked to the H+/K+-ATPase present in the apical membrane [21]. about [22] potassium excretion through apical channels, where reabsorption of sodium through epithelial sodium channels, and potassium reabsorption takes place in the colon through the activity of luminal H+/K+-ATPase's, which is essential in potassium deficiency.

Blood K+ concentrations are within the limits of 3.5 to 5.5 mmol /L, but plasma concentrations are within 3.2-5.1 mmol/L variation in potassium usage in clot formation [23]. Homeostasis is the regulation of blood potassium concentration in a small margin, even if the dietary potassium supply is a big difference [24], [25], [15]. The majority of total cellular potassium is in the cells, making potassium the most intracellular positive ion muscle contains seventy per cent, and bone, liver, skin, and red blood cells contain less [26]. Visceral potassium is approximately 85 per cent exchanged speedily, and the exchanges with red blood cells and brain pools are less rapid [27]. Both intracellular and extracellular potassium concentrations are within a narrow range. Potassium concentration spikes after a meal; the plasma concentration is with fast cellular uptake [28], [25]. The sodium and potassium adenosine triphosphates act in the movement of sodium and potassium in and out of the cell against electrochemical gradients [29].

Potassium is one of the important minerals in the human diet; it is present in all-natural foods, such as starchy tubers, vegetables, fruits, whole grains, dairy products and coffee and is the most abundant intracellular cat-ion in the body [30]. Potassium is known to be the most common osmotic active element in cells. Together with sodium and chloride, they are characteristic of the extracellular fluid; potassium contributes to osmolality and plays a preeminent role in the distribution of fluids inside and outside cells. Potassium also involved in the regulation of the acid-base balance [15]. The disparity in potassium and sodium concentrations in the cell membranes are being managed by the specific permeability of membranes to each of these ions, and Na+/K+- ATPase activity, which pumps sodium out of and potassium into the cells [16], [15].

Deficiency in Potassium is termed hypokalemia, and, defined as a serum potassium concentration lower than 3.5 mmol/ L [31]. Deficiency is perhaps caused by increased potassium losses through body fluids resulting to low total body potassium [32], [33]. Hyperkalemia most times is presented without symptom but investigation is carried out when conduction abnormalities is observed using electrocardiogram 34]. Clinical manifestations of mild to moderate hyperkalemia are usually non-specific and may include generalized weakness, paralysis, nausea, vomiting and diarrhea [31]. Severe hyperkalemia may lead to life-threatening cardiac arrhythmias [34]. The extent of potassium consumption has been linked with many health issues. Studies mostly tailored toward effects on cardiovascular illnesses especially blood pressure and stroke. Other conditions such as bone health, kidney stones and metabolic disease, has been examined. Numerous observational and intervention studies have addressed the relationship between the dietary intake of potassium and risk of cardiovascular disease in adults, focusing on blood pressure and hypertension, as well as the risk of stroke, ischemic heart disease and arrhythmia [35], [36]. Most studies solely examine a critically ill patient population, but it is of concern to know if such outcomes are present in the general population. This study aimed to evaluate the staff potassium contents of Ogun State Polytechnics of Health and Allied Sciences, Ilese- ijebu, Nigeria.

2. METHODS

A. Study Population

The study population comprises of hundred (100) staff Ogun State Polytechnics of Health and Allied Sciences

B. Sampling Technique

Hundred (100) staff of Ogun State Polytechnics of Health and Allied Sciences, Ilese-Ijebu was randomly selected within the campus. The blood samples were taken with consent from counseled individuals. Demographic information about each participant was obtained by oral interview, includes sex and age. 2.3 Ethical consideration. The blood samples were obtained by informed consent of the subjects (staffs of Ogun State Polytechnics of Health and Allied Sciences, Ilese-Ijebu, and the permission to that effect was obtained from the ethical research committee of the institution.

C. Collection of samples

Blood samples were collected from the selected staff using needles and syringes into lithium heparin bottles and analyzed for potassium concentration at the Chemical Pathology department of the State Hospital, Sango-Ota, Ogun State.

D. Principles of potassium estimation using spectrophotometric method

Spectrophotometric method was used for direct determination of potassium in blood serum or plasma, as a result of selectivity complex of potassium by a specific macro cyclic polyether and resultant formation of a coloured anion of an ion pair. The anion formed is again extracted with an organic solvent, clarified by centrifugation and measured at 415 nm.

3. RESULTS AND DISCUSSION

Blood samples were collected from one hundred (100) staff of Ogun State Polytechnics of Health and Allied Sciences, Ilese-Ijebu into disposable sample bottles and then analyzed for potassium level. The mean age of the study participants was 36.566±9.42 with age ranges from 21-57 years. The potassium concentration ranges from 3.7mmol/l to 7.5mmol/l.

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A. Analysis bio data

Table 1: Showing Age Group Distribution of the Participants

Age (Years)	Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
21-30	20	20.0	20.0	20.0
31-40	30	30.0	30.0	50.0
41-50	36.7	36.7	36.7	86.7
51-60	13.3	13.3	13.3	100.0
Total	100	100	100	

The above table 1, Shows the age distribution of the respondents; 20 (20%) of the study participants are within the ages of 21–30 years, 30 (30%) are within the ages of 31–40 years, 36.7 (36.7%) are within the ages of 41–50 years and 13.3 (13.3%) are within the ages of 51–60 years. From the table above, the majority of the study participants are within the age group 41–50 years representing 36.7%.

Table 2: Showing Sex Distribution of the Participants

Age (Years)	Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Male	30	30	30	30
Female	70	70	70	100
Total	100	100	100	

The above table 2 shows that 30(30%) of the study participants are male while 70(70%) are female. From the table above, the majority of the participants were female representing 70% on the table 2.

Table 3: Evaluation of Serum Potassium Concentration of Staff in Ogun State Polytechnics of Health and Allied Sciences, Ilese-Ijebu (N=100)

Status	Frequency	Mean ±SD	T-test value	P-value
< 3.5mmol/l	-	-	-	-
3.5–5.5 mmol/l	66.7(66.7%)	4.825±3.69	169.126	0.000
>5,5 mmol/l	33.7(33.3%)	6.256±1.48	128.870	0.000

(Mean significant at $P<0.05$)

The above table 3, shows that none of the study population has serum potassium concentration<3.5mmol/l. And, 66.7(66.7%) have serum potassium concentration between 3.5–5.5mmol/l with mean potassium values 4.825±3.69, however, 33.3(33.3%) of the study population have serum potassium concentration > 5.5mmol/l with mean value 6.256±1.48. The mean differences obtained were statistically significant ($p<0.05$).

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Table 4: Showing Age Distribution of the Study Participants in Relation to Serum Potassium Concentration (N=100)

	21-30 yrs.		31-40yrs		41-50yrs		51-60yrs	
	Mean ±SD	P-value	Mean ±SD	P-value	Mean ±SD	P-value	Mean ±SD	P-value
< 3.5mmol/l	-	-	-	-	-	-	-	-
3.5-5.5 mmol/l	4.725±1.19	0.00	4.475±1.13	0.00	4.602±1.88	0.00	4.617±2.17	0.00
>5.5 mmol/l	6.256±1.48	0.00	6.287±2.27	0.00	6.132±1.99	0.00	6..211±1.08	0.00

(Mean significant at P<0.05)

The above table 4 shows the age distribution of the respondents in relation to serum potassium concentration. None of the study population has serum potassium concentration < 3.5mmol/l. In age group 21-30 yrs.; mean normal potassium concentration is 4.725±1.19mmol/l while mean higher potassium concentration is 6.256±1.48mmol/l. In age group 31-4yrs; mean normal potassium concentration is 4.475±1.13mmol/l while mean higher potassium concentration is 6.287±2.27mmol/l. In age group 41-50yrs; mean normal potassium concentration is 4.602±1.88mmol/l while mean higher potassium concentration is 6.132±1.99mmol/l. In age group 51-60yrs; mean normal potassium concentration is 4.617±2.17mmol/l while mean higher potassium concentration is 6.211±1.08mmol/l. The differences in mean value observed in each age were statistically significant (P<0.05).

Table 5: Showing Sex Distribution of the Study Participants in Relation to Serum Potassium Concentration (N=100).

Sex	< 3.5mmol/l		3.5–5.5 mmol/l		>5.5 mmol/l	
	Mean ±SD	P-value	Mean ±SD	P-value	Mean ±SD	P-value
Male	-	0.00	4.615±2.19	0.00	6.234±1.28	0.00
Female	-	0.00	4.927±3.69	0.00	6.556±1.41	0.00

(Mean significant at P<0.05)

The above table 5, shows the sex distribution of the respondents in relation to serum potassium concentration. None of the study population has serum potassium concentration < 3.5mmol/l. Among the male study population; mean normal potassium concentration is 4.615±2.19mmol/l while mean higher potassium concentration is 6.234±1.28mmol/l. Among the female study population; mean normal potassium concentration is 4.927±3.69mmol/l while mean higher potassium concentration is 6.556±1.41mmol/l. The mean differences observed in male and male subjects were statistically significant (P<0.05).

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4. DISCUSSION

The only derangement encountered was hyperkalemia 10 (33.3%). This is in contrast to a study done in Netherland [37] which revealed that hyperkalemia (12%) electrolyte derangements. This may be due to the restriction of age in the study participants since the Netherlands researcher was focused on the older age groups above 55 years. Besides, no one was hypokalemia in this study unlike that of the Netherland's study. And, 33.3% hyperkalemia found in this study is also much higher than the result obtained by Kieneker et al., [38], from the general population in all inhabitants of Groningen, the Netherlands (age 28–75) which reports 3.8%. Hyperkalemia observed in this present study may be due to underlying sickness, eating too much food that is high in potassium can also cause hyperkalemia (melon, orange juice, and bananas are high in potassium).

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