Journal of Advances in Medicine and Medical Research

34(22): 44-53, 2022; Article no.JAMMR.91803
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Hypokalemia in Hospitalized COVID-19 Patients: Prevalence and Correlates

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Authors' contributions

This work was carried out in collaboration among all authors. All the authors participated in the conception and design of the study, literature review, data collection, analysis and interpretation, drafting of the manuscript and review of the draft of the manuscript for sound intellectual content. All the authors approved the final version of the manuscript.

Article Information

DOI: 10.9734/JAMMR/2022/v34i2231577

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/91803

Original Research Article

Received 07 July 2022
Accepted 10 September 2022
Published 12 September 2022

ABSTRACT

Objectives: This study was designed to evaluate the prevalence, and the severity of hypokalemia, and the factors associated with hypokalemia among patients hospitalized with COVID-19.
Methods: Random sampling technique was employed in this study. Socio-demographic data such as age, gender, weight (kg), height (meters) and BMI (kg/m^2) as well as presenting symptoms (pulmonary and extra-pulmonary), duration of admission, the need for mechanical ventilation and

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treatment outcomes (discharged or died) as well as the plasma level of potassium (mmol/l) were extracted from the medical records of RT-PCR confirmed hospitalized cases of COVID-19 patients. Data collected were analyzed with IBM/ SPSS version 25.0 software. Discrete variables were presented as percentages and frequencies and the associations between qualitative variables tested using the Chi-square test at a level of significance of $p < 0.05$.

Results: Hypokalaemia was detected in 61 out of 117 COVID-19 positive subjects used for this study during hospitalization. The mean serum potassium was 3.45±0.633 mmol/L. The majority of hypokalemic patients (n=35, 29.9%) patients experienced a mild decrease in serum potassium level (3–3.4 mmol/L). Risk factors for hypokalaemia were female sex and patients presenting with sneezing or/and sore throat. There was no relationship between the plasma potassium level and comorbid factors. There was no increasing trend of 30-day mortality associated with lower plasma potassium level.

Conclusion: Plasma potassium levels should be monitored routinely and maintained within appropriate ranges in patients with COVID-19 especially in female patients as well as patient with significant upper respiratory symptoms such as sore throat and sneezing.

Keywords: Angiotensin II; COVID-19; hypokalemia; pauci-symptomatic; SARS-CoV-2.

1. INTRODUCTION

The World health Organization (WHO) declared coronavirus disease 2019 (COVID-19) a world-wide pandemic on the 11th of March, 2020 [1]. Nigeria confirmed the first case of COVID-19 in the country on the 27th of February, 2020 and this led to the institution of stringent preventive measures designed to curb the rapid spread of the infection [2]. The clinical spectrum of COVID-19 varies from asymptomatic or pauci-symptomatic presentations to severe cases leading to severe acute respiratory syndrome, respiratory failure and may require the use of mechanical ventilation. This may be complicated by multiple organ failures and systemic complications such as sepsis and septic shock [3]. The most typical symptoms of COVID-19 include fever, fatigue, dry cough, and diarrhoea [4].

Human angiotensin converting enzyme 2 (hACE2) has been identified as the functional receptor of severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) [5]. It has been shown to be expressed in several organs of the body such as the heart, liver, kidney and lungs. However, in the kidneys, it is mainly expressed in the proximal tubules, collecting ducts and the ascending limb of the loop of Henle [6,7]. The down regulation of these receptors leads to the elevation of angiotensin II level which ultimately leads to hyper stimulation of angiotensin II type 1 receptors. This subsequently cause increase secretion of aldosterone, with antecedent potassium excretion, increase in sodium reabsorption and blood pressure elevation. As a result of atypical presentation of COVID-19 infection, potassium may also be lost from diarrhoea and/or vomiting which may contribute to hypokalaemia [5,7].

A review article carried out by Pourfridoni M et al. aimed at investigating the fluid and electrolyte disturbances in COVID-19 patients and the complications that may occur following these disorders in patients revealed that electrolyte imbalance is quite common in patients with COVID-19 infection [8]. The most common disorders are hyponatremia, hypernatremia, hypokalaemia, hypocalcaemia, hypochloremia, hypervolemia, and hypovolemia, which if left untreated may lead to increase mortality [8].

New insight into COVID-19 pathophysiology revealed solidifying evidences showing that hypokalaemia is a frequent laboratory abnormality. There is a troubling fear of potential occurrence of fatal arrhythmia occurring in COVID-19 patients [9,10]. This study is the first of its kind in Sub-Saharan Africa. In Nigeria and Africa in general, there is limited data and studies on hypokalaemia in COVID-19 patients.

Therefore, the aim of this study was to evaluate the prevalence, and the severity of hypokalemia, and the factors associated with hypokalemia among patients hospitalized with COVID-19

2. MATERIALS AND METHODS

2.1 Study Area

We carried out a retrospective cross-sectional study from January 2021 to June 2022 among hospitalized COVID -19 patients at a private tertiary hospital in Ogun State, Nigeria. Babcock University Teaching Hospital Ilishan-Remo, is one of the foremost private teaching hospitals to be built in Nigeria. Ogun State is one of the states located in the southwestern region of Nigeria with a population of 6.15 million and density of 263.9/km2. The hospital is a 150-bed referral facility which caters for residents of three southwest states of Ogun, Oyo and Lagos.

2.2 Study Participants

The study population consisted of teenager, adolescent and adult males and females with age range of between 10- 84 years who were hospitalized with moderate to severe symptoms of COVID-19 who had at least a serum potassium result done while on admission for COVID-19. Positivity to COVID-19 was confirmed with the use of Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) test.

2.3 Sampling Technique

We employed the consecutive sampling method in this study. Participants were consecutively recruited from the admission list until the estimated sample size was reached. Each case was given a serial number and all confirmed cases of COVID-19 with viable serum potassium results were included in this study.

2.4 Sample Size Estimation

In a finite sample population of 218 hospitalized COVID-19 positive patients, where the outcome variable is the proportion of patients with low level of serum potassium, the sample size calculation was calculated with a prevalence of 20% at 95% confidence level and precision level of 5%. The calculated sample size was 115 but we used 117 subjects who fulfilled the inclusion criteria in this study.

2.5 Data Collection

We obtained the medical records of participants from the record department and retrieved appropriate data. Information obtained include age, gender, occupation, religion, weight (kg) and height (meters), Body mass index (BMI), presenting symptoms (pulmonary and extra-pulmonary), co-morbidity, duration of admission, use of mechanical ventilation during admission, plasma level of potassium and treatment outcomes (discharged or died).

2.5.1 Outcomes measures

The primary objective of our study was to evaluate the prevalence of hypokalaemia. Secondary outcomes included assessment of hypokalaemia severity and the relationship if any between serum potassium value and socio-demographic factors, symptoms, comorbidities, need for mechanical ventilation and treatment outcome.

2.5.2 Variable and definition

Hypokalemia (low plasma potassium) was defined as a serum potassium level < 3.5 mmol/l. The normal level of serum potassium value ranges from 3.5 to 5.5 mmol/L. The diagnosis of hypokalaemia was performed on a single value of serum potassium < 3.5 mmol/L at any time during hospitalization using E170 modular analyzer. Laboratory derived values were used and all potassium values generated by blood gas analysis were excluded. Severity of hypokalemia was classified as mild when the serum potassium level ranged between 3–3.4 mmol/L, moderate when the serum potassium level ranged between 2.5–3 mmol/L, and severe when the serum potassium level fell below 2.5 mmol/L.

2.6 Data Analysis

Data obtained was analyzed with International Business Machine/ Statistical Package for Social sciences (IBM/ SPSS) version 25.0 software [SPSS Inc. Ill., Chicago, USA]. The normality of variables was determined using Kolmogorov-Smirnov test. Continuous variables such as weight, height, BMI duration of admission and plasma potassium level were expressed as mean ± Standard deviation. Discrete variables such as gender, hypokalemia severity, use of mechanical ventilation and outcome were presented as percentages and frequencies. Other variables such as age that assume non- Gaussian distribution are expressed as ranges and frequency. The comparison of means was done using the student t-test and the associations between qualitative variables tested using the Chi-square test. All statistical analyses were carried out at a level of significance of $p < 0.05$.

3. RESULTS

A total of 218 individuals were hospitalized for COVID-19 during the period of this study (126 males and 92 females). Only 117 subjects (71 males and 46 females) were enrolled in the study with male: female ratio of 1.5:1.

3.1 Socio-demographic Characteristics of Study Subjects

The socio-demographic characteristics of study subjects are shown in Table 1 reveals the socio-demographic characteristics of respondents who participated in the survey. The subjects are aged 16 years to 84 years. The age distribution reveals that 20 (17.1%) respondents were between the ages of 10 and 29 years, 26 (22.2%) respondents were between the ages of 30 and 49 years, 56 (47.9%) respondents were between the ages 50 and 69 years, while 15 (12.8%) respondents were age 70 and above. The mean age was 51.79± 19.223. It can thus be said that most of the respondents were between the ages of 50 and 69. Gender distribution reveals that 60.7% (n=71) of respondents were males, while the remaining 39.3% (n=46) were females.

Body Mass Index distribution showed that 3 (2.6%) respondents were underweight, 38 (32.5%) respondents were within the normal range (18-24.9) of BMI, 42 (35.9%) respondents were overweight, while 28 (23.9%) respondents had mild obesity, and the remaining 6 respondents had moderate obesity. The mean BMI was 27.19±4.685 kg/m^2.

This study also showed that less than half (n=50, 42.7%) of respondents were admitted for a duration between 0 and 7 days, 39.3% (n=46) were admitted for a duration between 8 and 14 days, 14.5% (n=17) were admitted for a duration between 15 and 21 days and only 3.5% (n=4) of respondents were admitted for more than 21 days. However, less than a tenth (6.8%) of respondents needed mechanical ventilation as treatment modality while on admission. 71.8% (n=84) of respondents were discharged after being treated at the hospital, while 28.2% (n=33) of respondents died during treatment.

3.2 Presenting Symptoms

The symptoms experienced by respondents who participated in the survey are shown in Table 2. From the data gathered, 83.8% (n=98) of respondents had cough, 86.3% (n=101) of respondents had shortness of breath, 68.4% (n=80) of respondents had fever, 32.5% (n=38) of respondents had body pain, 37.6% (n=44) had headache, while just 6% (n=7) of respondents experienced sneezing. 20.5% (n=24) of respondents had sore throat, 1.7% (n=2) of respondents experienced nausea, 9.4% (n=11) of respondents experienced vomiting, and 23.9% (n=28) of respondents had diarrhea.

Table 1. The social demographic characteristics of study subjects

Variables	Response	Frequency (N=117)	Percentage (%)
Mean age in years± SD	51.79± 19.223		
Age range in years	10-29	20	17.1
	30-49	26	22.2
	50-69	56	47.9
	70 & above	15	12.8
Gender	Male	71	60.7
	Female	46	39.3
Mean BMI±SD	27.19±4.685		
BMI (kg/m^2)	Underweight (BMI<18)	3	2.6
	Normal (BMI 18-24.9)	38	32.5
	Overweight (BMI 25-29.9)	42	35.9
	Mild obesity (BMI 30-34.9)	28	23.9
	Moderate obesity (BMI 35-39.9)	6	5.1
Duration of admission (days)	0-7	50	42.7
	8-14	46	39.3
	15-21	17	14.5
	>21	4	3.5
Treatment outcome	Discharged	83	71.8
	Died	33	28.2

BMI- Body mass index, SD- Standard Deviation

Table 2. The frequency of respiratory symptoms among study subjects

Symptoms	Responses: N (%)	
	Present	**Absent**
Cough	98(83.8)	19(16.2)
Shortness of breath	101(86.3)	16(13.7)
Fever	80(68.4)	37(31.6)
Body pain	38(32.5)	79(67.5)
Headache	44(37.6)	73(62.4)
Sneezing	7(6.0)	110(94.0)
Sore throat	24(20.5)	93(79.5)
Nausea	2(1.7)	115(98.3)
Vomiting	11(9.4)	106(90.6)
Diarrhea	28(23.9)	89(76.1)

3.3 Patients' Comorbidity

Table 3 reveals the frequency of comorbidities with COVID-19 amongst study subjects. From the data gathered, 24.8% (n=29) were above 65 years of age. 8.5% (n=10) were diagnosed asthmatics at presentation, 3.4% (n=4) had COPD, 57.3% (n=67) of respondents had hypertensive heart disease, 6.0% (n=7) were on treatment for heart failure, 31.6% (n=37) were receiving treatment for diabetes mellitus, 10.3% (n=12) of respondents had chronic kidney disease, 2.6% (n=3) had HIV/AIDS, while only 3.4% (n=4) of respondents had been diagnosed with various malignancies.

3.4 Plasma Potassium Values and Severity of Abnormal Potassium Level

The mean plasma potassium value in this study was 3.45±0.633 mmol/l. Hypokalemia was detected in 56 (47.9%) of the 117 subjects used for this study. The potassium level classification distribution shows that 47.9% (n=56) of subjects have a normal potassium level, 29.9% (n=35) have mild hypokalemia, 17.9% (n=21) have moderate hypokalemia, and 4.3% (n=5) have severe hypokalemia (Table 4).

Table 3. The frequency of comorbid diseases among study subjects

Comorbidities	Responses Frequency (N=117)	
	Present n (%)	**Absent n (%)**
Age> 65 years	29(24.8)	88(75.2)
Asthma	10(8.5)	107(91.5)
COPD	4(3.4)	113(96.6)
Hypertensive heart diseases	67(57.3)	50(42.7)
Heart failure	7(6.0)	110(94.0)
Diabetes Mellitus	37(31.6)	80(68.4)
CKD	12(10.3)	105(89.7)
HIV/AIDS	3(2.6)	114(97.4)
Malignancies	4(3.4)	113(96.6)

COPD- Chronic Obstructive Pulmonary Diseases, CKD- Chronic kidney diseases, HIV/AIDS- Human Immuno-deficiency Virus/ Acquired Immune Deficiency syndrome

Table 4. Serum plasma levels in study subjects

Variables	Categories (value range) (mmol/l)	Frequency (%)
Plasma potassium value (mmol/dl)	Normal (3.5-5.5)	56(47.9)
	Mild hypokalemia (3.0-3.4)	35(29.9)
	Moderate Hypokalemia (2.5-2.9)	21(17.9)
	Severe hypokalemia (<2.5)	5(4.3)
Mean plasma potassium value (mmol/dl) ±SD	3.45±0.633	

3.5 Relationships between Potassium Levels, Socio-demographic Characteristics, Symptoms, Comor bidities, use of Mechanical Ventilation and Treatment Outcome

Table 5 revealed the relationships between the plasma potassium level of subjects and gender, age range as well as the BMI. It can be concluded that there were no significant relationships between the age range and BMI of these patients and the plasma potassium levels as the p- values were > 0.05. However, the study showed a significant association exits between the plasma potassium level of subjects and their gender (p=0.04).

The study also revealed that there was no significant relationship between the plasma potassium levels in study subject and presenting symptoms of the patients (p>0.05) except for sneezing and sore throat with p-values of 0.009 and 0.01 respectively (Table 6). The study did not reveal any association between the plasma potassium level of the subjects and all the comorbid factors (p>0.05) (Table 7). The prevalence of hypokalaemia was 4.3% among admitted patients requiring the use of invasive mechanical ventilation. In this study, 30-day mortality rate was 28.2% (n=33) among whom only 20 (17.1%) had hypokalemia. The 30-day mortality rate observed did not have any association with lower plasma potassium level as only 1 (0.9%) patient with severe hypokalemia died. There was no significant relationship between respondents' treatment outcome and use of mechanical ventilation and their plasma potassium level (p>0.05) (Table 8).

Table 5. Relationship between socio-demographic characteristics and plasma potassium levels

Socio-demographic Characteristics		Plasma level categories (mmol/l) n (%)				P-value
		Normal Serum Potassium (3.5-5.5)	**Mild Hypokalemia (3.0-3.4)**	**Moderate Hypokalemia (2.5-2.9)**	**Sever Hypokalemia (<2.5)**	
Gender	Male	36(30.7)	21(17.8)	14(12.0)	0(0.0)	0.039*
	Female	20(17.2)	14(12.0)	7(6.0)	5(4.3)	
Age range (years)	10-29	10(8.5)	6(5.1)	2(1.7)	2(1.7)	
	30-49	12(1O.3)	9(7.7)	4(3.4)	1(0.9)	
	50-69	26(22.2)	16(13.6)	12(10.3)	2(1.7)	
	70 & above	8(6.8)	4(3.4)	3(2.6)	0(0.0)	0.918
BMI (kg/m^2)	Underweight (BMI<18)	2(1.7)	1(0.9)	0(0.0)	0(0.0)	
	Normal (BMI=18-24.9)	15(12.8)	11(9.4)	9(7.7)	3(2.6)	
	Overweight (BMI=25-29.9)	20(17.2)	14(11.7)	8(6.8)	0(0.0)	
	Mild obesity (BMI=30-34.9)					0.546
	Moderate obesity (BMI=35-39.9)	15(12.8)	9(7.7)	3(2.6)	1(0.9)	
		4(3.4)	0(0.0)	1(0.9)	1(0.9)	

*Statistically significant

Table 6. Relationship between COVID-19 symptoms and plasma potassium levels

Symptoms		Plasma level categories (mmol/l) n (%)				P-value
		Normal (Serum Potassium (3.5-5.5)	**Mild Hypokalemia (3.0-3.4)**	**Moderate Hypokalemia (2.5-2.9)**	**Sever Hypokalemia (<2.5)**	
Cough	Present	48(41.0)	29(24.8)	18(15.4)	3(2.6)	0.510
	Absent	8(6.8)	6(5.1)	3(2.6)	2(1.7)	
Shortness of breath	Present	50(42.7)	30(25.6)	17(14.6)	4(3.4)	0.775
	Absent	6(5.1)	5(4.3)	4(3.4)	1(0.9)	
Fever	Present	38(32.5)	24(20.5)	15(12.8)	3(2.6)	0.967
	Absent	18(15.4)	11(9.4)	6(5.1)	2(1.7)	
Body pain	Present	20(17.1)	13(11.0)	3(2.6)	2(1.7)	0.271
	Absent	36(30.8)	22(18.8)	18(15.4)	3(2.6)	
Headache	Present	21(17.9)	15(12.8)	6(5.1)	2(1.7)	0.764
	Absent	35(29.9)	20(17.2)	15(12.8)	3(2.6)	
Sneezing	Present	3 (2.6)	2(1.7)	0(0.0)	2(1.7)	0.009*
	Absent	53(45.3)	33(28.2)	21(17.9)	3(2.6)	
Sore throat	Present	10(8.5)	6(5.1)	4(3.4)	4(3.4)	0.010*
	Absent	46(39.3)	29(24.8)	17(14.6)	1(0.9)	
Nausea	Present	1(0.9)	1(0.9)	0(0.0)	0(0.0)	0.866
	Absent	55(46.9)	34(29.1)	21(17.9)	5(4.3)	
Vomiting	Present	4(3.4)	3(2.6)	3(2.6)	1(0.9)	0.657
	Absent	52(44.4)	32(27.4)	18(15.3)	4(3.4)	
Diarrhea	Present	13(11.1)	7(6.0)	8(6.8)	0(0.0)	0.241
	Absent	43(36.6)	28(24.1)	13(11.1)	5(4.3)	

**Statistically significant*

Table 7. Relationship between comorbidities and plasma potassium levels

Comorbidities		Plasma level categories (mmol/l) n (%)				P- value
		Normal (Serum Potassium)	**Mild Hypokalemia (3.0-3.4)**	**Moderate Hypokalemia (2.5-2.9)**	**Sever Hypokalemia (<2.5)**	
Age > 65 years	Present	15(12.8)	8(6.8)	5(4.3)	1(0.9)	0.967
	Absent	41(35.0)	27(23.1)	16(13.7)	4(3.4)	
Asthma	Present	5(4.3)	4(3.4)	1(0.9)	0(0.0)	0.745
	Absent	51(43.6)	31(26.3)	20(17.2)	5(4.3)	
COPD	Present	2(1.7)	1(0.9)	1(0.9)	0(0.0)	0.954
	Absent	54(46.1)	34(28.9)	20(17.2)	5(4.3)	
HHD	Present	32(27.4)	22(18.8)	11(9.4)	2(1.7)	0.738
	Absent	24(20.5)	13(11.1)	10(8.5)	3(2.6)	
Heart failure	Present	5(4.3)	2(1.7)	0(0.0)	0(0.0)	0.471
	Absent	51(43.6)	33(28.2)	21(17.9)	5(4.3)	
Diabetes Mellitus	Present	16(13.7)	12(10.3)	8(6.8)	1(0.9)	0.783
	Absent	40(34.2)	23(19.7)	13(11.0)	4(3.4)	
CKD	Present	6(5.1)	4(3.4)	2(1.7)	0(0.0)	0.885
	Absent	50(42.7)	31(26.3)	19(16.5)	5(4.3)	
HIV/AIDS	Present	1(0.9)	1(0.9)	1(0.9)	0(0.0)	0.877
	Absent	55(46.9)	34(28.9)	20(17.2)	5(4.3)	
Malignancies	Present	1(0.9)	3(2.6)	0(0.0)	0(0.0)	0.242
	Absent	55(46.9)	32(27.4)	21(17.9)	5(4.3)	

HHD- Hypertensive heart diseases

Table 8. Relationship between plasma potassium level, need for mechanical ventilation and treatment outcome

Variables		Potassium level Classification (mmol/l) n (%)				P-value
		Normal (Serum Pot 3.5-5.5)	Mild Hypokalemia (3.0-3.4)	Moderate Hypokalemia (2.5-2.9)	Severe Hypokalemia (<2.5)	
Use of Mechanical ventilation	Yes	3(2.6)	2(1.7)	3(2.6)	0(0.0)	
	No	53(45.3)	33(28.2)	18(15.3)	5(4.3)	0.483
Treatment outcome	Discharged	43(36.7)	24(20.5)	13(11.1)	4(3.4)	
	Died	13(11.1)	11(9.4)	8(6.9)	1(0.9)	0.562

4. DISCUSSION

Hypokalaemia has been implicated as a possible manifestation of moderate to severe COVID-19 infection as a result of interaction of SARS-CoV-2- 2 with the renin–angiotensin–aldosterone system in the body [5,8]. Although the prevalence and and aetio-pathological mechanism of hypokalaemia in COVID-19 patients have not been well studied and understood [9], our study showed that hypokalaemia was a common finding among moderate to severe cases of COVID-19. Hypokalaemia was seen in 52.1% of admitted patients who were hospitalized for moderate to severe SARS-CoV-2 infection.

The associations between SARS-CoV-2 (Coronavirus disease-2019) and hypokalemia have been reported in few studies so far. Hypokalaemia and other electrolyte abnormalities have been reported in a study done in has been reported during the SARS-CoV-2 pandemic in different parts of the world [10,11]. In Wenzhou, China, Chen D et al. [12] reported a low potassium level in 87 females (50%) out of 175 patients as a common electrolyte disorder. This finding is similar to the finding in this study where 52.1% mostly females were reported to have had hypokalemia. As a result of this finding, the authors suggested that the etiology of hypokalaemia was consistent with the disorder of ACE2 receptor by the binding of SARS-CoV-2 [13]. A further study done in Thailand buttress the fact that hypokalemia was seen and documented in asymptomatic cases of COVID-19 infection without evidence of significant extra renal potassium loss [14].

From available facts and literatures, the etiology of hypokalemia in cases of COVID-19 is likely to involve multiple factors with some contribution from urinary potassium loss. The direct cellular damaged caused by COVID-19 infection [7] and the indirect cytokine effects on renal tubular wall may be a major contributor to COVID-19 associated tubular wall damaged leading to potassium loss [10]. Despite the above, explaining the exact etiology of hypokalemia in COVID-19 patient is difficult in the presence of comorbidities and therapeutic agents [13].

In this study, the risk of hypokalaemia was higher in women than men but there are no apparent reasons associating female sex with hypokalaemia. A study carried out many decades ago conducted in the 50s [15] showed that women, particularly old, and aged women, have less exchangeable body potassium than other subsets of the population. The women are, therefore, at high risk to develop hypokalaemia because of lower deposits of potassium in women as a result of their body composition, characterized by lower amount of extracellular fluid compared to men [14].

The role of extra-pulmonary symptoms especially gastrointestinal symptoms in the development of hypokalaemia is not supported by the result of this study. This contrast a study done by Wong wai cheong et al in which there was a statistically significant relationship between the plasma potassium levels and GI symptoms ($p=0.03$), showing that a higher number of hypokalaemia patients had GI symptoms [13,16].

Chronic medical conditions and comorbid diseases before admission for COVID-19 were not associated with increased low plasma level of potassium in this study ($p>0.05$) which contrast an earlier study in which chronic kidney diseases was significantly associated with low or higher plasma potassium [17]. In this study, an abnormal plasma potassium level during hospitalization was not associated with adverse patient outcomes. The risk of 30-day mortality during hospitalization was not significantly higher in hospitalized patients with COVID-19 who had plasma potassium value ≤3.5mmol/L. This study therefore did not support the belief that low plasma potassium unlike in other studies [17,18] significantly, and negatively impacts the outcome in patients with COVID-19.

5. CONCLUSION

Plasma potassium levels should be monitored routinely and maintained within appropriate ranges in patients with COVID-19 especially in female patients as well as patient with significant upper respiratory symptoms such as sore throat and sneezing. This study had limitations due to the fact that it was, a retrospective, cross sectional, single-center study, and the collection of data was not standardized in advance. Other factors which can cause changes in serum potassium level during hospitalization, including the use of beta-lactam antibiotics (e.g. Ceftriaxone) and hydroxychloroquine were not exploited in this study.

ETHICAL APPROVAL AND CONSENT

Ethical clearance was sought and obtained from the ethical committee of Babcock University Health Research and Ethics Committee (BUHREC/029/22). Confidentiality and privacy of respondents was duly respected during and after the period of collecting and collating data. The study was performed following the ethical standards of the 2008 Declaration of Helsinki. All participants gave informed consent before they participated in the study.

ACKNOWLEDGEMENT

The authors appreciate Professor Francis Ani for his staunch support and encouragement in making sure that this work comes to fruition.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Cuccinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Bio-Medica Atenei Parm,* 2020;19(1):157-160. Available:https://doi.org/10.23750/abm.v9lil .9397.
2. Nigeria confirms first coronavirus case in sub-Saharan Africa. 2020;28;2, Accessed 20 March 2022. Available:http;//www.bbc.com/news/world-africa-51671834
3. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and Treatment Coronavirus (COVID-19), in StatPearls, Treasure Island (FL): Stat Pearls Publishing; 2020.
4. Hassan SA, Sheikh FN, Jamal S, Ezeh JK, Akhtar A. Coronavirus (COVID-19): A Review of Clinical Features, Diagnosis, and Treatment. Cureus. 2020; 12. Available:https://doi.org/10.7759/cureus.73 55.
5. Qian JY, Wang B and Liu BC. Acute kidney injury in the 2019 novel coronavirus disease. Kidney Dis. 2020;323:1-6. Available:https://www.doi.org/ 10.1159/000509086.
6. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020;579(7798):270–273. Available:https://doi.org/10.1038/s41586-020-2012-7
7. Batlle D, Soler MJ, Sparks MA, Hiremath S, South AM, Welling PA et al. Acute kidney injury in COVID-19: emerging evidence of a distinct pathophysiology. J Am Soc Nephrol. 2020;31(7):1380–1383. Available:https://www.doi.org/10.1681/ASN .2020040419
8. Pourfridoni M, Mahsa Abbasnia S, Shafaei F, Razaviyan J, Heidari-Soureshjani R. Fluid and Electrolyte Disturbances in COVID-19 and Their Complications. BioMed Research International. Volume 2021, Article ID 6667047, 5 pages. Available:https://doi.org/10.1155/2021/666 7047.
9. Noori M, Nejadghaderi SA Sullman MJM, Carson-Chahhoud K, Ali-Asghar K, Safiri S. Epidemiology, prognosis and management of potassium disorders in COVID-19. Rev Med Virol. 2022;32(1):e2262. Available:https://doi.org/10.1002/rmv.2262
10. Basu-Ray I, Soos MP. Cardiac Manifestations Of Coronavirus (COVID-19). 2022 May 2. StatPearls. Treasure Island (FL): StatPearls Publishing; 2020. Available:http://www.ncbi.nlm.nih.gov/book s /NBK55 6152/

11. Alfano G, Ferrari A, Fontana F, Perrone R, Mori G, Ascione E, Magistroni R et al. Hypokalemia in Patients with COVID‑19. Clin Exp Nephrol. 2021;25(4): 401-409. Available:https://doi.org/10.1007/s10157-020-01996-4.
12. Chen D, Li X, Song Q, Hu C, SU F, Dai J, et al. Assessment of Hypokalemia and Clinical Characteristics in Patients With Coronavirus Disease 2019 in Wenzhou, China. JAMA Netw Open. 2020;3(6):e2011122. Available:https://www.doi.org/10.1001/jamanetworkopen.2020.11122
13. Wong Wai Cheong N, Meyyur Aravamudan V, Venkatachalam J, Kuthiah N. Gastrointestinal Symptoms in Association with Hypokalemia can Be a Predictor of Inferior Outcomes in COVID-19. Cureus. 2021;13(4): e14466. Available:https://doi.org/10.7759/cureus.14466.
14. Nasomsong W, Ungthammakhun C, Phiboonbanakit D, Prapaso S, Luvira V, Changpradub D. Low serum potassium among patients with COVID-19 in Bangkok, Thailand: Coincidence or clinically relevant? Tropical Doctor. 2021;51(2) 212–215. Available:https://doi.org/10.1177/0049475520978174.
15. Sagild U. Total exchangeable potassium in normal subjects with special reference to changes with age. Scand J Clin Lab Invest. 1956;8(1):44–50. Available:https://www.doi.org/ 10.3109/00365515609049242.
16. Moreno-Pérez O, Leon-Ramirez J, Fuertes-Kenneally L, Perdiguero M, Andres M, Garcia-Navarro M. et al. Hypokalemia as a sensitive biomarker of disease severity and the requirement for invasive mechanical ventilation requirement in COVID-19 pneumonia: A case series of 306 Mediterranean patients. Intern Journal of Infectious Dis. 2020;100:449–454. Available:https://doi.org/10.1016/j.ijid.2020.09.033.
17. Jibrin YB, Okwong OK, Maigari IM, Dunga JA, Ballah AM, Umar MS et al. Clinical and laboratory characteristics of COVID-19 among adult patients admitted to the isolation centre at Abubakar Tafawa Balewa Teaching Hospital Bauchi, Northeast Nigeria. Pan African Medical Journal. 2020;37(1):27. Available:https://doi.org/10.11604/pamj.supp.2020.37.1.26162.
18. Liu S, Zhang L, Weng H, Yang F, Jin H, Fan F et al. Association Between Average Plasma Potassium Levels and 30-day Mortality During Hospitalization in Patients with COVID-19 in Wuhan, China. Intern. Jour. of Medical Sci. 2021;18(3):736-743. Available:https://doi.org/10.7150/ijms.50965.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/91803