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Prevalence of Hypokalaemia in patients presenting with Diarrhoea at Kiswa Health Centre III, Nakawa Division in Kampala District. A cross-sectional study.

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Abstract
Background:
This study aims to determine the prevalence of Hypokalaemia in patients presenting with Diarrhoea at Kiswa Health Centre III, Nakawa Division, in Kampala District.

Methodology:
A cross-sectional study was conducted among 138 patients presenting with diarrhea. Data were collected using structured questionnaires and laboratory analysis of serum sodium levels using an automated chemistry analyzer. Results are presented in tables, graphs, and charts.

Results:
The study enrolled 138 respondents presenting with diarrhea, with the largest age group being 18–35 years (40 participants, 29.0%), followed by children under five years (36 participants, 26.1%). Young children (<5 years) and elderly adults (≥60 years) were more prone to severe electrolyte imbalances. Males constituted a slightly higher proportion of the study population (51.4%) compared to females (46.4%). Hypokalemia affected participants across all age groups, with children under five being the most affected, accounting for 32 cases (23.2%) across all severities: 14 mild (10.1%), 11 moderate (8.0%), and 7 severe (5.1%). Elderly adults contributed 17 cases (12.3%), including 7 mild (5.1%), 5 moderate (3.6%), and 5 severe cases (3.6%). Adults aged 18–35 years recorded 16 cases (11.6%), adolescents 5–17 years 10 cases (7.2%), and adults 36–59 years 11 cases (8.0%). Mild hypokalemia was the most common across all age groups, followed by moderate cases, while severe hypokalemia was less frequent. Overall, children under five and elderly adults were consistently the most affected, highlighting their increased vulnerability to potassium depletion during diarrheal illness.

Conclusion:
Hypokalemia is common among diarrheal patients, with children under five and adults over 60 being most vulnerable, and mild cases being the most frequent.

Recommendation:
Routine potassium screening, proper rehydration, and patient education are essential to prevent and manage hypokalemia, especially in high-risk groups.

Keywords: *Diarrhoea, hypokalemia, electrolyte imbalance, high-risk groups, serum potassium.*
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Background of the study

Diarrheal diseases continue to pose a major global health burden, especially in low- and middle-income countries where access to safe water, sanitation, and timely medical care remains limited. The World Health Organization estimates that diarrheal diseases are responsible for approximately 1.2 million deaths annually, with a significant proportion occurring in vulnerable populations such as children under five years, pregnant women, and the elderly (WHO, 2022). Beyond mortality, diarrheal illnesses are associated with serious complications, including dehydration and electrolyte imbalances, which significantly contribute to morbidity. Among the key electrolyte disturbances associated with diarrhea is hypokalemia. Hypokalemia is defined as a serum potassium level below 3.5 mmol/L and results primarily from excessive loss of potassium through stool, vomiting, or inadequate dietary intake (Gennari, 1998). During episodes of acute or chronic diarrhea, large amounts of potassium are lost in feces, leading to a depletion of intracellular and extracellular

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potassium stores. This condition can be further aggravated by poor nutritional status and inappropriate fluid replacement therapies that do not adequately replenish potassium levels. Several studies have documented the prevalence of hypokalemia in patients suffering from diarrheal diseases. For example, a study conducted by Bakolia et al. (2021) among malnourished children with acute diarrhea found that 10% of the participants developed hypokalemia. Similarly, research by Patel et al. (2016) reported that hypokalemia was a common finding among hospitalized patients with acute gastroenteritis, particularly in those with prolonged diarrhea, severe dehydration, and persistent vomiting. These findings highlight that hypokalemia is a frequent and clinically significant complication of diarrheal illness. Hypokalemia has serious clinical implications due to the critical role potassium plays in maintaining normal cellular function, nerve conduction, and muscle contraction, including cardiac muscle activity. Low potassium levels can lead to symptoms such as muscle weakness, fatigue, constipation, and, in severe cases, life-threatening cardiac arrhythmias (Gennari, 1998). In patients with diarrhea, especially those who are already weakened or malnourished, hypokalemia can significantly worsen clinical outcomes and prolong recovery. The risk of hypokalemia is influenced by several factors, including the duration and severity of diarrhea, coexisting vomiting, inadequate intake of potassium-rich foods, and delayed or improper use of oral rehydration therapy. Vulnerable groups such as pregnant women are at increased risk due to physiological changes during pregnancy, including increased renal excretion of potassium and altered hormonal regulation, which may exacerbate potassium loss during illness (Davison, 2019). In Uganda, diarrheal diseases remain among the leading causes of morbidity and healthcare visits. According to the Ministry of Health Uganda, diarrheal illnesses contribute significantly to outpatient attendance and hospital admissions, particularly in urban and peri-urban health facilities (MOH Uganda, 2022). Despite this burden, routine assessment of electrolyte levels, including potassium, is often not performed in lower-level health facilities due to limited laboratory capacity and resource constraints. As a result, many cases of hypokalemia go undiagnosed, increasing the risk of complications such as cardiac abnormalities and prolonged illness. At Kiswa Health Centre III in Nakawa Division, Kampala District, many patients present with diarrheal symptoms; however, there is limited data on the prevalence of hypokalemia among these patients. Understanding the extent of hypokalemia in this setting is essential for improving patient management, guiding appropriate electrolyte replacement, and reducing complications associated with diarrheal diseases. Therefore, this study aims to determine the prevalence of Hypokalaemia in patients presenting with Diarrhoea at Kiswa Health Centre III, Nakawa Division, in Kampala District.

Methodology

Study design

A cross-sectional study design was used, where patients were sampled once and purposively selected.

Study area

The study was conducted at Kiswa Health Centre III, which is well known as Kiswa Hospital, a government-owned health facility operating under the Kampala Capital City Authority (KCCA), located along Spring Road in the Bugolobi Area, Nakawa Division, Kampala, Uganda. It serves a catchment population estimated at over 300,000 residents from Bugolobi, Kitintale, Luzira, Mutungo, Mbuya, and the surrounding neighborhoods. The facility handles between 800 and 1000 outpatient visits per month, including maternal and child health clients. This facility has been chosen for the study due to its large patient intake, thanks to the wide range of services it offers, and its proximity to numerous businesses and educational institutions, resulting in a high number of civilians and students in the area.

Study population

The study enrolled 138 consented participants attending the OPD at Kiswa HC III and present with signs and symptoms of diarrhea.

Inclusion Criteria

Patients who attended the OPD at Kiswa HC III with presumptive clinical diagnosis and were presenting with diarrhea (lasting less than 14 days or acute/persistent diarrhea) were sent to the laboratory by their physician for serum electrolyte test and consent to be enrolled into the study.

Exclusion Criteria

Patients with known chronic kidney diseases or other conditions that may independently affect electrolyte levels, patients currently on diuretics or other medications known to alter sodium or potassium levels, were not included in the study.

Sample size determination

The sample size was determined using the Kish and Leslie (1965) n = $\underline{Z^2pq}$

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d^2
Where: n = the desired sample size
Z = the standard normal deviation (1.96) at 95% confidence level
p = estimated prevalence of hyponatremia and hypokalemia, (0.1) 10% (Mwita *et al.*, 2024)
d = margin of error since the prevalence of hyponatremia and hypokalemia is unknown, an estimated value of 5% (0.05)
$Z^2 = 1.96^2 = 3.8416$
$q = (1-p) = (1 - 0.1) = 0.9$
$d^2 = (0.05)^2 = 0.0025$ n = $\underline{3.8416x0.1x0.9}$
0.0025
N= 138.3
Approximately 138 participants drawn from the population were used in the study.

Sampling Techniques

This study used a purposive sampling technique, and 138 participants were enrolled based on the researcher's judgment. This technique was cost-effective and minimized potential errors and biases.

Sampling Procedure

The researcher selected participants based on characteristics that were deemed appropriate for the research topic and that are easily accessible. Participants were systematically enrolled until the required number was reached.

Data Collection Methods

Data was collected through both clinical evaluation and laboratory testing. Upon presentation, patients meeting the inclusion criteria were enrolled in the study after informed consent was obtained. A structured data collection form was used to record demographic details (age, gender, clinical history, duration, and frequency of diarrhea) and relevant medical history. Venous blood samples were collected under aseptic conditions and sent to the hospital's laboratory for serum electrolyte analysis. This test measured serum levels of sodium (Na^+) and potassium (K^+) using an automated biochemistry analyzer. The results will be used to identify the presence of hyponatremia (Na+ <135mmol/l) and hypokalemia (K+ <3.5mmol/l). Data was recorded, coded, and entered into a secure database for subsequent analysis.

Data collection tool

A pretested questionnaire was used to collect social demographic data, predisposing factors of patients attending health care services at Kiswa HC III. Red top and purple top vacutainers with laboratory request forms were used with test results. Confidential laboratory request forms were used for quantitative data collection. The final data was presented using tables, bar graphs, and pie charts.

Data collection procedure

The introductory letter was obtained from the dean of the school and was presented to the Laboratory Manager of Kiswa Health Centre III, seeking permission to conduct the study at the facility. Questionnaires were issued to participants. Data was recorded in a study-specific record book.

Data concerning the test results were captured on the information sheet and in the laboratory register book, and blood samples were collected and put in a red/purple top vacutainer, then it was registered into the laboratory reception book and given a laboratory number on the workbench.

Laboratory Diagnosis and Method of Estimating Serum Electrolytes

These conditions had significant clinical implications, and their diagnosis relies on a combination of blood and urine tests to determine the underlying causes and guide appropriate treatment strategies. The **serum electrolyte test** was the most basic and commonly used test to assess sodium and potassium levels in the body. It is usually part of a routine metabolic panel or electrolyte panel. These tests were done by collecting a small blood sample from the patient and analyzing it using **an Automated Chemistry Analyzer** (WHO *et al.*, 2024; Mayo Clinic, 2023).

Serum Electrolytes Test (Specifically Sodium and Potassium Measurement)

This test measures the levels of potassium (K^+) in the blood serum, which is a part of a broader test called a serum electrolyte panel in an automated electrolyte analyzer.
Hypokalemia; Serum Potassium (K^+): Normal potassium levels range from 3.5 to 5.0mEq/L. A value below 3.5mEq/L confirms hypokalemia (Merck Manual *et al.*, 2022). Serum Potassium Measurement: This test confirms hypokalemia and is often part of an electrolyte panel or basic metabolic panel (MedlinePlus *et al.*, 2024).

Principle of the Serum Electrolyte Test (Ion-Selective Electrode Method):

This method is based on the principle that specific electrodes can selectively respond to a particular ion in solution, producing an electrical potential that is directly proportional to the concentration of that ion. Each electrode contains a membrane that is selective for a specific ion (e.g., sodium or

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potassium). When the serum sample comes into contact with the electrode membrane, the target ions (Na^+ or K^+) interact with the membrane, generating a potential difference that is then measured and converted by the analyzer into a concentration value using the Nernst equation.

Materials required to perform serum sodium and potassium testing using a fully automated chemical analyzer (indirect ISE method):

A. Sample Collection Materials

i. Vacutainer tubes (plain/red top) – for serum collection
ii. Sterile syringes and needles – to draw venous blood
iii. Tourniquet – to assist in venipuncture
iv. Alcohol swabs – for skin disinfection before sample collection
v. Gloves – for infection prevention
vi. Sample labels or stickers – for proper identification of specimens
vii. Biohazard disposal containers – for safe disposal of sharps and contaminated materials

B. Sample Processing Materials

viii. Centrifuge – to separate serum from whole blood
ix. Serum cups or secondary tubes – for transferring serum post-centrifugation
x. Micropipette or automated sample loader – to load serum into the analyzer

C. Chemistry Analyzer System

xi. Automated Clinical Chemistry Analyzer – with built-in electrolyte module (e.g., Roche COBAS, etc.) with electrodes specific for Na^+ and K^+ (usually integrated into the analyzer)
xii. Calibrators and Standards – for proper calibration of the electrolyte module
xiii. Electrolyte Reagents – specific for use with the analyzer (manufacturer-provided)
xiv. Quality Control sera – normal and abnormal levels to ensure accuracy and reliability

D. Support Materials

xv. Distilled water – for cleaning cycles and dilution (as required by the analyzer)
xvi. Analyzer printer or computer interface – for result printing and digital recording
xvii. Logbook or LIS (Laboratory Information System) – to record patient results manually or digitally

Performing the test: Sample collection; Use fresh serum or store at (2-8)0c if testing is delayed.

Step 1: Sample Collection & Preparation

- Collect 3–5 mL of venous blood into a plain vacutainer tube.
- Allow the blood to clot at room temperature for 15–30 minutes.
- Centrifuge the sample at 3000 rpm for 5–10 minutes to separate the serum.
- Transfer the clear serum into a clean, labeled sample cup for analysis.

Step 2: Analyzer Setup

- Turn on the automated chemical analyzer and perform internal system checks.
- Ensure the instrument has sufficient reagents, calibrators, and diluent loaded.
- Check that ion-selective electrodes (Na^+ and K^+) are properly installed and functioning.

Step 3: Calibration

- Run manufacturer-provided calibrators for sodium and potassium.
- Analyzer uses these standards to calibrate and validate measurement accuracy.
- Calibration should be performed according to the manufacturer's schedule or before each batch run.

Step 4: Perform Quality Control

- Always begin each testing session with QC sera (normal & abnormal levels).
- Run normal and abnormal control sera
- Accept results only if QC values fall within the specified reference ranges.
- If QC fails, do not proceed with patient testing until the issue is resolved.
- Only analyze patient samples after confirming QC is within the target range.
- Use fresh serum. (Avoid samples that have hemolysis)
- Regularly clean electrodes and replace reagents per manufacturer guidelines.
- Ensure proper storage of reagents and QC materials at 2–8°C.
- Document all QC runs and analyzer maintenance for audit and traceability

Step 5: Sample Analysis

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- Load the prepared serum samples into the sample tray or rack.
- Analyzer will automatically dilute, analyze, and read the concentrations of Na^+ and K^+ using indirect ISE technology.
- Results are displayed digitally and/or printed for recordkeeping.
- Properly discard the sample and clean analyzer surfaces after completion.

Result Reporting: Record the sodium and potassium values in the data collection form, flag any abnormal results, and notify the attending clinical staff for patient care decisions.

Interpretation:

Electrolyte	Normal Range (mmol/L)	Deviant Value	Condition
Sodium (Na+)	135-145mmol/L	<135mmol/L	**Hyponatremia**
		>145mmol/L	**Hypernatremia**
Potassium (K+)	3.5-5.0mmol/L	<3.5mmol/L	**Hypokalemia**
		>5.0mmol/L	**Hyperkalemia**

Quality Control

The questionnaire was pre-tested with some students at MIHS to ensure the validity and reliability of results and make necessary adjustments to cause improvement of the intended results with the questionnaire.

The sample was run concurrently with known samples that are known positive and negative samples.

SOPs were strictly followed for all the laboratory procedures.

Data analysis and Presentation

The quantitative data was organized, edited, and coded, and its demographic analysis was done using Microsoft Excel sheets and was finally presented in the form of tables, graphs, and pie charts to derive meaning for different users of such data at any point in time.

Ethical considerations

Before starting the study, a letter of introduction obtained from the administration of Mildmay Institute of Health Sciences (MIHS) was presented to the Hospital administration of Kiswa Hospital for approval, and then data collection commenced.

The researcher got the consent and approval from the participants to get involved in the study and informed them about the purpose and objective of the study.

Results

Socio-Demographic Characteristics of the Respondents

Table 1: A table showing demographic characteristics of the participants

Variable	Category	Frequency (N=138)	Percentage (%)
Age group (years)	**<5**	36	26.1
	5–17	22	15.9
	18–35	40	29.0
	36–59	24	17.4
	≥60	16	11.6
	Total	**138**	**100**
Gender	**Male**	71	51.4
	Female	67	48.6
	Total	**138**	**100**
Place of residence	**Urban**	20	14.5

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	Semi-urban	58	42.0
	Rural	60	43.5
	Total	**138**	**100**
Level of Education	**Primary**	20	14.5
	Secondary	50	36.2
	Tertiary	54	39.1
	None	14	10.1
	Total	**138**	**100**
Occupation	**Formal**	50	36.2
	Unemployed	48	34.8
	Casual work	40	29.0
	Total	**138**	**100**
Duration of diarrhea (days)	**<1**	18	13.0
	1–3	60	43.5
	4–7	38	27.5
	>7	22	15.9
	Total	**138**	**100**
Stool type	**Watery**	92	66.7
	Bloody	16	11.6
	With mucus	20	14.5
	Other	10	7.2
	Total	**138**	**100**
Symptoms	**Vomiting**	72	52.2
	Fever	50	36.2
	Abdominal pain	44	31.9
	Dizziness	20	14.5
	None	16	11.6
	Total	**138**	**100**
Medical conditions	**Yes**	7	5.1
	No	131	94.9
	Total	**138**	**100**
Hospitalization in past month	**Yes**	6	4.3

	No	132	95.7
	Total	**138**	**100**
Medication use	**Yes**	34	24.6
	No	104	75.4
	Total	**138**	**100**
Dietary/fluid intake during illness	**Normal intake**	90	65.2
	Not normal intake	48	34.8
	Total	**138**	**100**
Type of fluids consumed	**Water**	58	42.0
	Juice	20	14.5
	IV fluids	0	0.0
	ORS	2	1.4
	None	58	42.0
	Total	**138**	**100**

The study enrolled 138 respondents presenting with diarrhea. The majority of respondents (29.0%), a number of 40 participants, were aged 18- 35 years, followed by 36 participants below 5 years (26.1%). The elderly (□60 years), 16 participants accounted for 11.6% of the participants. Although diarrhea affected all age groups, young children under 5 years and the elderly were more prone to severe electrolyte imbalances.

Males constituted a slightly higher proportion (51.4%) of the 71 participants in the study population than females (46.4%) of the 67 participants, indicating a marginal male predominance among patients presenting with diarrhea. Most respondents lived in rural (43.5%) areas, with about 60 participants in number, and semi-urban (42.0%) areas, 58 participants in number, while only 20 participants (14.5%) resided in urban settings. Regarding education, secondary having 50 participants (36.2%) and tertiary having 54 participants (39.1%) were the most common, with fewer respondents having primary education having 20 participants (14.5%) or no formal education with 14 participants (10.1%).

Prevalence of Hypokalemia in Diarrheal Patients

Table 2: A Table showing the Prevalence of Hypokalemia

Severity	Age group (years)	Total *(n = 138)*	Percentage (%)
Mild (3.0–3.4 mmol/L)	<5	14	10.1
	5–17	5	3.6
	18–35	8	5.8

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	36–59	5	3.6
	≥60	7	5.1
Moderate (2.5–2.9 mmol/L)	<5	11	8.0
	5–17	3	2.2
	18–35	5	3.6
	36–59	4	2.9
	≥60	5	3.6
Severe (<2.5 mmol/L)	<5	7	5.1
	5–17	2	1.4
	18–35	3	2.2
	36–59	2	1.4
	≥60	5	3.6

Table 2 shows that hypokalemia affected patients across all age groups, with children <5 years being the most affected, contributing a total of 32 cases (23.2%) across all severities. Mild hypokalemia accounted for 14 cases (10.1%), moderate 11 cases (8.0%), and severe 7 cases (5.1%) in this age group. Adults ≥60 years were the second most affected group, contributing 17 cases (12.3%) overall, including 7 mild (5.1%), 5 moderate (3.6%), and 5 severe cases (3.6%).
Adults aged 18–35 years contributed 16 cases (11.6%) of hypokalemia, with 8 mild (5.8%), 5 moderate (3.6%), and 3 severe cases (2.2%). Adolescents aged 5–17 years recorded 10 cases (7.2%), while adults aged 36–59 years contributed 11 cases (8.0%) across all severity levels. Across most categories, males had slightly higher numbers than females. Overall, the pattern shows that mild hypokalemia was the most common, followed by moderate levels, while severe hypokalemia remained less frequent. The age groups <5 years and ≥60 years were consistently the most affected, highlighting increased vulnerability to potassium loss during diarrheal illness.

Discussion

Discussion of Hypokalemia Prevalence

Hypokalemia was even more prevalent in this study, affecting 49.3% (68/138) of participants. Mild hypokalemia accounted for 24.6% (34/138), moderate for 20.3% (28/138), and severe for 5.8% (8/138). Children below 5 years had the highest number of cases across all severity categories, reflecting their rapid potassium depletion during diarrheal episodes. This high prevalence aligns with findings from Pakistan, where Gangaraj et al. 2023) reported 31% hypokalemia in diarrheal children, and Khan et al. (2016) documented 28.6% in a pediatric population.
The prevalence in this study is considerably higher than figures reported in general medical settings. For instance, Ahmad et al. (2016) reported only 7.7% hypokalemia among hospitalized patients, and Adamczak et al (2021) found 0.84% in older adults in the PolSenior study. However, in diarrheal contexts, higher rates are expected

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due to the substantial gastrointestinal loss of potassium in stool. A study in Tehran (Barati et al., 2017) echoed this, highlighting significant potassium loss in severe diarrhoea due to inadequate potassium supplementation during rehydration.

The high hypokalemia prevalence in this study can be linked to prolonged diarrhoea (43.5%, 60/138 had 1–3 days; 15.9%, 22/138 had >7 days), vomiting, reduced food intake (34.8%, 48/138), and minimal use of ORS. Potassium is not replenished when patients consume only water, fruit juices, or no fluids at all, contributing to severe deficiency. The findings emphasize the importance of potassium-containing rehydration therapy and regular electrolyte assessment in diarrheal patients, particularly in children and older adults who are at the greatest risk.

Conclusion

Hypokalemia was found to be a common electrolyte imbalance among patients presenting with diarrhoea, affecting all age groups, with the highest burden observed in children under five years and adults aged 60 years and above. Mild hypokalemia was the most prevalent form, although moderate and severe cases were also present, indicating a significant risk of complications if not properly managed.

Recommendation

Routine screening of serum potassium levels should be implemented for patients with diarrhoea, especially among high-risk groups such as young children and the elderly. Additionally, healthcare providers should strengthen the use of appropriate rehydration therapies and educate patients on adequate nutritional and fluid intake to prevent and manage hypokalemia effectively.

Acknowledgement

I wish to express my profound appreciation to all those whose contributions made the successful completion of this research report possible. My sincere gratitude goes to the lecturers of Mildmay Institute of Health Sciences for their dedication, guidance, and for imparting both theoretical and practical knowledge that have been instrumental in shaping my academic journey.

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List of Abbreviations

CDC	Centers for Disease Control and Prevention
MOH	Ministry of Health
NGO	Non-governmental Organization
NIH	National Institutes of Health
UHPAB	Uganda Health Professions Assessment Board
WHO	World Health Organization

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Data availability

The data is available upon request.

Informed consent

Written informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty.

Source of funding

The study did not receive any external funding.

Conflict of interest

The author did not declare any conflict of interest.

Author contributions

Irene Birungi was the principal investigator.
Hasifa Nansereko, Anthony Ssekitoleko, Francisco Semuwemba, and Jane Frank Nalubega supervised the research project.

Author Biography

Irene Birungi holds a diploma in medical laboratory technology from Mildmay Institute of Health Sciences.
Francisco Ssemuwemba is the dean of the School of Allied Health.
Hasifah Nansereko is the Chairperson, Mildmay School of Allied Nursing and Midwifery-IRC.
Anthony Ssekitoleko and Jane Frank Nalubega are tutors at Mildmay Institute of Health Sciences.

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