Prevalence and Outcomes of Electrolyte Deficiency in Children Under Five with Diarrhea in Mwanza, Tanzania

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Dehydration from diarrhea leads to a loss of vital electrolytes in the body. The prevalence of electrolytes deficiency and its outcomes due to diarrhea among children under five in Mwanza, Tanzania was not clearly known, thus this study was performed to determine this statistic. A cohort study was conducted among 66 children less than five years old suffering from diarrhea attended and admitted to health centers in Mwanza, Tanzania. Vein puncture was performed to obtain peripheral blood, processed, and analyzed for two major electrolytes, Potassium and Sodium. This study was conducted because the loss of vital electrolytes (sodium and potassium) from diarrhea can be fatal if poorly treated. The median age of study participants was 1 year, ranged from 0.6 to 3 years. The prevalence of electrolytes deficiency in the cohort was determined to be 54.5%. Sodium deficiency (Hyponatremia) was the most prevalent (37.9%). After medication and oral rehydration therapy, all of the diarrheagenic children recovered, and those with electrolytes deficiency had their electrolytes balanced. Proper medication with oral rehydration therapy ensures complete recovery from diarrhea and electrolytes balance.

INTRODUCTION

Diarrhea is the passage of three or more loose or liquid stools per day; it may be a result of eating contaminated food and water or from food poisoning and is a common symptom of gastrointestinal infections caused by a wide range of pathogens, including bacteria, viruses and protozoa (Black et al., 1980; Kothari VR, & Thakur NA, 2014). Dehydration can be identified by experiencing dizziness, thirst, fatigue, infrequent urination and dark colored urine, nausea and headaches can leave the body without the electrolytes necessary for survival (Hirschhorn, 1980; Mackenzie, Barnes, & Shann, 1989). The electrolytes found in the body are potassium, calcium, sodium, magnesium, bicarbonate and chloride for cells functioning and signaling. According to WHO estimates; diarrheal disease is the leading cause of under-five mortality and is responsible for killing around 760,000 children every year (Kothari VR, & Thakur NA, 2014).

Epidemiological studies have shown that in developing countries, there are an estimated 1.3 billion episodes and 3.2 million deaths of those under age five each year due to diarrhea (Rahman, 2014). Overall, these children experience an average of 3.3 episodes of diarrhea per year, but in some areas, primarily in developing countries, the average exceeds 9 episodes per year (Rahman, 2014). Where episodes are frequent, children may spend more than 15% of their days with diarrhea and about 80% of deaths that occur in the first two years of life are due to the condition. In developing countries 50% of pediatric hospitalizations are due to acute diarrhea (Rahman, 2014).

A study carried out by the BP Koirala Institute of Health Sciences in Dharan, Nepal that examined acid, base, and electrolyte disturbance in diarrhea showed 56% sodium deficiency (hyponatremia), 46% potassium deficiency (hypokalemia) and 26% combined (hyponatremia and hypokalemia) (Shah, Das, Kumar, Singh, & Bhandari, 2007). The same study reported five children out of 57 had died due to electrolytes loss from diarrhea (Shah et al., 2007).

Statistical information about the prevalence of electrolyte deficiency and the outcomes among children under five years old with diarrhea that attended or was admitted to healthcare centers in Mwanza, Tanzania was not clearly known. We hypothesized that, vital electrolytes (sodium and potassium) are lost together with water due to excessive diarrhea among children under five years old. The outcome of vital electrolytes lost can be fatal, so this study was designed to guide management of children under five years old with diarrhea for early and complete recovery.

MATERIALS AND METHODS

A cohort study was conducted between July and August 2016. All children less than five years old suffering from diarrhea who was admitted at the pediatric wards in Mwanza Healthcare centers and whose parents or guardians gave their consent to take part in this study were used in the study. A serial sampling method was used to determine eligibility of these study participants. About 2.5 to 5ml of two blood samples were collected from each participant and...
placed in a plain vacutainer tubes whereby the serum was extract-
ed for electrolytes (sodium and potassium) analysis. Blood sample
A was collected on the first day of participant admission or visit
and sample B, as a follow up to sample A, was collected three
days after administering oral rehydration solution (ORS) or antibiotics
to all participants with electrolyte(s) [sodium and/or potassium] 
deficiency results.

**Laboratory Procedure**

Extracted sera were analyzed within two hours after specimen col-
lection for sodium and potassium following the internal standard
operating procedures, and as per reagents manufacturer guidelines
for the SP Twin Electrolytes Test Kit (ARKRAY Healthcare Pvt.
Ltd, India) in the Corolimeter manual analyzer (CL 157 Colorim-
eter).

**RESULTS**

**Demographic and Clinical Characteristics of Participants**

During this study, a total of 66 children were enrolled. Out of those,
53.0% (35/66) were females. The median age of study participant
was 1 (IQR: 0.6-3) year (Table 1).

**Electrolyte Deficiency Results**

The overall prevalence of electrolytes deficiency in diarrheagenic
under-five children was 54.5% (36/66). Hyponatremia, hypokale-
mia and both (hyponatremia and hypokalemia) electrolytes defi-
ciency were observed in 37.9% (25/66), 16.7% (11/66) and 15.2%
(10/66) of the cohort respectively.

**Factors Associated with Electrolyte Deficiency**

Factors found to be connected with electrolytes deficiency among
diarrheagenic under-five children in the bivariate analysis were 1) 
Present of symptoms like fever, vomiting and dehydration, 2) Du-
ration of diarrhea, and 3) Diarrhea treatment. Children with symp-
toms such as fever, vomiting and dehydration showed electrolyte
deficiency; 20/58 (34.5%) had hyponatremia, 10/58 (17.2%) had
hypokalemia, and 8/58 (13.8%) had both (p = .707) (Table 2).

Considering the duration of diarrhea, most of children showed
electrolyte deficiency during the early three up to seven days of
diarrhea; 13/36 (36.1%) had hyponatremia, 6/36 (16.7%) had
hypokalemia, and 8/36 (22.2%) had both hypokalemia and hypona-
tremia (p = .651).

Following diarrhea treatment with ORS, antibiotics or both,
for those who did not received any treatment; 12/34 (35.3%) had
hyponatremia, 4/34 (11.8%) had hypokalemia and 9/34 (26.5%)
had both hypokalemia and hyponatremia (p = .031) (Table 2).

**Electrolyte Deficiency Outcomes**

Out of 66 diarrheagenic children, 40 recovered completely, 18
were still suffering from diarrhea and 8 were lost prior to follow-
up (discharged or did not attend next visit) with no record of death.
Among the cohort, 32 received management with antibiotics, ORS
or both, whereby 62.5% (20/32) recovered completely from diar-
rhea (p = .0069). All diarrheagenic children who had recovered
after treatment, 20/20 (100%) had balanced electrolytes from day
three of follow up (Table 3).

**DISCUSSION**

In this study, the prevalence of electrolytes deficiency among un-
der-five diarrheagenic children was 54.5%, with the most preva-
lent depleted electrolyte being sodium (hyponatremia), 37.9%
followed by potassium depletion (hypokalemia), 16.7%. This is
comparable to another study done in Dharan, Nepal which found
that the most prevalent depleted electrolyte among children with
diarrhea was sodium (hyponatremia), 56% (Shah et al., 2007). An-
other study done in Nigeria in 2015 on serum electrolyte profiles
in children admitted with dehydration due to diarrhea showed that
hyponatremia and hypokalemia ranked first and second by 60.5%
and 44.3% respectively (Onyiriuka, & Iheagwara, 2015). Sodium
and potassium are the major lost electrolytes in diarrhea because
they form intracellular and extracellular fluids respectively at the
sodium-potassium pump (Skou, 1989).

The current study found that, electrolytes deficiency among diarrhoeagenic children to be associated with clinical symptoms like fever, duration of diarrhea and treatment type as previously reported (Bahl et al., 2002; Donowitz, Kokke, & Saidi, 1995; Thapar, & Sanderson, 2004; Weiner, & Epstein, 1970). The more episodes of diarrhea a child experiences, the greater amount of water and electrolytes are lost (Thapar, & Sanderson, 2004). Lack of treatment therapy to replace water and electrolytes results in a high level of deficiency (Thapar, & Sanderson, 2004).

This study found that most of the children experienced electrolyte deficiency after suffering from diarrhea during the early three to seven days. This may be because during the early days they had not yet received treatment; thus, the results showed electrolytes had decreased. However, as the days went on they underwent treatment and their levels began to rise as ORS replaced the lost electrolytes. Diarrhea treatment either with ORS or antibiotics ensures recovery and a rise in electrolyte levels (Hirschhorn, 1980). But for those children who received antibiotic treatment and ORS, still in diarrhea may be the exact aetiological cause of diarrhea was not bacteria (Black et al., 1980; Hirschhorn, 1980).

Most patients with electrolyte deficiency recovered completely after receiving treatment; those who had not received any treatment but recovered may have been affected by a bacterial toxin, in which case the diarrhea usually stops itself after some time (self-limiting) (Challapalli, Tess, Cunningham, Chopra, & Houston, 1988).

**CONCLUSION**

The current study found high prevalence of electrolytes deficiency, 54.5% among children under five years old with diarrhea. Electrolytes deficiency was connected with fever, vomiting and dehydration. The use of ORS as part of diarrhea management to replace water and the lost electrolytes is recommended. This study was unable to determine the aetiological causative agent of diarrhea among children under five years old. Further studies should attempt to determine the aetiological causative agent of diarrhea cases.

**REFERENCES**


