Original Research Article

Clinical profile and pattern of water and sodium disturbances in children suffering from diarrhoea with dehydration- experience of a tertiary care center

Manoj Kumar Ram[1], Dinesh Kumar Rajak[2*], Girijanand Jha[3], Binod Kumar Singh[4], Alka Singh[5]

[1]Assistant Professor, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India
[2]Assistant Professor, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India
[3]Senior Resident, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India
[4]Professor and HOD, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India
[5]Professor, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India

Received: 04-11-2021 / Revised: 27-12-2021 / Accepted: 13-01-2022

Abstract

Background and Objectives: Diarrhoeal disorders contribute significantly to childhood morbidity as well as mortality. Despite much advancements in medical field, diarrhoea continues to be the 3rd most common cause of deathin children less than 5 years of age. The commonest cause of complications in acute diarrhoea is dehydration and dyselectrolytemia, particularly sodium disturbances. Thorough understanding of variousclinical features, high index of clinical suspicion, timely recognition and proper managementof different types of dehydration is necessary in preventing deaths. Based on this background, we intended to study the clinical profile as well as spectrum of sodium disturbances in children suffering from AGE with some to severe dehydration. **Methodology:** We conducted this prospective observational study over 1 year from September 2020 to August 2021 at department of Pediatrics, NMCH, Patna, Bihar including children of 6-60 months of age admitted with acute diarrhoea and clinical features suggestive of some or severe dehydration as per WHO criteria. **Results:** Over the study period, we enrolled 148 children. Of these, 90 were males and 58 were females. Mean age at presentation was 2.04 ± 0.97 years and mean weight on admission was 9.553 ± 3.826 Kg.Mean serum sodium level was 138.6 ± 8.25 mEq/L. Majority of children suffered from isonatremic dehydration (n= 89, 60.1%) followed by hyponatremic dehydration (n= 45, 30.4%) and hypernatremic dehydration (n= 14, 9.5%).Only 51 (34.5%) children had been administered ORS prior to admission, while the rest 97 (65.5%) were deprived of this life saving remedy. Of these only 18 (35.3%) were given ORS in appropriate dilution and the rest 33 (64.7%) were given either over- or under concentrated ORS. Malnutrition was found in 51 (34.5%) children. 27 (52.9%) of such malnourished children had hyponatremia, 14 (27.4%) had Isonatremia and 10 (19.6%) had hypernatremia.Duration of hospital stay was 3.67 ± 1.39 days. Duration of hospital stay was maximum in children with hypernatremia, however no statistically significant trend was found between type of sodium disturbance and duration of hospital stay (p=0.13). Average duration of hospital stay in malnourished children was higher (4.75 days) as compared to non-malnourished children (3.0 days) which was statistically significant (p<0.01). Unfortunately, 10 (6.75%) children died. Hypernatremic dehydration had the highest mortality rate (14.3%) as compared to hyponatremic dehydration (5.7%) or isonatremic dehydration (5.6%). But, no statistically significant trend was found between the type of sodium disturbance and mortality (p=0.17). **Conclusion:** The incidence of sodium disturbance (hyponatremia and hypernatremia) in children is quite high (nearly 40%). Malnourished children and children taking improperly diluted WHO ORS were at a significantly higher risk of developing hyponatremia or hypernatremia. Hypernatremia in AGE was noted to be significantly more in infants of 6-12 months when compared to 1–5-year-old children. AGE with hyponatremia or hypernatremia is significantly associated with increased risk of seizures, increased duration of hospital stay and increased risk of death as compared to AGE with isonatremia.

Keywords: acute gastroenteritis, dehydration, diarrhea, hyponatremia, isonatremia, hypernatremia, ORS.

Introduction

Diarrhoeal disorders are a major public health problem worldwide, more so in low- and middle-income countries. This condition contributes to significant mortality as well as morbidity in children under five years of age. Over the last few years, India has witnessed a steady reduction of mortality in children younger than age of 5 years, with total deaths having declined from 2.5 million in 2001 to 1.5 million in 2012[1]. Such remarkable reduction could actually happen due to the inception and successful implementation of health programs like expanded program on immunization, program for the control of diarrheal diseases and acute respiratory infection. Whereas the overall mortality among children under-5 years hasreduced considerably, diarrhoeal diseases still account for a high proportion of such deaths. In children less than 5 years of age, diarrhoea is the 3rd most common cause of death which is responsible for 13% deaths in this age-group. It is estimated that diarrhoea still killsover 300,000 children in India each year[2]. Due to such high burden, it is very important to monitor information on diarrheal diseases, its determinants as well as preventive and control strategies to ensure better planning and organization of health services in a community.

WHO defines diarrhoeal disease as the passage of three or more loose or liquid stools per day. The high incidence of diarrheal disorders in India can be explained by under-nutrition and increased vulnerability to infections resulting from poor infant and young child feeding practices: failing to exclusively breastfed for the first 6 months of life, using infant feeding bottles, storing cooked food at room temperature, using drinking-water contaminated with faecal bacteria, poor education, socioeconomic status, sanitary conditions and unfortunate trend of early breast milk substitutes[3,4]. The clinical manifestations of acute diarrhoea are reflective of the underlying water deficit severity as well as pattern of electrolyte disturbances. The commonest

*Correspondence
Dr. Dinesh Kumar Rajak
Assistant Professor, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India.
E-mail: drgiriped@gmail.com

cause of mortality in acute diarrhoea is hypovolemia due to dehydration resulting from the loss of fluid and electrolytes in diarrheal stools. Other important causes of mortality are dyselectrolytemia, malnutrition, dysentery, associated serious infections such as pneumonia[5].Clinical recognition and prompt management of water and electrolyte disturbances is therefore of utmost importance, particularly hyponatremic and hypernatremic dehydration given their serious neurological consequences. Clinical features of these conditions are deceptive and the consequences can become irreversible if not treated appropriately. Hyponatremia usually becomes symptomatic when serum sodium has fallen rapidly below< 120 mEq/L.Hypernatremic dehydration on the other hand manifests quite late and is likely to be erroneously underestimated as mild dehydration[6]. Though hyponatremic dehydration and hypernatremic dehydration are less common when compared to isonatremic dehydration[7], a strong clinical suspicion is required for prompt diagnosis of these conditions. Proper management of diarrhoea and accompanying electrolyte imbalance requires judicious use of oral rehydration solution and/or intravenous fluids for repleting water deficit and correction of electrolyte imbalance. In some cases, these children are often brought to hospital late with severe dehydration and/or shock which mandates admission in pediatric intensive care unit for institution of proper therapy.Based on this background, this study was conducted at our tertiary care level teaching hospital to study the clinical profile as well as spectrum of sodium disturbances in children suffering from AGE with some to severe dehydration and to relate those parameters with their clinical status.

Aim & objectives

Aim

To study the occurrence of water and salt disturbances in children suffering from acute gastroenteritis with dehydration.

Objectives

- To study the clinical profile of children suffering from AGE with some or severe dehydration.
- To study the incidence of hyponatremia, isonatremia and hypernatremia in these children.
- To study the occurrence of hyponatremic, isonatremic and hypernatremic dehydration in relation to gender, age, malnutrition and ORS therapy.
- To study the outcome of these children.

Methodology

Study setting

I.P.D ward of department of Paediatrics at N.M.C.H, Patna, Bihar, India.

Study design

Prospective observational study.

Study duration

September 2020 to August 2021 (one year).

Inclusion criteria

Children of age 6 months to 5 years admitted in Pediatric ward with:

- Passage of 3 or more episodes of watery stools per day, and
- Duration of symptoms less than 2 weeks at the time of admission, and
- Clinical features suggestive of some or severe dehydration as per WHO criteria.

Exclusion criteria

Children with chronic diarrhoea, children with diarrhoea but no dehydration, children with serious systemic illnesses like pneumonia, nephrotic syndrome, congestive cardiac failure, chronic hepatitis as well as children in their post operative period were excluded from our study.

Study technique

After obtaining written informed consent, we evaluated participants for enrolment in the present study as per aforementioned inclusion and exclusion criteria. Information regarding demographic profile, socioeconomic status and detailed symptoms was collected and entered in a structured proforma. Clinical examination was done do assess the level of dehydration in these children at the time of admission. Nutritional status of the child was graded as per IAP classification of malnutrition. We also collected data regarding consumption of ORS, correctness of preparation and volume administered in detail. Blood sample was sent for estimation of serum electrolytes, random blood sugar, blood urea and serum creatinine at the time of admission. Children were managed as per standard WHO protocol, adequately hydrated and serum electrolytes were repeated as and when required. Hyponatremia was defined as serum sodium <135 meq/L, isonatremia between 135-145 meq/L and hypernatremia was taken as serum sodium >145 meq/L.

Statistical analysis

Data so collected was recorded, tabulated and entered in Microsoft excel sheet, and then analysed by using statistical software "SPSS ver.20®. Variables were expressed as mean, standard deviation, proportions and percentiles as appropriate. Dichotomous variables were compared using Chi-square test whereas continuous variables were compared using Student t-test. P-value <0.05 was taken as significant.

Observations & results

Over the study period, we enrolled 148 children with diarrhoea in our study. Of these, 90 were males and 58 were females. Mean age at presentation was 2.04 ± 0.97 years and mean weight on admission was 9.553 ± 3.826 Kg. AGE was more common in age group of 1 to 5 years (56.1%) as compared to 6-12 months infants (43.9%). Childhood gastroenteritis was more common in families with poor socioeconomic status. In the present study, 58.1% children belonged to class IV&V, 27.70% belonged to class III, while only 14.2% belonged to class I&II (modified B. G. Prasad's socioeconomic classification). 23 children had severe dehydration whereas the rest 125 had some dehydration. Table 1 depicts the general characteristics of our study population.

Table 1: General characteristics of the study population

Parameter	Value
Total no. of children enrolled	148
Male: Female ratio	1.55: 1
Age in years (Mean ± SD)	2.04 ± 0.97
Weight in Kg (Mean ± SD)	10.55 ± 3.82
Serum Sodium level at admission in mEq/L (Mean ± SD)	138.6 ± 8.25
Duration of diarrhoea in days (Mean ± SD)	3.16 ± 0.84
Number of loose stools per day (Mean ± SD)	11.66 ± 5.49
Duration of vomiting episodes in days (Mean ± SD)	2.32 ± 1.41
Number of vomiting episodes per day (Mean ± SD)	3.08 ± 1.91
Duration of hospital stay in days (Mean ± SD)	3.67 ± 1.39

Sodium alteration

Mean serum sodium level was 138.6 ± 8.25 mEq/L which lies in the normal range. Nevertheless, majority of children suffered from isonatremic dehydration (n= 89, 60.1%) followed by hyponatremic dehydration (n= 45, 30.4%) and hypernatremic dehydration (n= 14, 9.5%). Table 2 depicts the serum sodium alteration in relation to age and gender. Interestingly, incidence of hypernatremia was significantly higher in infants as compared to older children (p= 0.006). However, there was no sex predilection for the different types of sodium disturbances in these children.

Table 2: Sodium alteration in relation to age and gender

Age	Hyponatremia		Hypernatremia		Isonatremia	
	Number	Percentage	Number	Percentage	Number	Percentage
6months- 1 year	23	35.38	11	16.92	31	47.69
1-5 YEARS	22	26.5	3	3.61	58	69.87
Gender	**Hyponatremia**		**Hypernatremia**		**Isonatremia**	
	Number	Percentage	Number	Percentage	Number	Percentage
Male	29	32.2	7	7.8	54	60.0
Female	16	27.6	7	12.1	35	60.3

ORS in relation to gastroenteritis

Out of the 148 children studied, only 51 (34.5%) had been administered ORS prior to admission, while the rest 97 (65.5%) were deprived of this life saving remedy. This differential usage of ORS was statistically significant (p <0.01) between the two groups. Among the 51 children who were administered ORS, only 18 (35.3%) were given ORS in appropriate dilution and the rest 33 (64.7%) were given either over- or under concentrated ORS. Children having received diluted ORS had a higher incidence of hyponatremia as compared to children who were given properly diluted ORS (P <0.01). Similarly, children who were given concentrated ORS had a higher incidence of hypernatremia as compared to children who were given properly diluted ORS (P <0.01). Table 3 depicts sodium alterations in relation to the dilution of ORS.

Table 3: Sodium changes in relation to dilution of ORS

	Hyponatremia		Hypernatremia		Isonatremia	
	Number	Percent	Number	Percent	Number	Percent
Appropriate dilution (n=18)	2	11.1	0	0	16	88.9
Diluted ORS (n=23)	19	82.6	0	0	4	17.4
Concentrated ORS (n=10)	0	0	8	80.0	2	20.0

Nutritional status of children with AGE

Among the 148 children studied, malnutrition was found in 51 (34.5%) children. Of these 51 malnourished children, 23 had grade I, 16 had grade II, 8 had grade III and 4 had grade IV malnutrition. 27 (52.9%) of such malnourished children had hyponatremia, 14 (27.4%) had Isonatremia and 10 (19.6%) had hypernatremia. Malnourished children had a higher incidence of hyponatremia (p <0.01) and hypernatremia (p <0.01) as compared to non-malnourished children. Table 4 depicts sodium changes in different grades of nutrition.

Table 4: Grades of nutrition in relation to serum sodium alteration

Nutritional status	Hyponatremic dehydration (n=45)		Hypernatremic dehydration (n=14)		Isonatremic dehydration (n=89)	
	Number	Percent	Number	Percent	Number	Percent
Normal (n=97)	18	40.0	4	28.6	75	84.3
Grade I PEM (n=23)	13	28.9	2	14.3	8	8.9
Grade II PEM (n=16)	8	17.8	3	21.4	5	5.6
Grade III PEM (n=8)	4	8.9	3	21.4	1	1.1
Grade IV PEM (n=4)	2	4.4	2	14.3	0	0.0

Degree of dehydration in relation to the sodium alteration

86 out of 125 (68.8%) children with some dehydration had normal sodium levels, whereas only 3 out of 23 (13.04%) children with severe dehydration had normal sodium levels. 60.86% of children with severe dehydration suffered from hyponatremia, while only 24.8% of children with some dehydration developed hyponatremia. Similarly, 26.08% of children with severe dehydration suffered from hypernatremia, while only 6.4% of children with some dehydration developed hypernatremia as shown in table 5.

Table 5: Comparison of degree of dehydration and sodium levels

Degree of dehydration	AGE with hyponatremia (N=45)		AGE with hypernatremia (N=14)		AGE with isonatremia (N=89)	
	N	%	N	%	N	%
Some (125)	31	68.89	8	57.14	86	96.63
Severe (23)	14	31.11	6	42.86	3	3.37

Outcome

Overall, the duration of hospital stay of the enrolled children was 3.67 ± 1.39 days. Duration of hospital stay was maximum in children with hypernatremia, however no statistically significant trend was found between type of sodium disturbance and duration of hospital stay (p=0.13). The average duration of hospital stay in malnourished children was higher (4.75 days) as compared to non-malnourished children (3.0 days) which was statistically significant (p<0.01). Incidence of seizures in this study was 4.72%(7 cases). Out of these 7 children, 3 were hyponatremic and 4 were hypernatremic. No seizures occurred in isonatremic group. Incidence of seizures in hyponatremic dehydration was 6.66% whereas in hypernatremic dehydration it was 28.6%.Unfortunately, 10 children died during their hospital stay (mortality rate= 6.75%). All deaths occurred within 48 hours of admission and all such children had presented late to the hospital. The principal cause of death in such children could be attributed to the severity of hypovolemia and/or electrolyte disturbances. Apparently, hypernatremic dehydration had the highest mortality rate (14.3%) as compared to hyponatremic dehydration (5.7%) or isonatremic dehydration (5.6%). However, no statistically significant trend was found between type of sodium disturbance and mortality (p=0.17). Table 6 depicts the outcome of these children in terms of duration of hospital stay and mortality in relation to the severity of sodium disturbance.

Table 6: Duration of hospital stay & mortality with respect to the severity of sodium disturbance

	AGE with hyponatremia (N=45)	AGE with hypernatremia (N=14)	AGE with isonatremia (N=89)
Duration of hospital stay in days (Mean ± SD)	3.55 ±1.35	4.14 ± 1.47	3.36 ± 1.27
Mortality	3 (6.7%)	2 (14.3%)	5 (5.6%)

Discussion

Acute gastroenteritis (AGE) denotes infection of the gastrointestinal tract although several non-infectious causes of vomiting and/or diarrhoea are well recognized. In the present study, 148 children with AGE and some or severe dehydration were enrolled and studied.

We found AGE to be more common in age group of 1 to 5 years (56.1%) as compared to 6-12 months infants (43.9%). Age distribution in our study was similar to the study conducted by Smok B et al[8] (18% in infancy, 82% in >1 year). However, some Indian studies have reported slightly higher prevalence during infancy[9]. We found higher incidence of diarrhoea in males as compared to females (65.5% vs 34.5%). The sex distribution in our study was similar to the studies conducted by Gopchade A[10] who reported that almost two-third cases of AGE occurred in male children. However, such higher rate of admission in males may also be due to preferential rate of admission of male children in our society. In our study the incidence of hyponatremia was 30.4%, hypernatremia was 9.45% and isonatremia was 60.15%. There is a general agreement that isonatremic dehydration is the commonest type of dehydration and the same has been reported by different researchers in India[11,12]. Among the hyponatremic children, 51.11%(23) were infants of 6-12 month and 48.88%(22) were older 1–5year children. However, Samadi AR et al[13] showed that incidence of hyponatremia was different among different age groups and the incidence of hyponatremia increases with age. In the present study, incidence of hypernatremia was significantly higher in infants as compared to older children (78.6% vs 21.4%, p <0.01). Such higher prevalence of hypernatremia in younger infants might be attributed to the use of overconcentrated ORS or formula milk and larger evaporative water loss through skin of young children[14]. Neither hyponatremia nor hyponatremia was found to affect a particular gender preferentially. Incidence of hyponatremia was significantly higher among children who were given diluted WHO ORS (82.60%) compared to children who were given appropriate WHO ORS (11.11%). Similarly, the incidence of Hypernatremia was significantly higher among children who were given concentrated WHO ORS (80%) compared to children who were given appropriate WHO ORS (20%). Dastidar et al[15] have also highlighted the importance of appropriate dilution of ORS in diarrhoeal children to reduce the risk of sodium imbalance. More than half of the children (58.12%) belonged to lower socioeconomic groups of class IV and Class V of modified B.G. Prasad's classification[16]. This could be due to high prevalence of risk factors such as poor sanitation, unhygienic practices, illiteracy, unsafe water and food etc. in these underprivileged people.34.5% of children were malnourished in this study which didn't surprise us. Anand K et al[17]reported prevalence of moderate to severe malnutrition in their study children was 35% out of which 8.8% were severely malnourished. Malnourished children had a longer hospital stay as compared to children of adequate nutritional status (4.75 days vs 3 days, p <0.01). Such children also had a significantly higher incidence of hyponatremia and hypernatremia. Malnourished children due to their poor nutritional reserve are generally sicker and more prone to suffer from complications.

Incidence of seizures in this study was 4.72% (7 children). Out of these 7 children, 3 were hyponatremic and 4 were hypernatremic. Incidence of seizures in hyponatremic dehydration was 6.66% whereas in hypernatremic dehydration it was 28.57%. Caksen et al[18] reported a higher incidence of seizures in 15.3% of patients with hyponatremicdehydration whileEkteish Abu F et al[19] reported only 9% incidence of seizures in hypernatremicdehydration. Apparently, hypernatremic dehydration had the highest mortality rate (14.3%) as compared to hyponatremic dehydration (5.7%) or isonatremic dehydration (5.6%). But, no statistically significant trend was found between type of sodium disturbance and mortality (p=0.17). However, Eke F et al[20] showed significant difference in mortality rate between Hypernatremia and isonatremia, which probably had resulted from a high incidence of inadequately diluted formula feeds in their study.

Conclusion

The incidence of sodium disturbance (hyponatremia and hypernatremia) in children with AGE and dehydration is quite high (nearly 40%).Malnourished children and children taking diluted WHO ORS were at a significantly higher risk of developing hyponatremia in AGE.Hypernatremia in AGE was noted to be significantly more in infants of 6-12 months when compared to 1–5-year-old children. Malnourished children and children taking concentrated WHO ORS were significantly at increased risk of developing hypernatremia in AGE.AGE with hyponatremia or hypernatremia is associated with increased risk of seizures, increased duration of hospital stay and increased risk of death as compared to AGE with isonatremia. Hence, it is imperative on the part of the treating paediatrician to be alert for the occurrence of dyselectrolytemia and its complications. Clinical as well as laboratory monitoring would help manage such children properly.

Limitations of this study

First limitation is that ours is a single centre study and so our findings might not be reflective of the general population. Second limitation is that we didn't do long term follow up of these patients. Third limitation is that we didn't include children with AGE and systemic illness(es) in our study. However, this was done for the making the study population more homogenous.

References

1. Bhan MK. Accelerated progress to reduce under-5 mortality in India. Lancet Glob Health. 2013;1(4):e172-3.
2. Million Death Study Collaborators, Bassani DG, Kumar R, Awasthi S, Morris SK, Paul VK, Shet A et al. Causes of neonatal and child mortality in India: a nationally representative mortality survey. Lancet. 2010 Nov;376(9755):1853-60.
3. Troeger C, Blacker BF, Khalil IA, Rao PC, Cao S, Zimsen SR et al. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of diarrhoea in 195 countries: a systematic analysis for the global burden of disease study 2016. Lancet Infect Dis. 2018;18(11):1211–28.
4. Lakshminarayanan S, Jayalakshmy R. Diarrheal diseases among children in India: Current scenario and future perspectives. J Nat Sci biol Med. 2015;6(1):24-27.
5. GBD Diarrhoeal Diseases Collaborators. Estimates of global, regional, and national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Infect Dis. 2017 Sep;17(9):909-948.
6. Ben-Shalom E, Toker O, Schwartz S. Hypernatremic Dehydration in Young Children: Is There a Solution? Isr Med Assoc J. 2016 Feb;18(2):95-9.
7. Shah G, Das B, Kumar S, Singh M, Bhandari G. Electrolyte disturbances in diarrhoea. PediatrOncall J. 2006;3: 61-62.
8. Smok B, Zieniewicz-Cieślik K, Smukalska E, Pawłowska M. Acute diarrhoea induced by rotavirus in children hospitalysed in Provincial Hospital for Infectious Diseases in Bydgoszcz in 2014 year. PrzeglEpidemiol. 2016;70(3):462-70.
9. Behera SK, Mohapatra SS, Kar S, Das D, Panda C. Incidence and mortality of hospitalized diarrhoea cases. Part III. Indian Pediatrics. 1980; 17: 607-12.
10. Gopchade A. Electrolyte Disturbances in Children Presenting with Acute Diarrhea: A Prospective Cohort Study. JMSCR.2019;7 (9): 777-83.
11. Pratima P, Geethanjali PM. Study of electrolyte imbalance in children suffering from acute gastroenteritis of under 5 age group. J Evid Based Med Healthc. 2018; 5(46): 3210-13.
12. Ankireddy K, Kumar RT. A prospective study on biochemical disturbances among cases of acute diarrhoea in children attending a tertiary care hospital of South India. Int J ContempPediatr. 2019; 6 (1):1-4.
13. Samadi AR, Wahed MA, Islam MR, Ahmed SM. Consequences of hyponatraemia and hypernatraemia in children with acute diarrhoea in Bangladesh. Br Med J (Clin Res Ed). 1983; 286(6366):671-3.
14. Bannister A,Hatcher GW.Treatment of hypernatraemic dehydration in infancy. Archives of Disease in Childhood. 1975; 50:179-86.
15. Dastidar RG, Konar. A Study of Electrolyte Disturbances in a Child Presenting with Acute Gastroenteritis, with Special

Emphasis on Hyponatremic Dehydration-A Hospital based CrossSectional Study. PediatrTher. 2017; 7: 322-25.
16. Mangal A, Kumar V, Panesar S, Talwar R, Raut D, Singh S. Updated BG Prasad socioeconomic classification,2014. Indian journal of public health. 2015;59(1):42-4.
17. Anand K, Sundaram KR, Lobo J, Kapoor SK. Are diarrheal incidence and malnutrition related in under five children? A longitudinal study in an area of poor sanitary conditions. Indian Pediatr. 1994;31:943–8.
18. Caksen H, Odabas D, Sar S, Celebi V, Arrlan S, Kuru M, Abuhandan M. Hyponatremic dehydration: an anlysis of 78 cases. Int Urol Nephrol 2001; 33(3):445-8.
19. Abu-Ekteish F, Zahraa J. Hypernatraemic dehydration and acute gastro-enteritis in children. Ann Trop Paediatr. 2002;22(3):245-9.
20. Eke, Nte.A prospective clinical study of patients with hypernatraemic dehydration. Afr J Med Med Sci. 1996;25(3): 209-12.

Conflict of Interest: Nil
Source of support: Nil