

# Severity of Diarrhea and Dehydration in Children Under 5 Years

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**Abstract:** *The aim of this study was to assess the severity and type of dehydration in children with diarrhea who were admitted hospital. This is a retrospective study. A total of 345 cases of acute diarrhea mainly in children below 5 years of age admitted at tertiary care Pediatric hospital in University Center "Mother Theresa" over the period 2011-2013 were included in the study. Medical history, diarrhea symptoms, treatment prior to hospitalization and demographics were obtained from medical records. Dehydration degree was assessed and all patients were treated with intravenous fluids. 345 (99%) of children had a moderate dehydration whereas 3 (1%) children who were unable to drink/swallow had a severe dehydration. Upon admission, 137 (39.7%) patients had isotonic dehydration, 201 (58.3%) hypotonic and 6 (5%) had mild hypertonic dehydration. The mean Na value upon admission was 133.7 ( $\pm 5.4$ ) mmol/l whereas with hydration the mean value increased to 136.8 ( $\pm 3.2$ ) mmol/l ( $p < 0.01$ ). The management of dehydration, its prevention and it is very important in the management of diarrheal diseases, irrespective of etiology.*

**Keywords:** diarrhea, severity, children, dehydration, fluids

## 1. Introduction

Gastroenteritis is one of the most common medical conditions seen by pediatricians, accounting for over 150,000 hospitalizations per year or approximately 10% of all hospital admissions in children <5 years of age in many countries (1). Patients with diarrhea should first be assessed quickly to determine the nature and pattern of diarrhea, the degree of dehydration (no signs of dehydration, some or severe dehydration), and the presence of any other comorbidities and malnutrition, in order that appropriate treatment can be initiated without delay. Although most patients with infectious diarrhea can be treated at an outpatient clinic or at home, some patients will still need hospitalization, mainly for intravenous rehydration (2). The three essential parts in the effective clinical management of acute diarrhea are: prevention of dehydration, if the patient is not already dehydrated; prompt rehydration therapy by oral or intravenous fluids when dehydration is present, followed by maintenance therapy; and maintaining the patient's usual diet during and after diarrhea. The common approach to intravenous fluid therapy for these children has been to administer sodium chloride (NaCl) to make up for the losses plus and maintenance if patients are unable to get oral rehydration solution (3). The majority of patients with gastroenteritis have isotonic dehydration. In these patients, the volume deficit is primarily extracellular. Hypotonic maintenance fluids are not appropriate for patients with increased arginine vasopressin (AVP) as this will result in hyponatremia due to free water retention (4). A better strategy in the management of children with gastroenteritis would be to administer a continuous infusion with a sodium concentration of 0.9% NaCl following intensive therapy. 0.9% would not only serve as prophylaxis against hyponatremia, but it yields better results than hypotonic fluids in enlarging the extracellular volume and correcting the volume deficit faster. 0.9% NaCl could be discontinued in favor of a hypotonic solution once the patient is deemed to be volume saturated, as evidenced by good peripheral

perfusion and urine output, and intravenous fluid could be stopped altogether when oral fluids are taken well. 0.9% would seem to be the best choice to correct volume depletion and prevent the development of dysnatremia in patients with gastroenteritis, but it is not without risk (5). Hypertonic dehydration can develop in patients with gastroenteritis treated with 0.9% NaCl from either large gastrointestinal water losses or increased water losses from high fever (6). These high-risk patients should be closely monitored, and measures to prevent hypernatremia should be taken. 0.9% NaCl should only be used until the patient is assessed to be volume saturated, at which point hypotonic fluids could be used (7). Electrolytes should be monitored at least daily in these high-risk patients, and isotonic fluid should be discontinued if the patient is hypernatremic (sodium >144 mEq/L). Under normal circumstances, serum sodium (Na) concentration is tightly controlled by osmoreceptors interacting with the thirst center and the vasopressin-kidney axis (8). The aim of this study was to assess the severity and type of dehydration in children with diarrhea who were admitted hospital.

## 2. Material and Methods

This is a retrospective study. A total of 345 cases with diagnosis of acute diarrhea and dehydration mainly in children below 5 years of age admitted at tertiary care Pediatric Hospital in University Center "Mother Theresa" over the period 2011- 2013 were included in the study. Medical history, diarrhea symptoms, treatment prior to hospitalization and demographics were obtained from medical records. None of the patients had renal disease, endocrinopathy, heart failure or central nervous system disorders. Weight and body mass index (BMI) measurements were available for all patients. Also, patients were weighted on the following day. Patients who had at least two serum Na measurements, one on admission and the second between 4 and 24h. The severity of dehydration was assessed according to standard clinical methods (9), and if

the patient had evidence of hypoperfusion, normal saline, 10-40 ml/kg was infused over 1-2 h. Subsequently, the estimated fluid deficit (based on the degree of dehydration/acute weight loss) and maintenance fluid was replaced with the administration of 5% dextrose in 0.2% to 0.45% saline over 24h

### Statistical Analysis

Data analysis was performed using statistical software SPSS 16. The  $\chi^2$  test (goodness of fit) was used to compare the percentages within categorical variables. Paired t test was used to examine changes in measurements within patients. A p value  $\leq 0.05$  was considered statistically significant.

## 3. Results and Discussion

The mean age of children with diarrhea was 20.3  $\pm$  28.8 (SD) months. One hundred ninety-one children (55.4%) were boys. 181 (52.5%) were younger than 12 months of age, 132 (38.3%) were between 1 and 4 years of age and 32 (9.3%) were elder than 4yrs of age. The vast majority of children (61%) had 4-5 watery episodes of diarrhea. The degree of dehydration was clinically assessed according to the presence of symptoms and signs that reflect the magnitude of fluid loss, which in turn forms the basis for estimating the amount of fluid to be administered (table 1). Clinical objective examination revealed that all (100%) patients had dry mucosa and reduced turgor. 345 (99%) of children had a moderate dehydration whereas 3 (1%) children who were unable to drink/swallow had a severe dehydration. The mean Na value upon admission was 133.7 ( $\pm$ 5.4)mmol/l whereas the mean K value was 4.2 ( $\pm$ 3.6)mmol/l. Upon admission, 137(39.7%) had isotonic dehydration (Na 135–145mmol/l), 201 (58.3%) were mildly hyponatremic (Na 130–134mmol/l), and six (5%) had mild hypernatremia (Na 146–150mmol/l) (fig.1) ( $p < 0.01$ ). Following IV fluid therapy, the patients initially hypo- or hypernatremic, moved to the isonatremic state (table 2). The mean Na value upon admission was 133.7 ( $\pm$ 5.4) mmol/ whereas with hydration the mean value increased to 136.8 ( $\pm$ 3.2) mmol/l (paired t test  $p < 0.01$ ). There were also beneficial changes in the blood chemistry of children receiving IV fluid, reflecting improved hydration. The interval between admission serum Na measurements and the last serum Na measurement was 15.4 $\pm$ 4.7 h. There was a slight but statistically significant increase in weight (10.9 $\pm$ 6.1 to 11.6 $\pm$ 4.2 kg, (paired t test  $p = 0.03$ ). The management of dehydration (prevention and treatment) and maintaining the patient's usual diet during and after diarrhea it is very important in the management of diarrheal diseases, irrespective of etiology, while antimicrobial therapy is indicated for specific etiologic diarrheas.

Ongoing diarrheal losses and vomits and fever are the main factors that lead to dehydration (10).

The treatment should focus on the resuscitation requirements, current deficit, ongoing losses, and maintenance requirements, because the volume, composition, and rate of replacement differ for each (11). During the treatment it is essential the ongoing monitoring of vital signs, clinical appearance, urine output, weight, and serum electrolyte levels. In our study all patients with

diarrhea are treated with IV fluid and rapid replacement protocols at various rates for 24–48 h. Estimation of the severity of dehydration when it is mild to moderate can vary between observers (12). In our study 99% children had dry mucosa and reduced turgor showing a moderate dehydration whereas 1% of them who were unable to drink/swallow had a severe dehydration. Many patients had saline boluses before the hydration status was assessed by measuring blood chemistry parameters because of vomiting and watery diarrhea (13). Upon admission, 39.7% patients had isotonic dehydration, 58.3% were mildly hyponatremic and 5% had mild hypernatremia which improved due to fluid therapy. The mean Na value upon admission was 133.7 ( $\pm$ 5.4) mmol/ whereas with hydration the mean value increased to 136.8 ( $\pm$ 3.2) mmol/l. Also, other blood chemistry parameters Cl<sub>2</sub>, Asotemia and Creatinine were restored to normal values as well as the weight of patients (14).

## 4. Conclusion

For better management of diarrhea in children, every treatment center can formulate their own treatment protocol according to their needs, determined on the basis of epidemiologic knowledge of the disease and socio-cultural background, although most centers in developing countries follow WHO recommended treatment guidelines.

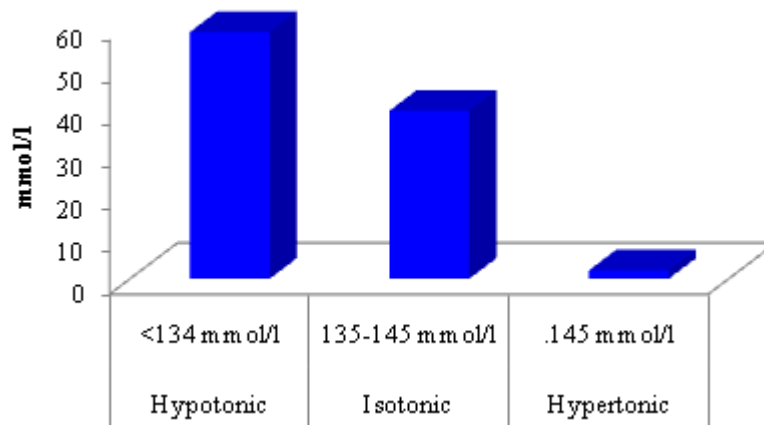
## References

- [1] Canavan A, Arant BS Jr. Diagnosis and management of dehydration in children. *Am Fam Physician*. 2009 Oct 1;80(7):692-6.
- [2] Goldman RD, Friedman JN, Parkin PC. Validation of the clinical dehydration scale for children with acute gastroenteritis. *Pediatrics*. 2008;122(3):545–549.
- [3] Colletti JE, Brown KM, Sharieff GQ, Barata IA, Ishimine P; The management of children with gastroenteritis and dehydration in the emergency department. *J Emerg Med*. 2010 Jun;38(5):686-98. doi: 10.1016/j.jemermed.2008.06.015. Epub 2009 Apr 5. Review.
- [4] Friedman AL (2005) Pediatric hydration therapy: Historical review and a new approach. *Kidney Int* (2005) 67:380–388
- [5] Hoorn EJ, Geary D, Robb M, Halperin ML, Bohn D. Acute hyponatremia related to intravenous fluid administration in hospitalized children: an observational study. *Pediatrics* 2004 113:1279–1284
- [6] Neville KA, Verge CF, O'Meara MW, Walker JL. High antidiuretic hormone levels and hyponatremia in children with gastroenteritis. *Pediatrics* 2005 116:1401–1407
- [7] Holliday M. Isotonic saline expands extracellular fluid and is inappropriate for maintenance therapy. *Pediatrics* 2005 115:193–194
- [8] Neville K, Verge C, Rosenberg A, O'Meara M, Walker J. Isotonic is better than hypotonic saline for intravenous rehydration of children with gastroenteritis: a prospective randomized study. *Arch Dis Child* 2006 91:226–232
- [9] <http://www.who.int/topics/diarrhoea/en/>

- [10] Duke T, Molyneux E. Intravenous fluid for seriously ill children: time to reconsider. *Lancet* 2003 362:1320–1323
- [11] Friedman A, Ray P. Maintenance fluid therapy: what it is and what it is not. *Pediatr Nephrol* 2008 23:677–680
- [12] Neville KA, Sandeman DJ, Rubinstein A, Henry GM, McGlynn M, Walker JL. Prevention of hyponatremia during maintenance intravenous fluid administration: a prospective randomized study of fluid type versus fluid rate. *J Pediatr* 2010 156:313–319.e2
- [13] Yung M, Keeley S. Randomised controlled trial of intravenous maintenance fluids. *J Paediatr Child Health* 2009 45:9–14
- [14] Niescierenko M, Bachur R. Advances pediatric dehydration therapy. *Curr Opin Pediatr.* 2013 Jun;25(3):304-9.

**Table 1:** Clinical assessment of dehydration, as provided in the World Health Organization treatment guidelines

Diagnostic criteria	No dehydration	Moderate dehydration	Severe dehydration
Signs/symptoms	No significant signs/symptoms	At least two signs/symptoms, including one key sign (*) present	Criteria for some dehydration plus one of these key (*) signs/symptoms present
Condition	Normal	Irritable/less	
Eyes	Normal	Sunken	Lethargic/comatose*
Mucosa	Normal	Dry	
Thirst	Normal	Thirsty*	Unable to drink/swallow
Skin	turgor	Reduced*	
Radial pulse	pulse		Uncountable/absent*
Bodyweight loss	0–4%	5–9%	≥10%



**Figure 1:** Type of dehydration

**Table 2:** Values of serum chemistry parameters upon admission and with hydration

Blood chemistry parameters	Upon admission	With hydration
	M (SD)	
Na (mmol/l)	133.7 (±5.4)	136.8 (±3.2)
K (mmol/l)	3.9 (±3.6)	4.1 (±0.9)
Cl <sub>2</sub> (mmol/l)	104.8 (±5.6)	107.9 (±5.7)
Asotemia (mg/dl)	18.9 (±5.4)	8.9 (±3.7)
Creatinine (mg/dl)	0.70 (±3.4)	0.36 (±0.13)

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