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Effectiveness of Rice-Based Oral Rehydration Solution in Correcting Dehydration and Electrolyte Imbalance Among Preschool Children with Acute Diarrhea

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Abstract **Objectives:** Acute diarrhea remains a significant cause of morbidity and mortality among children under five, primarily due to dehydration and electrolyte imbalances. Oral rehydration solutions (ORS) are widely recommended as the cornerstone of treatment; however, rice-based formulations may provide enhanced therapeutic benefits by improving hydration and electrolyte restoration. **Aim**: This study aimed to evaluate the effectiveness of oral rice solution in correcting dehydration and electrolyte disturbances among preschool children admitted with acute diarrhea. **Method:** A true experimental pre-test and posttest control design was employed. The study was conducted among 20 children aged 3-6 years admitted with acute diarrhea in the pediatric ward of Government Rajaji Hospital, Madurai, selected by simple random sampling. The experimental group received 150 ml of rice solution three times daily for three consecutive days along with standard diarrheal management, while the control group received only standard care. Dehydration status was assessed using the IMNCI Dehydration Scale (WHO), and electrolyte levels (sodium, potassium, chloride) were measured from blood samples. Statistical analysis was performed using chi-square, paired t-test/Wilcoxon signed rank test, and independent t-test. **Results:** Dehydration was prevalent at the start in both groups. After the intervention, children receiving the oral rice solution showed complete recovery from dehydration, while improvement in the control group was limited. Both groups experienced notable improvements in electrolyte levels, with slightly greater gains in the experimental group. **Conclusion:** Oral rice solution is highly effective in resolving dehydration and improving electrolyte balance in preschool children with acute diarrhea. Its inclusion in pediatric diarrheal management protocols may lead to better clinical outcomes.

Key Words Oral rice solution, dehydration, electrolytes, acute diarrhea, preschool children, pediatric care

INTRODUCTION

Acute diarrhea remains a major global health concern, especially among children under five years of age. This population experiences a disproportionately high incidence of diarrheal diseases, which continue to be a leading cause of morbidity and mortality worldwide. According to the World Health Organization (WHO), diarrhea is responsible for approximately 525,000 annual deaths in children under five, primarily due to dehydration caused by excessive fluid loss [1]. Clinically, acute diarrhea can result in severe dehydration, electrolyte imbalances, and potentially life-threatening complications if not managed promptly [2]. Inadequate rehydration further exacerbates the condition, underscoring the urgent need for effective interventions [3].

Oral rehydration solutions (ORS) are widely recognized as the cornerstone of treatment for dehydration associated with diarrhea in children [4]. By replenishing fluids and electrolytes, ORS prevents the progression to severe dehydration and its associated risks [4]. Their simplicity, cost-effectiveness, and suitability for varying levels of dehydration have made ORS a global standard of care [5]. Leading health organizations consistently recommend ORS as the first-line therapy in pediatric diarrheal management, citing its substantial impact in reducing child mortality rates [5,6]. Moreover, the preventive use of ORS in early stages can significantly lower the likelihood of complications [7].

The therapeutic effectiveness of ORS lies in its composition, which typically includes sodium, potassium,

and glucose to enhance intestinal fluid absorption (8). Research has also investigated modified ORS formulations and adjunctive therapies such as zinc supplementation and probiotics, aiming to improve recovery outcomes in children [9]. Assessing the efficacy of standard versus modified ORS in managing dehydration and restoring electrolyte balance in preschool children is therefore essential to refine clinical protocols [10].

There is limited research on the specific effects of rice-based oral rehydration solution in preschool children with acute diarrhea. Most studies have focused on broader pediatric age groups or on cholera rather than acute, non-cholera diarrhea. Detailed data on electrolyte balance restoration with rice-based ORS in this target group are scarce. Further investigation is needed to clarify its advantages over standard solutions in routine pediatric care.

The inevitability of dehydration as a complication of acute diarrhea highlights the indispensable role of ORS in pediatric care. By addressing gaps in current literature, the findings of this research will provide valuable insights for clinicians and contribute to improving treatment strategies and health outcomes in vulnerable pediatric populations.

Aim of the study

The study aimed to evaluate effectiveness of rice-based oral rehydration solution in correcting dehydration and electrolyte imbalance among preschool children with acute diarrhea.

METHODOS

Study Design and Setting: This study utilized a quantitative approach with a true experimental design, specifically a pre-test-posttest control group format. It was conducted in the pediatric ward of Government Rajaji Hospital (GRH), Madurai, focusing on children admitted with acute diarrhea.

Participants and Sampling

The sample comprised children aged 3-6 years who met predefined inclusion criteria, selected using probability sampling via the simple random using a lottery method. Inclusion required children to be diagnosed with acute diarrhea, admitted to the pediatric ward, and have parental or guardian consent. Exclusion criteria were chronic diarrhea, severe systemic illness, or concurrent special treatments for diarrhea.

Intervention

Parboiled rice (100 g) was rinsed once and soaked for 30 minutes. It was then boiled with 1000 ml of water and 5 g of salt in a stainless-steel vessel for 40-50 minutes on low flame with occasional stirring until the water turned cloudy. The solution was drained using a strainer. Each child received 150 ml of the rice solution three times daily for three consecutive days along with standard diarrheal management [11].

Data Collection Tool

Data collection was carried out by the researcher using the IMNCI Assessment of Dehydration Scale (WHO), which evaluates general condition, eyes, tears, mouth and tongue, thirst, and skin pinch to determine the level of dehydration in both experimental and control groups. In addition, laboratory investigations of electrolytes including sodium, potassium, and chloride were conducted from blood samples to assess electrolyte balance.

Data Analysis

The analysis was performed using SPSS version 28. Demographic and clinical variables were summarized through descriptive statistics. Normality was assessed using the Shapiro-Wilk test to determine appropriate statistical methods. Changes in electrolyte levels across groups and time points were analyzed using repeated measures ANOVA to assess main effects and interactions.

Ethical clearance

Approval was obtained from an institutional ethics committee (Reference number: 12129/1EC/2024-26) and written informed consent was secured from parents or guardians before enrolling children. All measures were taken to minimize risks and safeguard the welfare, privacy, and confidentiality of the child participants throughout the study.

RESULTS

Demographic Variables: Most children were aged 3-5 years (60-70%), with a higher proportion of males in the experimental group (70% vs. 50%). The majority were Hindu, lived in urban areas, and relied on corporation water. Most fathers had school-level education, and family income was mainly ₹10,000-20,000. Sanitary latrine use was common (80% control; 60% experimental). Chi-square tests showed no significant differences ($p>0.05$), indicating baseline homogeneity between groups (Table 1).

Clinical Variables

Among clinical variables, most children had a nutritional status of 76-90%, while respiratory or gastrointestinal disorders were reported in 60% of control vs. 80% of experimental groups. Body temperature distribution was identical (50% normal and 50% elevated in both groups). Vomiting was more common in the experimental group (50% vs. 10%), and abdominal cramping was also higher (80% vs. 50%). Chi-square tests showed no significant differences ($p>0.05$), indicating clinical homogeneity between the groups (Table 2).

Dehydration

Table 3 shows the dehydration status of children in the control and experimental groups assessed using the WHO tool. In the pre-test, dehydration was present in all children

Table 1: Socio-demographic characteristics of control and experimental groups (n = 10 each)

S. No	Variable	Category	Control n (%)	Experimentaln (%)	χ^2, p-value
1	Age (years)	3	3 (30)	3 (30)	$\chi^2 = 1.400$, p = 0.706
		4	3 (30)	2 (20)	
		5	3 (30)	2 (20)	
		6	1 (10)	3 (30)	
2	Gender	Male	5 (50)	7 (70)	$\chi^2 = 0.208$, p = 0.648
		Female	5 (50)	3 (30)	
3	Religion	Hindu	6 (60)	5 (50)	$\chi^2 = 0.424$, p = 0.809
		Christian	3 (30)	3 (30)	
		Muslim	1 (10)	2 (20)	
4	Place of residence	Urban	6 (60)	5 (50)	$\chi^2 = 1.091$, p = 0.580
		Sub-urban	2 (20)	4 (40)	
		Rural	2 (20)	1 (10)	
5	Father's education	Schooling	7 (70)	5 (50)	$\chi^2 = 0.208$, p = 0.648
		Diploma/Degree	3 (30)	5 (50)	
6	Family income (₹)	<10,000	5 (50)	4 (40)	$\chi^2 = 0.444$, p = 0.801
		10,000-20,000	4 (40)	4 (40)	
		>20,000	1 (10)	2 (20)	
7	Drinking water source	Corporation	7 (70)	7 (70)	$\chi^2 = 1.200$, p = 0.549
		Mineral	2 (20)	3 (30)	
		Bore well	1 (10)	0 (0)	
8	Area of defecation	Open field	2 (20)	4 (40)	$\chi^2 = 0.238$, p = 0.626
		Sanitary latrine	8 (80)	6 (60)	

Table 2: Clinical variables analysis of control and experimental groups (n = 10 each)

S. No	Variable	Category	Control n (%)	Experimental n (%)	χ^2, p-value
1	Nutritional status	76-90%	8 (80)	5 (50)	$\chi^2 = 2.359$, p = 0.307
		61-75%	2 (20)	4 (40)	
2	Respiratory/gastro disorders	Yes	6 (60)	8 (80)	$\chi^2 = 0.238$, p = 0.626
3	Body temperature	<37.5°C	5 (50)	5 (50)	$\chi^2 = 0.200$, p = 0.655
		>37.5°C	5 (50)	5 (50)	
4	Episodes of vomiting	Yes	1 (10)	5 (50)	$\chi^2 = 2.143$, p = 0.143
5	Abdominal cramping pain	Yes	5 (50)	8 (80)	$\chi^2 = 0.879$, p = 0.348

Table 3: Dehydration analysis of control and experimental groups by WHO tool (n = 10 each)

S. No	Test	Category	Control n (%)	Experimental n (%)	χ^2, p-value
1	Pre-test	No dehydration	0 (0)	2 (20)	$\chi^2 = 0.556$, p = 0.456
		Dehydration	10 (100)	8 (80)	$\chi^2 = 15.556$, p<0.001 (overall)
2	Post-test	No dehydration	2 (20)	10 (100)	$\chi^2 = 10.208$, p<0.001
		Dehydration	8 (80)	0 (0)	

of the control group (100%) and in most of the experimental group (80%), with no significant difference between groups (p = 0.456). In the post-test, only 20% of the control group improved to no dehydration, whereas 100% of the experimental group showed no dehydration. The difference was highly significant (p<0.001), indicating the effectiveness of the intervention in reducing dehydration.

Comparison on Electrolyte

Table 4 shows a comparison of sodium, potassium, and chloride levels between the control and experimental groups across pre- and post-tests. Both groups exhibited a significant increase in all electrolyte levels after the intervention (p < 0.001). The improvement was more pronounced in the experimental group compared to the control group, indicating a stronger effect of the intervention on overall electrolyte balance. Two-way ANOVA indicated a significant effect of time for all electrolytes (p<0.001), while differences between groups and group-test interactions were not statistically significant (p>0.05), confirming that both groups improved, with slightly higher mean values in the experimental group.

DISCUSSION

The study presents strong evidence regarding the effectiveness of the intervention in addressing dehydration and electrolyte imbalances among preschool children with acute diarrhea. Both control and experimental groups were initially homogeneous in their socio-demographic and clinical characteristics, ensuring that post-intervention differences could be attributed to the treatment rather than pre-existing disparities [12].

At baseline, dehydration was present in 100% of children in the control group and 80% in the experimental group, highlighting the severity of the condition [13]. Following the intervention, 100% of the experimental group achieved full hydration, compared to only 20% of the control group, with the difference being highly significant (p<0.001) [14].

Table 4: Comparison of control and experimental groups on sodium (Na), potassium (K) and chloride (Cl) (n = 10 each)

S. No	Groups/Comparisons	Na (mEq/L) (Mean±SE)	K (mEq/L) (Mean±SE)	Cl (mEq/L) (Mean±SE)
1	Control - Pre-test	131.3±0.5	3.28±0.05	92.5±0.6
	Control - Post-test	136.7±0.7	3.57±0.04	97.6±0.6
	Experimental - Pre-test	130.7±1.3	3.19±0.07	92.0±0.5
	Experimental - Post-test	138.5±0.3	3.77±0.04	97.5±0.7
2	Significance among groups	F = 0.656, p = 0.429		
	Significance among tests	F = 66.447, p < 0.001		
	Significance in interaction (G×T)	F = 2.197, p = 0.156		

This striking contrast underscores the superior efficacy of the intervention.

Electrolyte analysis further demonstrated significant improvements across both groups ($p<0.001$). In the experimental group, sodium levels increased from 130.7 to 138.5 mEq/L, while in the control group, the rise was more modest, from 131.3 to 136.7 mEq/L [14]. Similar positive shifts were observed for potassium and chloride. Although between-group differences in electrolyte changes were not statistically significant, the overall trends indicated better outcomes in the experimental group, suggesting that the intervention provided greater protection against dehydration-related complications [16].

These findings are consistent with prior research. Oral rehydration therapy (ORT) has long been established as an effective approach to restoring hydration and electrolyte balance, significantly reducing hospitalization and morbidity [17]. The mechanism of ORT involves enhanced absorption of sodium and water in the intestines, thereby counteracting fluid loss. A clinical trial showed rice-based ORS reduces stool output and improves hydration effectiveness compared to glucose-based ORS, supporting its superior rehydration efficacy [18].

The substantial recovery in the experimental group highlights a notable advancement in therapeutic strategies for pediatric diarrhea management. Electrolyte replenishment remains crucial, but targeted interventions such as the one tested here may yield superior outcomes [19]. Earlier investigations have also documented marked electrolyte disturbances in pediatric gastroenteritis, stressing that timely ORT administration can prevent severe imbalances and complications [20].

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