

Clinical Trial of Pap-salt Solution in the Treatment of Dehydrated Children

DM OLANREWAJU* O OLUSANYA** AND FA OLUWOLE***

Summary

Olanrewaju DM, Olusanya O and Oluwole FA. Clinical Trial of Pap-salt Solution in the treatment of dehydrated Children. *Nigerian Journal of Paediatrics* 1993; 20:1. In a randomised clinical trial, the efficacy of Pap-salt solution (PSS) was compared with the WHO oral rehydration salt (ORS) solution in 212 children, aged between six months and five years. All the children who received PSS were successfully treated and there was no difference ($p > 0.05$) in the pre- and post-treatment values of the serum electrolytes in the two groups of children. Pap-salt solution was acceptable to the patients, readily available and much cheaper than the ORS solution. PSS is, therefore, recommended for the rehydration of children with mild and some degree of dehydration in situations where ORS solution is not available.

Introduction

DIARRHOEA is a leading cause of morbidity and mortality among children in developing countries where an estimated four million deaths occur each year among the under-fives.¹ The main cause of death from acute diarrhoea is dehydration, which results from the loss of fluids and electrolytes in diarrhoeal stools. Treatment of dehydration usually consists of oral administration of specially-prepared oral rehydration salt (ORS) solution as recom-

mended by WHO/UNICEF.² Although their composition is not as appropriate as that of ORS solution for treating dehydration, other fluids, such as salt-sugar solution (SSS), rice-water solution and green coconut water, have been used successfully in the treatment of dehydrated children.^{3,4}

In Nigeria, SSS is the nationally-recommended fluid for the prevention of dehydration resulting from diarrhoea.¹ However, with the rising cost of living in the country, it has become increasingly difficult for many families to buy sugar regularly, even for domestic use. Furthermore, ORS sachets are not readily available for the treatment of dehydrated patients. It has therefore, become necessary to seek for cheaper and more readily available solutions for the treatment of dehydration. The present study was thus undertaken to compare the efficacy, including acceptability, of *Pap (Ogi)*-salt solution (PSS) with that of ORS solution in the treatment of children with some (mild and moderate) dehydration.

Ogun State University Teaching Hospital, Sagamu

Department of Paediatrics

* Senior Lecturer

Department of Medical Microbiology

** Registrar

Department of Community Medicine/Primary Care

*** Senior Lecturer

Correspondence: DM Olanrewaju

Materials and Methods

Preliminary studies were carried out to determine the glucose and electrolyte contents of the three common varieties of *Pap* in Nigeria: white *Pap* (prepared from white maize), yellow *Pap* (prepared from yellow maize) and *Ogi baba* (*Pap* prepared from guinea corn). The raw and cooked preparations were similarly subjected to microbiological analysis.

The subjects and controls consisted of 101 and 111 children, respectively. They were randomly selected from children with acute watery diarrhoea and some degree of dehydration seen at the primary health centres in Ijebu-Igbo, Ita-Oba in Sagamu and at the oral rehydration therapy (ORT) unit of the Ogun State University Teaching Hospital (OSUTH), Sagamu, between June 1991 and June 1992. Both the subjects and controls were within the age group, six months to five years. After informed parental consent had been obtained and detailed clinical history and physical examination were undertaken, the children were alternately assigned to the ORS solution and the PSS solution treatment groups. Children with diarrhoea secondary to systemic illness, such as bronchopneumonia or otitis media etc., were excluded from the study as were those with severe dehydration, or severe protein-energy malnutrition. The degree of dehydration was assessed, using the current WHO guidelines. Each patient was admitted into the ORT unit for treatment with either ORS solution, or PSS.

Maize pap (*Ogi*) was prepared by soaking maize in water for two to three days for fermentation to occur. The now softened maize was washed and ground; the ground material was rinsed with water and passed through a sieve to remove parts of the husk. The filtrate, almost pure starch, was placed in pots to settle and water was added to cover it completely. Samples were taken from this raw stock at intervals and made into a maize gruel called *Ogi* or *Pap*. Pap-

salt-solution was prepared from raw pap as follows: one level teaspoonful (3ml) of raw pap (5gm) was dissolved in 5ml of cold water; boiling water was then added until it formed a gel. The cooked pap was then made up to 600ml (two soft-drink bottles) with the addition of more water, following which one level (3ml) of table salt was added.

Each child received 75ml per kg of ORS solution, or PSS orally, over a four-hour period, using cup and spoon. The progress of each child was assessed every hour. Those patients that still showed signs of dehydration after four hours were given a further 75ml/kg of the same solution over another four-hour period, or as much as the child could tolerate. Upon recovery, patients were sent home, the mothers having been taught how to prepare and administer the PSS or ORS solution. Furthermore, mothers were advised to administer at home, 50-100ml of fluid per bowel motion for patients below the age of two years, while those older than two years were to receive 100-200ml per bowel motion.¹ Mothers were encouraged to continue breastfeeding and to give fresh fruit-juice, or mashed bananas, if available. Venous blood samples (10ml) were collected before and 48 hours after commencement of rehydration, to determine the serum electrolyte concentrations.

Patients were followed up on two consecutive days at home by community health nurses who monitored the children's progress and completed questionnaires earlier given to the mothers. These questionnaires were designed to elicit information concerning parental socio-economic background, acceptability of the solution used and the mother's general attitude towards the solution. Those requiring further treatment were followed up in the clinic.

Data obtained were analysed statistically, using the chi-square and the two-tailed normal test (Z test). P values of less than 0.05 ($p < 0.05$) were regarded as statistically significant.

Results

The 101 subjects who received PSS consisted of 52 males and 49 females, a M : F ratio of 1.6 : 1, while the 111 controls who were treated with ORS solution were made up of 41 males and 70 females, a M : F ratio of 0.6 : 1 ($p > 0.05$). The ages of the subjects ranged between six and 57 months (mean, 15.5 ± 7.4 months), while those of the controls ranged between six and 60 months (mean, 14.0 ± 6.5 months) ($p > 0.05$). The weights of the subjects ranged between 4.9kg and 20kg (mean, 9.47 ± 2.97 kg), while those of the controls ranged between 5.2kg and 11.0kg (mean, 8.1 ± 1.8 kg) ($p > 0.05$).

Based on the social classification suggested by Oyedeji,⁵ 164 children (77.3 percent) were regarded as belonging to socio-economic classes iv and v (Table 1). Table 11 shows the chemical composition of the three common varieties of maize in Nigeria. It is worthy to note that the three varieties of the maize contained about 10 percent protein and had high energy content.⁶ Table III shows the glucose and electrolyte contents of the three main varieties of *Pap* in the Sagamu and Ijebu North Local Government Areas of Ogun State where PSS is prepared as described earlier. There was no significant difference ($p > 0.05$) in the glucose or electrolyte contents of PSS prepared from the three varieties of maize. However, these varieties of PSS contained significantly lower levels of potassium than the ORS solution ($p < 0.001$). It is noteworthy that the three varieties of maize contained no bicarbonate. Microbiological analysis of raw *Pap* yielded significant growth of spore-forming gram-positive bacilli and atypical bacilli, while cooked *Pap* which was used in the present study, yielded no significant growth of any of these organisms.

All the 101 patients treated with PSS recovered fully and none required intravenous fluid

TABLE I

Classification of Subjects and Controls according to Socio-economic Classes⁵

Class	No of Cases		Total
	Subjects	Controls	
I	1	0	1
II	2	9	11
III	14	22	36
IV	37	23	60
V	47	57	104
Total	101	111	212

TABLE II

Chemical Composition of Three Varieties of Nigerian Maize⁶

Maize Variety	Percent Composition					Energy (Calories/100gm)
	Starch	Protein	Fat	Moisture	Ash	
White	70.0	9.5	4.2	10.8	1.2	410.0
Yellow	65.0	9.6	4.7	10.7	1.1	410.0
Guinea Corn	68.0	12.5	3.0	11.0	2.0	394.0

TABLE III

Glucose and Electrolyte Contents of PSS as prepared from three Varieties of Maize

Electrolytes (mmol/L)	White PSS	Yellow PSS	Ogi-baba	ORS
Sodium	96.0	97.0	98.0	90.0
Potassium	1.0	0.9	0.9	20.0
Bicarbonate				30.0
Chloride	52.0	57.0	56.0	80.0
Glucose	82.5	77.7	75.0	111.0

treatment. Similarly, 109 of the 111 patients who received ORS solution made satisfactory

recovery; the remaining two were lost to follow-up because their homes could not be traced. There was no significant difference in the mean volumes of PSS (1015.4ml) and ORS ((1036ml) required for rehydration ($p>0.05$). There were also no differences in the mean values of the serum electrolytes before and after rehydration (Table IV)

TABLE IV
Mean Serum Electrolyte Content, 48 Hours after
Common Oral Treatment

Electrolyte	PSS		ORS		P
	Mean (mmol/L)	SD	Mean (mmol/L)	SD	
Serum Sodium					
Pre-Rx	131.5	2.5	130.6	2.8	0.05
Post-Rx	134.8	2.5	135.3	3.7	
Serum Potassium					
Pre-Rx	3.3	0.2	3.5	0.3	0.05
Post-Rx	3.8	0.3	4.2	0.4	
Serum Bicarbonate					
Pre-Rx	15.3	1.5	15.2	1.4	>0.05
Post-Rx	17.1	1.6	18.9	1.7	

SD Rx Standard deviation therapy

Ninety-six mothers found PSS easy to prepare and readily accepted by their children, while 97 admitted that the ingredients required for its preparation were readily available. None of the mothers reported any taboos against the administration of pap-salt solution to children with diarrhoea. The mean cost of PSS used was 23k (twenty three kobo). The cost of WHO ORS used could not be determined since it was supplied free of charge by the Ogun State Ministry of Health.

Discussion

The present study has shown that pap-salt solution is effective in the management of children with mild to moderate dehydration. It is considered that this finding is of great importance because ORS solution is not readily avail-

able in many developing countries for a number of reasons, including poor distribution and non-accessibility of some health centres to patients. The study has therefore, fulfilled the need for the development of an effective substitute for rehydration, using locally-available and affordable ingredients.

The lack of bicarbonate in PSS was not considered a contra-indication to its use, because it has been shown that the average faecal bicarbonate content in children suffering from rotavirus and *Escherichia coli* diarrhoea was only six and 18mmol/L respectively.⁷ These amounts of faecal bicarbonate loss may be handled physiologically by renal compensation in most patients without severe dehydration, thus suggesting that a successful oral rehydration solution could be developed without the addition of bicarbonate. Indeed, Islam and Ahmed⁸ have reported the successful rehydration of 95 children with varying degrees of dehydration, using an oral rehydration solution without bicarbonate. Patients in the present study were well-nourished and this would explain the absence of significant hypokalaemia after treatment, despite the fact that PSS contains only traces of potassium. Patients with severe protein-energy malnutrition were excluded because of the possibility that they might have had multiple electrolyte derangements even in the absence of dehydration.

Earlier studies have shown that simple salt and sugar solution without potassium is also effective in the treatment of both infantile⁹ and adult¹⁰ diarrhoea. However, the present high cost of sugar in Nigeria does not make SSS a viable option to the ORS solution. A major advantage of PSS is its cheapness. In the present study, the cost to rehydrate a patient was 23 kobo only, while the comparative cost, using the same volume of SSS, would have been 112 kobo. Thus, PSS is about five times cheaper than SSS. Oral rehydration salt sachets are presently distributed

free of charge when they are available, but ORS solution will certainly be more expensive than SSS, if the cost of production of the sachets is taken into consideration. Other advantages of PSS included easy preparation and palatability; mothers had no reservations about administering the fluid since it was prepared from the usual weaning formula that is available in the locality. Furthermore, maize contains about 10 percent protein which is said to be rich in sulphur-containing amino-acids as well as aromatic amino-acids.⁶ As there is not much difference in the glucose and electrolyte contents of the three varieties of the maize, PSS may be prepared, using any of the varieties. The PSS used in the present study contained a slightly less quantity of glucose than ORS, but more glucose molecules will be available for enhancement of sodium reabsorption when the starch in Pap is eventually hydrolyzed into its component glucose sub-units in the intestinal lumen and at the brushborder.³

Based on the present findings, PSS is recommended for the rehydration of children with mild to moderate dehydration when ORS solution is not available, provided the patient is older than four months and is not severely malnourished. It may also be used at home by mothers in the treatment of diarrhoea so as to prevent dehydration.

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