

# Oral rehydration therapy: a community trial comparing the acceptability of homemade sucrose and cereal-based solutions

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*Sugar-based oral rehydration therapy (ORT) for diarrhoea is promoted in many countries of the world. One programme in Bangladesh has instructed more than 13 million mothers in the preparation of a sugar-salt solution in the home; despite very high rates of correct mixing and knowledge, subsequent application was found in only some 20% of all diarrhoea episodes. Since rice is far more available in rural homes (95%) than any type of sugar (30%) and rice gruel is a widely accepted food during illness, a field trial was conducted in three areas (total population, 68 345) to compare the acceptability and use of rice-based ORT with that of sugar-based ORT. Although the mothers unanimously agreed that the rice-based solutions "stopped" the diarrhoea more quickly, they used the sugar-based solutions twice as often (in 40% of severe watery episodes) as the rice-based solutions (in 18%), because the rice-ORT was much more time-consuming and difficult to prepare. The observed reduced utilization of home-made rice-ORT makes it a poor substitute for sugar-ORT at the community level in rural Bangladesh.*

## Introduction

The Bangladesh Rural Advancement Committee (BRAC) has a programme for promoting the use of table salt (*lobon*), unrefined brown sugar (*gur*), and water or *lobon-gur* solution (LGS) for the treatment of diarrhoea (1). This programme has already reached over 13 million households where the mothers were taught how to make and use a safe and effective LGS. However, in spite of high levels of knowledge (>90% of mothers), the rates of utilization remain less than 20% throughout Bangladesh. Sugar, either refined or unrefined, is available in a minority of households (<30%), and mothers often complain that even when used as directed, LGS does not stop diarrhoea and may even exacerbate the frequency or quantity of stools (2).

Recent research has shown that a rice-based oral rehydration solution may decrease the fluid loss from diarrhoea as well as provide more calories, while reducing the osmotic load to the intestine (3). Rice soups are traditionally given during illness and, unlike sugar, rice is universally available in all homes (4). We therefore decided to test the acceptability and use of a home-made rice-salt rehydration fluid compared with the standard LGS promoted by BRAC.

## Methods

### Development of rice-based preparations

Based on the proven successful method of teaching mothers about LGS (5), we conducted trials in 995 rural households, during which 5 women and 2 men, all experienced BRAC trainers, developed the most practical and culturally relevant techniques to make rice-salt ORT (RSORT), with a desired concentration of 60 mmol of sodium chloride per litre and 50 g/l rice. Working directly with these rural mothers the trainers investigated the following: the availability, preparation, and cooking of various types of rice; measuring techniques for rice, salt and water; and various approaches to teaching mothers at home so as to give the maximum demonstrated competency in preparation and use of RSORT. The resulting optimum approach was standardized and used by experienced BRAC trainers throughout the study, along with similar proven methods for teaching LGS.

### Study population

Joypurhat, a rural district (population, 619 351) which is not yet covered by the nationwide house-to-house LGS teaching programme of BRAC, was the site of the field trial. Three non-contiguous unions<sup>a</sup> (out of 31), which were similar in geography, population and social patterns, were used to study the extent of utilization of LGS in Dhalahar (pop. 25 622), RSORT in Baratara (pop. 17 322), and both

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<sup>a</sup> A union is an administrative unit of approximately 21 000 population.

of these in Bhadsha (pop. 25 401) which is located between the former two.

Within each union, twenty contiguous villages (about one half of the total) with approximately 2500 households (approximate pop. 13 750) were selected, by convenience, for baseline and subsequent follow-up studies. After preparation of village maps and a precise census, three teams of 15 female interviewers, each with a male supervisor, collected information (using a precoded questionnaire) on the availability of ingredients and equipment for preparing the solution, and on the practices during diarrhoea. Local terms were used to identify the recognized types of loose motions which included *dud haga* (diarrhoea in breast-feeding children), *ajirno* (diarrhoea due to indigestion), *amasha* (mucoid diarrhoea with or without blood), and *daeria* (severe watery diarrhoea) (2, 6). The baseline survey was conducted over five weeks in January and February 1987.

#### Randomization of implementation

Following completion of the baseline survey, experienced BRAC training teams, one in each union, conducted house-to-house training throughout the entire union. The standard BRAC method of teaching the "seven points to remember" (2), including the actual preparation and testing of fluids, was conducted among small groups of women, up to a maximum of five, in each *bari* (patrilineally related cluster of households). Teaching by discussions, demonstrations, and trial was repeated until each woman demonstrated her competency. Simultaneously, male workers gave similar lessons in schools to village practitioners, male village elders, and informal gatherings in mosques. During the period when the teams conducted the detailed training, which required 8–9 weeks in each union, they sought and treated diarrhoea cases following the recommended procedures, thus reinforcing their demonstration.

#### Follow-up surveys and analysis of solutions

One month after the departure of the training team, an independent monitoring team visited a 5% sample of households, chosen by random number table, from the lists of households originally trained. They used a standardized interview to test the retention of knowledge of the seven points, assess the correct preparation of the fluid, and measure, by chloride titration in a field laboratory, the salt concentration in the prepared sample. A random 10% subsample of these were sent to the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B), in Dhaka, for analysis of

sodium and potassium content by flame photometry and glucose by the glucose-oxidase method (7). Based on the simultaneous analysis of sodium and chloride, regression equation ( $\text{Na}^+ = 9.44 + 0.86 \text{Cl}^-$ ) was constructed, which was then used to estimate sodium from the measured chloride values.

Follow-up surveys of all households interviewed in the baseline study were conducted at three-month intervals for one year, and a 5% random subsample was interviewed again at 24 months to assess the retention of knowledge, skill in preparation, and extent of use of the home-made solution for recent diarrhoea episodes (within 2-weeks recall). The composition of the teams of interviewers was constantly changed and interviewers rotated between different research teams working in this project and other BRAC research projects elsewhere in Bangladesh. The interviewers did not instruct again when they encountered incorrect knowledge or practices.

**Focus group discussions.** In Bhadsha, six focus group discussions (8), four comprising 8–10 mothers of young children and two with village men, were organized by experienced anthropologists. These determined the reactions to and perceptions of the desirability, efficacy, and ease of use of the two types of oral fluid under study.

## Results

#### Determination of optimal preparation of RSORT

Rice powder, unboiled rice (*atap chal*)<sup>b</sup> and parboiled rice (*shiddha chal*)<sup>b</sup> were available in 20%, 11%, and 84% of households, respectively, in the pilot study area. Direct cooking of parboiled rice required approximately 50–60 minutes to achieve a soft rice that could be pasted and suspended in solution. Moreover, the small quantity of rice (one fistful or 34 grams for a recommended 550 ml preparation) frequently resulted in burning of the pot and all mothers complained of the amount of fuel required, since this is becoming increasingly scarce. The alternative was to first soak the rice for approximately 3 to 8 minutes and then grind it to a paste, using the *sheel pata* (the traditional grinding stone and pestel which is more often used to grind spices). This labour-intensive procedure, which required 7 minutes for unboiled rice and up to 27

<sup>b</sup> In most areas of Bangladesh, paddy (unhusked rice) is boiled soon after harvest to enhance storage and pest resistance of the grain. When this paddy is husked, it is termed *shiddha chal*, which is much harder and hence takes a longer time to cook but is nutritionally richer than *atap chal*. Both types of rice have to be cooked before being eaten.

minutes for parboiled rice, reduced the subsequent cooking time (bringing the solution to first boil) to 5 minutes, and was widely preferred. The amount of water, ideally 550 ml to allow some loss during cooking, was actually described as "10 *chhatak* or 2.5 (*arai*) *poa*—a bit more than half a *seer*" (or 467 ml). Each mother's own measuring vessel was calibrated to the proper amount. A 3-finger pinch of salt, previously shown in the LGS trial to give 60–70 mmol/l of sodium chloride (9), was recommended.

**Teaching of mothers and their cost**

Teaching of mothers was conducted in their own *bari* in groups until two instructors were confident that all the trainees were fully competent. This required 20–25 minutes in the LGS villages, 60–70 minutes in the RSORT villages, and 70–75 minutes in villages where the preparation of both fluids was taught. The number of mothers taught per day per worker varied from 24.8 (in the LGS villages) to 14.3 (RSORT) to 12.4 (combined). The direct cost per mother taught, including the monitoring activities, was US\$ 0.27, 0.39, and 0.43, respectively.

**Composition of solutions**

Results of the independent monitoring survey, conducted one month after training, and follow-up in the baseline households after 3–12 and 24 months are shown in Table 1. Sodium concentrations were mostly within the desirable limits of 30–99 mmol/l, with no significant differences between the different solutions. While there was a tendency towards higher salt concentrations on follow-up visits, there were only about 2–4% of samples above 120 mmol/l at 24 months. Knowledge scores (5) (not shown in the Table) were comparably good in all three unions

with averages of 9.1, 9.1, and 9.6 out of 10 marks for mothers in the LGS, RSORT, and combined villages, respectively.

The concentration of potassium was invariably less than 5 mmol/l (in the RSORT villages) and approximately 20 mmol/l (LGS). Glucose concentrations in hydrolysed LGS and RSORT samples were 109 mmol/l and 98 mmol/l, respectively.

The percentage of households possessing ingredients and equipment for the preparation of either LGS or RSORT, which did not differ between unions or in the baseline and four follow-up surveys conducted quarterly, were: rice, 91%; rice powder, 10%; *sheel pata* (grinding stone), 69%; *gur*, 21%; sugar, 13%; no *gur* or sugar, 72%; and salt, 97%.

**Diarrhoea incidence rates**

The reported incidence of diarrhoea (2-weeks recall in four surveys), by age, sex, and type of diarrhoea, are shown in Table 2. Only about 5% of episodes were in the *daeria* (severe watery diarrhoea) category. Nearly 27% of all episodes and more than a third of *daeria* types occurred in children under 5 years of age (some 17% of the population). Males reported a slightly higher incidence except in the 15–44 age group where female cases were 10% higher. Incidence rates, as reported in four two-week recall periods, ranged from 232 (per 1000 population) in Dhalahar and 248 in Barataria to 305 in Bhadsha.

**Utilization rates**

Approximately a third of the diarrhoea episodes received no treatment at all. Rates of rehydration fluid utilization, by type of diarrhoea and union, are shown in Table 3. In all unions, there were higher

Table 1: Percentage distribution of sodium levels (estimated from chloride) in ORS solutions prepared by mothers at different time periods following instruction

Na <sup>+</sup> level (mmol/l)	Percentage distribution in:											
	LGS union			RSORT union			Combined union					
	1 month	3–12 months	24 months	1 month	3–12 months	24 months	LGS			RSORT		
	1 month	3–12 months	24 months	1 month	3–12 months	24 months	1 month	3–12 months	24 months	1 month	3–12 months	24 months
<30	0.8	6.2	0.7	1.2	3.8	3.5	3.3	4.3	4.0	8.2	4.9	5.4
30–99	98.4	75.0	91.7	95.7	74.3	93.5	87.4	75.2	84.0	88.1	83.3	83.2
100–119	0.4	7.8	4.9	1.9	10.4	1.2	5.1	14.5	7.3	2.3	2.9	8.1
≥120	0.4	10.9	2.7	1.2	11.5	1.8	4.2	5.9	4.7	1.4	8.9	3.3
No. of mothers	227	384	144	160	183	169	214	371	150	218	102	149
Mean Na <sup>+</sup> level	61.0	74.6	68.2	69.5	73.9	66.2	70.4	70.9	73.5	59.6	72.6	65.4
S.D.	10.2	32.5	21.8	11.6	28.0	22.5	16.7	27.7	24.0	14.8	27.3	25.8

Table 2: Number of episodes of diarrhoea in three unions reported through four retrospective surveys (two-weeks recall), by age of patient and type of diarrhoea

Age group	Type of diarrhoea <sup>a</sup>				
	<i>Dud haga</i>	<i>Ajirno</i>	<i>Amasha</i>	<i>Daeria</i>	All types
<5 years	507 (17.7) <sup>b</sup>	1022 (35.7)	1188 (41.6)	141 (5.0)	2858 (100)
5-14 years		866 (53.3)	692 (42.6)	65 (4.1)	1623 (100)
15-44 years		1841 (46.9)	1935 (49.3)	149 (3.8)	3925 (100)
≥45 years		887 (43.1)	1111 (54.0)	58 (2.3)	2056 (100)
Total	507 (4.8)	4616 (44.1)	4926 (47.1)	413 (4.0)	10 462 (100)

<sup>a</sup> For definition of the types of diarrhoea see text (under Methods) and references 2 and 6.

<sup>b</sup> Figures in parentheses are percentages.

Table 3: Percentage utilization of LGS and RSORT for all episodes of diarrhoea, by type of diarrhoea and union

Types of diarrhoea <sup>a</sup>	% using LGS in Dhalahar	% using RSORT in Baratara	% in Bhadsha using	
			LGS	RSORT
<i>Dud haga</i>	26.3 (40) <sup>b</sup>	6.7 (12)	15.1 (30)	2.0 (4)
<i>Ajirno</i>	18.2 (224)	7.3 (125)	10.9 (190)	2.7 (47)
<i>Amasha</i>	9.0 (148)	4.1 (57)	6.9 (143)	2.3 (49)
<i>Daeria</i>	40.3 (60)	18.4 (28)	19.5 (32)	6.1 (10)
All types	14.9 (472)	6.5 (222)	9.4 (395)	2.6 (110)

<sup>a</sup> See text for definition of diarrhoeal types.

<sup>b</sup> Figures in parentheses indicate the number of episodes using LGS or RSORT from all four follow-up surveys.

rates with the *daeria* type (severe watery diarrhoea) (18-40%) than for all diarrhoeas (7-15%). A more notable difference between unions is due to less RSORT utilization than LGS for all types of diarrhoea. While the rate of RSORT use was 46% of LGS use for *daeria* cases, it was only 25% of LGS use for diarrhoea in breast-fed children (*dud haga*), all of which occurred in children under 5 years of age. In Bhadsha where use of both solutions was taught simultaneously, LGS was consistently used 3 to 7 times more than RSORT. Interestingly, the overall treatment rates for all types of diarrhoea in all ages were remarkably similar between unions (16-17% of episodes), as the use of commercially packaged ORS in the RSORT union was double that in the LGS union (Table 4). There were no trends in utilization rates over time following the initial training, nor was any difference reported in usage between males and females.

### Cultural perceptions

The perceptions of mothers about LGS and RSORT in Bhadsha union, where both were equally promoted, were investigated through focus group discussions. Mothers appeared to recognize the benefit of

Table 4: Percentage utilization of different types of ORS (including packets), by union

Types of ORS	Percentage use in:		
	Dhalahar	Baratara	Bhadsha
Packet (standard)	2.6 (84) <sup>a</sup>	5.5 (188)	5.5 (228)
LGS	14.7 (472)	3.6 (125)	9.4 (395)
RSORT	0.2 (6)	6.5 (222)	2.6 (110)
Total	17.5 (562)	15.6 (534)	17.5 (733)

<sup>a</sup> Figures in parentheses indicate the number of episodes for which packeted ORS, LGS or RSORT was used.

RSORT over LGS and claimed that it stopped diarrhoea and vomiting more quickly. But they used it less frequently for the following reasons: (a) more labour and time were needed to prepare RSORT (average of 42 minutes compared to 5 minutes for LGS); (b) some cultural beliefs<sup>c</sup> prohibit giving

<sup>c</sup> *Anna prashana*, an important ceremony particularly among Hindus, normally takes place at age 6-12 months and before this no child is given any solids, particularly rice. There is a similar practice among middle-class Muslims.

solids, particularly rice, before 6–12 months of age (mothers believe that very young children are unable to digest rice before this age); (c) LGS was preferred by children because it is sweet; and (d) fuel (firewood) was scarce in rural areas (for the necessary cooking of RSORT).

In general, almost all mothers participating in the discussions preferred the freshly-made LGS or RSORT to packeted ORS, which was not promoted through the study but was available from local health centres and some pharmacies. The mothers considered the latter (but not LGS or RSORT) to be a medicine as it was also recommended by doctors.<sup>d</sup>

## Discussion

The effectiveness of oral rehydration fluids in combating diarrhoea has been established in clinical as well as community settings. During the past 10 years BRAC conducted a programme for village women throughout Bangladesh employing a person-to-person teaching methodology which has resulted in a high degree of knowledge and competency in the preparation of home-made LGS solution (5, 9). Through the past ten years, various investigations and follow-up studies have been carried out on samples of this large population of 13 million rural mothers to understand more about the factors determining the use of this solution in the early management of diarrhoea at home (1, 2, 5, 9). Previous studies had shown that the infrequent use of LGS was associated with difficulties in obtaining sugar and the low priority given to mild and moderate diarrhoea (2). Most importantly we found that the mothers recognize four types of loose motions, one of which (called *daeria*) is more serious but less prevalent than the other three (3–5% of episodes) and requires immediate rehydration owing to the passage of watery stools. The study identified these rates as high as 52% in these cases (2). Recent studies have shown that rice-based ORT has a high degree of acceptability and results in improved absorption of intestinal fluids followed by a 20–30% reduction in stool output in young children with diarrhoea (3, 4). Considering these advantages and the wider availability of rice at home, we decided to teach rural mothers how to make and use rice-salt ORT (RSORT) in the hope that it would be better accepted and used than LGS for all types of diarrhoea.

The first step was to develop a standardized methodology which would fit into the BRAC approach of household teaching of ORT (1). At any time, about 85% of households have parboiled rice,

making it far more available than sugar. However, parboiled rice is hard and takes a long time to cook (50–60 minutes); in addition the extra fuel needed and the tendency to burn the pot (owing to the small amount of rice being prepared) led to general rejection of the direct cooking method. Thus, it was necessary to paste the rice using a home grinding stone which is widely available in Bangladesh (70% of households in our area), even if in other parts it is nearly unavailable (i.e., Rangpur). In Joypurhat, the demonstration and teaching of the standard methodology, including grinding, cooking, cooling and administration of the fluid, was possible and resulted in almost 100% understanding and ability to prepare an acceptable RSORT. It is, however, necessary to explore different field situations and determine what is culturally and practically a reasonable method of preparation.

Previous studies employed either rice powder (found in only 20% of homes in our areas) or puffed rice or some other readily powdered rice products (generally available in less than 10% of households). Where rice powder has been provided free in packets, its acceptance is extremely high (10). Our experience has also shown that if it is provided free, it will be more widely used because households will not have to purchase or borrow the ingredients and preparation is easier and faster. Recent research in ICDDR,B, however, puts even this into question since pre-packed glucose-ORS was more frequently preferred to pre-packed rice-ORS when both were provided free of cost to households (11).

We have shown that it is possible to teach mothers about RSORT as effectively as LGS, although the time and cost were double with RSORT. Retention of knowledge and capabilities to make the solution were equal in all three study areas and did not depend on the particular solution recommended. The sodium content of the resulting solution was similar among the three groups.

It is useful to note that LGS (based on *gur* or unrefined sugar) had a potassium content of roughly 20 mmol/l, virtually identical with the WHO-recommended ORS. This is an added benefit of LGS compared to RSORT since patients in Bangladesh are often malnourished and hypokalaemia is an important problem (12).

The highest use of both solutions was in the *daeria* type (19.5–40.3% for LGS and 6.1–18.4% for RSORT) and the lowest in the *amasha* type (mucoid stool with little loss of fluid). Overall, the use of LGS (in Dhalahar) was twice that of RSORT (in Baratara). Significantly, in Bhadsha where both LGS and RSORT were taught and equally promoted, the use of LGS surpassed that of RSORT by more than three times. RSORT was used even less

<sup>d</sup> An earlier study documented the negative attitude of doctors as a major impediment to the widescale use of LGS (2).

than packeted ORS which was not promoted by our study. While an earlier report by Rahman et al. found that rice-ORS was used more than glucose-ORS (4), a recent study by the same authors has reported results that are similar to ours (62% use of rice-ORS, 82% use of glucose-ORS) (11). Because of the inherent problems in preparing rice-ORS this group is now studying the acceptability of ORS made from precooked rice (Dr A.S.M.M. Rahman, personal communication, 1990).

Our study shows that an effective method for preparing RSORT has been developed in Bangladesh, which can be taught (with a high degree of reproducibility) and remembered for at least 24 months by most village women. Rice-salt ORT was clearly preferred by mothers who claimed in interviews that it shortened the diarrhoea and was a more acceptable drink. Although rice was more available in their homes, the time, effort, and fuel needed to prepare RSORT made its use far less common in this large-scale field trial. The convenience factor clearly outweighed the preference factor. Cultural barriers to the use of cereals in the very young were also an important impediment to the use of RSORT in this most vulnerable age group.

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#### Résumé

##### Réhydratation orale: essai communautaire comparant l'acceptabilité des solutions à base de saccharose ou de céréales préparées à la maison

Le traitement de la diarrhée par réhydratation orale au moyen d'une solution sucrée est préconisé dans de nombreux pays du monde. Au Bangladesh, un programme s'est chargé d'apprendre à plus de 13 millions de mères comment préparer une solution sucrée-salée à la maison; cependant, bien que ces mères aient une bonne connaissance du procédé et qu'elles effectuent les mélanges correctement dans la plupart des cas, elles ne les ont utilisés par la

suite que dans quelque 20% des épisodes diarrhéiques. Comme le riz est beaucoup plus facile à se procurer dans les foyers ruraux (95%) que n'importe quel type de sucre (<30%) et que la bouillie de riz est une nourriture largement acceptée en cas de maladie, on a effectué un essai de terrain dans trois zones (population totale de 68 345 habitants), afin de comparer l'acceptabilité et l'utilisation d'une réhydratation orale à base de riz par rapport à une solution à base de sucre. Bien que les mères aient été unanimes à convenir que les solutions à base de riz "stoppaient" la diarrhée plus rapidement, elles employaient des solutions à base de sucre deux fois plus souvent (dans 40% de épisodes de diarrhée aqueuse sévères contre 18%), les solutions à base de riz étant bien plus longues et difficiles à préparer. Cette diminution observée dans l'utilisation des solutions à base de riz préparées à la maison en fait donc de mauvais substituts des solutions sucrées dans les communautés rurales du Bangladesh.

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