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Standardization of Home-made Salt-sugar Solution for the Treatment of Acute Diarrhoeal Diseases of Childhood in Nigeria

AO GRANGE,* TC OKEAHIALAM,** O SERIKI,***
DC MUOGBO,† O OPALEYE,†† O SALAWU,†††
G GLEASON,*† A BRODY**† AND A MAGAN**††

Summary

Grange AO, Okeahialam TC, Seriki O, Muogbo DC, Opaleye O, Salawu O, Gleason G, Brody A and Magan A. Standardization of Home-made Salt-sugar Solution for the Treatment of Acute Diarrhoeal Diseases of Childhood in Nigeria. *Nigerian Journal of Paediatrics*, **1985: 12:41.** A study was carried out to identify a simple reproducible method for preparing home-made salt-sugar solution in Nigeria. The formula for a standard salt-sugar solution is one level teaspoon of salt, 10 level teaspoons of granulated sugar (or 5 cubes of sugar) mixed in one standard beer bottle (or 2 standard soft drink bottles) of clean water. A level teaspoon is defined as the amount obtained when a heaped 3ml teaspoon is levelled down so that the edge of the teaspoon is visible and free from salt. The solution so obtained would be 650ml and would contain 45–70mmol/litre of sodium and about 83mmol/litre of sucrose. This is a safe and effective mixture for the prevention of dehydration at the onset of diarrhoea and for the treatment of mild cases of dehydration.

College of Medicine, University of Lagos, Lagos
Department of Paediatrics
* Senior Lecturer
College of Medicine, University of Nigeria, Enugu
Department of Paediatrics
** Professor
College of Medicine, University of Ibadan, Ibadan
Department of Paediatrics
*** Reader
College of Medical Sciences, University of Benin, Benin City
Department of Paediatrics
+ Lecturer
Massey Street, Children's Hospital, Lagos
†† Chief Consultant
Epidemiology Unit, Federal Ministry of Health, Lagos
††† Registrar
UNICEF, Lagos
*† Programme Communications Officer
**† ORT Promotion Officer
**†† EPI Field Service Coordinator

Introduction

MANAGEMENT of acute diarrhoeal diseases in children commonly takes place at two levels of health care delivery. The first and more important level is in the home where appropriate treatment given early in the course of diarrhoea can prevent the development of dehydration which is associated with a high mortality and morbidity. Children who have failed to receive effective and safe forms of treatment may die at home or end up in health institutions severely dehydrated. There, invasive, expensive and sometimes, hazardous forms of management

such as intravenous therapy are undertaken. In spite of such measures, many children do not survive.

The salt-sugar solution is particularly useful for the prevention of dehydration at the onset of diarrhoea at home and it may also suffice in the treatment of mild dehydration. Majority of dehydrated children can be treated with oral rehydration salts (ORS)[1]. The World Health Organization (WHO) recommended—ORS packet contains in addition to sodium chloride, potassium chloride and sodium bicarbonate (or trisodium citrate) for correction of possible hypokalaemia and acidosis. Studies in some parts of the world[2-4] have shown that a marked reduction in infant and childhood mortality from diarrhoeal diseases can be achieved if all mothers have the knowledge and simple skill for preventing dehydration in the home. The widespread use of a home-made salt-sugar solution should satisfy this need provided mothers are taught the correct amounts of solutes which are effective and safe. Some workers have pointed out the possible danger of hypernatraemia resulting from home-made application of this solution if a mother uses an excessive amount of salt[5-7]. Various techniques have therefore, been recommended to avoid this potential danger while making a safe and effective home-made mixture[8 9].

We have found that the recommendations made and instructions given to health workers in Nigeria on the preparation of simple salt solutions vary considerably. There are no recognised local standards and it is likely that there is a wide variation of sugar and salt concentrations in the solutions prepared by mothers; some of these may be ineffective and others potentially harmful to the children.

For effective implementation of Oral Rehydration Therapy (ORT) as an important component of primary health care, there is need for the establishment of an acceptable local standard for the preparation of salt-sugar solution which the average Nigerian mother can learn and use correctly in her home. There should also be some uniformity, based on scientific information, on what is taught in health institutions in the country to ensure consistency of knowledge and skills among health workers. It is against this background that the present study was carried out:

1. to determine the amount of salt and sugar for a safe, effective home-made solution,
2. to identify easily available measures and containers for the preparation of the solution in the home,
3. to adopt a simple, fairly accurate and reproducible method of measuring salt and sugar which can be easily taught by health workers and practised by mothers and
4. to produce a formula for a home-made salt-sugar solution which is feasible and acceptable nation-wide.

Materials and Methods

Various methods for the preparation of salt-sugar solution which have been described, recommended and practised by health workers in Nigeria were identified and critically examined.

Measures

It was clear from the onset that a one-litre measure was not a common household item in Nigeria. Conversely, the standard Nigerian beer bottle was easily available throughout the country. It measures 650 ml of fluid to the neck and this is twice the full volume of a standard soft-drink bottle. The beer bottle was therefore, accepted as the unit measure of water for this study.

Salt

Preliminary studies were carried out independently in the departments of Paediatrics of Lagos and Benin University Teaching Hospitals by

two of us (AOG and DCM) to determine: (*a*) the amount of salt measured with locally available teaspoons, using methods practised by health workers, and (*b*) the concentration of sodium in the prepared salt-sugar solutions. The amounts of salt measured using the various locally available teaspoons are as listed in Table I.

TABLE I

Variations in the Amount of Salt Measured by Several Observers (Preliminary Study)

Measure	*Levelling Method*	*Range of quantity of salt (gm)*	*Mean (gm)*
One metallic 3ml teaspoon	Edge of knife	1.9–3.9	2.84
One plastic 3ml teaspoon	"	1.8–3.9	2.81
One-half of 3ml plastic teaspoon	"	0.9–2.0	1.53
One-quarter of 3ml plastic teaspoon	"	0.6–1.0	0.89
One-quarter of 2ml metallic teaspoon	"	0.4–0.7	0.57
One plastic 5ml teaspoon	"	3.9–4.3	4.14

The spoon was levelled in each case, with the edge of a knife or handle of another spoon. The solutions were analysed with a flame photometer and the results of the sodium content are shown in Table II. The wide variations in the results are due to the various sizes of teaspoons and the methods used for levelling the salt. There are over 12 types of teaspoons in Nigerian homes and these vary in volume from 1.8 to 5ml. However, the most common is the 3ml teaspoon and it is made both in metal and cheap plastic forms. It is found in most markets in the country; the plastic version costs 10k (10 US cents). It was therefore, accepted as the unit for salt and sugar in this study.

TABLE II

Variations in the Sodium Concentrations of Solutions made during the Preliminary Study

Amount of Salt	*Volume of Water Used*	*Sodium Concentration (mmol/litre)*
One level of 3ml teaspoon	1 beer bottle (650ml)	52–120
One-half level of 3ml teaspoon	"	40–64
One-quarter level of 3ml teaspoon	"	22–24
One-quarter level of 2ml teaspoon	"	18–24
One level of 5ml teaspoon	"	68–130

A safe and effective salt-sugar solution should contain 45 to 70mmol/litre of sodium. The content of one standard WHO recommended Oral Rehydration Salt packet when dissolved in 1 litre of water gives 90 mmol/litre of sodium. The amount of salt required for 45 to 70 mmol/litre of sodium in 650 ml of water was calculated and found to be in the range, 1.71–2.66 gm. The marked variation in the amount of salt and the resulting concentrations obtained when different measures of teaspoons of various sizes were tested (Tables I and II) indicated a need for a standardised teaspoon size. Any method adopted for measuring salt for the solution must be easy and capable of producing an amount within this range, using the household 3ml teaspoon. The goal of the study then, was to evolve a method matching these criteria.

In the final study, each participant in the study measured what he or she understood as a 'level teaspoon' of salt and the amount obtained was weighed on a scale with .01gm sensitivity. The results obtained by the group varied considerably as in the preliminary study. It became clear that apart from differences in levelling

techniques, there was marked variation in individual concepts of a 'level teaspoon' and this was also responsible for these results. The consensus reached was that a *level teaspoon of salt was the amount obtained when a heaped spoonful is levelled right down so that the edge of the spoon is visible and free from salt* (Fig. 1). This was tested several times by each participant; it was easy to achieve and the amount of salt obtained with this method was fairly consistent. It was also found that it made no difference if the levelling was carried out with the edge of a finger or knife; in fact, the edge of the little finger while obviously easily accessible, also proved to be most effective.

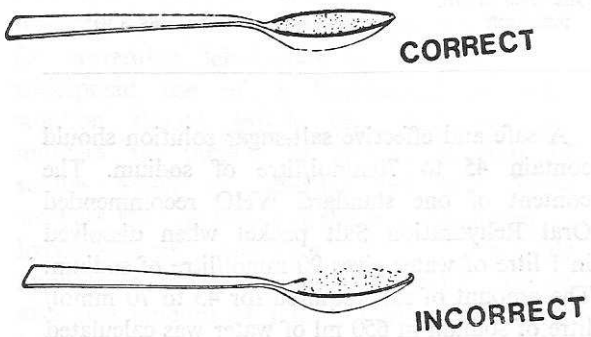

Fig 1. Levelling a teaspoon.

Sugar

The average weight of a cube of sugar was determined and found to be 5.2gm; both rectangular and square cubes available in Nigeria weighed the same. However, since granulated sugar is becoming more readily available than the cube sugar in the Nigerian market and local production is growing, the weight of a level teaspoon of sugar was also determined. Each participant did several measurements of teaspoon of sugar using the new levelling definition already described for salt; individual and average weights obtained were recorded.

Results

It was found that the weight of salt in a level 3ml teaspoon using the new technique for levelling, varied from 1.9 to 2.6gm with a mean of 2.3gm (Fig. 2). This narrow variation coincidentally, corresponds closely to the range of amounts required for a safe and an effective solution which contains 45 to 70mmol/litre of sodium in 650ml of water.

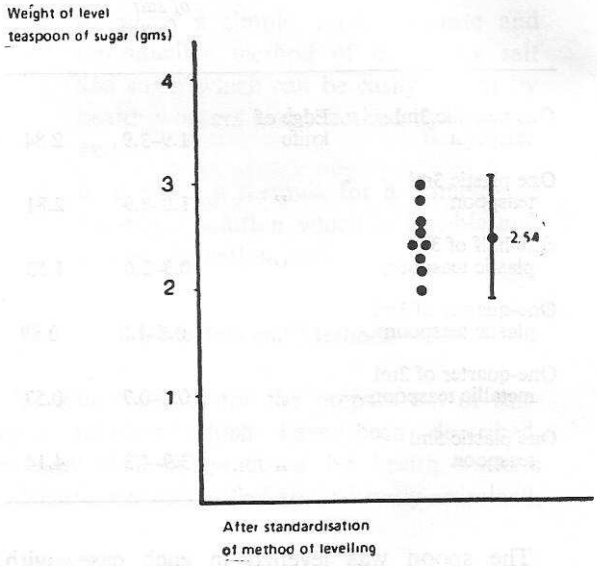

Fig 2. Weights of level teaspoons of salt measured by various individuals in the study group.

A cube or rectangular piece of sugar weighed 5.2gm and one level teaspoon of granulated sugar weighed an average of 2.5gm (Fig 3). The quantity of sugar required for a four per cent solution (83mmol/litre of sucrose in 650ml of water) was approximately, 25gm; this is equivalent to 10 level teaspoons of granulated sugar or five cubes of sugar.

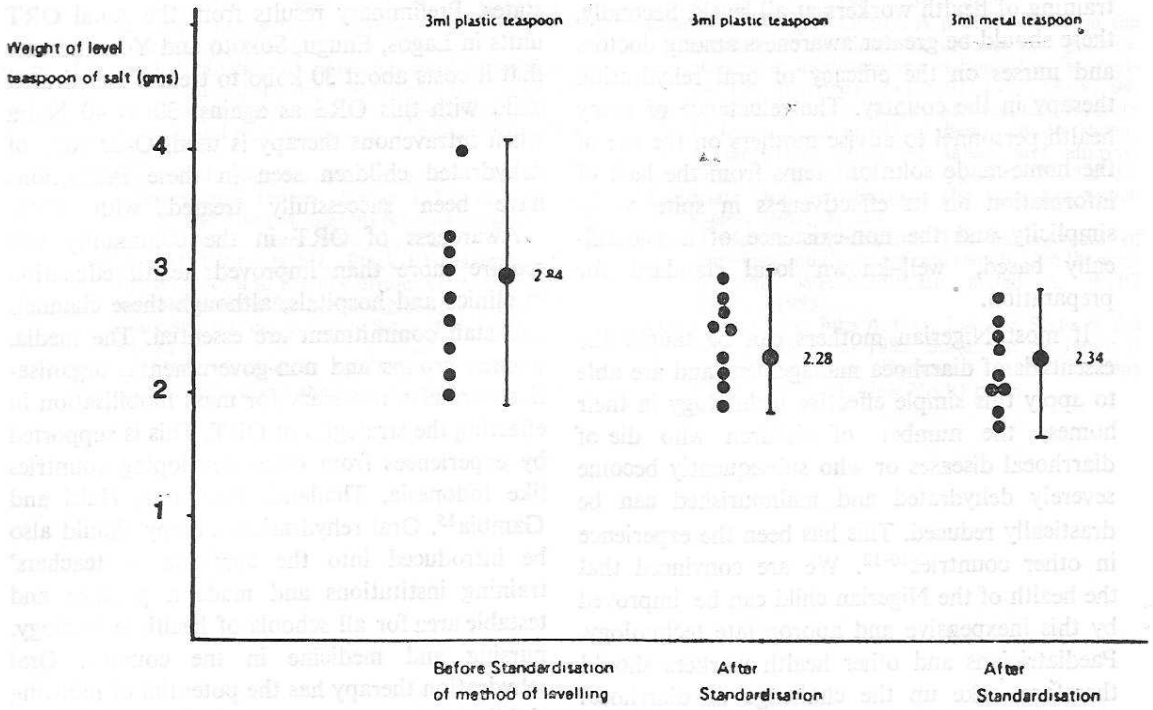

Fig 3. Weights of sugar measured with a plastic 3ml teaspoon by the study group, using the new standard method of levelling.

Discussion

Based on this study, a new formula which is recommended for making a safe and effective salt-sugar solution in the Nigerian home consists of:

1 level 3ml teaspoon of salt	(1.9–2.6gm)
10 level 3ml teaspoons of sugar (or 5 cubes)	(25gm)
1 beer bottle (or 2 soft drink bottles) of clean water	(650ml)

A mixture of these ingredients gives a solution which should contain 45 to 70mmol/litre of sodium and about 83mmol/litre of sucrose. Several mothers were tested at the Massey Street Children's Hospital and they found it easy to measure the salt and sugar correctly by the new finger technique. The 3ml teaspoon is the ideal for salt-sugar solution in every Nigerian home. It is easily available and it can be used for measuring the solutes in units of 'One for Salt' and 'Ten for Sugar' which can be remembered by mothers.

It is significant to note from this study that one-quarter of a level of 2–3ml teaspoon of salt to a beer bottle of water (a formula in which the quarter of a teaspoon is usually estimated rather than measured) used by many health workers gives 18 to 24 mmol/litre of sodium. This is low for efficacy of the solution and may give rise to hyponatraemia. Some health workers use the 5ml paediatric teaspoon found in drug packs as the standard measure. One level of salt with this gives a solution which contains 68 to 130mmol/litre of sodium; this may be dangerous. To ensure that the improved formula and the new definition of teaspoon levelling are

known to mothers, there must be some retraining of health workers at all levels. Secondly, there should be greater awareness among doctors and nurses on the efficacy of oral rehydration therapy in the country. The reluctance of many health personnel to advise mothers on the use of the home-made solution stems from the lack of information on its effectiveness in spite of its simplicity and the non-existence of a scientifically based, well-known local standard for preparation.

If most Nigerian mothers can be taught the essentials of diarrhoea management and are able to apply this simple effective technology in their homes, the number of children who die of diarrhoeal diseases or who subsequently become severely dehydrated and malnourished can be drastically reduced. This has been the experience in other countries[10-12]. We are convinced that the health of the Nigerian child can be improved by this inexpensive and appropriate technology. Paediatricians and other health workers should therefore, take up the challenge of diarrhoeal diseases and strongly promote ORT as a child protection strategy throughout the country[13]. Every family in Nigeria should be taught to make and use the standard salt-sugar solution at home as the first line of action in the management of diarrhoea.

It is pertinent to point out that much experience has been gained in the use of the WHO/UNICEF ORS for the treatment of dehydration in hospitals, clinics and homes. When used correctly, it is extremely cost-effective and safe compared to intravenous solutions, drip sets and hospital care related to severe dehydration[14]. In Nigeria, the WHO/UNICEF ORS is imported and the quantity available is small; therefore, it cannot be recommended nation-wide for use in the home at present, but there are plans for local manufacture. For the national ORT implementation programme, emphasis is placed, through health education, on the use of the home-made solution; the imported ORS is reserved for use in health institutions and it is supplied free by the Federal Government to all states. Preliminary results from the zonal ORT units in Lagos, Enugu, Sokoto and Yola indicate that it costs about 30 kobo to treat a dehydrated child with this ORS as against 30 to 40 Naira when intravenous therapy is used. Over 90% of dehydrated children seen in these institutions have been successfully treated with ORS.

Awareness of ORT in the community will require more than improved health education in clinics and hospitals, although these channels and staff commitment are essential. The media, women groups and non-governmental organisations are also necessary for mass mobilisation in effecting the strategies of ORT. This is supported by experiences from other developing countries like Indonesia, Thailand, Honduras, Haiti and Gambia[15]. Oral rehydration therapy should also be introduced into the curricula of teachers' training institutions and made a practice and testable area for all schools of health technology, nursing and medicine in the country. Oral rehydration therapy has the potential of reducing childhood mortality and morbidity and the cost of health care delivery from primary to tertiary levels.

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