**Evaluation of mothers’ knowledge about oral rehydration therapy and sodium concentration in homemade sugar salt solutions**

Lauro Virgílio de Sena,1 Helcio de S. Maranhão,2 Mauro Batista de Moraes3

**Abstract**

**Objective:** to evaluate mothers’ knowledge about oral rehydration therapy and to determine the concentration of sodium in sugar salt solutions prepared by the interviewed mothers.

**Methods:** cross-sectional study of low-income families from the suburbs of Natal, a city in the state of Rio Grande do Norte. One hundred and thirty six households with children younger than 5 years were visited. The information on when to use the solution, how to administrate it and how to prepare it was provided by the interviewed mothers. The concentration of sodium was determined in 100 solutions prepared by those mothers.

**Results:** only 9.0% of mothers had appropriate knowledge about when to use the solution and 21.0% knew how to administer it correctly. The error rates regarding the measurement of ingredients were: 2.5% for salt, 22.2% for water and 43.2% for sugar, according to the answers given by 81 mothers, who used a double-ended spoon made of plastic to measure quantities. In fifty percent of the analyzed samples, sodium was within safe limits (30 mmol/l to 100 mmol/l). Those considered dangerous (>100 mmol/l) or inefficient solutions (<30 mmol/l) reached the percentage of 47.0% and 3.0%, respectively. Out of the 69 solutions prepared with the double-ended spoon, 63.8% were found appropriate in terms of sodium concentration, while only 19.3% of the 31 solutions prepared using other measuring utensils were within acceptable limits (P=0.0001).

**Conclusion:** mothers’ knowledge about oral rehydration therapy was considered poor. Moreover, the concentration of sodium in sugar salt solutions seldom remains within safe limits, particularly those solutions in which the double-ended spoon was not used for preparation. These conclusions should be considered in future educational programs on oral rehydration.


1. Master of Science; Associate professor, Universidade Federal do Rio Grande do Norte.
2. Ph.D.; Associate professor, Universidade Federal do Rio Grande do Norte.
3. Associate professor, Head, Pediatric Gastroenterology Discipline, Paulista School of Medicine, Universidade Federal de São Paulo.

**Introduction**

Diarrheal disease is one of the most important causes of morbidity and mortality in children aged less than five years, especially in developing countries.1-5
In Brazil, approximately 50,000 children die annually as a result of this infirmity. In the northeastern region of the country, where the risk of death is five-fold higher than that of southern Brazil, the prevalence of mortality due to diarrhea in children aged less than five years, in 1997, was 10.9%; the state of Rio Grande do Norte alone accounts for 13.9% of this total percentage.6-8

It is estimated that the oral rehydration therapy saves approximately 1 million children aged less than five years worldwide.1-4

However, in developing countries, there are difficulties in the distribution of oral rehydration salts (ORS) packets to all the population. In this sense, the World Health Organization (WHO) has recommended the use of a home-based salt-sugar solution as an alternative for the prevention of dehydration caused by diarrhea.2,9,10 This alternative is extremely important considering that the solution is widely accepted by the community and that it does not depend on a system of distribution.11-13

However, there are certain problems related to its use, especially considering the knowledge and abilities of mothers in relation to preparing and administering the solution.14

In order for the salt-sugar solution to be considered safe and adequate for the prevention of dehydration, it requires being prepared within the safe limits of sodium concentration (30 mmol/l to 100 mmol/l). Concentrations below or above these values are considered ineffective and unsafe, respectively, in their administration during diarrhea. Solutions prepared with concentrations above 100 mmol/l can result in hypernatremia.13,15-17 It is also important to observe proper administration of the solution in order to adequately correct hydroelectrolytic abnormalities.11-13

Our study was carried out in a neighborhood located in the suburban region of the city of Natal, state of Rio Grande do Norte, northeastern Brazil, with the objective of assessing knowledge of mothers regarding oral rehydration therapy and of determining sodium concentrations in salt-sugar solutions prepared by the mothers interviewed.

Methods

We carried out a cross-sectional study in the Felipe Camarão neighborhood, suburban Natal. This region is inhabited by families of lower social and economical status who live in poor basic sanitary conditions. The families commonly receive orientation from community healthcare agents on maternal and child health, including information on prevention and treatment of dehydration caused by diarrhea using ORS and salt-sugar solutions. In the referred region, the salt-sugar solution is of great importance considering that there is no systematic distribution of ORS packets among the families. ORS packets are usually distributed in hospitals and healthcare units; at times, however, not even the hospitals or units have these packets. From November 1997 to February 1998 we visited 136 homes out of the 1,009 residences with children aged less than five years. Our visits were made according to the normal schedule routine of the healthcare agents; also, every two days we accompanied a different agent in order to obtain a more diversified population sample. After we obtained the consent of parents or guardians, we carried out interviews based on a standardized questionnaire, which inquired about information on the social and economical status of the family; the maternal schooling; the number of children aged less than five years; and the knowledge of mothers in relation to indication, preparation, and administration of the salt-sugar solution during diarrhea. We also assessed the social and economical status of families based on a questionnaire specific for poorer populations, which stratifies families into the following categories: upper lower status, lower lower status, and poverty status.18

In order to evaluate the knowledge of interviewees regarding the indication of the salt-sugar solution, we considered as correct the answers that the solution was indicated for the prevention of dehydration. To evaluate the knowledge of frequency of administration of the solution, we considered as correct the answers that the solution should be administered after the evacuation.2,6,11

In relation to the preparation of the solution, initially we inquired into the measure of the ingredients. Next, in the case of mothers who made use of a special measuring spoon (double-ended plastic spoon) advocated by the Brazilian Ministry of Health,6 we inquired into the measure and mixture of the ingredients water, salt, and sugar. The answers were considered correct according to the information printed on the spoon: one small spoon measure of salt and two large spoonful measures of sugar in a glass of water (approximately 200 ml).

The mothers who reported using other types of measure were not evaluated for the variable measure and mixture due to the great diversity of instruments used, which rendered the standardization and assessment of the data very difficult. After the interview, we requested all mothers who reported knowing how to prepare the salt-sugar solution to prepare the solution, which was to be later submitted to laboratory analysis. We collected a 10-ml sample of each solution; samples were frozen until they were submitted to the analysis for sodium concentrations. Samples were marked for whether the solution was prepared using the referred plastic spoon or with other measure, considering that some mothers did not have the earlier. Sodium concentration was determined at the Clinical and Toxicological Analyses Laboratory of the Universidade Federal do Rio Grande do Norte. Concentrations were determined using flame spectrophotometer (Tecnov 7000).

Solutions were considered appropriate for administration during diarrhea when the sodium concentrations were within the 30 mmol/l to 100 mmol/l range. Concentrations below
or above these values were considered inappropriate (ineffective < 30 mmol/l and unsafe > 100 mmol/l).\textsuperscript{13,16,19}

For the statistical analysis, we applied the chi-squared test and the Mann-Whitney test considering a statistical significance of P < 0.05.

\section*{Results}

Out of the 136 mothers interviewed, 134 (97.6\%) claimed awareness of the salt-sugar solution; out of the 134 mothers, 126 (94.0\%) reported knowing how to prepare the solution and 106 agreed to prepare a sample of the solution for our study. We analyzed the sodium concentration in 100 of the 106 samples collected; six samples were lost due to technical problems. The results presented are related to the 100 mothers who were interviewed, who prepared solutions, and whose solution sample was analyzed for sodium concentration.

The questions about indication and frequency of administration of the solution were answered correctly by only 9.0\% and 21.0\% of mothers, respectively.

Eighty-one of the 100 mothers reported using the plastic spoon advocated by the Brazilian Ministry of Health; all 100 mothers, however, reported knowing about the spoon. Out of the 81 mothers, the percentages of incorrect answers on amounts of salt, water, and sugar were, respectively, 2.5\%, 22.2\%, and 43.2\%. Incorrect answers concerning measures of at least two ingredients, including salt, were reported by 27.7\% for salt/water measures and by 54.3\% for salt/water/sugar measures. As mentioned above, the data collected from the 19 mothers who reported using other measures were not assessed due to the great variability of instruments used for preparing the solution.

Out of the 81 mothers who reported use of the double-ended plastic spoon for preparation of the solution, 69 (85.2\%) actually used the spoon to prepare the sample for our study. Thus, out of the 100 salt-sugar solutions analyzed, 69 were prepared using the plastic spoon and 31 using other instruments. Analysis of the sodium concentrations of samples independently of instruments used to prepare the solution (the plastic spoon or other instrument) indicated that 50.0\% of the solutions were safe and effective for use in cases of diarrhea (concentration within the 30 and 100 mmol/l limits), and the other 50.0\% were inappropriate (47.0\% with sodium concentration > 100 mmol/l and 3.0\% < 30 mmol/l). Comparison of solutions prepared using the plastic spoon with those prepared using other measures indicated a greater percentage of adequate solutions when the earlier was used, as presented in Table 1. The average sodium concentration for solutions prepared with the spoon was 91.7 more or less 37.5 mmol/l, and for those prepared with other measures, 138.4 more or less 56.0 mmol/l (P <0.05). Figure 1 illustrates the distribution of sodium concentrations with the median, 25th and 75th percentile, and minimum and maximum values for the different solutions.

Data on the social and economical status of families indicated that 71.0\% were in the upper lower stratum, 29.0\% in the lower lower stratum, and none in the poverty stratum. In relation to the maternal schooling, 58.0\% had completed fifth grade or above, 34.0\% had completed first to fourth grade, and 8.0\% were illiterate. Results on the number of children aged less than five years in the family indicated 60.0\% of families with one child, 34.0\% with two children, and 6.0\% with more than two children. Social and economical status, maternal schooling, and number of children aged less than five years did not present a statistically significant correlation with the answers on indication.

\begin{table}
\centering
\begin{tabular}{|l|c|c|}
\hline
Sodium concentration (mmol/l) & Double-ended spoon & Other measuring tools \\
\hline
Adequate (30 to 100) & 44 & 63.8 \\
Inefficient (< 30) & 2 & 2.9 \\
Dangerous (> 100) & 23 & 33.3 \\
Total & 69 & 100 \\
\hline
\end{tabular}
\caption{Distribution of sodium concentration in 100 samples of sugar-salt solution prepared with the double-ended spoon and other measuring tools}
\end{table}

P = 0.00017 \hspace{1cm} Odds-ratio - Dangerous versus Adequate + Inefficient = 6.86 (confidence interval- 95\%: 2.35 - 20.69)
frequency, and administration of the salt-sugar solution; with correct answers on amount of ingredients (water, salt, and sugar); with the use of the plastic spoon for preparation of the sample; or with the adequate concentration of sodium.

Discussion

In our study, more than 90.0% of the 136 mothers in the population claimed being aware of the existence of the salt-sugar solution and knowing how to prepare it. Out of the 100 mothers who agreed to prepare a sample and whose sample was analyzed, only 9.0% and 21.0% answered the questions about indication and frequency of administration, respectively, correctly. A study carried out in Zimbabwe with 300 mothers showed that despite the fact that 81.6% of mothers reported being aware and making use of the salt-sugar solution, only half of the study population knew the correct indication for the solution and 38.0% administered the solution after the evacuations. In turn, analysis of each separate ingredient indicated 63.0% of incorrect amounts of salt, 35.0% of incorrect amounts of water, and 73.0% of incorrect amounts of sugar. These results indicate a greater percentage of incorrect measures in comparison to our study, especially in relation to measures of salt.

Our results and those reported in the literature show a significant probability of use of incorrect measures of the ingredients. These results allow us to restate that increased support and attention are required in order to provide proper guidance on correct preparation and administration of the oral rehydration therapy using the home-based salt-sugar solution; the orientation should be aimed at teaching the preparation of solutions with adequate concentrations for cases of diarrhea.

Analysis of sodium concentration indicated that only 50% of the 100 solutions examined, independently of the type of measure used in the preparation, were within the safe and effective ranges (30 mmol/l to 100 mmol/l) for children with diarrhea. Unsafe (sodium > 100 mmol/l) and ineffective (sodium < mmol/l) solutions were detected in, respectively, 47.0% and 3.0% of samples. In a rural area of Zimbabwe the analysis of the sodium concentration of 147 salt-sugar solutions prepared by mothers in the community indicated that 48.0% of the samples were within the safe and effective ranges; 23.0% were considered unsafe; and 29.0% ineffective. Considering that the World Health Organization recommends that 90% of solutions should be within the safe and effective limits, both our results and those of the referred literature are well below the recommendations. Moreover, in our study we observed that the percentage of safe and effective solutions is well below the recommendations especially due to the percentage of unsafe solutions. These findings indicate the need to carry out educational, practical and reproducible programs in the community studied in order to avoid cases of hypernatremia, as reported in the literature.

As indicated in Table 1, there was a statistically significant association between safe, effective sodium concentrations and use of the double-ended plastic spoon. The data are also presented in Figure 1, which illustrates the greater dispersion of sodium concentration values and the deviation of the median toward higher concentrations of sodium. In the city of Baltimore, a study was carried out...
to analyze the sodium concentrations of solutions prepared by five nurses who had theoretical and practical knowledge of oral rehydration therapy and used three different methods (double-ended plastic spoon, teaspoon, and fingers). The solutions prepared with the special measuring spoon presented a minimum and a maximum sodium concentration of 64 mEq/l and 93 mEq/l, respectively. The solutions prepared with a teaspoon and fingers presented minimum and maximum concentrations of 24 mEq/l and 140 mEq/l, and of 20 mEq/l and 167 mEq/l, respectively. Consequently, based on our information and on that reported by the literature, the use of the double-ended plastic spoon can be associated with the preparation of safe and effective salt-sugar solutions for children with diarrhea. The odds ratio calculated shows that there is an almost seven-fold higher probability of solutions that are prepared with other measures to present unsafe sodium concentrations in comparison to those prepared with the double-ended spoon (Table 1).

We did not find an association between the knowledge of mothers or the sodium concentrations analyzed by social and economical status, with maternal schooling, or with number of children aged less than five years. Our population sample was reasonably homogeneous within the spectrum of low social and economical status (including low schooling), which is probably in agreement with the characteristics of other suburban populations of large Brazilian urban centers. It is possible that mothers with higher schooling and of higher social and economical status are better able to prepare safe, effective salt-sugar solutions when necessary and given the proper orientation. A study carried out in Bangladesh\(^{13}\) showed that mothers with elementary education were better able to prepare salt-sugar solutions, after receiving proper information on how to prepare the solution and practical demonstrations, in comparison to illiterate mothers.

Despite the fact that our population receives periodical visits of community healthcare agents who provide orientation on educational healthcare activities (including orientation regarding oral rehydration therapy with salt-sugar solution) we concluded that the knowledge of mothers regarding this matter was insufficient. The sodium concentrations of the solutions were frequently outside the safe and effective ranges. Our results should be taken into consideration in future educational programs on oral rehydration therapy and used three different methods of instructing the population, preferably with practical demonstrations. Finally, it is important to note that the use of the double-ended spoons favors the preparation of adequate solutions and its use should thus be stimulated.

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References


Correspondence:
Dr. Lauro Virgílio de Sena
Avenida Amintas Barros, 2763 - Lagoa Nova
CEP 59060-250 – Natal, RN, Brazil
Phone: + 55 84 234.3568
E-mail: lvs@ufrnet.br