

Selection of culturally sound home fluid management of infantile diarrhoea in rural Mexico

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Abstract

An ethnographic study was conducted in 12 villages located in the central highland plateau of Mexico to explore mothers' practices for the management of acute diarrhoea, in order to identify a fluid that could be safely used as a rehydration solution for the sick child. Teas were reported to be used by 90% of 142 mothers interviewed, while rice-based beverages, which included rice water and rice gruel, were used by 77% of them; another 19% said they would accept using rice-based beverages if advised to do so. A key difference was that teas were mainly used as a treatment to stop diarrhoea, while rice-based gruels were used as a palliative to soothe the child. Rice-based beverages were selected to be further tested as a likely rehydration solution, as mothers reported using them longer than teas during the diarrhoeal episode. Their use was not subject to a complicated system of specific remedies for particular types of disease, as was the case with herbal teas. They were widely accepted and compliance was expected to be greater than with teas, as there was no expectation that rice-based beverages would shorten the duration of diarrhoea. The preparation of rice-based beverages was assessed in those mothers who mentioned using it. Fifty-nine percent of mothers used a concentration of rice between 40 and 70 g/L, which was deemed to be safe, as previous studies had successfully used 50 g/L for oral rehydration solutions.

Introduction

Most childhood diseases occur at home, and the initial management, as well as the decision to seek outside health care, is primarily undertaken by mothers or other home caregivers [1-3]. This is particularly true for children with acute diarrhoea, [4]. It is common for children in the developing world to have between 3 and 11 episodes of diarrhoea per year [5-8]. Such frequency causes mothers to develop different strategies for managing the episodes. Thus, they establish their own conceptual framework of what causes diarrhoea [9], and learn to recognize symptoms and signs that prompt their choice of particular health-seeking behaviours [4, 10, 11]. Over

the years, mothers and other caregivers have developed numerous home remedies to treat sick children [12, 13]. This cultural domain [14, 15] is often rich in indigenous societies [16, 17], although not all such remedies are efficacious in treating the disease they were meant to treat, and in some cases they may be harmful [18].

Common to numerous societies in the developing world is the coexistence of several medical systems, between which people move back and forth in seeking care [8]. As a result, mothers' conceptions about the illness and their expectations about treatment often are at odds with those of physicians [19]. This is at least one of the reasons why physicians' advice is not always followed (or even understood) by mothers. Therefore, it is the health sector's responsibility to find effective ways of delivering their interventions in ways that are culturally appropriate for the population [20]. The fact that diarrhoeal episodes are initially managed by mothers who have little or no professional medical training should not be a deterrent to looking for a common ground of understanding between them and the health sector.

This was the first of three studies [21] aimed at understanding practices that mothers usually carry out at home when faced with an episode of acute diarrhoea in a child, and that could be safely applied to the most important aspect of treatment, re-establishing and maintaining the child's water and electrolyte balance.

Methods

Study area

The study was conducted in the valley of Solis, an area in the central highland plateau of Mexico, 170 km northwest of the capital city. The floor of the valley is 2,600 m above sea level, and the surrounding peaks reach an altitude of over 3,000 m. Winters are cold and dry, with temperatures regularly between 5° and 8°C. Summers are warm and rainy, with midday temperatures over 25°C. A group of villages in the valley is scattered along an area 4 to 5 km wide by 20 km long, bisected from east to west by the Lerma River. Agriculture is the main economic activity

of the people. The highly polluted water of the river is used to irrigate the fields and is also a drinking source for animals; drinking water for human consumption comes from wells. The area has no sewage disposal.

All of these features contribute to a high level of contamination of the environment with human faeces, thus making diarrhoea a common problem. Its prevalence in this area is higher than that reported for the rest of the state (6.5 vs 4.2 episodes/child/year) and also higher than the national average at the time of the study (6.2 episodes/child/year) [7, 22].

Study design

The study had three components:

1. A pilot study to construct the questionnaire to be used during the general survey, and adapted to local, colloquial language;
2. A general survey of beliefs and practices related to fluid management during infantile diarrhoea;
3. A survey on the use and observation of the preparation of home-made beverages from which samples were taken for chemical analyses.

Five of 12 communities in the valley were selected for the pretests required to develop the questionnaires. The other seven villages were chosen because they had not been exposed to any other research or intervention project in recent years.

The pilot study and the general survey were conducted by three physicians and a senior social worker, all of whom had field experience in the area. Respondents were allocated randomly to each of them, and each interviewer conducted approximately the same number of interviews. All of the analyses were checked for possible interviewer bias. The interviews on home preparation of beverages and the collection of samples for chemical analyses were conducted by field auxiliaries, who were women from the communities. They all had elementary school training, as well as previous training in supporting field activities in the area, and ample knowledge of their own community.

Pilot study

Sample

Before beginning the survey study, exploratory ethnography was carried out with 10 mothers in each of the five villages to obtain the qualitative data necessary to construct appropriate interview schedules [15, 23]. The 50 mothers were selected from women over 30 years of age who had more than one child, as they were likely to be experienced in dealing with diarrhoea. They were

identified on the basis of the experience and judgement of each community's health auxiliary and a senior social worker.

Interviews

The mothers were visited in their homes and were given vignettes [24] of hypothetical cases of children with diarrhoea, as well as a set of open- and closed-ended questions. Vignettes were chosen based on experience reported in the literature suggesting that interviewees feel less intimidated giving their opinion about a hypothetical case than committing themselves when asked what they would do [25]. The open-ended questions included a free list of fluids usually fed to the sick child during an episode of diarrhoea [15, 26, 27]. This exploratory technique helped us to define the semantic domain of mothers in the study area in relation to their use of homemade fluids, as well as to define the best format for phrasing the questions that were later included in the general survey [15].

General survey

Sample

We selected a random sample of mothers from the other seven communities in the valley, stratifying the sample within each community by age and literacy. Such stratification was not meant to be representative of the age and literacy distribution of the mothers; rather, it was considered necessary because literacy could be an important factor in choosing treatments for diarrhoea, the expectation being that more literate mothers would be likely to select Western-type remedies such as oral rehydration salts (ORS). In addition, we thought that older mothers would have greater experience dealing with diarrhoea. Therefore, we decided on such purposeful sampling, which amounted to six strata, including three age groups (15-24, 25-34, >34 years) by literacy and non-literacy. Choosing four mothers from each stratum resulted in a sample of 24 mothers per community, for a total of 168 mothers. In actual practice, however, only 161 mothers were eligible according to our criteria. These were selected from a total of 415 mothers who had at least one child under five years of age in these communities.

Interviews

The survey questionnaire consisted of a series of precoded, close-ended questions. This version took into account interview experience and was phrased in local expressions and colloquial language. Each of the four researchers conducted face-to-face interviews with individual mothers, either alone or accompanied by the

health auxiliary in the community. The interviews usually took place in the front yard of the mother's house. When a mother was not found at home, the interviewer returned at least twice (a total of three attempts). The mean time for each interview was approximately 15 minutes, and the entire survey was completed in a month.

Associations between beliefs and practices were assessed by correlation. The statistical significance of the mother's age and literacy in relation to choice of fluids and reasons to use each of them was tested by χ^2 [28].

Preparation and chemical analyses of the homemade beverages

As the last stage, the ethnographic study contemplated an additional round of home visits to assess mothers' preparation of the selected beverage, as well as chemical analyses of the beverage.

Sample

For this stage we chose a subsample of 48 mothers, drawn at random from the 109 mothers in the general survey who had affirmed their use of the homemade beverage. This subsample consisted of six mothers in each community except the largest one, which was treated as two communities, as it had twice the number of inhabitants as the rest. One mother was randomly selected from each of the six age-by-literacy strata.

Measurements

The field auxiliaries visited mothers in their homes and asked them to prepare one of the beverages that they usually made for their children with diarrhoea. To facilitate this, the field auxiliaries carried with them the ingredients that the mother needed to prepare the beverage, as well as measuring instruments to assess its exact preparation. The number and type of home measures of each ingredient that each mother used were recorded, and the interviewer weighed or measured the amount of each.

Samples were collected to study the chemical composition of the beverages [29]. Aliquots from the samples collected were transported in an ice box to the field station, where they were kept refrigerated until transported to the central laboratory. Moisture was determined in a vacuum oven (AOAC 7.003), protein by the Kjeltex method (AOAC 7.061), lipids by ether extract (AOAC 7.061), carbohydrate by difference with crude fibre (AOAC 7.071), sodium and potassium by standard clinical laboratory methods, and osmolality by a clinical osmometer.

Results

Pilot study: The difference in use between tea and rice water

Contrary to the expected reaction to the vignettes, early during the pilot study interviews we found several mothers who were unwilling to respond to hypothetical cases. They generally felt that they could not speak for another person. When the schedule was changed to more direct questions, they were more comfortable discussing home remedies and other aspects of home treatment.

When asked to list what fluids they gave their children during diarrhoeal episodes, all 50 mothers said they gave some fluids. The most frequently mentioned home-made beverages were herbal teas and rice-based beverages (rice water, rice-based gruel). Both looked promising as choices for a hydration fluid. Teas were supported by the fact that they required boiled water to prepare them, and all mothers added sugar. One mother said that when preparing tea, she broke the bubbles that formed when water started boiling by adding a pinch of baking soda, thus providing bicarbonate, a desired component of the hydration formula [30].

Rice-based beverages seemed to be given for a longer time than teas, and mothers associated their use with caring for the sick child [31]. Therefore, further interviews were done to find reasons that would support the choice of one of these beverages.

To help make this choice, we added two questions designed to probe the use of these beverages and to give confirmatory information regarding the choice of either one. However, answers to these questions resulted in an apparent contradiction. Several mothers, when asked "What do you give your child for diarrhoea?," mentioned different types of herbal teas (camomile, cinnamon, anise, etc.). However, when further asked "What do you think is better to give a child with diarrhoea to drink, herbal tea or rice water?," the same mothers replied rice water.

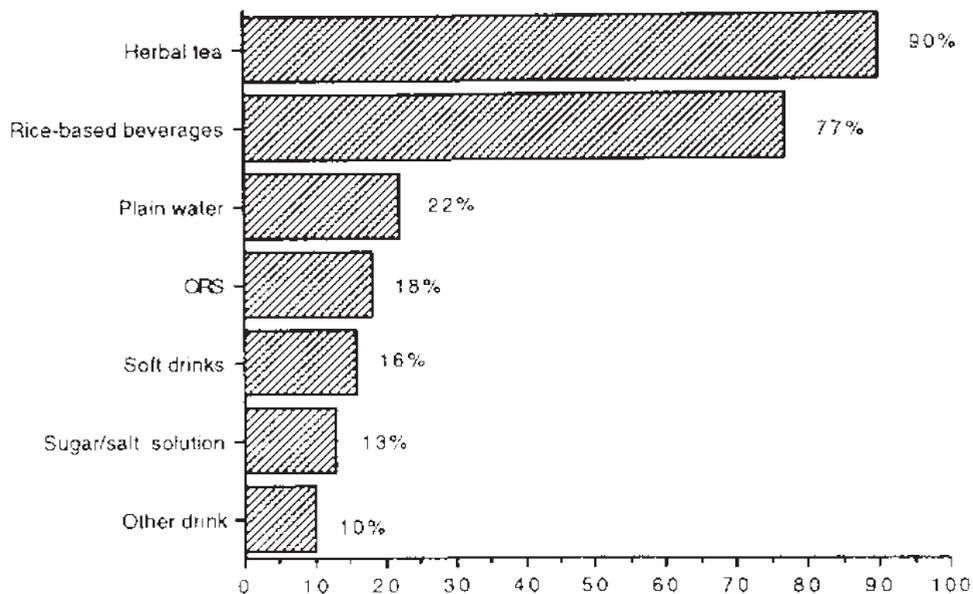
After several such instances, it became clear that the two questions, which were intended to tap the same information, were not actually addressing the same issue. Mothers would give their sick children a herbal tea as an immediate remedy to stop diarrhoea, but they would feed the children rice water or other rice-based beverage during the course of the episode. That is, the rice beverage was given during the episode to alleviate symptoms associated with the disease, such as an upset stomach. Further in-depth interviewing reinforced this interpretation.

It became apparent that the two beverages were given for different specific purposes, and although they had the connotation of a “remedy,” a different expectation was associated with Bach. In response to additional probing, mothers explained that teas were given in relation to the type of diarrhoea, and their main purpose was to stop the disease (i.e., a remedy). Fluid replacement was another benefit of tea (according to 60% of respondents, versus 8% for rice water). Mothers cited nourishment as the main purpose of giving rice water or rice-powder gruel (30% of respondents, versus 1% for tea).

Furthermore, we discovered a complex taxonomic system [32] regarding teas, associating the type of diarrhoea with the type of tea: a “hot” diarrhoea required a “cola” tea. In addition, hints of a decision-making process related to a second option when diarrhoea was not stopped by the first-tried tea [33, 34]. Rice-based beverages, on the other hand, were given regardless of the type of diarrhoea, and as their purpose was to provide nourishment to the child, they were given throughout the episode.

General survey: The choice of home-made beverage

The general survey was answered by 142 (88%) of the 161 eligible mothers. The 19 mothers who were not interviewed were absent because they had temporarily left the area in search of employment. No respondent refused to be interviewed. The distribution of respondents within each stratum is shown in table 1. Seventeen percent of mothers in the youngest age group were illiterate, compared with 47% in the oldest age group ($\chi^2 = 11, p < .01$). As in the pilot study, the most frequently mentioned beverages (90%) were herbal teas, followed by rice water or rice-powder gruel: 77% of mothers gave these rice-based beverages to their children (see FIG 1 Percentage of mothers reporting preparing particular beverages when their children had diarrhoea (n = 142) (may include more than one answer)). Of 33 (23%) mothers who reported not giving rice water, 27 (82%) said they would be willing to use it if advised to do so.



We asked about the reasons for giving the teas and rice beverages. The two most common reasons for providing tea were that it was meant to stop diarrhoea and to replace fluid. Only one mother mentioned nourishment as a reason for giving tea. Rice-based beverages were given both as a remedy and for nourishment; nine mothers said that rice water could also be used for fluid replacement (table 2). None of these results was significantly affected by mothers' age ($p > .06$) or literacy ($p > .30$).

Rice beverage preparation and chemical analyses

As the observations from the general survey confirmed the findings of the pilot study, the third phase of the project focused on the chemical composition of rice-based beverages. During the interviews we gradually realized that these beverages actually were of two different types: rice water, or *agua de arroz*, and rice-powder gruel, or *atole de arroz*. In the survey questionnaire, we lumped the two together; when we looked at how each was

prepared, we found the difference. Based on the authors' experience, and supported by medical colleagues in Mexico City, in Mexican urban settings the term atole usually refers to a milk-based beverage, whereas in rural areas rice atole is usually prepared with rice powder diluted in water, which makes the beverage thicker than rice water.

Mothers were visited at home and asked to prepare

rice-based beverages as usual, and samples were taken to determine the composition of the beverages (table 3). The most widely prepared beverage was rice gruel (75% vs 25% who prepared rice water), and its preparation was not dependent on maternal age ($p=.89$). The only significant difference in the nutrient composition between the beverages was the much higher amount of protein in the gruel due to the amino acids present in the rice powder ($p < .0001$).

TABLE 1. Distribution of mothers interviewed in the general survey, according to stratification by age and literacy status

Age group (yr)	Literate		Illiterate		Total	
	No.	%	No.	%	No.	%
15 - 24	34	83	7	17 ^a	41	100
25 - 34	28	56	22	44 ^b	50	100
>34	27	53	24	47 ^b	51	100
Total	89		53		142	

a,b. Distribution of literacy by age group with different superscripts is statistically different ($p < .01$).

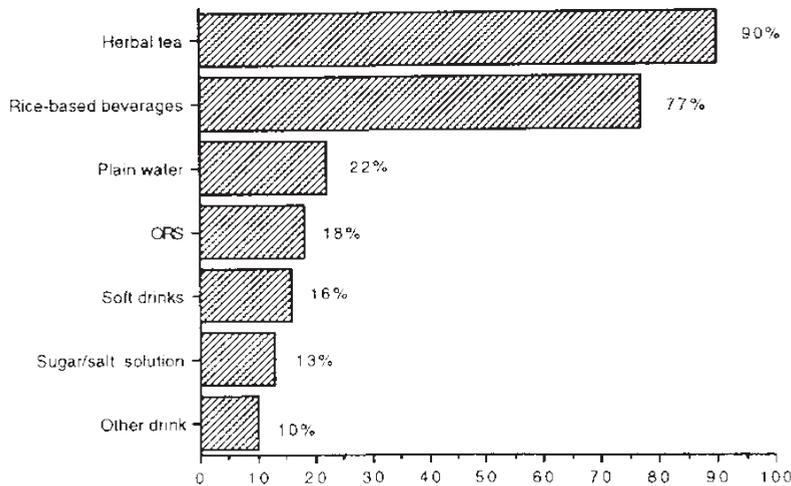


FIG 1 Percentage of mothers reporting preparing particular beverages when their children had diarrhoea (n = 142) (may include more than one answer)

TABLE 2. Main reasons cited by mothers for giving particular home-made beverages

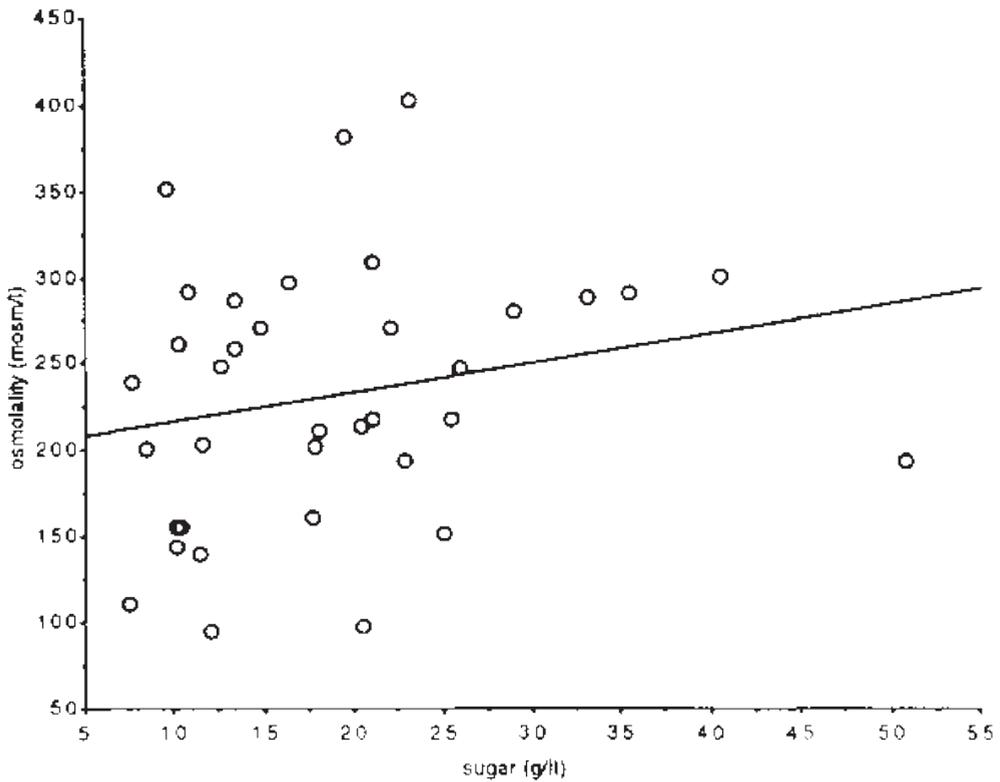
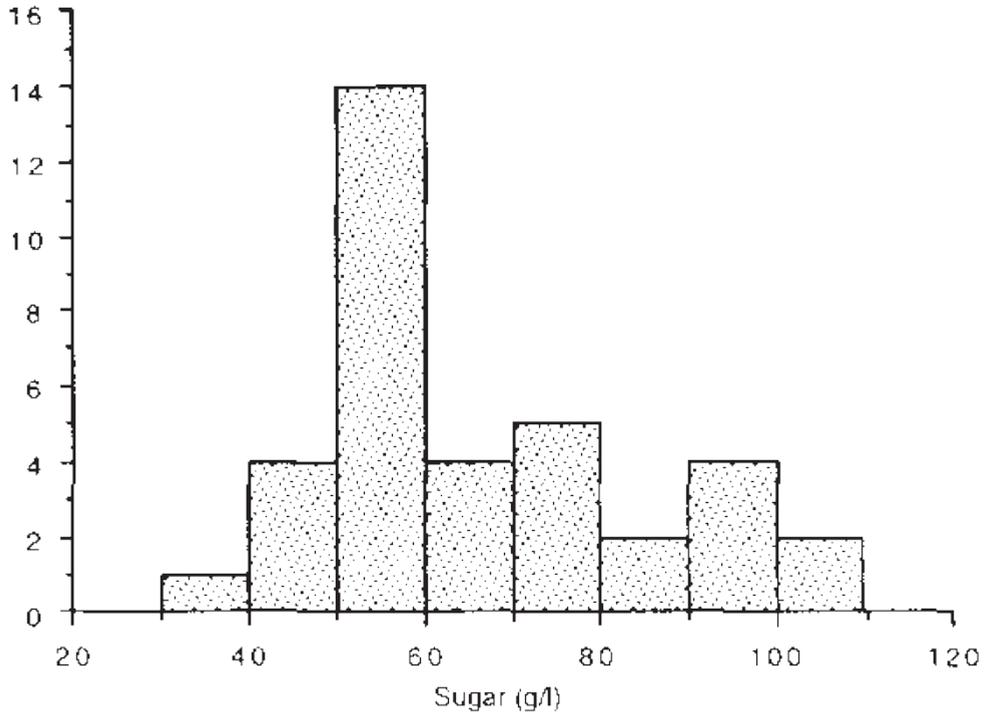
Reasons	Herbal teas n = 128		Rice beverages n = 109	
	No.	%	No.	%
Remedy	64	50	64	58.7
Nourishment	1	0.8	33	30.3
Fluid replacement	69	53.9	9	8.3

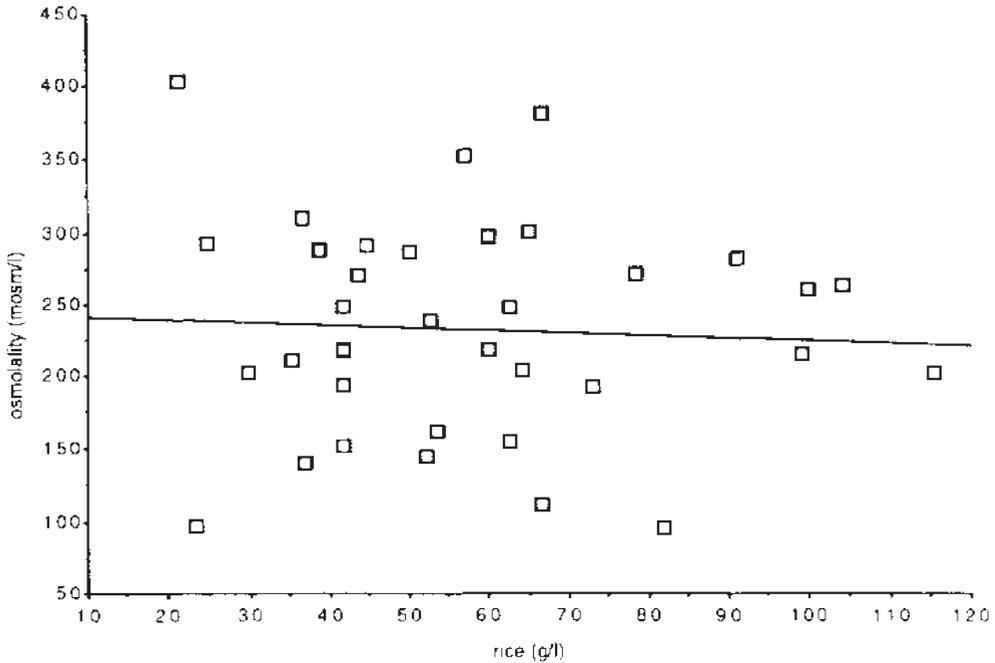
A strong association was found between what mothers in the previous survey said they usually prepared and

what they actually prepared when visited ($r = .63$, $p < .05$) (table 4). There were also strong associations between the amount of water that mothers reported using and the amount they actually used in preparing rice-based beverages ($r = .95$), and the time that they said they boiled water for the beverages and the amount of time they actually did ($r = .88$). All the mothers added sugar to the beverage, and none added salt. The mean (\pm SD) concentration of sugar added to the gruel was 66.4 (± 19.2) g/L. Two percent of mothers used a concentration less than 40 g/L and 22% used more than 80 g/L (see FIG. 2. Number of mothers who used different sugar concentrations in preparing atole (g/L)), but none of

them added sugar in excess of 110 g/L. The osmolality of the rice-based beverages was predominantly determined by the concentration of sugar ($r=.47$, $p=.003$) and was barely influenced by the concentration of rice ($r = .13$, p

$= .46$) (see FIG. 3. Association between the concentration of sugar and the osmolality of the rice-based beverages and FIG. 4. Association between the concentration of rice and the osmolality of the rice-based beverages).





Discussion

The finding that mothers gave a wide variety of home-based beverages to children with diarrhoea was not surprising, as it is a common empirical observation that mothers have different home remedies for this indication. The selection of herbal tea as a possible hydration solution was particularly appealing in the initial stages of our fieldwork because water had to be boiled to prepare the tea, thus addressing one of the main concerns associated with oral solutions, cleanliness of the water. In addition, teas were usually sweetened with sugar, another basic component of oral hydration solutions. The addition of baking soda by some mothers to break the bubbles of the boiling water was another desirable component of the formula, as it was a source of bicarbonate.

However, if we had followed this example and selected tea as a suitable vehicle for rehydration, taking advantage of the mothers' stated reason that they gave tea to replace fluids, we would most likely have failed in the attempt to find a fluid-replacement beverage, because we would have ignored a most important consideration for the mothers: the main reason for giving tea was to stop diarrhoea. It is now known that oral rehydration solutions will not make diarrhoea subside, but purging rates may actually increase with the administration of oral fluids, especially in the first hours of treatment [35, 36]. Therefore, it was important not only to find another candidate for an oral rehydration solution, but also to understand the mothers' expectations regarding such a beverage.

TABLE 3 . Composition of the rice-based beverages as prepared by mothers

Components	Beverage	
	Rice water	Atole
Rice (g/L)	59.0 ± 20.7	57.3 ± 24.7
Moisture (%)	91.3 ± 5.1	87.4 ± 0.6
Carbohydrate (%)	8.1 ± 5.0	6.7 ± 0.5
Protein (%)	0.02 ± 0.0	5.3 ± 0.9
Lipids (%)	0.4 ± 0.1	0.4 ± 0.02
Sodium (mEq/L)	2.30 ± 3.0	2.5 ± 1.8
Potassium (mEq/L)	2.1 ± 0.8	2.0 ± 0.6
Osmolality (mOsm/L)	249.2 ± 107.0	225.5 ± 63.0
Osmolality >300 mOsm/L (%)	11	4

TABLE 4. Comparison of the rice-based beverage that mothers said they usually prepared and what they actually prepared

What mothers said they usually prepared	What mothers prepared (%)	
	Rice water	Atole
Rice water	89	11
Atole	0	100
Both	17	83

r = .63, p < .05.

In view of the results of our ethnographic exploration, we were inclined toward a rice-based beverage as our test beverage. The difference between rice water and rice gruel was in the type of rice used in their preparation. Rice water was almost always made with rice grain and rice gruel with rice powder, as reported elsewhere [37, 38]. In our sample of mothers, rice gruel was the most frequently prepared beverage. We decided to focus on it as a likely solution for the clinical trial for the following reasons: mothers continued to give it throughout the diarrhoeal episode; its use was not governed by a complicated system of remedies for particular types of the disease, as was the case with herbal teas; the beverage was widely accepted by mothers in this area; its preparation was not affected by the mother's age or literacy; and the mothers did not expect that the administration of rice gruel would shorten the duration of diarrhoea, so compliance should be good.

From the clinical point of view, the two main issues regarding the choice of this beverage had to do with the uniformity of its preparation by mothers, and its adequacy in achieving hydration. The variability in composition as prepared by mothers during acute diarrhoeal episodes was determined and proved to be largely acceptable by clinical criteria. Fifty-nine percent of mothers prepared it with a concentration of rice between 40 and 70 g/L. Clinical trials using rice powder for oral rehydration cited a concentration of 50 g/L [38, 39]. As the osmolality of rice-based beverages is mostly due to sugar and not rice concentration, if too much sugar were added it would result in a hyperosmolar beverage, which is highly undesirable for children with diarrhoea, as it could worsen the course of the disease.

Sucrose is a disaccharide that contains 1 g glucose (molecular weight 180) and 1 g fructose (molecular weight 180), so the molecular weight of sucrose is 360. Using the formula to find the osmolality of a substance in a solution (mass in grams/molecular weight), it became clear that adding 20 to 30 g sugar on top of the upper concentration in this sample (i.e., 110 g/L) would result in a hyperosmolar solution (>300 mOsm/L). However, none of the mothers in our sample used sugar in concentrations higher than 110 g/L. Therefore, for the clinical trial we decided to prepare the solution with a concentration of sugar of 60 g/L, very close to the one used by the mothers (66 g/L), which would have an osmolality of 167 mOsm/L (60/360).

Although all the mothers in our sample added sugar to the rice gruels, none added salt. From a clinical point of view, it is less risky to give a hyponatraemic solution than a hypernatraemic one, especially because the usual forms of diarrhoea in Mexico are not severe sodium-losing

types [7], such as cholera. Besides, we expected that the intestinal sodium carriers present in the rice gruel (sugar, starch, amino acids) [40-42] would prevent the loss of sodium by increasing its endogenous reabsorption [43]. This expectation was supported by other published studies describing successful rehydration of children with a no-sodium rice-water solution [38, 44]. Therefore, the next step of the programme was to submit the selected home-made beverage to a clinical trial to test its efficacy as a rehydration solution.

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