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Childhood Diarrhea and Observed Hygiene Behavior in Salvador, Brazil

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Brief biweekly home visits, made as part of a cohort study of diarrhea in young children under age 5 years that was carried out in Salvador, Brazil, in 1998–1999, were used as a low-cost way to collect structured observation data on domestic hygiene behavior. Field-workers were trained to check a list of 23 forms of hygienic or unhygienic behavior by the child or the child's caretaker, if any behaviors were seen during the visit. Children were grouped according to whether mainly unhygienic behavior or mainly hygienic behavior had been recorded. This permitted study of the determinants of hygiene behavior and of its role in the transmission or prevention of diarrheal disease. Observations were recorded on roughly one visit in 20. Households with adequate excreta disposal were significantly more likely to be in the "mainly hygienic" group. The prevalence of diarrhea among children for whom mainly unhygienic behavior was recorded was 2.2 times that among children in the "mainly hygienic" group. The relative risk for prevalence was 2.2 (95% confidence interval: 1.7, 2.8). The relative risk fell to 1.9 (95% confidence interval: 1.5, 2.5) after data were controlled for confounding, but the difference was still highly significant.

behavior; child; diarrhea; house calls; hygiene; risk factors; sanitation; water supply

Diarrhea continues to be an important cause of morbidity and mortality among young children in developing countries (1). In Brazil, it still carries a severe burden of child morbidity and mortality in some regions (2, 3). Improved case management has reduced mortality rates in recent years (4) but has not had as great an impact on persistent and bloody diarrhea. Measures to prevent transmission are still needed.

It is now widely accepted that water supplies and sanitation, though necessary for the prevention of diarrheal diseases in young children, are not sufficient (5) unless they are accompanied by changes in domestic hygiene behavior (6). There is also a growing realization that questionnaire surveys are inadequate for studying behavior with regard to such a stigmatized topic as hygiene. Wide divergence has been found between what people say they do and what they are seen to do when structured observation is used (7–9). People also demonstrate reactivity, changing their behavior to present a more favorable image when they know they are under observation (10, 11). Nevertheless, structured observation seems to be less subject to bias than other quantitative approaches to assessing behavior (12).

We conducted an epidemiologic study of the relation between diarrhea and hygiene behavior, using structured observations collected over a 1-year period at very modest cost. Observations were made opportunistically during brief twice-weekly household visits whose main purpose was to record episodes of diarrhea in young children. To test the usefulness of this approach, we evaluated the role of sanitation facilities and hygiene behavior in diarrheal disease determination.

MATERIALS AND METHODS

Study population

The study households were selected from a set of 30 sampling areas chosen to represent the full range of socioeconomic and environmental conditions in the city of Salvador (population, 2.4 million) in northeastern Brazil. A census of the 20,000 households in these areas was conducted. The characteristics of this population have been given elsewhere (13). Households with children under 3 years of age were selected at random from the full list of households.

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Observation schedule

Twenty-three specific behaviors were selected as being likely to be observed during a home visit of a few minutes and also to carry a risk of diarrheal disease transmission. The experience of the fieldwork team, including the interviewers' comments during the preliminary phase of the fieldwork and the observations of anthropologists, and the findings of previous studies (14–17) were used as a basis for this selection. The list included behavior by the child as well as by the mother or other caretaker in the family. These behaviors are listed in table 1.

With a view to minimizing errors in recording and entering the data, we decided to design the observation schedule so as to include both of the mutually exclusive "positive" and "negative" options related to the same type of action. "Positive" is used here in the sense of helping to prevent (and "negative" of favoring) diarrheal disease transmission. This was done to avoid ambiguity when an action was not recorded; for example, if "washes hands with soap before eating" was not marked, it was necessary to distinguish between the case where the *opposite* behavior was observed and the case in which *neither* the positive nor the negative version of the behavior was seen during the visit.

This arrangement of the observation recording schedule with explicit alternatives also helped with data quality assurance; it would be most unlikely that both positive and negative variants of a behavior would be observed during the brief duration of a visit. Marking "no" against an action indicated clearly that it had not been observed, in either a positive or a negative form.

Data regarding a number of environmental variables, including the presence or absence of piped water and sanitation in the household and of any open sewage channels in the vicinity (i.e., visible from the house) were collected by questionnaire and observation at the beginning of the fieldwork. "Adequate excreta disposal" was defined to include toilets discharging to sewers, drains, and septic tanks.

TABLE 1. Frequency of observation of 23 hygiene behaviors during biweekly home visits made over a 1-year period, Salvador, Brazil, 1998–1999

Behavior	Mother	Child
Drinks tap water	61	212
Drinks water from a filter	33	828
Drinks water from a vessel with cover	12	17
Drinks water from a vessel without cover	4	18
Adds chlorine to the water (mother or other adult)	11	NA*
Washes salad/vegetables (for eating raw)	10	NA
Eats vegetables unwashed	4	7
Washes hands with soap before eating	3	14
Washes hands without soap before eating	4	8
Does not wash hands before eating	41	130
Washes hands with soap after defecation	4	9
Washes hands without soap after defecation	6	9
Does not wash hands after defecation	11	63
Bathes before breakfast	22	902
Bathes before lunch	327	2,322
Eats while sitting on the ground	125	837
Eats food which fell onto the ground	23	603
Drops utensil on ground; it is picked up and subject continues eating	17	98
Drops utensil on ground; it is washed or replaced and subject continues eating	7	23
Drops pacifier on ground; it is picked up and is replaced in mouth	12	104
Drops pacifier on ground; it is washed and replaced in mouth	13	47
Drops baby bottle on ground; it is picked up and replaced in mouth	7	32
Drops baby bottle on ground; it is washed and replaced in mouth	3	30
Total no. of observations	760	6,338

* NA, not applicable.

Field-workers and implementation

The 15 field-workers employed for the work had all completed a secondary education. They were selected on the basis of their performance in a role-playing exercise simulating the conditions of the home visits. Their training lasted 10 days, including the pilot-testing of the observation schedule in the field.

The observations were made twice weekly during the home follow-up visits from the 18th week to the 70th week of the epidemiologic study, that is, from March 30, 1998, to April 29, 1999. The data covered 942 of the 1,153 children in the main study—a total of approximately 90,000 home visits.

Data analysis

For the analysis, not all of the behaviors listed in table 1 were considered. Giving priority to those referring directly to the protection or exposure of the index child, we dropped some of the behaviors because they referred to mother's/caretaker's behaviors that had no effect on child diarrhea (for instance, the mother's drinking tap water or sitting on the ground when eating) or because they would not be expected from a small child (adding chlorine to the water or washing vegetables). Of the remaining behaviors, a few were combined; thus, for the analysis, 33 possibilities were considered. The observations "bathes before breakfast" and "bathes before lunch" were used as proxies for "washes hands before eating," since this latter behavior was rarely recorded directly.

The 33 options were divided into 15 "negative" behaviors likely to favor fecal-oral disease transmission and 18 "positive" practices that were more likely to help prevent it (table 2). If a given behavior by the child or the caretaker was observed one or more times, one point was added to the child's positive score. Similarly, if a given negative behavior was seen at least once, one point was added to the negative score of that child.

We added the values for all positive behaviors and divided the total by 18 to obtain a standardized score between 0 and 1 for each child. Similarly, the values for negative behaviors were totalled and divided by 15. These standardized scores

TABLE 2. "Positive" and "negative" hygiene behaviors observed in children under 3 years of age and their caretakers, Salvador, Brazil, 1998–1999

Hygiene behavior
Positive behaviors
Mother washes vegetables to eat raw
Mother washes hands (with or without soap) before eating
Child's hands are washed (with or without soap) before eating
Mother washes hands (with or without soap) after defecation
Child's hands are washed (with or without soap) after defecation
Mother bathes before breakfast
Child is bathed before breakfast
Mother bathes before lunch
Child is bathed before lunch
Mother drops utensil on floor, but washes it or replaces it with a clean one
Child drops utensil on floor, but it is washed or replaced with a clean one
Mother drops child's pacifier on floor, but washes it or replaces it with a clean one
Child drops pacifier on floor, but it is washed or replaced with a clean one
Mother drops child's bottle on floor, but washes it or replaces it with a clean one
Child drops bottle on floor, but it is washed or replaced with a clean one
Child drinks water from a filter
Child drinks water from a covered vessel
Mother or other adult puts chlorine in the water
Negative behaviors
Child eats raw vegetables unwashed
Mother eats without washing hands
Child eats without washing hands
Child's hands are not washed after defecation
Mother does not wash hands after defecation
Caretaker drops utensil, picks it up, and continues to eat with it
Child drops utensil; it is picked up and the child continues to eat with it
Mother drops child's pacifier on floor, picks it up, and replaces it in child's mouth
Child drops pacifier on floor; it is picked up and replaced in child's mouth
Mother drops child's bottle on floor, picks it up, and replaces it in child's mouth
Child drops bottle on floor; it is picked up and replaced in child's mouth
Child drinks water from tap
Child drinks water from an uncovered vessel
Child eats while sitting on the floor
Child eats food which has fallen on floor

were rounded to one decimal place. Finally, the children were divided into three categories: 1) those whose "negative" standardized score was greater than the positive score; 2) those with a greater positive standardized score than negative score; and 3) those with equal positive and negative scores.

For a specific study of behaviors involving use of water for hygiene, a similar categorization was performed using a selection of 15 positive behaviors and 11 negative behaviors. Of the positive behaviors, all but the last three were used (table 2). Of the negative behaviors, the last four were dropped. The total scores were standardized as before, dividing by 15 and 11, respectively.

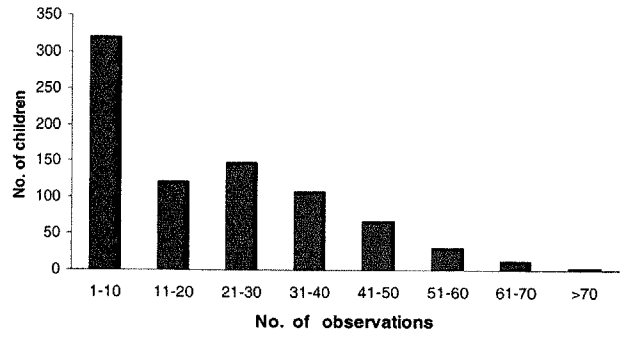

FIGURE 1. Distribution of the number of behavioral observations recorded for each child in a cohort study of diarrhea, Salvador, Brazil, 1998–1999.

Incidence of diarrhea—that is, the number of episodes of diarrhea per child-year—and longitudinal prevalence—that is, the fraction of days of follow-up with diarrhea, which has been shown (18) to be more closely associated than incidence with long-term health effects such as weight gain and mortality—were used as the outcome measures.

Data analysis was performed using Stata software (Stata Corporation, College Station, Texas). Poisson regression analysis was used to estimate the effect of behaviors on the longitudinal prevalence and incidence of diarrhea, and the χ^2 test was used for significance testing in the contingency tables.

Ethics

Informed consent was obtained from all study households. Ethical approval for the study was given by the Ethics Review Board of the Federal University of Bahia.

RESULTS

One or more observations were recorded on 4,883 visits, or more than one in every 20, but during the great majority of visits no behavior listed in table 1 could be observed. Figure 1 shows the distribution of the number of observations made for each child. Some behaviors were observed far more frequently than others. Bathing before lunch, for example, accounted for more than one third of all observations recorded for the children and nearly half of those recorded for the mothers. The mothers' behavior with respect to themselves was also different from what they practiced with their children. Children were seen to be bathed or to have their hands washed before meals on 3,246 occasions, but this was true of the mothers on only 356 visits.

Of the total of 942 study children, 222 had predominantly positive scorings, while the scores of 124 were mainly negative. For 596 children (63.3 percent), the positive and negative scores were the same. In fact, for 520 of these children, both scores were nil. These were children for whom neither positive nor negative behavior had been recorded. There was

TABLE 3. Incidence, prevalence, and relative risk of diarrhea among children under 3 years of age, according to hygiene behavior score group, Salvador, Brazil, 1998–1999

Hygiene behavior score group	No. of children	No. of days with diarrhea	No. of episodes of diarrhea	No. of days of follow-up	Prevalence of diarrhea (days/child-year)*	Incidence of diarrhea (episodes/child-year)	Relative risk of diarrhea for mainly negative scores vs. mainly positive scores			
							Prevalence		Incidence	
							Unadjusted RR†	Adjusted‡ RR	Unadjusted RR	Adjusted‡ RR
Mainly positive	222	1,332	505	75,716	6.42	2.43	1.00§	1.00§	1.00§	1.00§
Intermediate group	596	3,520	1,331	174,508	7.36	2.79				
Mainly negative	124	1,578	458	40,468	14.23	4.13	2.22 (1.75, 2.81)¶	1.95 (1.54, 2.47)	1.70 (1.44, 2.01)	1.61 (1.36, 1.90)

* Chi-squared test for trend: $\chi^2 = 434$; $p < 0.001$.
† RR, relative risk.
‡ Adjusted for child's age, mother's education, population density, housing quality index, the presence of a toilet and a piped water supply, and the effectiveness of refuse and sewage disposal in the immediate neighborhood of the household.
§ Reference category.
¶ Numbers in parentheses, 95% confidence interval.

no significant correlation between the child's score and the number of observations made relating to that child and his or her caretaker.

Table 3 shows the association between hygiene behavior and the prevalence and incidence of diarrheal disease in the study children. Among children for whom mainly positive hygiene behavior was recorded, the prevalence of diarrhea was 6.4 days per child-year, while it was 14.2 days per child-year in children with mainly negative scores. Children with no observations experienced an intermediate prevalence. The difference between the positive and negative groups was highly significant, corresponding to a relative risk of 2.22 (95 percent confidence interval: 1.75, 2.81). After data were controlled for seven potentially confounding factors, including the presence of piped water and a toilet in the house, the relative risk was reduced to 1.95 (95 percent confidence interval: 1.54, 2.47) but was still highly significant. The incidence was 2.4 episodes per child-year among children with mainly positive scores and 4.1 episodes per child-year among children with mainly negative scores. This yielded a highly significant unadjusted relative risk of 1.70 (95 percent confidence interval: 1.44, 2.01), which was reduced to 1.61 (95 percent confidence interval: 1.36, 1.90) but remained significant after we controlled for the same potentially confounding factors as for prevalence.

Table 4 shows the grouping of the children in the three hygiene categories according to a number of environmental variables for which data had also been recorded during the home visits: the presence of piped water in the house, adequate means of excreta disposal, and the presence of an open sewage channel nearby. Among households that had adequate excreta disposal, there were 2.2 times more children with positive scores than negative scores but only 1.2 times more in households that did not. A lesser degree of association (not significant) was seen with household water supply, and no association was seen with the presence of an open sewer nearby. Excreta disposal and behaviors were independently associated with diarrhea.

TABLE 4. Distribution of children by hygiene score grouping and the environmental sanitation status of their households, Salvador, Brazil, 1998–1999

Environmental factor	Hygiene behavior score group*			Relative risk of a positive hygiene score (mainly positive scores vs. mainly negative scores)	
	Mainly positive scores ($n = 222$)	Intermediate scores ($n = 596$)	Mainly negative scores ($n = 124$)	RR†	95% CI†
Piped water in the house					
Yes	199	503	108	1.14	0.85, 1.53
No	21	86	16		
Excreta disposal					
Adequate	166	411	76	1.26	1.03, 1.55
Inadequate	51	181	43		
Open sewer nearby					
Yes	127	351	71	1.00	0.85, 1.17
No	95	245	53		

* Totals exclude missing data.
† RR, relative risk; CI, confidence interval.

TABLE 5. Distribution of children by hygiene score group (water-using behaviors only) according to availability of piped water in the household, Salvador, Brazil, 1998–1999

Piped water in the house	Hygiene behavior score group*			Relative risk of a positive score (mainly positive scores vs. mainly negative scores)	
	Mainly positive scores ($n = 238$)	Intermediate scores ($n = 622$)	Mainly negative scores ($n = 73$)	RR†	95% CI†
Yes	213	532	65	1.01	0.83, 1.24
No	25	90	8		

* Totals exclude missing data.
† RR, relative risk; CI, confidence interval.

Table 5 shows the distribution of the children with regard to behaviors specifically related to use of water for hygiene. Since the categories here were defined in terms of a smaller set of behaviors, a larger number of children had no score of either sign and so remained in the middle category. As in table 4, there was no significant difference in the distribution between categories when households with and without piped water were compared.

DISCUSSION

Structured observations have been used in only a few studies of diarrhea epidemiology (15, 16, 19), because implementation of structured observation is extremely expensive, requiring substantial investments of time by trained staff. Observation over a longer period of time would reduce the degree of reactivity as people became habituated to the observer's presence, but this would increase the cost still further. There is also a wide degree of variation in the hygiene behavior of each individual from one occasion to the next (20).

In this study, structured observations were made as a part of biweekly visits to households for collection of data on children's diarrhea in the previous 3 or 4 days. Each visit took only a few minutes and was used as an opportunity for the visitor to observe and record hygiene behaviors by the child and the mother/caretaker. The results presented here are indicative that there would be advantages in an approach to structured observation by which snapshots taken over many months could be pooled to obtain a score representing a person's characteristic standard of hygiene behavior over the long term. Through systematic recording of behaviors by observers, investigators using this strategy would avoid the well-known limitations of recall methods that rely on questionnaires. This method also has advantages over either spot or in-depth observations, being as unobtrusive and low cost as the former but potentially more reliable than both because of its repetition over an extended period of time. To us, the most attractive feature of such a strategy is that information on behavior, which is generally treated with qualitative tools, can be turned into variables for quantitative epidemiologic analysis, allowing the coupling of behavioral observations and epidemiologic data, which, with few exceptions (15, 17, 19, 21), is rarely encountered in the relevant literature on diarrhea.

The strength of the association between hygienic behavior and lower diarrhea morbidity is suggestive of the validity of the observational data and hence of the feasibility of this strategy of collecting meaningful information about hygiene behavior using a low-cost opportunistic approach. The intermediate diarrhea prevalence in the intermediate behavior group, for most of whom no behavioral observations had been made, supports the assertion that this group was not a biased selection from the population, with particularly positive or negative hygiene behavior.

The data presented here are indicative of the important role of hygiene behavior, in addition to the well-known importance of a water supply and sanitation facilities in the household, in the causation and prevention of diarrheal disease. The significant relative risk of diarrhea, which was associated with mainly negative behavior as compared with positive, was, at 2.2 for longitudinal prevalence, the highest in the univariate analysis of 12 environmental determinants of diarrhea (Strina, unpublished data).

A remarkable finding is the significant association between a positive hygiene score and the presence of adequate excreta disposal facilities in the household (table 4). It does not seem likely that the presence of a toilet was the cause of the difference in behavior, because none of the specific behaviors contributing to the score were concerned with excreta disposal practices. Nevertheless, there could be a degree of such a causal link if piped water led people to practice positive hygiene behaviors using water and if piped water were associated, as it is in most settings, with the presence of a toilet. In order to establish whether this could be so, we carried out a similar analysis with the list of behaviors restricted to those associated with water use. However, no association between a positive hygiene behavior score and a water supply was observed when the limited list of behaviors was used (table 5).

We concluded that the causality runs the other way; that is, it would seem that families predisposed to have adequate sanitation in their homes have a measurably better awareness of hygiene, expressed in their behavior, than those which do not. Moreover, such differences in behavior are reflected in the prevalence of diarrhea among their children.

No such association with behavior was found with the presence of open sewage channels near the household, a characteristic of neighborhoods where community sanitation infrastructure is lacking and a factor that is beyond the control of an individual household. This suggests that the difference is associated with a family's individual predisposition to install and use a toilet, rather than a characteristic of the neighborhood in which they live.

Similar associations between sanitary facilities and hygiene behavior have been found elsewhere. Curtis et al. (22) found that households in Bobo Dioulasso, Burkina Faso, which had piped water were more likely to keep their yards free of visible contamination with excreta. Hoque et al. (23) found in Bangladesh that the hand-washing technique used in households owning a latrine was more thorough than that in households which did not. In both of these cases, the nature of the behavior was such that it could not be attributed to the facilitating effect of the water supply or toilet.

The association of adequate sanitation and hygienic behavior casts doubt on a substantial body of literature in which the health impact of sanitation is assessed by observational studies (in the sense of nonintervention studies) of diarrheal disease (24, 25). The best such studies have used multivariate analysis in an effort to control for confounding by socioeconomic status, but there are limits to the degree to which such methods can control for all possible confounding factors, particularly when the data relate to self-selected exposure groups (26) and the relative risks involved are quite small (27). If families that install toilets behave in more hygienic ways anyway, then the fact that such households have less diarrhea is attributable not to the toilet but to the characteristics of the household which led them to install it.

Fortunately, this does not call into question the conclusion that sanitation offers health benefits in Salvador, because other research carried out in the city has shown that the association of high diarrhea rates with a lack of sanitation is stronger when whole neighborhoods are compared than when the data are analyzed by individual household (28; Strina, unpublished data).

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