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# Acute Diarrhea among Children from High and Low Socioeconomic Communities in Salvador, Brazil

Rebecca R. Seigel, MD;* Círia Santana e Sant'anna, MD;† Katia Salgado, MD;‡ and Paulo de Jesus‡


## ABSTRACT

*Objective:* The etiology and epidemiologic characteristics of acute diarrhea among children of high socioeconomic status (HSES) and low socioeconomic status (LSES) in Salvador, Brazil, were compared.

*Methods:* From February to May 1994, children with (cases) and without (controls) acute diarrhea less than 5 years of age attending a public university pediatric outpatient clinic (LSES children) and two private outpatient clinics (HSES children) were identified, and their demographic, clinical, and epidemiologic characteristics were analyzed. Their stool samples were examined for enteric bacterial pathogens, rotavirus, and parasites. A polymerase chain reaction (PCR)-based method was used to differentiate *Escherichia coli* strains associated with diarrhea.

*Results:* During the 4-month study period, 59 LSES case children, 60 LSES control children, 52 HSES case children, and 49 HSES control children were identified. Low socioeconomic status children with diarrhea were two times younger than HSES children ($P < 0.001$). Sanitary and water supply conditions were significantly different between the two socioeconomic groups. However, within the same group, with the exception of association of fewer water supplies among HSES cases compared to HSES controls ($P < 0.05$), these variables were not associated with acute diarrhea. Diarrhea was significantly associated with isolation of one or more pathogens in each group. Enteropathogenic *E. coli* and *Shigella* spp were the most common pathogens in LSES children, whereas rotavirus was the most common organism associated with diarrhea in HSES children.

*Conclusion:* The differences in etiology of acute diarrhea among LSES and HSES children indicate that despite living in the same urban environment in northeastern Brazil, they have distinct risk factors and exposures to infectious agents. Diarrheal control strategies need to take these differences into consideration.


Key words: *acute diarrhea,* Escherichia coli *diarrhea, socioeconomic status*

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*Division of International Medicine and Infectious Diseases, Cornell University Medical College, New York, New York; †Serviço de Pediâtria do Centro Pediátrico Professor Hosannah de Oliveira; and ‡Enterics Laboratory, Department of Medicine, Universidade Federal da Bahia, Brazil.

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Address correspondence and requests for reprints to Dr. Lee W. Riley, Division of International Medicine and Infectious Diseases, Cornell University Medical College, 1300 York Avenue, Room A-431, New York, NY 10021.

Diarrhea is a major cause of morbidity worldwide, and remains the leading cause of childhood mortality in the developing world.[1,2] In Latin America and the Caribbean, diarrheal diseases account for nearly 20% of deaths in children 0–4 years of age, with 49% of these deaths attributable to acute watery diarrhea.[3] In northeastern Brazil, childhood mortality exceeds 14% during the first 5 years of life, and more than 50% of these recorded deaths are associated with diarrhea.[4] In rural northeast Brazil 22/1000 children less than 1 year of age die of diarrheal disease,[5] and attack rates of diarrhea are higher in urban poor than among rural poor in this region.[6] Recent studies of children living in urban slums in northeastern Brazil describe rates of 14 to 16 diarrheal episodes per child per year.[7,8]

Infants in poor neighborhoods of Porto Alegre, Brazil, have a mortality rate more than twice that of infants living in non-poor neighborhoods of the same city.[9] In a prospective study in Pacatuba, a small town in northeastern Brazil, Guerrant et al found diarrheal attack rates to be significantly higher in the poorest areas than in the non-poor area.[10] In urban infants in São Paulo, Brazil, significant associations between the following risk factors and acute diarrheal disease were found: prior hospitalization, daycare center exposure, diarrhea in a household member, and low family income.[11]

Despite these observations of increased incidence of acute diarrhea among low-income children, diarrhea remains a significant cause of morbidity among all children in developing countries. The present study examines, using a case-control design, if risk factors and etiology for acute diarrhea differ between children residing in poor and non-poor neighborhoods of the same urban environment. This study was conducted in Salvador, a city in northeast Brazil with a population of approximately 2.5 million, which has populations residing in *favelas,* slum residences, distributed among middle to high socioeconomic residential neighborhoods.

## MATERIAL AND METHODS

### Inclusion Criteria and Case-Control Definitions

Children age 0 to 5 years were included in the study. Cases were defined as children who had diarrhea at the time of the interview or in the preceding 24 hours. Diarrhea was defined, according to World Health Organization (WHO) criteria, as three loose stools per 24-hour period, that the mother of the child believed were distinct from the child's normal stools. Only acute cases of less than 2 weeks duration were included.

Controls were children without diarrhea matched to the case children by sex and age (±3 months) within the same socioeconomic status. These children presented with medical complaints other than diarrhea and did not have diarrhea at the time of the interview or in the preceding 2 weeks.

### Recruitment of Study Subjects

Study subjects were designated as belonging to high socioeconomic status (HSES) or low socioeconomic status (LSES) based on the pediatric facility from which they were recruited. The validity of this grouping system was confirmed by responses to the "socioeconomic situation" section of the questionnaire that was administered to each patient's guardian.

Subjects of HSES were recruited from one of two private pediatric ambulatory care centers. One center is a private, group pediatric office practice without laboratory, inpatient, or holding facilities. From January through May 1994, this center had 694 general pediatric visits, 56 (8%) of which were for acute diarrhea. High socioeconomic status cases and controls were recruited during weekday afternoon office hours. The second center is a private 24-hour pediatric acute care facility, with an enterics laboratory on the premises, and seven private, short-term, holding rooms. The investigators visited this clinic daily at intermittent times and identified and recruited cases and controls by interviewing patients' guardians in the waiting area, or by reviewing patients' charts in the nursing station.

All LSES subjects were recruited from the ambulatory clinic or holding area of a public university pediatric hospital in Salvador. This hospital also serves as the state of Bahia's main pediatric referral center for diarrhea, dehydration, and respiratory diseases. From January through May 1994, 19,754 (66%) of the hospital's 30,020 patient visits were for diarrhea. All LSES subjects were identified and recruited Monday through Friday mornings either as they presented to Hospital Infantil's ambulatory clinic or from the holding area, a room within the clinic where children could receive oral or intravenous rehydration for a short period of time, generally ranging from several hours to a few days. Patients admitted to the hospital's inpatient unit were excluded.

During the study period, it was expected that 50 to 60 acute diarrhea cases would be identified from the two private clinics who met the inclusion criteria. Hence, the recruitment of cases from the public university hospital clinic was terminated when 60 children were identified.

### Questionnaire Administration and Sample Collection

After informed consent was obtained, a questionnaire was administered by the investigators to the guardian of each case and control child. The questionnaire solicited information regarding patient demographic and clinical characteristics, socioeconomic situation, and possible risk factors.

Two rectal swabs were collected from each case and control child at the time of interview. One was placed in Cary-Blair transport medium for bacterial culture, and the second was placed in 2 mL of phosphate-buffered saline (PBS, pH 7.4) for rotavirus detection by enzyme-linked immunosorbent assay (ELISA). Samples were stored at 4°C until processed in the laboratory.

### Laboratory and Microbiologic Procedures

All microbiologic cultures, biochemical assays, and rotavirus ELISA were performed at the enterics disease laboratory at the Federal University of Bahia at Professor Edgar Santos Hospital, adjacent to Hospital Infantil. In most cases, standard microbiologic and biochemical tests to identify *Escherichia coli*, *Salmonella* spp, *Shigella* spp, and *Vibrio cholerae* were begun the same day of the specimen collection.[13] When this was not possible, samples were stored at 4°C and processed within 24 hours. Samples were tested for rotavirus by ELISA (LMD Laboratories, Inc., Carlsbad, CA), in batch, as groups of 30 to 40 samples were collected, and results were detected visually.

The identification of pathogenic strains of *E. coli* by polymerase chain reaction (PCR) consisted of testing, from each child, 3 to 6 lactose fermenting, and up to three non-fermenting colonies identified as *E. coli* by biochemical assays, selected from MacConkey plates. In this study, pathogenic *E. coli* sought for identification by PCR included enteropathogenic *E. coli* (EPEC), heat-stable (ST) and heat-labile (LT) toxin-producing enterotoxigenic *E. coli* (ETEC), and enteroinvasive *E. coli* (EIEC). The protocol followed has been previously described and validated.[14] Individual colonies were stored on tryptic soy agar (TSA) (Difco Laboratories, Detroit, MI) grid plates at 4°C. The tests of *E. coli* samples were performed on site in Brazil, as well as at Cornell Medical College in New York, USA. All colonies from a single patient were pooled for template DNA preparation. Small loopfuls of bacterial growth from each colony were combined and suspended in 300 μL sterile distilled water and boiled for 5 minutes. A 10 μL aliquot of this suspension was added to 90 μL of PCR reaction mixture (10 mM Tris-HCl [pH 8.3]), 50 mM KCl, 0.01% [w/v] gelatin, 1 mM MgCl, 0.2 mM each of dNTPs (Pharmacia Biotech Inc., Piscataway, NJ), and 2.5 units of Taq-polymerase (Boehriger Mannheim Biochemicals, Indianapolis, IN), and previously described primers designed to specifically amplify *E. coli* associated virulence factor gene fragments.[14,15] The samples were heated for 10 minutes at 95°C in a thermocycler (Perkin Elmer Cetus, Norwalk, CT) and were run for 30 cycles of denaturation at 94°C for 1 minute, annealing at 56°C for 2 minutes, and extension at 72°C for 1 minute. The amplified DNA products were resolved by gel electrophoresis (1.8% agarose gel), stained with ethidium bromide, and visualized by ultraviolet transillumination. If a pooled sample was positively identified as an *E. coli* pathogen, each individual colony was then retested.

### Data Analysis

The data obtained from the interviews, charts, and laboratory were entered and analyzed on a desktop computer with the program Epi-Info (version 5.01b, WHO, Geneva, Switzerland). Proportional data were compared by chi-square with Yate's correction or Fisher's exact test. Student's t-test was used to compare means of numerical variables. A 95% confidence interval (CI) was calculated around odds ratio (OR).

## RESULTS

### Study Population

Between February 1 and May 15, 1994, 59 LSES case and 60 LSES control children were recruited from the public pediatric hospital's ambulatory clinic, and 52 HSES case and 49 HSES control children were recruited from the two private pediatric care centers previously described. Twenty-eight percent of LSES cases and 9% of LSES controls were recruited from the clinic's holding area; 63% of HSES cases and 16% of HSES controls were recruited from the holding rooms at the 24-hour private pediatric acute care facility.

### Demographic Features

High socioeconomic status children seeking medical attention for diarrhea were nearly twice as old ($P < 0.001$, Student's t-test) as LSES case children (mean age, 23.8 months; SD, 17.9 vs. 12.1 months; SD, 10.1). Fifty-nine percent of HSES and 54% of LSES study children were male. As controls were age and sex-matched to cases, there were no significant age or sex differences between diarrhea cases and controls within each socioeconomic study group.

### Clinical Data

The mean duration of diarrhea prior to date of interview and specimen collection was 3.6 days in both HSES cases (SD, 2.9) and LSES cases (SD, 2.6). Among the HSES cases, 67% reported fever (objective or subjective), 35% reported seeing blood in the child's stool, and 50% reported seeing mucus in the child's stool. Similarly, among the LSES cases, 71% reported fever, 29% reported blood in the stool, and 52% reported mucus in the stool.

Twelve percent of HSES cases and 14% of LSES cases reported some antibiotic use in the 2 weeks preceding the start of the diarrhea. Seventeen percent of both HSES cases and LSES cases reported using an antibiotic to treat the diarrhea prior to presenting to the clinic. Interestingly, even among children without diarrhea, 25% of HSES and 14% of LSES children reported some antibiotic use in the 2 weeks prior to the date of specimen collection ($P > 0.1$).

### Socioeconomic Factors

Family income was reported as combined number of minimum salaries (in February 1994, one minimum salary equaled $50.00 US per month) earned by all working members of the household. Households of HSES earned 8.1 times more than LSES households (mean, 15.4; SD, 10.7 vs. 1.9; SD, 1.8 minimum salaries; $P < 0.001$) (Table 1). The homes of HSES families were 2.8 times larger ($P < 0.001$) than those of LSES families (mean, 6.9 and 2.4 rooms, respectively) and 3.2 times less crowded, given equal household sizes (4.7 persons in HSES homes, including domestic aides, vs. 4.8 in LSES homes). Households of HSES had fewer children under 10 years of age than LSES households (1.7 vs. 2.2, $P < 0.001$).

Ninety-one percent of HSES and only 8.5% of LSES homes had a telephone ($P < 0.001$), and 100% of HSES and 54% of LSES homes had a refrigerator ($P < 0.001$). Ninety-four percent of HSES and 38% of LSES homes were located on paved roads ($P < 0.001$) versus dirt roads. Fifty-four percent of HSES and 21% of LSES mothers were employed outside the home ($P < 0.001$). There were no significant differences in any of the above socioeconomic variables between cases and controls within each socioeconomic group.

### Risk Factors

The mother was the primary caretaker for 87% of LSES children, whereas HSES children were as likely to be taken care of by an unrelated babysitter as by their mother ($P < 0.001$) (Table 2). There were no significant associations between the relationship of the caretaker to the child and diarrhea in either group. Seventeen percent of LSES children and 11% of HSES children reported

**Table 1.** Comparison of Socioeconomic Variables between High Socioeconomic and Low Socioeconomic Status Children with Diarrhea (Cases) and without Diarrhea (Controls)*

| | *HSES* | | *LSES* | | |
|---|---|---|---|---|---|
| *Socioeconomic Variable* | *Cases* | *Controls* | *Cases* | *Controls* | *P Value*† |
| Minimal salaries (n) | 16.2 | 14.2 | 2.1 | 1.7 | < 0.001 |
| Household size | 4.5 | 4.8 | 4.9 | 4.7 | NS |
| Number of rooms in home | 6.7 | 7.2 | 2.6 | 2.3 | < 0.001 |
| Number of children <10 y | 1.6 | 1.8 | 2.4 | 2.0 | < 0.001 |
| Mother employed | 23/51 (45%) | 30/47 (64%) | 10/59 (17%) | 15/60 (25%) | < 0.001 |
| Appliances at home | | | | | |
| Telephone | 45/51 (88%) | 45/48 (94%) | 4/59 (7%) | 6/60 (10%) | < 0.001 |
| Refrigerator | 49/49 (100%) | 47/47 (100%) | 26/49 (53%) | 30/52 (55%) | < 0.001 |
| Stove | 49/49 (100%) | 47/47 (100%) | 46/49 (94%) | 51/52 (98%) | NS |

*There were no significant differences in any socioeconomic variables between cases and controls within the same socioeconomic group. †The P value refers to a comparison across socioeconomic groups (cases and controls combined) and not between cases and controls within the same group.
HSES = high socioeconomic status; LSES = low socioeconomic status.

having an episode of diarrhea within the previous 3 months. However there were no associations between having had a previous episode of diarrhea and current diarrhea in either group. There were no significant associations between hospitalization in the previous 2 weeks (for something other than diarrhea) and diarrhea in either group. Eighteen percent of HSES cases and only 4% of HSES controls reported that the child's mother had diarrhea in the previous 2 weeks ($P > 0.5$). There were no differences in maternal diarrhea between LSES cases and controls.

Although the majority of both HSES and LSES homes reported having piped water, significantly fewer LSES than HSES homes had piped water (91% vs. 99%, $P < 0.05$) or indoor toilet facilities (63% vs. 99%, $P < 0.001$). Homes of LSES had nearly five times fewer water sources (including sinks, toilets, baths, showers, washing machines) in their homes (means, 2.0 vs. 9.3, $P < 0.001$) and were nearly six times more likely to report an interruption of water service during the previous 2 weeks (54% vs. 8%, $P < 0.001$). Interestingly, HSES case children's homes had significantly fewer water sources than HSES control children's homes (means, 8.2 and 10.6, $P < 0.05$). Ninety-four percent of HSES and 78% of LSES homes possessed a water filter ($P < 0.005$), and 58% of HSES and 49% of LSES children reportedly drank only boiled water ($P > 0.1$).

Ninety-three percent of HSES and 95% of LSES children were breastfed for some period. However, duration of breast feeding was not ascertained. The finding that 16% of HSES cases and 40% of LSES cases were breast feeding at the time of interview may be explained by the significant age difference between the study populations. Ninety-nine percent of HSES and 88% of LSES children ($P < 0.005$) reportedly received some vaccination during their lifetime, which, again, may be attributable to the age difference between the populations.

With the exception of fewer water sources in HSES case homes, no significant associations between the above risk factors and diarrheal disease were established within each socioeconomic group.

## Enteropathogens

One or more enteropathogens was identified in 52% of HSES cases and 11% of HSES controls ($P < 0.001$), and in 50% of LSES cases and 22% of LSES controls ($P < 0.001$) (Table 3). Rotavirus was the organism most commonly identified in all study groups but was only significantly

**Table 2.** Comparison of Environmental Variables between High Socioeconomic and Low Socioeconomic Status Children with Diarrhea and without Diarrhea

| | *HSES* | | *LSES* | | |
|---|---|---|---|---|---|
| *Variable* | *Cases* | *Controls* | *Cases* | *Controls* | *P Value** |
| Mother primary caretaker | 23/51 (45%) | 23/48 (48%) | 50/59 (85%) | 52/60 (87%) | < 0.001 |
| Piped water | 51/51 (100%) | 47/48 (98%) | 52/59 (88%) | 57/60 (95%) | < 0.05 |
| Water interruption (in past 2 wk) | 5/51 (10%) | 3/47 (6%) | 32/52 (62%) | 27/56 (48%) | < 0.001 |
| Water filter | 43/47 (91%) | 45/47 (96%) | 43/59 (73%) | 50/60 (83%) | < 0.005 |
| Indoor toilet | 51/51 (100%) | 46/47 (98%) | 38/59 (64%) | 37/60 (62%) | < 0.001 |
| Water sources† | 8.2 | 10.6 | 2.0 | 2.1 | < 0.001 |
| Previous diarrhea (past 3 mo) | 5/51 (10%) | 6/48 (13%) | 7/59 (12%) | 13/60 (22%) | NS |
| Breastfed (ever) | 46/51 (90%) | 45/47 (96%) | 57/59 (97%) | 56/60 (93%) | NS |
| Breastfed (now) | 7/51 (14%) | 15/48 (31%) | 17/59 (29%) | 21/60 (35%) | NS |
| Vaccinated | 51/51 (100%) | 47/48 (98%) | 50/58 (86%) | 54/60 (90%) | < 0.005 |

*The P value refers to a comparison of variables between socioeconomic groups and not between cases and controls in the same group. †Mean number per group.
HSES = high socioeconomic status; LSES = low socioeconomic status.

associated with diarrhea in the HSES group (37% of HSES cases vs. 8% of HSES controls, P < 0.01). Rotavirus was most commonly seen in younger children, ages 0 to 12 months; among cases with rotavirus infection, 44% of HSES and 67% of LSES children belonged to this age group. This is particularly notable given the greater mean age of HSES children (23.3 months). All four mixed infections included rotavirus as one of the organisms, and all were from within the LSES group (3 cases, 1 control).

*E. coli* strains (pathogenic and nonpathogenic) isolated from case and control children were tested for pathogenic genotypes by PCR. Pathogenic *E. coli* were more common in the LSES group and were identified in 8% of HSES cases, 4% of HSES controls (P > 0.1), and in 18% of LSES cases and 5% of LSES controls (P < 0.051) (see Table 3). Enteropathogenic *E. coli* (EPEC) was the bacterial enteropathogen most commonly identified (4% HSES cases, 2% HSES controls, 10% LSES cases, 2% LSES controls), but its association with diarrhea approached significance only in the LSES group (P = 0.1, Fisher's exact test, 2-tailed). Enteropathogenic *E. coli* was seen in the youngest children, ages 0 to 12 months (6 of 6 or 100% of LSES cases). Enterotoxigenic *E. coli*-LT was not significantly associated with diarrhea in either the HSES or LSES group and, in the LSES group, was identified only in asymptomatic controls. Enterotoxigenic *E. coli*-ST and enteroinvasive *E. coli* were identified in LSES cases only (5% and 3%, respectively) and in no HSES cases or controls or LSES controls.

*Shigella* was isolated more often in LSES cases (12%, P = 0.06, Fisher's exact test, 2-tailed) than HSES cases (8%, P = 0.1). *Shigella* was identified in older children with the mean age of 19.8 months (range, 7–32 mo) in the LSES cases and 39.6 months (range, 15–60 mo) in the HSES cases. *Salmonella* was cultured from one HSES case, age 44 months.

## DISCUSSION

Within the same urban setting in northeastern Brazil, significant differences in the etiology and epidemiologic characteristics of acute diarrhea between children of high and low socioeconomic status were identified. Diarrhea was found to cause significant morbidity in both communities. However, more LSES children than HSES children reported having had an episode of diarrhea in the previous 3 months (17% vs. 11%, P > 0.1). Although the incidence of diarrhea in the two groups was not examined, the fact that 66% of yearly visits to the public clinic and only 8% of visits to the private pediatrician's office were diarrhea-related, suggests that diarrhea causes a greater proportion of overall childhood morbidity, and uses a greater proportion of available health care resources in the LSES community.

The threshold for holding a child for intravenous rehydration or antibiotic therapy was much lower in the private acute care facility than in the public hospital's ambulatory clinic. Therefore, whether or not the child was held for further treatment was not an indicator of severity of disease across the two study groups. Community use of antibiotics was found to be common in both socioeconomic groups (antibiotics are available at most pharmacies without a prescription), and equal percentages (17%) of both LSES and HSES case children received some antibiotic to treat their diarrhea prior to seeking medical attention.

**Table 3.** Enteropathogens Identified from High and Low Socioeconomic Status Case and Control Children by Conventional Microbiologic Culture and Biochemical Tests

| | *HSES* | | | *LSES* | | |
|---|---|---|---|---|---|---|
| | *Cases (n = 52) (%)* | *Controls (n = 46) (%)* | *P Value* | *Cases (n = 60) (%)* | *Controls (n = 59) (%)* | *P Value* |
| PCR | | | | | | |
| Pathogenic *E. coli* | 4 (8) | 2 (4) | > 0.1 | 11 (18) | 3 (5) | < 0.051 |
| EPEC | 2 (4) | 1 (2) | > 0.1 | 6 (10) | 1 (2) | 0.1* |
| ETEC-LT | 2 (4) | 1 (2) | > 0.1 | 0 | 2 (3) | > 0.1 |
| ETEC-ST | 0 | 0 | | 3 (5) | 0 | > 0.1 |
| EIEC | 0 | 0 | | 2 (3) | 0 | > 0.1 |
| Conventional Microbiologic Culture and Biochemical Tests | | | | | | |
| *Salmonella* spp | 1 (2) | 0 | > 0.1 | 0 | 0 | |
| *Shigella* spp | 4 (8) | 0 | 0.1* | 7 (12) | 1 (2) | 0.06* |
| ELISA | | | | | | |
| Rotavirus | 18/49 (37) | 3/37 (8) | < 0.01 | 15/59 (25) | 10/58 (17) | > 0.1 |
| Any pathogen† | 27 (52) | 5 (11) | < 0.001 | 30 (50) | 14 (24) | < 0.001 |
| Mixed infections‡ | 0 | 0 | | 3 | 1 | |

*Fisher's exact test, 2-tailed; †Includes cases and controls in which more than one pathogen was identified (mixed infections); ‡Mixed infections: 4/4 include rotavirus. LSES cases: 2 rotavirus + EPEC, 1 rotavirus + *Shigella*. LSES control: 1 rotavirus + ETEC-LT.
HSES = high socioeconomic status; LSES = low socioeconomic status; EPEC = enteropathogenic *E. coli*; ETEC = enterotoxigenic *E. coli*; LT = heat-labile; ST = heat-stable; EIEC = enteroinvasive *E. coli*.

The LSES children were nearly two times younger than the HSES children (12.3 vs. 23.3 mo) (Table 4). The reasons for this significant difference are likely multifactorial and probably reflect the true epidemiology of diarrhea in the two socioeconomic groups, as well as differences in rates of seeking medical attention for diarrhea. The younger mean age of the LSES children is consistent with studies in developing countries that show the greatest median incidence of diarrhea in infants 6 to 11 months of age.[1] As observed in one Honduran study, it is possible that LSES mothers of younger children with diarrhea are more likely to consult a health care professional than are LSES mothers of older children.[16] Mothers in HSES households were twice as likely to be employed outside the home ($P < 0.001$). This is generally reflective of maternal education, which has been associated with both a lower prevalence of diarrhea and a greater likelihood to seek medical attention for children with diarrhea.[16,17]

With the exception of fewer water sources in HSES case than control homes, within each socioeconomic group no associations were found between environmental risk factors, including lack of indoor toilet, inconsistent water supply, and overcrowded housing, and the occurrence of diarrhea. However, across socioeconomic groups these differences were significant: the LSES homes reported fewer indoor toilets, water sources, and water filters, and more frequent interruptions of water service. In addition, LSES homes had significantly fewer rooms and were, consequently, more crowded. The lack of availability of piped water was shown to increase risk of infant mortality from diarrhea in Brazil, and inadequate housing was found to increase incidence of infantile diarrhea in Egypt.[18,19] However, other studies have failed to show similar associations,[20] and questions have been raised regarding the validity of several studies that conclude associations between water supply, sanitation, and housing conditions, and diarrhea.[18]

The association between isolating one or more recognized pathogens and the occurrence of diarrhea was significant in both socioeconomic groups ($P < 0.001$). However, the distribution of etiologic agents and their relative contributions to the overall isolation rates were distinct in each group. In the lower socioeconomic group, EPEC and *Shigella* spp were found to be the most important pathogens, whereas in the higher socioeconomic group, rotavirus was the pathogen most associated with diarrhea. Part of this difference may be attributable to the difference in mean age of the two groups. Enteropathogenic *E. coli* disease occurs predominantly in infants, whereas shigellosis is a diarrheal disease of older children. Observations show, however, that the expected number of EPEC cases among 20 HSES case infants, and *Shigella* infections among 22 older (>13 mo) LSES children was proportionately less than that among their comparison groups (see Table 4), suggesting that the differences in etiologic agents reflect epidemiologic differences rather than ages of the two groups.

Rotavirus infections among HSES children in Salvador, Brazil, more closely resemble those among children from developed countries than those from developing ones. Rotavirus is the most common cause of childhood diarrhea in North America, accounting for approximately 25% of cases.[21] In developing countries, isolation rates for rotavirus vary greatly,[10,22-27] and rotavirus is commonly detected in children without diarrhea.[12,24] The high background infection rate, and perhaps exposures to the virus earlier in life among children of LSES, may provide protective immunity for them later in life.

The identification of *E. coli* strains associated with diarrhea was facilitated by a recently validated PCR-based method of detecting *E. coli*-specific virulence determinants.[14] The authors found the method to be simple and rapid, and well-suited for use in the field setting. By this technique, diarrheagenic *E. coli* strains were found to be most commonly associated with diarrhea in LSES children. Because of the small number, the association of EPEC with diarrhea showed marginal significance among the LSES children (Fisher's exact test, 2-tailed, $P = 0.1$). In this study EPEC was detected most often in the youngest LSES children, age 0 to 6 months (4 of 6 cases, 67%). These results are consistent with studies of urban infants in São Paulo, Brazil, in which EPEC was isolated in 26 to 30% of infants with diarrhea, most frequently in early infancy.[27,28]

Environmental and household conditions, often cited as risk factors for diarrheal disease, were not found to be associated with diarrhea within each socioeconomic group. However, the significant differences in these

**Table 4.** Age Distribution of Children with Diarrhea and Distribution of Pathogens by Age of Cases

| *Age (mo)* | *0–12* | | *13–24* | | *25–36* | | *> 36* | |
|---|---|---|---|---|---|---|---|---|
| *Status* | *HSES* | *LSES* | *HSES* | *LSES* | *HSES* | *LSES* | *HSES* | *LSES* |
| Number* | 20 (38%) | 37 (63%) | 10 (19%) | 14 (24%) | 7 (13%) | 7 (12%) | 15 (29%) | 1 (2%) |
| EPEC | 1 | 6 | 1 | – | – | – | – | – |
| Rotavirus | 8 | 10 | 2 | 3 | 4 | 2 | 4 | – |
| *Shigella* | – | 2 | 1 | 2 | – | 3 | 3 | – |

*Numbers in parentheses equal percentage of total cases from each socioeconomic group that fall within each age range.
HSES = high socioeconomic status; LSES = low socioeconomic status.

potential factors across socioeconomic groups may contribute to conditions that predispose children of the lower socioeconomic group to be exposed to vehicles associated with diarrhea. Diarrheal disease among children of different socioeconomic groups living within the same urban community in a developing country appears to have distinct epidemiology and etiology, and therefore, its management may require that these differences be taken into consideration.

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