

# Epidemiology of persistent diarrhea among Guatemalan rural children

JR Cruz<sup>1</sup>, AV Bartlett<sup>1,4</sup>, H Mendez<sup>2</sup> and R Sibrian<sup>3</sup>

*Program on Infection, Nutrition and Immunology<sup>1</sup>, Division of Nutrition and Health<sup>3</sup>, and the Computer Center<sup>2</sup>, Institute of Nutrition of Central America and Panama, Guatemala City, Guatemala; Department of International Health<sup>4</sup>, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD, USA*

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A prospective, longitudinal two-year study to determine the epidemiology of persistent ( $\geq 14$  days' duration) diarrhea in rural children of Guatemala was undertaken. Three-hundred and twenty-one children aged 0–35 months were kept under surveillance by twice-a-week home visits. The overall incidence of diarrhea was 0.147 per child-week; the incidence of persistent diarrhea was 0.014 per child-week. The peak of persistent diarrhea was observed in infants below six months of age, with a continuous decline thereafter. This trend in incidence of persistent diarrhea was associated with a higher proportion (16%) of illnesses persisting for more than 13 days in children younger than six months of age as compared to children 30–35 months old (4%). Males had more diarrhea (0.156 per child-week) than females (0.139 per child week). Among children above 18 months of age, the proportion of episodes that lasted for more than 13 days was lower in females than in males. □  
*Diarrhea, persistent diarrhea, rural children*

JR Cruz, Program on Infection, Nutrition and Immunology, Division of Nutrition and Health, PO Box 1188, Guatemala City, Guatemala

Diarrheal diseases continue to be the principal health problem among children living in underprivileged areas of the world (1, 2). The use of oral rehydration therapy has been shown to decrease diarrhea-associated mortality, to shorten the duration of the diarrhea episodes and to reduce the nutritional consequences of the disease (3, 4). The appropriate use of antibiotics in cases of dysentery, especially that associated with *Shigella*, also results in decreased fatality rates (5). Nevertheless, a proportion of episodes of diarrhea may persist for prolonged periods of time, inducing not only deleterious effects on nutritional status, but also high mortality (6). We conducted a longitudinal prospective field study to determine the factors that may contribute to the occurrence of persistent diarrhea (14-day duration or longer) among children aged 0–35 months living in rural settings of Guatemala. Here we describe our findings in relation to the natural history of diarrhea in the community.

## Materials and methods

### Study population

The study was conducted in Santa Maria de Jesus, a rural community of approximately 10,000 inhabitants, located at 2050 m above sea level and 50 km from Guatemala City. Eighty-two percent of the male heads of household worked in subsistence agriculture; literacy rates among individuals over nine years of age were 77%

for males and 39% for females. The most common causes of preschool mortality during the five years preceding our study, 1982–86, were diarrhea and dehydration (25%), and pneumonia and respiratory infections (22%). Breast-feeding is a common practice among community mothers: 99% of children 11 months old, 95% of those aged 12 to 17 months, 63% of those between 18 and 23 months, 54% of the children aged 24 to 29 months and 14% of those aged 30–36 months were breast-fed. Introduction of foods into the children's diets begins at 3–6 months of life, although sporadic ingestion of liquids is very common from the first week of life.

After informed consent was given by the parents, 321 children aged 0–30 months, each one from a different family, were enrolled in the study; the age distribution at entry is depicted in Fig. 1. One-hundred-and-seventy-one subjects between 0 and 30 months of age were enrolled at the beginning of the study period; this group forms the panel. Among panel children, 29 were 0–5 months old. During the next 15 months, a cohort of 150 newborns was admitted into the study. Of all children, 165 (51.4%) were males and 156 (48.6%) were females. Among study families, 289 (90.6%) collected their water from public spigots; 160 (49.8%) had no excreta disposal facilities and therefore defecated "on the ground" in the household complex, while 153 (47.7%) had latrines. Other family characteristics are summarized in Table 1. The study children were kept under surveillance for two consecutive years, February 1987 to February 1989, by

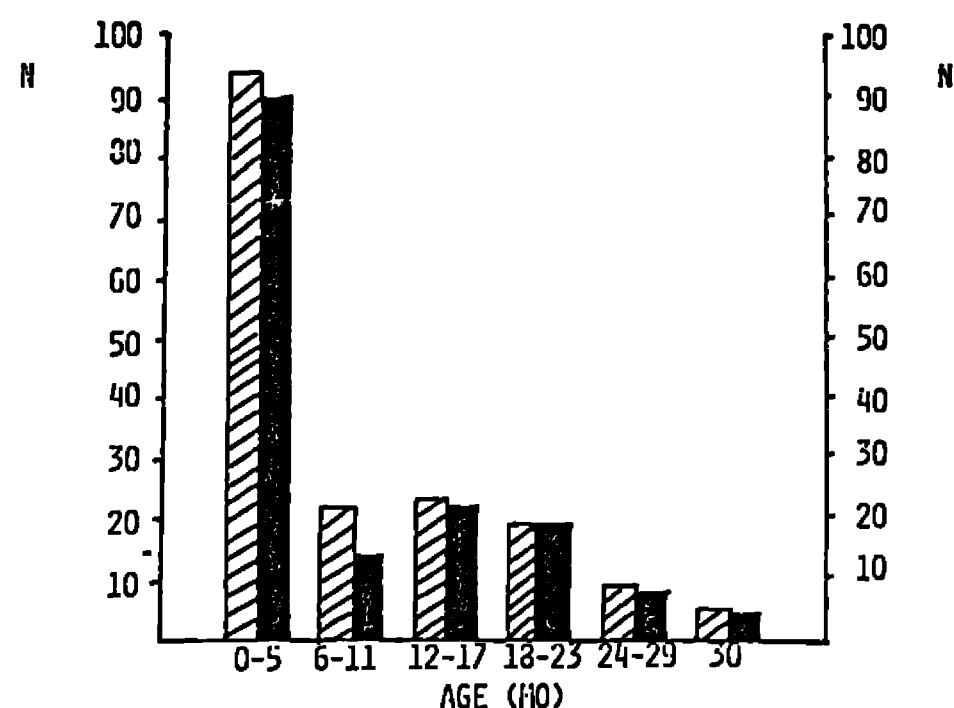


Fig. 1. Age at entry into the study. Santa Maria de Jesus. (▨) Males; (■) Females.

field personnel who conducted home visits twice a week. During these visits, the auxiliary nurses inquired about the presence of diarrhea and other morbidity among the study children, their dietary habits, and intake of both traditional and non-traditional medications. Children were weighed and measured on a routine basis every month. When a case of diarrhea was detected, the initial date of the episode was recorded and anthropometric measurements were obtained; sick children were visited every other day, until the illness subsided (72 continuous hours without symptoms). Our program provided free oral rehydration salts for all the participating families. *Shigella*-associated dysentery was treated with trimethoprim-sulfamethoxazole and, when resistance to these antibiotics was detected in the patient isolate, with appropriate antimicrobials which were also provided by us.

### Statistical methods

Incidence rates of diarrhea were calculated by dividing the number of episodes of diarrhea by the number of child-weeks at risk (number of child-weeks of observation minus the number of child-weeks with illness); differences in the incidence rates adjusted for confounding variables were determined by analyses of proportions (7).

### Results

Children in the panel contributed 11,649 weeks of observation, while those in the cohort were observed during 7719 weeks (Table 2). During the two-year period, we detected 2506 episodes of diarrhea, 275 (11%) of which lasted 14 days or more. The overall incidence of diarrhea in our population was 0.147/child-

Table 1. Characteristics of the families included in the study Santa Maria de Jesus

	N	(%)
Presence of children < 3 years old		
0	4	(1.2)
1	215	(67.0)
2,3	102	(31.7)
Presence of children 3-5 years old		
0	100	(31.2)
1	183	(57.0)
2,3	38	(11.8)
Previous under 5-mortality		
0	200	(62.3)
1	76	(23.7)
2	31	(9.7)
3-5	14	(4.4)
Number of bedrooms		
1	246	(76.6)
2	56	(17.4)
3-5	18	(5.6)
Number of people sharing sleeping quarters with child		
2	77	(24.0)
3, 4	115	(35.7)
5, 6	82	(25.7)
> 6	44	(13.6)
Material used in the		
Roof		
Mud tile	6	(1.9)
Straw	41	(12.8)
Tin	274	(85.4)
Floor		
Finished cement	20	(6.2)
Rustic cement	52	(16.2)
Dirt	240	(74.8)
Walls		
Tin	6	(1.9)
Wood	12	(3.7)
Adobe	22	(6.9)
Brick, cement block	78	(24.4)
Cane	181	(56.6)

Table 2. Weeks of observation in children from the panel and the cohort, according to age.

Group	Age (months)					
	0-5	6-11	12-17	18-23	24-29	30-35
Panel	379	1316	1611	2713	2945	2685
Cohort	2766	3135	1487	331	—	—
Total	3145	4451	3098	3044	2945	2685

week or 7.64 episodes per child per year; the incidence rates of acute and persistent diarrhea were 0.131 (6.81 episodes per year) and 0.014/child-week (0.73 episodes per year), respectively. Males suffered from more episodes of diarrhea, 8.11 per year, than females, 7.22 per year (Table 3). The peak incidence of diarrhea was observed among those children between 12 and 17 months old (0.190/child-week). Persistent diarrhea was more common among infants below six months of age

(0.020/child-week), with a continuous decline as the children became older, to reach the lowest incidence rate (0.004/child-week) among those aged 30–35 months (Fig 2). This decline was more marked among females than among males: the proportion of episodes that lasted for at least 14 days was identical for both genders at 0–5, 6–11 and 12–17 months of age; starting at 18 months, however, the proportion of persistent episodes decreased continuously among females, to reach 3.9% in the oldest study group; this tendency was not observed among boys (Fig. 3).

Table 3. Incidence of diarrhea according to gender.

Gender	Diarrhea		
	All	Acute	Persistent
Male	0.156	0.137	0.016
Female	0.139	0.125	0.014
Odds ratio	1.12	1.10	1.14
95% CI	1.03–1.22	1.01–1.20	0.93–1.39
<i>p</i>	0.006	0.034	0.209
Gender, adjusted for age			
Odds ratio	1.10	1.08	1.23
95% CI	1.01–1.20	0.99–1.18	0.98–1.56
<i>p</i>	0.026	0.089	0.081

## Discussion

The incidence of diarrheal diseases in Santa Maria de Jesus is high, 0.147 episodes/child-week at risk or eight episodes/child/year. This high incidence may be related to several factors: the lack of appropriate means to dispose of human excreta would seem an important one, since almost half of our study families reported defecating "on the ground". Additionally, the unavailability of a sufficient quantity of good quality water would also favor the transmission of enteric pathogens, including in

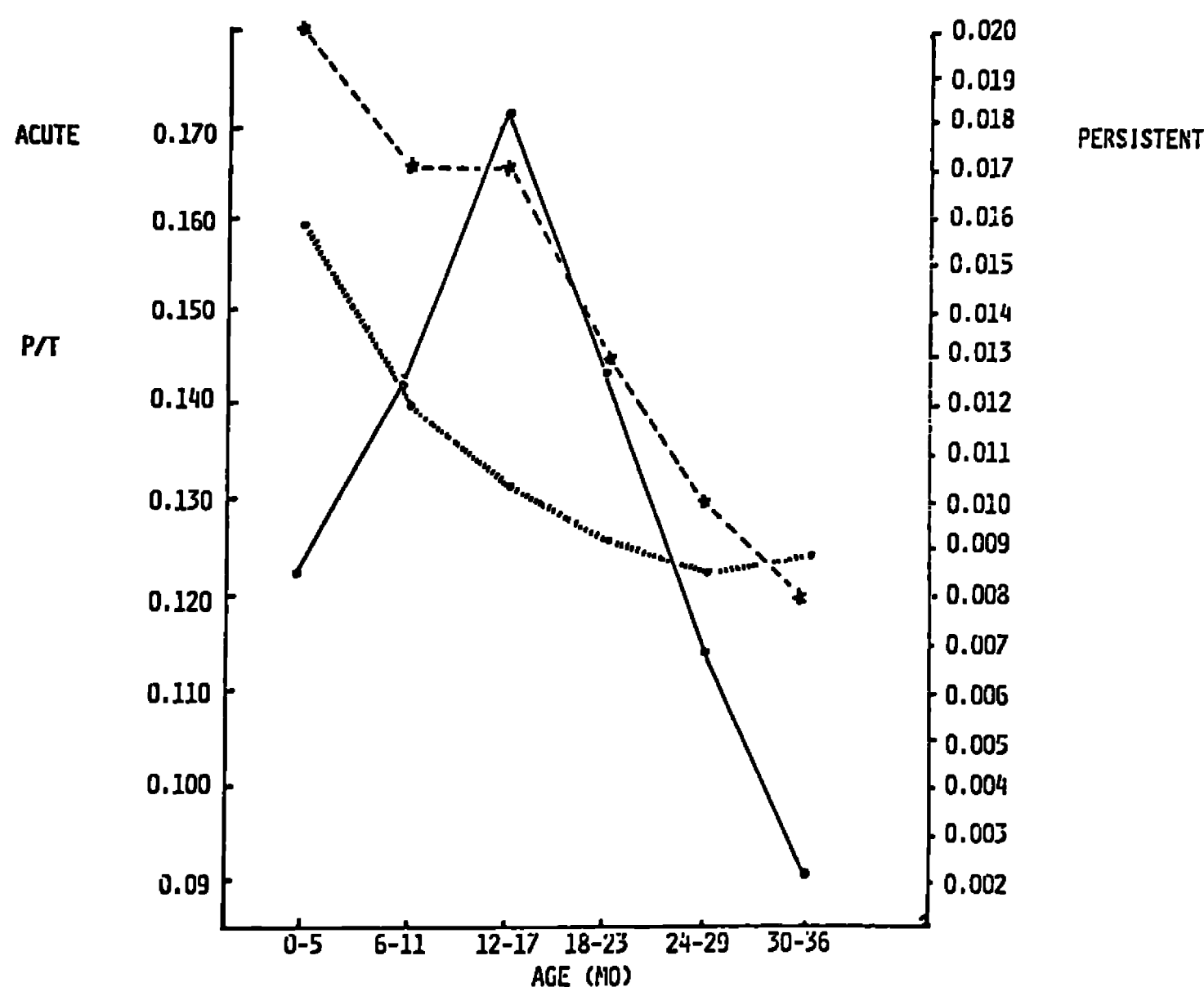


Fig. 2. Incidence of acute (●—●) and persistent (\*--\*) diarrhea in Santa Maria de Jesus. Proportion of persistent/total episodes (P/T, ----○----) is also shown.

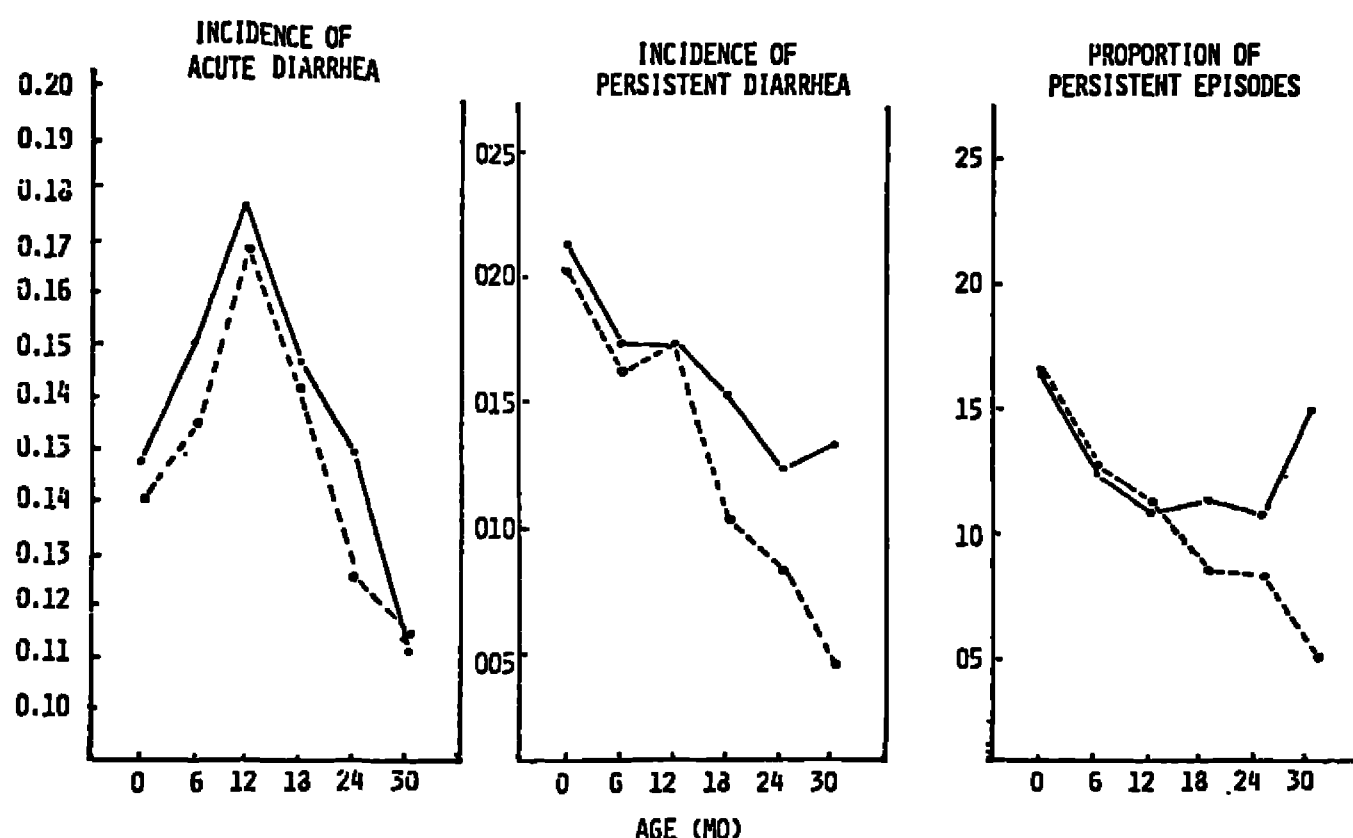


Fig. 3. Incidence of acute and persistent diarrhea in Santa Maria de Jesus. (—) Males. (---) Females.

young children who are given liquids from the first days of life.

The incidence rate of diarrhea in Santa Maria de Jesus is similar to that observed by Mata (8) in another rural setting of Guatemala 20 years ago, and to the one reported from a slum area of Brazil (9); these studies were done in communities where hygienic conditions are suboptimal and, therefore, the risk of enteric infections is high.

We found that 11% of the diarrhea illnesses last for at least 14 days, a figure which is identical to the one reported by Schorling and collaborators in Brazil (9). The pattern of age-specific incidence rates differs in the two studies: in Brazil, the highest rates were found in those 19–24 months old; in our study, we found that persistent diarrhea peaked in infants under the age of six months. Again, this may be related to early exposure to a heavy microbial load; the infants, among whom the local system of defense is immature (10), would not be capable of clearing intestinal infections in a manner similar to older children. In studies carried out by us in an urban, low socioeconomic neighborhood of Guatemala City we found that, among infants under one year of age, 9% of the episodes of diarrhea become persistent, and that it is young infants who are at higher risk of developing diarrhea that lasts 14 days or longer (11). In this population group the pattern of breast-feeding and of introduction of complementary foods is totally different from that prevalent in Santa Maria de Jesus, and the incidence of diarrhea is 5.2 episodes per year, with the younger ones having the lowest incidence rate, 2.64 episodes per year.

Of special interest is the fact that, in our population in Santa Maria de Jesus, males had a higher incidence of diarrhea than females. In this case, referral systems or

health seeking behaviors would not affect the detection rates of illness, since all the episodes of diarrhea were identified by active surveillance by our field personnel. Furthermore, the incidence and proportion of persistent diarrhea were similar among boys and girls up to their second birthday, but boys had more persistent diarrhea in the higher age groups. The explanations for the observed differences include the possibility of older males being more exposed to microbial pathogens since they may be allowed to move around the community more freely than girls. In our previous study we found that the duration of the illnesses was associated with the number of infecting pathogens that could be detected in the acute phase of the episode (11). Additionally, gender-associated immune differences could possibly play a role; we and others (12, 13) have found that, at the community level, acute respiratory infections are more common among males than among females. It is necessary to carry out further risk factor analyses to elucidate the reasons for the observed gender-associated difference.

We consider it of high priority to identify, during the acute phase of the episode, indicators that may predict which episodes are at risk of becoming persistent in order to implement curative measures. Additionally, it is imperative to identify the factors that are important in the genesis of persistent diarrhea so that appropriate preventive interventions aimed at the underlying host factors can be implemented. In the long term, only measures that improve the quality of life of the population will result in a significant reduction of diarrhea morbidity among the young of underprivileged areas.

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