CHILDREN AND MOTHERS AT RISK FOR DIARRHEAL DISEASE IN NEPAL

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Introduction

Diarrheal disease remains one of the primary causes of death in children under 5 in developing countries. Understanding the many causes of this cluster of diseases is vital if intervention programmes for the promotion of maternal and child health are to be effective.

The purpose of this paper is to examine the role of hygiene and food related behaviors, nutritional status and age as risk factors for diarrheal disease in preschool children and their mothers in Nepal.

The objectives of this paper are to: (1) identify risk factors for diarrheal disease, (2) examine the pathways through which the risk factors affect diarrheas rates, and (3) determine areas for intervention based on the results of the first two objectives.

The data for this study were collected between July, 1989, and January, 1990, in 3 villages located in the eastern Kathmandu Valley of Nepal.

Information was obtained by household and included demographic data for all household members, monthly anthropometric measurements of children, twice weekly diarrhea occurrence for all household members and twice monthly behavioral observations of each household's focal child.

The study sample was comprised of 349 high caste Hindu children who were four years of age or less. This sample was stratified by age of the child, economic status of the household and number of siblings. Each child's diarrheal status as well as that of other household members was recorded twice weekly. Measurements of height and weight and dietary histories were obtained each month for each child.

A structured observation protocol was developed to permit rapid categorization of behaviors and to maximize comparability of data from different observers. This protocol was developed following key informant

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interviews and three two-hour unstructured observation periods in nine non-study households.

During the six month study period, one focal child per each of the 349 study households was observed for ninety minutes twice a month, providing twelve observation periods during various times of the day. The occurrence of risk behaviors and information about direct contacts including duration of contacts, number of contacts and relationship of the contact individual were recorded for each ninety minute observation.

The risk behaviors addressed during the study are presented in Appendix 1. The risk behaviors associated with hygiene included handwashing activities and the dirtiness of the focus child. Environmental factors recorded were the presence of stool on the floor, flies observed on the child, the presence of a pit latrine and the stabling of animals in the house. Ingestion risk variables included placing fingers or objects in the mouth and eating leftover food or food that had fallen on the floor. Risk scores were computed for the sample children by averaging the risk scores for the two observations in each of the six study months and then summing the averages for the total study period. This provided an overall risk score for each behavioral variable during the study.

Results

From the diarrhea surveillance data, the incidence or number of new episodes of diarrhea ranged from 0 to 8 episodes per child table. 28.9% of the sample had no diarrhea during the 6 month study while 23.2% had one episode. Diarrhea was defined as 4 or more loose or watery stools per day. At least four diarrhea free days were required before a diarrhea day could be classified as the start of a new episode.

The prevalence of diarrhea among the focal children during the six month study period was highest near the beginning of the study, during the final months of the monsoon season (table 2). 49.4% of the focal children experienced at least one episode of diarrhea in August while only 10.4% had an occurrence in January.

The occurrence of diarrhea in the mothers of the 349 study children was also highest during the month of August. Mothers in nearly 5% of the households reported at least one occurrence of diarrhea in August while less than 1% reported diarrhea in January (table 3).

While there seems to be some association between the levels of education and diarrhea episodes for the sample children, the relationship is not linear (table 4). T-tests determined that the difference between the average number of episodes of diarrhea for the levels of education for the mother and father were not statistically significant.

The differences between maternal and paternal education and average diarrhea incidence may be related to the significant disparity in male and female educational levels. 73.9% of the mothers were uneducated while only 19.8% of the fathers had no education. Another explanation may be that maternal and paternal educational levels affect the diarrhea incidence of children through different mechanisms. Maternal education is related more to direct care of the child and hygienic practices of the mother. Educated fathers may be more perceptive of possible areas of contamination in the household environment and try to improve the families living conditions (build latrines, stable).

Although education was not significantly related to diarrhea incidence, associations between maternal and paternal education and household income and the behavioral risk variables were recorded (table 5). All three of the socioeconomic variables were related to the dirtiness of the child and whether the child put dirt or their fingers in its mouth. The associations were negative indicating that in households with higher educational levels and income, the children were less often observed engaging in higher risk ingestion behaviors. Maternal education was negatively associated with more ingestion behaviors. The level of the mother's education was also associated with handwashing but in an unexpected positive direction. This suggests that less educated mothers were more likely to wash their hands. It may be that uneducated mothers may perceive increased contamination in their environment and wash their hands more frequently as a result. Group T-tests indicated the presence of pit latrine and the stabling of animals in the house were significantly related to household income and the levels of parental education.

Multivariate analysis of the data required the use of Poisson regression. The distribution of the counted outcome variable, number of diarrhea episodes, was appropriate for Poisson regression analysis.

Only children with observation data available for each study month in the sample summed scores for the risk variables for the study period were included in these analyses. The number of cases available for the total six month period of analysis was 292.

Variables (indirect determinants) that were entered in the equation to test for possible confounding effects included caste status and village of residence. None of the variables were determinants of diarrhea incidence. As previously discussed, the education levels of the mother and father were not significant determinants of diarrhea incidence in the multivariate analysis.

The sample children in the analysis results presented in table 6 included 170 children with at least one sibling from four to ten years of age residing in the household. The occurrence of diarrhea in a sibling and the duration of

sibling holding were strong determinants in this model. The nutritional status and age of the child were also significant.

In the regression results for the individual risk variables age is again significantly associated with a decrease in diarrhea incidence, while nutritional status approaches the level of significance (p = .068) (table 7). The dirtiness of the child and putting fingers in the mouth are both significant determinants of diarrhea incidence. The dirtier the child appeared during the observation periods, the greater the number of diarrhea episodes. A child's appearance or dirtiness may indicate direct contact with dirt, putting dirty hands in the mouth, as well as the quality of caretaking. Handwashing before cooking was significantly related to incidence but in a negative direction. Over 90% of the cooks observed washed their hands before food preparation. Handwashing involved pouring water over the hands without the use of soap,ash or mud. Only 2% of the cooks washed their hands with soap. Merely rinsing the hands before food preparation is not sufficient for a significant reduction in the number of pathogens on the hands.

Because age was consistently a strong determinant for diarrhea incidence, separate regressions were conducted for study children under the age of two at the beginning of the study period and children over two years of age. Among children under two years for diarrhea incidence during the total study period, age remains a significant determinant, possibly due to risks associated with the introduction of weaning foods in the child's diet (table 8). If an adult in the household was observed putting her finger in the child's mouth, there was a negative association with diarrhea incidence (p. = .005). Although one would expect an increase in diarrhea incidence, the pacifying effect of a adult putting her finger in the mouth of a fretful child may be an indication of increased adult attention or quality of caretaking. There was a negative relationship between handwashing by the cook and increased incidence, as discussed previously. For these younger children, a significant determinant was the foodgiver washing their hands before handfeeding the child. These younger children were more likely to be handfed by other household members by virtue of their age. Because utensils are not used for feeding the child, handwashing by the foodgiver (even if it's only a water rinse) is important in decreasing diarrhea incidence.

For older children over the age of two years nutritional status is an important determinant of diarrhea incidence (p = .006) (Table 9). More of the ingestion variables are significantly associated with diarrhea incidence in these children compared to the younger sample. Eating leftover food, putting fingers in the mouth and the siblings putting their fingers in the child's mouth were all significant determinants of incidence. If the child was observed putting objects in its mouth, there was a negative association

(decrease) with incidence. It may be that the older children were observed putting in their mouth were not highly contaminated. Cleanliness was also a significant determinant ($p = .010$) of diarrhea incidence in the older children, who were more likely to be walking and playing further from the house and courtyard area.

For the mothers of the children during the study period, handwashing by the cook was associated with decreased diarrhea risk in the mother. The importance of handwashing determining diarrhea for the mothers may suggest a complex of hygienic behaviors in the household that provide a greater protective effect for adults than for the younger children.

Conclusions and Policy Implications

The policy implications and recommendations based on this research include:

1. Hygiene Education: The handwashing variable in this study provided ambiguous relationships with diarrhea morbidity. One explanation may be that rinsing hands with water is insufficient in a heavily contaminated environment, especially if the water is also contaminated. A study in Bangladesh (Hoque and Briend 1991) found that handwashing with mud or ash was as efficient as soap in pathogen reduction. Ash is readily available in all village households from the cook stoves and there is little risk of fecal contamination. Ash is often used to wash dishes after meals but not as frequently for handwashing. This low cost (no cost) method of handwashing could be emphasized to the mothers, grandmothers and sibling caretakers by the village health workers in the local schools, village clinic and during household visits.

2. Child Caretaking: The ingestion behaviors of the child are important areas of education for both mothers and siblings. Bamboo cribs are available for young children (infants) that elevate them from the contamination that may be present on the floor. Encouraging caretakers to keep the older children off the dirt floor or place them on a bamboo mat whenever possible should provide some protection. Caretakers should also be reminded to pick up objects, food or dirt from the floor to prevent the young child from putting these items in his/her mouth. Caretakers should be encouraged to wash the crawling child's hands frequently, with ash if possible, to decrease the pathogens present when the child puts his/her fingers in his/her mouth.

3. Food Preparation: It is important to stress to food preparers that meals, particularly weaning foods, should be freshly cooked and immediately consumed. The risk of food contamination is very high in developing

countries and the lack of firewood often forces the storage of cooked food for later consumption. If cooked food must be stored it should be covered to prevent further contamination by flies or fingers.

4. Education and Nutritional Status: The nutritional status of the children in this study remained a strong determinant of diarrhea incidence after controlling for household and environmental factors. Maternal education may be more effective for improving the nutritional status of children than the current government emphasis on food production. Studies in Bangladesh indicate that parental education is a determinant of the quality of the diet and the nutritional status of children. The present study found that maternal and paternal education were significantly related to the nutritional status of the children controlling for the effect of income. The importance of education should be stressed, particularly for young girls in the village and nutrition education (weaning food preparation) made available through the village health workers.

5. Education and Diarrhea Incidence: The important relationship between parental education and the health of children is apparent in the diarrhea morbidity as well as nutritional status, as described above. In this study, the level of education operates through the environmental factors to affect diarrhea incidence rates. This relationship remained significant after controlling for the effect of household income. The results of this study and previous research indicate that education must be addressed to achieve lasting improvements in both nutritional status and diarrhea morbidity. The interaction of nutritional status and diarrhea may be affected, jointly, through long-term education policies.

Promoting education at the household and community level for the preceding recommendations can provide a low cost (monetary and time investment) intervention scheme. Some of the behavioral interventions seem rather obvious, but reminders of the risk associated with putting dirty fingers in the child's mouth may be necessary to decrease pathogen transmission in the household members. The mothers in the research villages are receptive to ideas or interventions that protect their children, especially low cost, intra-household strategies under their control.

In conclusion, any planned intervention must involve the household members in the design of what they perceive as important to the health of their children. Outlining the specific behaviors that are determinants of diarrhea in the children encourages family involvement. As their understanding of the linkages between behavior and illness increases, their role as a health promoter for their child provides the incentive to induce behavioral changes.

Appendix 1

HYGIENE VARIABLES

Dirtiness of focus child
Child's hands washed before a meal
Hand washed before handfeeding child
Cook's hands washed before meal preparation

ENVIRONMENT VARIABLES

Animals stabled in house
Presence of a pit latrine
Flies on the focus child
Stool observed on the floor

INGESTION VARIABLES

Child ate food not freshly prepared
Child observed putting dirt in mouth
Child ate food that fell on the floor
Child put object in mouth
Child, adult or sib put finger in child's mouth

TABLE 1:

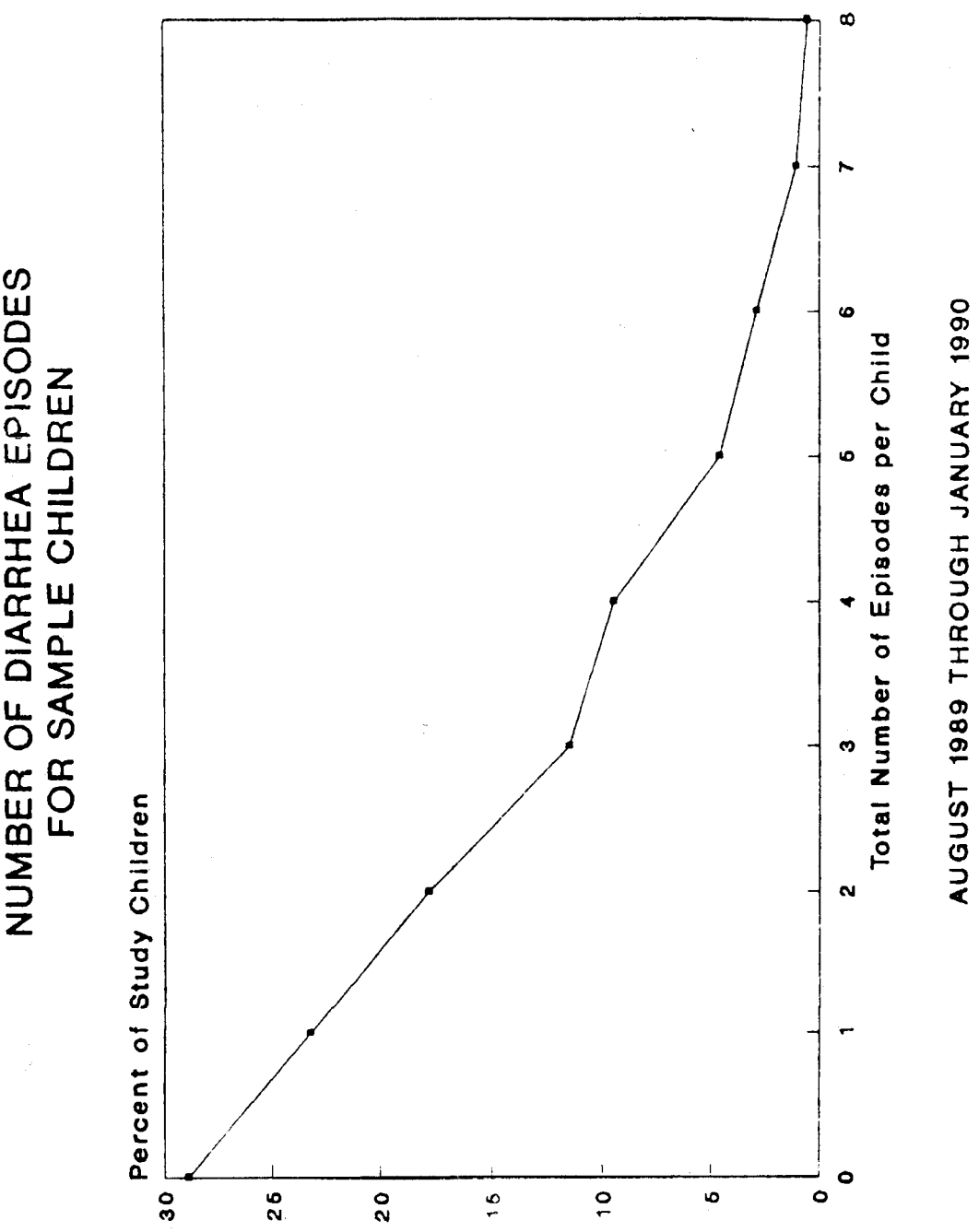
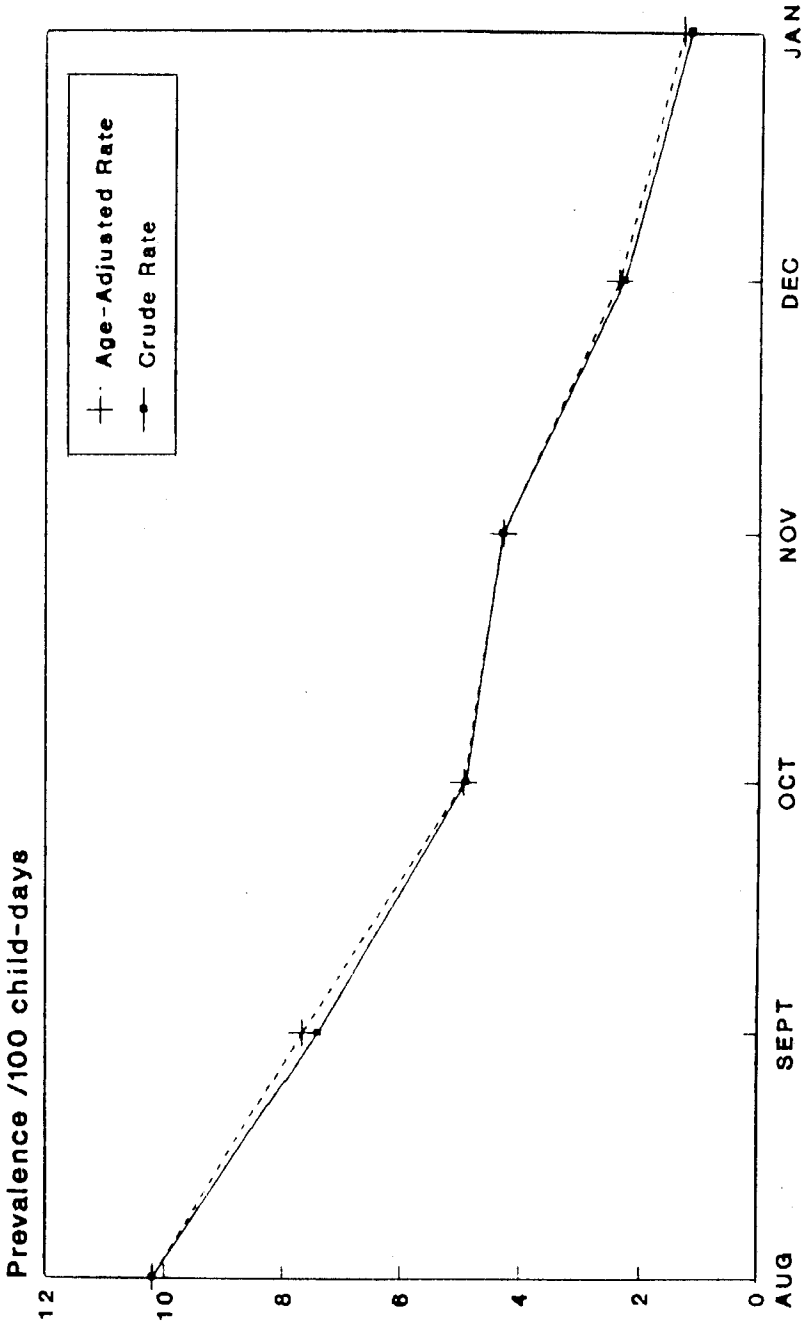

NUMBER OF DIARRHEA EPISODES
FOR SAMPLE CHILDREN
Percent of Study Children
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
Total Number of Episodes per Child
AUGUST 1989 THROUGH JANUARY 1990

TABLE 2:

DIARRHEA PREVALENCE (PER 100 CHILD-DAYS)
BY MONTH OF STUDY



CRUDE AND AGE-ADJUSTED RATES
AUGUST 1989 THROUGH JANUARY 1990

TABLE 3:

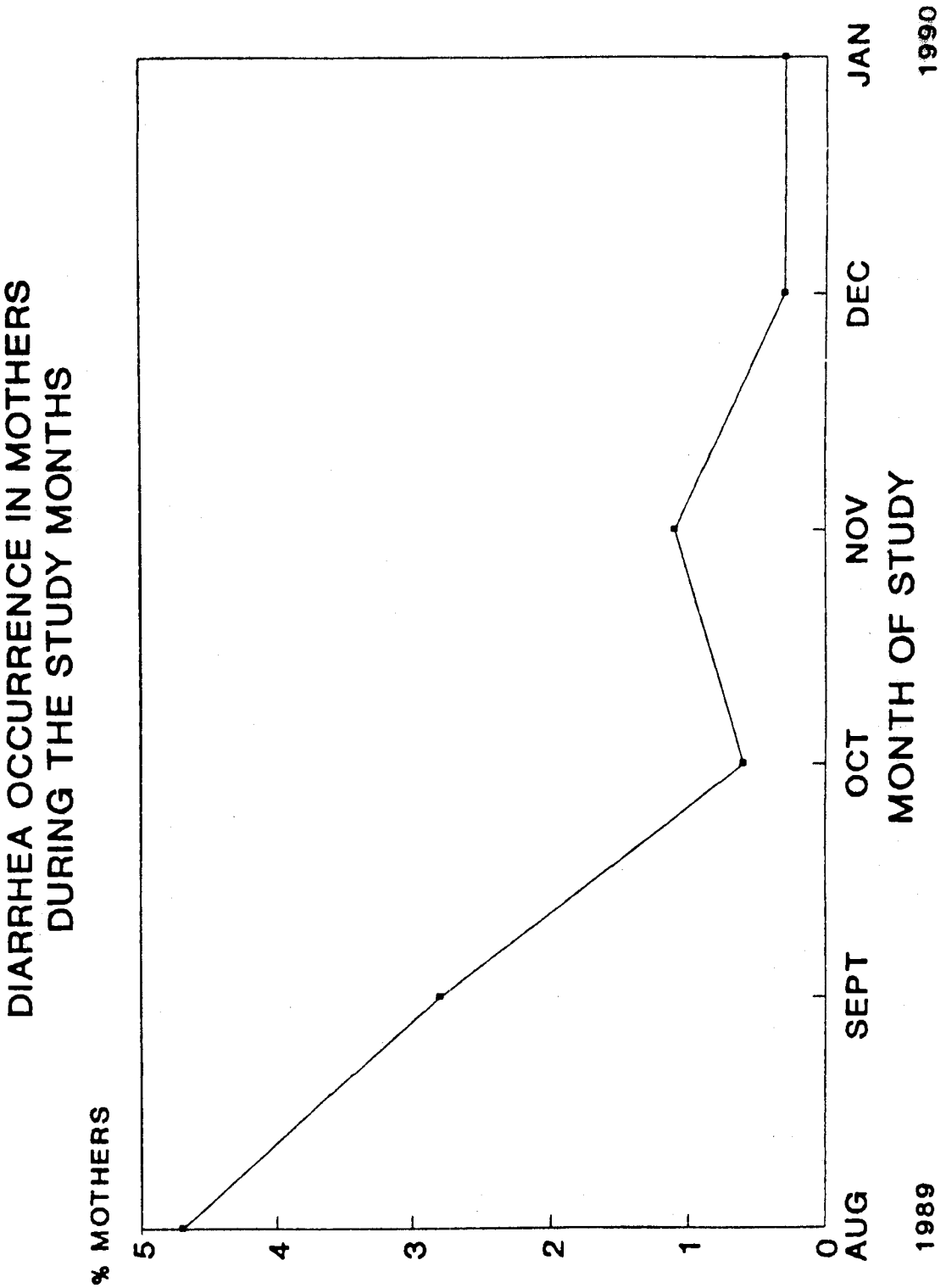

DIARRHEA OCCURRENCE IN MOTHERS
DURING THE STUDY MONTHS
% MOTHERS
5
4
3
2
1
0
AUG
SEPT
OCT
NOV
DEC
JAN
1989
1990
MONTH OF STUDY

Table 4: T-test results for the average number of diarrhea episodes by parental educational levels (n = 349)

	Average Diarrhea Episodes			
MOTHER:	**Mean**	**St. Dev.**	**T Value**	**Level of Signif.**
no education (73.9%)	1.89	1.79		
			1.72	.100
1 - 5 years (5.2%)	1.33	1.28		
			–1.19	.242
6 years or more (20.9%)	1.78	1.92		
			.43	.671
FATHER:	**Mean**	**St. Dev.**	**T Value**	**Level of Signif.**
no education (19.8%)	1.61	1.61		
			–.91	.374
1 - 5 years (4.6%)	2.06	1.84		
			.38	.709
6 years or more (75.6%)	1.88	1.84		
			–1.22	.225

Table 5: Significant correlations between household income, parental education and scores for risk behaviors during study period. (Pearson correlation coefficient)

	Monthly Income Education	Maternal Education	Paternal
Dirtiness of child	–.2260**	–.2894**	–.2326**
Hands washed before handfeeding		.1401*	
Hands washed after touching stool		.1277*	
Child's hands washed before meal		.1278*	
Child puts dirt in mouth	–.1196*	–.1102*	–.1071*
Child puts fingers in mouth	–.1436*	–.2454**	–.1799*
Adult puts finger in child's mouth	–.0973*		
Sibling puts finger in child's mouths		–.1266*	
Child puts object in mouth		–.1006*	

* = $p < .05$
** = $p < .001$

Table 6: Poisson regression: Relationship of diarrhea incidence with diarrhea occurrence in siblings and duration of sibling holding (n = 170).

Variable	Beta Coefficient	P- Vallue	Rate Ratio
Intercept	–5.312	<.001	.0049
Weight- for- age Z score (August)	–.1200	.033	.8870
Age in months	–.0214	<.001	.9788
Sibling with diarrhea	.5339	.001	1.700
Duration of Sib holding (in minutes)	.0447	.021	1.046
degress of freedom = 165			

Table 7: Poisson regression: Relationship of diarrhea incidence with risk variables, age and nutritional Status of children over 2 years.

Variable	Bate Coefficient	P- Vallue	Rate Ratio
Intercept	–6.449	<.001	.0016
Weight- for- age Z score (August)	–.2094	.006	.8111
Eats leftover food	.0904	.012	1.095
Sibling puts fingers in child's mouth	.4686	.007	1.598
Child's puts fingers in mouth	.0659	.031	1.068
Child puts object in mouth	–.1473	.006.	.8631
Clean liness of child	.0415	.010	1.042
degress of freedom = 136			

Tabl 8: Logistic Regression results for Diarrhea Occurrence in Mothers

Variable	Coefficient	Odds Ratio	Significance
MOTHERS:			
Cook's hands Washed before meal preparation	1.0949	2.724	.002
Constant	-3.668	.0255	<.001
Likelihood ratio statistic = 181.332, P <.001			

Table 9: Poisson regression: Relationship of diarrhea incidence with risk variables, age and nutritional status for the total suduy period, august 1989 through January 1990.

Variable	Beta Coefficient	P–Value	Rate Ratio
Intercept	–4.718	<.001	.0893
Age (August)	–.0218	<.001	.9784
Weight / age Z- score (August)	–.0762	.068	.9267
Cleanliness of child (Aug.- Jan.)	.0307	.002	1.031
Child puts fingers in mount	.0374	.049	1.038
Cook washes hands (Aug. - Jan.)	–.1519	.046	.8590
degress of freedom = 292			

Table 10: Poisson regression: Relationship of diarrhea incidence with risk variables, age and nutritional status for children under 2 years.

Variable	Beta Coefficient	P- Value	Rate Ratio
Intercept	–3.940	<.001	.0195
Age (August)	–.0335	<.001	.9671
Adult fingers in mouth	–.1899	.005	.8271
Cooks hands washed	–.2284	.021	.7958
Hands washed before hand-feeding child	.0577	.045	1.059

degrees of freedom = 153