PUBLICATIONS OF ADDR-SUPPORTED STUDIES IN PAKISTAN

THE APPLIED DIARRHEAL DISEASE RESEARCH PROJECT

HARVARD INSTITUTE FOR INTERNATIONAL DEVELOPMENT
One Eliot Street
Cambridge, MA 02138, USA

IN COLLABORATION WITH

Johns Hopkins University School of Hygiene and Public Health

and

The New England Medical Center Hospitals

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HIID

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November 24, 1992

Dear Colleagues:

The ADDR Project endeavors to fund research on topics of importance for the national disease control programs and to disseminate the research results to a broad audience. As participants in the VIth Asian Conference on Diarrhoeal Diseases, we thought you would be interested in the research results produced to date by your Pakistan colleagues supported by the ADDR Project with funds from USAID.

The compilation of published work in this volume reflects the broad range of clinical and community-based behavioral research undertaken over the past few years. The transdisciplinary approaches taken by many of these studies point to the biologic and social complexities of the illnesses under investigation.

This collected work is a small part of the ADDR-supported research work here in Pakistan. Over twenty-five ADDR studies are currently underway on topics including diarrheal disease, acute respiratory illnesses, and nutritional issues. They encompass both clinical and behavioral methodologies, with an emphasis on intervention trials. We will continue to work closely with all the research teams to assist in the completion of the studies, analysis of the data, and dissemination of results to your academic colleagues, national program managers and personnel, and general practitioners of Pakistan.

On behalf of the ADDR Project staff, thank you for your participation. We look forward to continuing our collaborative efforts.

Sincerely,

Richard A. Cash

Richard A. Cash, M.D., M.P.H.
Institute Fellow

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Grant #	Title	Principal Investigator/ Co-Investigators	Institution
P001	First Proposal Development Workshop	Various scientists	QUETTA
P002	Evaluation of Dowdo as a Diet for Children with Acute Diarrhea	Drs. Agha Jan, Mohammad Rafi	Children's Ward, District Headquarters Hospital, GILGIT
P003	Home Fluids in the Management of Diarrheal Disease in Children	Prof. Mushtaq A. Khan Drs. Qazi and Gul	Department of Pediatrics, PIMS, ISLAMABAD
P004	Comparison of Yogurt with Soya Based Lactose Free Formula in Secondary Lactose Deficiency	Prof. Abdul Waheed	Department of Pediatrics, Lahore General Hospital, LAHORE
P005	A Study of the Efficacy of Cereal Based (Sabodana) ORS Solution in Children with Acute Diarrhea	Prof. Zeenat Isani Dr. Sidiqua Ibrahim	National Institute of Child Health, KARACHI
P006	Risk Factors in the Development of Post-Diarrheal Ileus in Infants in Lahore	Prof. Abdul Tawwab Khan Dr. Mary Taj	Department of Pediatrics, King Edward Medical College, LAHORE
P007	Drug Prescribing Practices in Childhood Diarrhea	Dr. S.Q. Nizami Iktidar Khan	Department of Pediatrics. Aga Khan University, KARACHI
P008	Risk Factors for the Hemolytic Uremic Syndrome in Children (A Multicenter Trial)	Prof. Sajid Maqbool Dr. Zulfiqa Bhutta Gen. C.M. Anwar Dr. Imran Khan	Shaikh Zayed Hospital, LAHORE

P009	Simple Health Messages and Their Impact on Duration of Exclusive Breastfeeding and Improved Weaning Practices	Prof. A. G. Soomro Dr. Shaikh Anveer Ahmed	Department of Pediatrics I, Dow Medical College, KARACHI
P010	Promotion of Exclusive Breastfeeding and its Effect on Diarrhea Morbidity	Prof. D.S. Akram Dr. Agboatwalla	Department of Pediatrics II, Dow Medical College, KARACHI
P011	Dietary Management of Persistent Diarrhea in Malnourished Children, A Controlled Trial	Prof. D.S. Akram Dr. Agboatwalla	Department of Pediatrics II, Dow Medical College, KARACHI
P012	Evaluation of Diarrhea Treatment Unit	Prof. Zeenat Isani Dr. Sidiqua Ibrahim	National Institute for Child Health, KARACHI
P013	Study to Find Treatment Practices of Non-Qualified Practitioners (Quacks) in the Management of Diarrhea in Children under 5 Years of Age	Dr. Khalid Iqbal Tahir Prof. S. Malik	Nishtar Medical College, MULTAN
P014	Assessment of Practices of Doctors Trained at Diarrhea Training Unit, Rawalpindi General Hospital	Prof. M.Z. Malik Kundi Dr. Ijaz Ahmad Dr. Mohammad Anjum	Rawalpindi General Hospital, RAWALPINDI
P015	Knowledge and Practices of Mothers Reporting the Use of Drugs for the Treatment of Acute Watery Diarrhea in Children in Urban Slums of Lahore	Dr. Nosheen Javaid Dr. Abdoul Waheed (jun)	Department of Preventive Pediatrics, Allama Iqbal Medical College, LAHORE

P016	Study of Current Practices and Factors Affecting the Management of Acute Watery Diarrhea in Children 0-5 Years by General Practitioners in Lahore	Prof. Mahmuda Mubasher Dr. Abdul Jamil	Department of Community Medicine, Allama Iqbal Medical College, LAHORE
P017	Second Proposal Development Workshop	Various scientists	SHURBAN
P018	Impact of Appropriate Breastfeeding Practices on Diarrhea Morbidity and Nutritional Status of Infants	Dr. Salma Badruddin Dr. S.N. Bazmi Imam Ms. Tazeen Jamal	Department of Medicine, The Aga Khan University, KARACHI
P019	Impact of Vitamin A Supplementation on ALRI in 6-24 Months Old Children in Urban Slums of Lahore	Prof. Fehmida Jalil Dr. Mohammad Imtiaz	King Edward Medical College, Department of Preventive Pediatrics, LAHORE
P020	Assessment of Nutritional Beliefs and Practices, and Factors Affecting Them in Pregnant and Lactating Mothers	Dr. Shahid Mahmood Dr. Fayyaz Atif Dr. Naira Bano Siddiqui Dr. Humera Mubasher	Allama Iqbal Medical College, Department of Community Medicine, LAHORE
P021	A Study of Pakistani Parents Knowledge and Management of ARI	Dr. Naeem Ahmed Vohra Prof. M. Anwar Prof. Sajid Maqbool Dr. Nasim Mahmood	Shaikh Zayed Hospital, LAHORE
P022	Assessment of Maternal Risk Factors for Birth of Small for Gestational Age Babies in Hospital-Based Urban Populations	Prof. M. A. Arif Dr. Samina Shamim Dr. Aslam Qureshi	National Institute for Child Health, KARACHI
P023	Assessment of ARI Case and Management by Medical Officers Working in Primary Health Care Facilities in Peshawar NWFP	Dr. Tasleem Akhtar Dr. Nisar Ahmed	PMRC Research Center, Khyber Medical College, PESHAWAR

P024	Efficacy of Aerolized Salbutamol in Bronchiolitis	Dr. Mary Taj Dr. Iqbal Sheikh, Dr. Tariq I. Bhutta	Department of Pediatrics, King Edward Medical College, LAHORE
P025	Role of Community Health Workers (CHW's) in Detection and Management of Pneumonia and Determination of Cost and Time Savings by the Community and Health Care System	Dr. Aisha Mehnaz Prof. A.G. Billoo	Department of Pediatrics I, Dow Medical College, KARACHI
P026	Assessment of Weaning Beliefs and Practices among Mothers in An Urban Community of Lahore	Dr. Ume Kulsoom Dr. Rubina Malik	Department of Maternal and Child Health, College of Community Medicine, LAHORE
P027	Acute Respiratory Infections (ARI) in Children of Urban Slums and Rural Localities of Rawalpindi/ Islamabad	Prof. Iftikhar A. Malik Drs. Nazir Ahmad, Aftab Ahmed, Noreen Bukhtiari, Muhammad Nawaz	Army Medical College, PULSE RAWALPINDI
P028	Assessment of Maternal Antibodies in Children 5,7, and 9 Months of Age and Study of Measles Seroconversion Rates in Children of 12-23 Months of Age in Pakistan	Dr. Humayun Asghar Dr. Muhammad Akram	National Institute for Health, ISLAMABAD
P029	Community Perceptions of ALRI in Urban Slums of Karachi	Dr. Rafat Hussain Dr. Melvyn Lobo	Department of Community Health Sciences, Aga Khan University, KARACHI
P030	Impact of Iron Supplementation on Infant Morbidity and Growth in NW Frontier Province	Dr. Parvez Paracha Dr. A. Hameed	NWFP Agricultural University PESHAWAR

P031	A Sociological Study of Malnutrition among Children Between 6-36 Months of Age in Lahore	Abdus Salam Toor Prof. Sultan Alam Usmani	Department of Sociology, University of the Punjab, LAHORE
P032	Clinical Diagnosis and Case Management of Children with ARI	Dr. Imran Iqbal Mr. Shahid Pervez	Nishtar Medical College, MULTAN
P033	Childhood Pneumonia in the Northern Areas of Pakistan: Relationship of In Vitro Antibiotic Resistance with Clinical Response to Cotrimoxazole	Dr. Zeba Rasmussen Dr. Musa Rahim	Aga Khan Health Services, Northern Area and Chitral, GILGIT
P034	A Comparative Study of Clinical Signs, Etiology, and Outcome of Pneumonia in Severely Undernourished Children up to 2-59 Months	Dr. Shamim A. Qazi Drs. Rehman, Iqbal, Khan, Mrs. Nomani	The Children Hospital, PIMS, ISLAMABAD
P035	A Randomized Controlled Trial of Zinc Supplementation in Children with Persistent Diarrhea: Impact on Diarrhea and Nutritional Status (Pending Proposal)	Dr. Z. A. Bhutta	The Aga Khan University, Department of Pediatrics, KARACHI
P036	Support for Participation at the 6th Asian Conference on Diarrheal Diseases	Various scientists	College of Physicians and Surgeons, KARACHI
P037	Practices and Problems of Health Technicians in Health Facilities in NWFP (Pending Proposal)	Dr. Parveen Azam Dr. Arjumand Faisel	Female Health Technicians School, PESHAWAR

121	Evaluation of a Nutrition-Based Algorithm for the Management of Persistent Diarrhea	Dr. Sohail Thobani (and multi-centre collaborators)	Department of Pediatrics, Aga Khan University, KARACHI

PERSISTENT DIARRHEA

Dietary risk factors associated with acute and persistent diarrhea in children in Karachi, Pakistan[1-3]

Salma H Badruddin, Asma Islam, Kristy M Hendricks, Zulfiqar A Bhutta, Salahuddin Shaikh, John D Snyder, and A Majid Molla

ABSTRACT Feeding practices may have an important impact on diarrheal diseases in developing countries. This study evaluated feeding practices in three groups of male children aged 6–36 mo: 100 with persistent diarrhea (PD), 79 with acute diarrhea (AD), and 86 in a comparison group (CG). The children came from comparably poor socioeconomic settings in Karachi, Pakistan, except that the literacy rates were higher in mothers of the CG ($P = 0.0001$). Although > 95% of all infants were breast-fed, delayed initiation of breast-feeding was more common in the diarrhea groups. Children with diarrhea were also more likely to receive supplemental milk (PD = 92%, AD = 87%) than were children in the CG (69%, $P < 0.05$). Feedings were not withheld during diarrhea but changes were made in the nature of foods given. These results indicate that several feeding practices may be important risk factors for diarrhea in Pakistan. *Am J Clin Nutr* 1991;54:745–9.

KEY WORDS Infant feeding, breast-feeding, diarrhea, nutrition, oral rehydration

Introduction

Diarrheal disease is one of the leading causes of infant and childhood mortality and a common cause of malnutrition in the developing world (1). Of the many factors that affect diarrheal incidence, severity, and its impact on growth, infant-feeding practices are among the most important (2).

Recommendations for infant feeding are similar for developed and developing countries and include exclusive breast-feeding for ≥ 4–6 mo followed by introduction of nutritionally balanced weaning foods from locally available foodstuffs (3–5). In developing countries continuation of breast-feeding is recommended into the second year of life (6). The nutritional and immunologic superiority of breast-feeding compared with artificial feeding is universally recognized (6, 7). However, infant formula may be safely used as a breast-milk substitute in developed countries if the mother is unable to breast-feed. In developing countries formula feeding is associated with increased infant morbidity and mortality from diarrheal disease (8). Exclusively breast-fed infants have been shown to be at a lesser risk of developing diarrhea than are partially breast-fed infants, with infants totally weaned being at highest risk (9, 10). The protective effects of breast-feeding against diarrheal disease are felt to be due to immunologic and antimicrobial factors, reduced exposure to enteric pathogens, and improved nutrient intake (11).

Most studies of infants in developing countries show a short duration of exclusive breast-feeding with supplements introduced much earlier than the recommended 4–6 mo (12). In Pakistan it is a common practice to delay initiation of breast-feeding until the third day after birth, during which time a variety of prelacteal feeds, including animal milk, are given.

Jalil et al (13) recently documented a high frequency of early weaning in a poor urban population in Pakistan, with 50% of breast-fed infants receiving breast-milk substitutes by 1 mo of age. In addition to the increased risk of contamination and infection, weaning foods may also be deficient in calories and selected nutrients, contributing to malnutrition (14).

The specific nature of feeding regimens during diarrhea may also influence the outcome of episodes. Few data are available in Pakistan about continuing or withholding feeding and what alterations are made in the usual diet during acute or persistent diarrhea.

Information on specific infant-feeding practices and the evaluation of their possible impact on health could be useful in determining which practices should be reinforced by health practitioners and which practices need to be discouraged. The present study was undertaken to determine whether specific infant-feeding practices in Karachi, Pakistan, were associated with increased risk of acute or persistent diarrhea.

Subjects and methods

Subject selection

The mothers of three groups of children were studied during September 1987–December 1988. The children were all males, aged 6–36 mo, who resided in socioeconomically disadvantaged

[1] From the Department of Medicine/Community Health Science and the Department of Pediatrics, Aga Khan Medical College, Karachi, Pakistan; and Harvard Medical School and Sargent College of Allied Health, Boston University, Boston.

[2] Supported in part by the Applied Diarrheal Disease Research Project at Harvard University by means of a cooperative agreement with the US Agency for International Development.

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areas of Karachi. Only children who had weaning foods introduced into their diet were included in the three groups. The study was approved by the ethical review committees of the Aga Khan, Civil, and Jinnah Postgraduate Institute Hospitals, and of Harvard University.

The first group comprised mothers whose children suffered from persistent diarrhea for ≥ 2 wk. One hundred such children were identified in the outpatient department at the National Institute of Child Health, Karachi, and were enrolled in a study on the dietary management of persistent diarrhea (15). Group two included the mothers of 79 children who suffered from acute diarrhea for ≤ 72 h. These children were identified in the outpatient department of Civil Hospital, Karachi, and were enrolled in a study on the dietary management of acute diarrhea (S Shaikh, AM Molla, A Islam, AG Billoo, K Hendricks, JD Snyder, unpublished observations, 1990). Only children whose diarrhea resolved in 3–5 d were included in the study. The comparison group was made up of the mothers of two groups of well-nourished children who had not had diarrhea in the previous week. The first were 41 mothers of healthy children without diarrhea who were seen in the outpatient departments at Civil and Jinnah Hospitals. The children were accompanying their mothers, who had brought another sibling for treatment in the outpatient departments at the hospitals. Forty-five additional mothers of healthy children without diarrhea who resided in two urban slum areas near the two hospitals were also selected. These children were identified by a nonrandomized house-to-house survey. Only those children who were healthy, were ≥ 80% of expected weight for age, and whose mothers reported that they were at least partly weaned and had not had a recent episode of diarrhea were included in the comparison group.

The mothers of the children were interviewed by a trained dietitian regarding their infant-feeding practices by using an open-ended questionnaire. The age, height, and weight of the child were recorded at the time of admission into the study. The children in the persistent and acute-diarrhea groups were weighed by using a Detecto balance (Grapenut, NY) (accuracy, ±20 g) whereas the comparison group was weighed on Salter scales (Lawrence, MA) (accuracy, ±50 g). The degree of malnutrition was determined by using the Waterlow criteria (16). Feeding practices were examined in three general categories: breast-feeding, weaning, and feeding during diarrhea.

TABLE 1
Demographic characteristics of the parents

	Persistent diarrhea (n = 100)	Acute diarrhea (n = 79)	Comparison (n = 86)
	%		
Mother's occupation			
Housewife	90	85	96
Self-employed	5	10	8
Employed outside home	5	5	2
Father's occupation			
Unemployed	8	8	5
Self-employed	5	4	11
Unskilled laborer	26	29	12*
Skilled laborer	60	57	71
Mother's literacy			
Able to read and write	14	19	43†

*† Significantly different from persistent and acute-diarrhea groups: *$P < 0.01$, †$P < 0.0001$.

TABLE 2
Physical characteristics of the children in the diarrhea groups and the comparison group

	Persistent diarrhea (n = 100)	Acute diarrhea (n = 79)	Comparison (n = 86)
	%		
Age (mo)	14.1 ± 7.5*†	17.6 ± 8.9	18.8 ± 8.9
Weight (kg)	6.9 ± 1.7	7.4 ± 1.4	10.2 ± 1.6
Nutritional status			
Percent with malnutrition (%)			
Normal	26	14	100
First degree	13	44	0
Second degree	24	34	0
Third degree	35‡	8	0
Birth order (%)			
1	22§	11	30
2	20	14	17
>2	58	75	72

* ± SD
†§ Significantly different from acute-diarrhea and comparison groups: *$P < 0.006$, §$P < 0.05$
‡ Significantly different from acute-diarrhea group: $P < 0.005$.

Statistics

The chi-square test was used to determine the significant percent differences between groups except for mean age, mean weight, and mean length of breast-feeding, for which Student's t test was used.

Results

Demographic characteristics

The three groups were similar in most of the family demographic characteristics studied (**Table 1**). However, the literacy rate of the mothers of the comparison group (41%) was significantly greater than that for the persistent diarrhea (14%) and acute diarrhea (19%) groups ($P < 0.0001$). The housing conditions and water supply and storage were similar in the three groups. Forty-four percent of the comparison group, 55% of the persistent diarrhea group, and 56% of the acute diarrhea group came from households that had a private water connection or household tap. Greater than 85% of the mothers were housewives living predominantly in extended families. Slightly more of the fathers of the infants with diarrhea were engaged in unskilled rather than skilled labor.

Several statistically significant differences were noted in the physical characteristics of the children (**Table 2**). The children in the persistent diarrhea group were younger (14.1 ± 7.5 mo) than the children with acute diarrhea (17.6 ± 8.9 mo) and those in the comparison group (18.8 ± 8.9 mo) ($P < 0.005$). The children in the persistent diarrhea group were more likely to be the first-born child compared with the acute diarrhea and comparison groups ($P < 0.05$) and were also more likely to be malnourished compared with the acute diarrhea group ($P < 0.005$).

Breast-feeding

More than 95% of the children in all three groups were initially breast-fed (**Table 3**). However, the comparison group was more likely to initiate breast-feeding on day one as compared with the persistent diarrhea and acute diarrhea groups ($P < 0.0001$). About half of the children with diarrhea did not begin breast-feeding until at least the second day of life. The control subjects were also breast-fed for an average of 2.5 mo longer than the persistent diarrhea or acute diarrhea group. Failure of lactation and subsequent pregnancy were the primary reasons for discontinuing breast-feeding and accounted for ~50% of all the cases in each group. Poor lactation was more commonly reported in the persistent and acute-diarrhea groups than in the comparison group ($P < 0.001$). Illness in the mother was a more commonly reported reason for discontinuing breast-feeding in the persistent diarrhea group than in the acute diarrhea and comparison groups ($P < 0.05$).

Weaning

More than half of the infants in each group had been given supplemental milk feeds before 6 mo of age (**Table 4**). At the time of the study significantly more children in the comparison group still had received no supplemental milk compared with the children in the two diarrhea groups ($P < 0.00001$). Buffalo milk was the most commonly used supplemental milk in all three groups but was used most frequently in the persistent diarrhea and acute diarrhea groups ($P < 0.001$) than in the comparison group. Cow-milk formula, the second most commonly used supplemental milk, was more frequently used in the comparison group than in the diarrhea groups ($P < 0.05$). A significantly greater percentage of mothers in both the persistent diarrhea (38%) and acute diarrhea (28%) groups than in the comparison group added sugar to cereal gruel (7%, $P < 0.00001$). A higher percentage of these mothers (persistent diarrhea 39%, acute diarrhea 43%) also added sugar to drinking water compared with the mothers in the comparison group (23%, $P < 0.02$).

Greater than 70% of the mothers in all three groups introduced more than one food at the start of weaning. The most common weaning foods were khichri (a mixture of rice, lentils, and oil), cereal, bananas, biscuits, and unleavened bread.

TABLE 3
Breast-feeding patterns of the diarrhea groups and the comparison group

	Persistent diarrhea (n = 100)	Acute diarrhea (n = 79)	Comparison (n = 86)
	%		
Number who were ever breast-fed	97	97	96
Number in whom breast-feeding was initiated on the first day of life	44	54	76*
Reasons for discontinuation			
Poor lactation	35	36	14*
Pregnancy	17†	40	36
Illness in mother	14†	4	7

* Significantly different from persistent and acute-diarrhea groups. $P < 0.001$.

† Significantly different from acute diarrhea and comparison groups. $P < 0.05$.

TABLE 4
Weaning practices

	Persistent diarrhea (n = 100)	Acute diarrhea (n = 79)	Comparison (n = 86)
	%		
Number in whom supplementary milk was initiated at <6 mo of age	63	60	55
Number in whom no supplementary milk was given	8	13	31*
Type of supplementary milk feed*			
Buffalo	75	81	31‡
Formula†	24	22	41‡
Others	3	3	7

*‡ Significantly different from persistent and acute-diarrhea groups. *$P < 0.0001$, ‡$P < 0.001$.

* More than one type of milk was given in some cases.

† Cow-milk based.

Feeding during diarrhea

No mother in the study reported withholding milk and food during diarrheal episodes. However, the nature and amount of fluids and food given did change. The majority of children in all three groups received some breast-milk during diarrheal episodes (**Table 5**). When other milk was given, buffalo milk was the most commonly used type. Significantly more children with diarrhea were given buffalo milk compared with children in the comparison group ($P < 0.005$); the buffalo milk was usually diluted with water. The use of World Health Organization (WHO) oral rehydration salts (ORS) was greater in the persistent diarrhea and acute diarrhea groups than in the comparison group ($P < 0.0001$). Sixty percent of the mothers in the persistent diarrhea group and 51% in the acute diarrhea group reported that they always boiled water given to their child as compared with 34% of the mothers in the comparison group ($P < 0.002$).

More than 85% of the children in all three groups were given weaning foods during diarrheal episodes and the reported feeding practices differed between the children with persistent and acute diarrhea (Table 5). Significantly more children with persistent diarrhea received khichri and cereals than did children with acute diarrhea. Home remedies, defined as sabo dana (thin sago gruel), albumin water (egg white and water), and herbal medicines and teas were given to 42% of the persistent diarrhea group as compared with 22% of the acute diarrhea and 23% of the comparison groups ($P < 0.005$). Problems with poor appetite and decreased food intake during diarrhea were reported for 39% of the persistent diarrhea group as compared with 23% of the acute diarrhea group and 24% of the comparison group ($P < 0.05$).

Discussion

These results identify several possible feeding-related risk factors that may be associated with persistent or acute diarrhea in

TABLE 5
Breast-feeding pattern of the diarrhea groups and the comparison group

	Persistent diarrhea (n = 100)	Acute diarrhea (n = 79)	Comparison (n = 86)
		%	
ORS during diarrhea	79	72	40*
Milk feeding during diarrhea			
Breast milk	61	44	54
Buffalo milk	48	51	23†
Formula‡	15	2§	20
No milk	2	5	6
Foods given during diarrhea			
Khichri	46	28‖	39
Cereals	47¶	24	22
Banana	33**	20	16
No solids	6	6	13

*† Significantly different from persistent and acute-diarrhea groups: *$P < 0.0001$, †$P < 0.0005$.

‡ Cow-milk based.

§ Significantly different from persistent-diarrhea and comparison groups, $P < 0.05$.

‖ Significantly different from persistent-diarrhea group, $P < 0.05$.

¶** Significantly different from acute-diarrhea and comparison groups: ¶$P < 0.005$, **$P < 0.02$.

young children in a poor urban community in Pakistan. Potentially harmful practices were associated with delayed initiation of breast-feeding, early weaning, and feeding during diarrhea.

However, several important constraints should be considered when reviewing these data. The dietary information was obtained by mother's recall, which has been shown to have a poor correlation with actual practices (17). No observations of feeding were done. The potential discrepancy between recall and actual events may be greatest for the data on feeding practices during diarrhea of the comparison group, because they had not had a recent episode.

The characteristics of the children may also have influenced the types of feeding received. More children were malnourished in the persistent diarrhea group and their poorer nutritional status may have influenced the nature of the feedings they received. The persistent diarrhea group was also younger than the acute diarrhea and comparison groups but we feel that the 4-mo difference in age (14 vs 18 mo) was not likely to be associated with important differences in general feeding patterns in this population.

Several potentially important risk factors associated with the development of persistent or acute diarrhea are suggested by the results of this study. The literacy rate, defined as the ability to read and write, was significantly greater in the mothers of the children in the comparison group than in the diarrheal groups, which was similar to the national literacy rate of 19% for females (18). Data in many countries, including Pakistan, show a direct correlation between higher levels of maternal literacy and lower levels of infant-child mortality (19). Jalil et al (13) showed that the child's growth and the total number of episodes of diarrhea were significantly associated with family educational level in a group of 910 infants from a poor urban population in Lahore, Pakistan, who were followed longitudinally from birth to 2 y.

Otherwise, the socioeconomic conditions of the families of children with diarrhea and the comparison group were very similar. They all came from urban slums and sought care for their children at the same government institutions. Similar percentages of the mothers were housewives. These data are comparable with data obtained from various squatter settlements in Karachi, which are the field sites for the Aga Khan University Department of Community Health Sciences. Data from these field sites show that 11% of the mothers are gainfully employed and 18% are literate. Housing and water-supply conditions are also similar with 50% of the homes having private water connections (Department of Community Health Sciences, unpublished observations, 1990).

Significantly more children with persistent diarrhea were the first-born children in their family, suggesting an obvious group to target for increased educational efforts by the health care system. Children with diarrhea were also more likely to be malnourished than were children from the same socioeconomic group in general, indicating another important target group for educational and nutritional interventions. The prevalence of second-degree malnutrition was 24% for the persistent diarrhea group and 27% for the acute diarrhea group. Prevalence of third-degree malnutrition was 35% for the persistent diarrhea group and 8% for the acute diarrhea group. These rates were considerably higher than data reported from six squatter settlements in Karachi, which showed a range of 6–16% for the prevalence of second-degree malnutrition and 1–4% for the prevalence of third-degree malnutrition (Department of Community Health Sciences, unpublished observations, 1990).

Breast-feeding practices differed between the children in the comparison and diarrhea groups. In the diarrhea groups, breast-feeding was delayed until after the first few days of life in nearly twice as many children as in the comparison group. The early initiation of breast-feeding by infants is the essential stimulus to the development of an adequate supply of mature milk (11). To sustain this supply a regular pattern of suckling is required, which may be affected by this delayed start. Taylor et al (20) reported that even a del[illegible]n after birth in the initiation of suckling resulted [illegible] of almost 50% in the duration of breast-feeding as compa[illegible] those infants who were suckled within an hour of birth. Thus, the delay in initiation of breast-feeding may also have played a role in the much higher rate of lactation failure reported by the mothers of the children with diarrhea.

Supplemental milk feedings were also a common practice that was initiated in the majority of children before the age of 6 mo. These supplemental feedings are likely to increase the infants' exposure to enteric pathogens and may lead to illness. This increased risk for infection is underscored by the fact that unpasteurized buffalo milk, which is routinely diluted with untreated water, was the most commonly used supplemental milk. Almost three times as many children in the comparison group had not been exposed to supplemental milk as compared with the children with diarrhea ($P < 0.001$). Popkins et al (21) followed 3000 mother-infant pairs from pregnancy through infancy and reported that the addition of water, teas, and other nonnutritive liquids to the breast-milk diet more than doubled the likelihood of diarrhea. In addition, supplementation of breast-feeding with foods or nutritive liquids such as milk or juice also increased the risk of diarrhea (21).

We did not examine the reasons why supplemental milk feedings were started but maternal perception of insufficient milk supply is the most common reason for discontinuation of breast-feeding (11, 22). The reasons for this perception may be multiple and include factors such as urbanization, industrialization, and maternal anxiety about lactation. The late initiation of breast-feeding and its negative effect on the establishment of a regular and effective pattern may also play a role.

Weaning practices in addition to supplemental milk feedings showed some important differences between the children in the diarrhea and comparison groups. The risk of contamination of food and fluids may have been greater for children in the diarrhea groups because significantly more mothers added sugar to water, milk, and food. Otherwise, the weaning practices appeared fairly similar. Semisolid weaning foods were generally introduced by 6 mo of age and > 70% of the mothers introduced more than one food at the start of weaning. Khichri, the most commonly used weaning food, appears to be a nutritionally advantageous food that has a caloric density of > 4.18 kJ/g (1 kcal/g) and a composition of 55% carbohydrate, 35% fat, and 10% protein in its cooked form (15).

Although withholding food and milk during diarrhea is felt to be a common practice (23), no mother in our study reported doing so. The general patterns of feeding were similar although there were some differences in the persistent- and acute-diarrhea groups. Significantly more children in the persistent diarrhea group received khichri and cereals than did children in the acute diarrhea group. Rather than indicate an important possible risk factor for the development of persistent diarrhea, these data may simply underscore different feeding regimens in these two groups. Khichri is widely used throughout Pakistan and India as a weaning food and is used as a food during diarrhea in adults. Recent studies from our group indicate that khichri may be an effective food to give to children who have diarrhea (15; S Shaikh, AM Molla, A Islam, AG Billoo, K Hendricks, JD Snyder, unpublished observations, 1990). As discussed earlier, the more frequent use of buffalo milk in the children with diarrhea may be evidence for greater exposure of these groups to contaminated foods.

Our explanation for the greater use of ORS and more frequent boiling of water in the diarrhea groups is that these positive practices may have resulted because the mothers of children with diarrhea had more contact with the health care system.

These results identify several potentially important risk factors that may influence the development of persistent or acute diarrhea. Policy decisions emphasizing improved maternal education, targeting mothers of first-born children, reinforcing the need to begin breast-feeding at birth, and discouraging early use of supplemental milk feedings may all be of benefit. Prospective trials for interventions in these areas are now indicated to measure the potential impact of the interventions on improving child health.

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Dietary Management of Persistent Diarrhea: Comparison of a Traditional Rice-Lentil Based Diet with Soy Formula

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ABSTRACT. Recent studies have indicated that enteral diets can play an important role in the treatment of persistent diarrhea. Khitchri, a local weaning food in Pakistan, is composed of rice and lentils, which have previously been shown to be well tolerated in many children with acute diarrhea. The effectiveness of a khitchri and yogurt (KY) diet, which is inexpensive and widely available in Pakistan, was studied. One hundred two weaned boys (6 to 36 months old) with persistent diarrhea were randomly assigned to receive either soy formula (group A) or the KY diet (group B) for 14 days. Group A also received the KY diet in addition to formula for days 8 through 14. Twenty-nine children did not complete the study because of severe infection (13) or their family's decision to leave the study early (9 in group A and 7 in group B). Sixty-six children successfully completed the study protocol; there were five clinical failures in group A and two in group B. On a comparable caloric intake, there was a significantly lower stool volume (group B: 38 ± 16 [mean ± SD] vs group A: 64 ± 75 g/kg per day, $P < .05$) and frequency (B: 4.4 ± 2.0 vs. A: 6.6 ± 4.2 stools per day, $P < .005$) in children fed KY during the first week of therapy. Group B children also had a significantly greater weight gain than children in group A during the first week (B: 468 ± 373 g/wk vs A: 68 ± 286 g/wk, $P < .005$). The addition of KY to the diet of the soy-fed group in the second week of therapy resulted in a significantly greater weight gain compared with the first week (575 ± 408 g/wk, $P < .005$). These data indicate that a traditional rice-lentil and yogurt diet can be successfully used for the dietary management of persistent diarrhea in children. *Pediatrics* 1991;88:1010–1018; *persistent diarrhea, khitchri, dietary therapy.*

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ABBREVIATIONS. PD, persistent diarrhea; NICH, National Institute of Child Health.

Despite major advances in the knowledge and use of oral rehydration therapy,[1] diarrheal diseases continue to be one of the main causes of mortality and morbidity in the developing world.[2] Persistent diarrhea (PD; defined as diarrhea lasting more than 2 weeks usually with weight loss) is receiving increasing attention because more than one third of all diarrhea-associated deaths may be related to PD, with case-fatality rates as high as 14%.[3]

Although the pathogenesis of PD remains unknown, a close relationship between PD and malnutrition has been identified.[4,5] There is evidence that malnutrition itself predisposes to PD,[6] and in the developing world the two almost universally coexist in affected children. Persistent diarrhea has, therefore, been viewed by some as a nutritional disorder,[7,8] and nutritional rehabilitation may well play an integral role in its successful management.[8]

The optimal form of nutritional therapy, whether enteral or parenteral, has not yet been identified. The enteral route has the potential advantages of decreased expense, far greater availability, and lower risk of infection. Recent studies have also demonstrated that enteral feeding may result in faster recovery and shortened duration of hospitalization compared with parenteral nutrition.[9]

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A variety of enteral diets including cow's milk protein and lactose-free (usually soy) formulas,[10,11] protein hydrolysate formulas,[9] and comminuted chicken[12] have been recommended for PD. Soy formulas, although expensive by Pakistani standards, are widely used in Pakistan as cow's milk substitutes for suspected lactose or milk protein intolerance. Socioeconomic realities in the developing world, however, dictate the need for even less expensive, culturally acceptable, locally available, and easily absorbable diets for PD. Unfortunately, controlled trials of such diets, especially using semisolid foods, have not yet been reported.[8]

In recent years a number of dietary staples in the developing world have been identified to be of potential benefit in the treatment of acute diarrhea, especially in oral rehydration solutions.[13,14] Rice powder solutions have been shown to reduce stool output in diarrhea.[15] Rice carbohydrate can be easily digested in young children.[16] The hydrolysis of glucose polymers from rice starch is also aided by high levels of brush border maltase activity which is maintained in children with diarrhea and malnutrition.[17] Previous studies have also demonstrated that rice and lentils can serve as effective carbohydrate sources for oral rehydration solutions in children with diarrhea.[18] Yogurt is also fairly widely used as a dietary supplement in Pakistan and does not usually lead to clinical malabsorption.[19]

Although rice and lentils are important components of many weaning and semisolid diets in the south Asian region, the role of such diets in the dietary therapy of PD has never been scientifically assessed. Khitchri is a traditional semisolid diet of rice, lentils, and cottonseed oil and is widely used in Pakistan and India. It is commonly given as a weaning diet, and along with yogurt it is used as food during diarrhea in adults. We prospectively studied the effect of feeding khitchri and yogurt to children with PD in comparison with a soy-based formula.

METHODS

This study was a collaboration among the Department of Pediatrics, Aga Khan University, National Institute of Child Health (NICH) (Karachi) and the Combined Program in Pediatric Gastroenterology and Nutrition, Harvard Medical School (Boston).

Selection and Allocation of Patients

The study was carried out between September 1987 and December 1988 at the Clinical Research Unit of the NICH (Karachi). Weaned boys, 6 months to 3 years of age, presenting to the outpatient department of the NICH with PD, were considered for inclusion in the study. Diarrhea was defined as increased frequency and reduced consistency of stool by mother's report. For this study, PD was defined as diarrhea lasting for 2 weeks or more; no data on previous growth were available. Female patients were excluded to permit separate quantitative collections of urine and feces.

The study protocol was approved by the ethical review committees at the Aga Khan University Hospital, the NICH, and Harvard University. Informed consent was obtained from the parents or guardians of the children prior to inclusion in the study.

Patients with clinical signs of intercurrent infections (including respiratory distress, meningeal signs, and dysuria), those with temperature >39°C, severely malnourished children (weight for age <50% of the 50th centile of National Center for Health Statistics standard), and those with peripheral edema were excluded from the study. All drugs were stopped prior to study initiation. Clinical dehydration, if any, was corrected before entry into the study, using the World Health Organization oral rehydration salts, in millimoles per liter: glucose, 111 (20 g/L); sodium chloride, 90 (3.5 g/L); potassium chloride, 20 (1.5 g/L); and trisodium citrate, 10 (2.9 g/L). Continuing diarrheal losses during the study were replaced with oral rehydration salts.

Patients were randomly allocated to two study groups by using a random number table. Group A patients received soy milk (Nutrisoja, Nutricia, Holland) alone for the first 7 days, followed by a combination of soy milk, khitchri, and yogurt for the next 7 days. Group B patients received only khitchri and yogurt for 14 consecutive days.

The soy milk consisted of soybean protein supplemented with L-methionine, corn syrup carbohydrate, and vegetable fat and had an osmolarity of 150 mOsm/L. Khitchri (rice 60 g, dal 30 g, cottonseed oil 10 g dry weight) was prepared in bulk, frozen in aliquots, and distributed under the supervision of a clinical nutritionist (S.B.). Yogurt was obtained from a single commercial source (Fine Dairy Products, Karachi). The ratio of khitchri to yogurt offered was 3:1. Children in both groups were allowed to feed ad libitum to achieve a minimum caloric target of 100 kcal/kg per day by day 4 of the study. For children unable to consume this amount orally, the diet was liquified in a blender and fed by nasogastric tube. Table 1 gives the macronutrient composition of soy milk, khitchri, and yogurt.[20] In week 2, group A patients received

approximately equal volumes of khitchri-yogurt and soy formula.

Patients were examined twice daily by the research physician during the course of the study, and careful measurements of food and fluid intake and stool, urine, and emesis were recorded. Nutritional status was evaluated by using the Gomez criteria.[21] All food was weighed prior to administration and any unconsumed food weighed and deducted. Adhesive urine bags were used to collect urine separately from stools. Stool volume was measured by weighing preweighed diapers containing stools on electronic scales accurate to ±2 g (Tanita Inc, Tokyo, Japan). Daily nude weight was obtained prior to the morning feed on a double beam balance (Detecto), accurate to ±20 g. Other anthropometric measurements were obtained at admission and on days 7 and 14 of the study. Improvement in nutritional status was evaluated by using standard deviation scores (z scores) of weight-for-age.[22] Following the World Health Organization criteria, two standard deviations below the mean weight-for-age is defined as −2.[22] Length was measured on an infant stadiometer, and midarm circumference and occipitofrontal circumference were measured by using a fiberglass tape. Midtriceps skinfold thickness was measured by one of us (Z.A.B.) in an unblinded fashion on the left arm, by taking the mean of three determinations with a skinfold calliper (Holtain Inc, Crymych, Wales).

Laboratory Investigations

Stool specimens were daily examined microscopically for white blood cells, red blood cells, ova, and parasites. Stool pH was measured using a pH strip. Blood samples were obtained at admission and on day 14. The complete blood cell count was obtained from a Coulter counter (Coulter Inc, Hialeah, FL), and serum albumin concentration was estimated on an automated analyzer (Beckman, Astra, CA) by using the bromcresol green procedure. One-hour serum D-xylose value was estimated at initiation and end of study after a 6-hour fast, by using the method of Roe and Rice.[23] Reliable stool cultures for bacterial pathogens were not available during the course of the study.

Outcome

Clinical failures were defined as children having PD with inability to maintain hydration by the oral route or children with weight loss for three or more consecutive days after achieving a caloric intake target of a minimum 100 cal/kg per day. Cessation of diarrhea was defined as achievement of semisolid stool consistency, a stool frequency of three or fewer per day, and a stool volume of less than 30 g/kg per day.

Statistical Analysis

We performed both the two-tailed Student's t test and two sample Wilcoxon rank sum test to determine the significance of differences in the mean values between the two groups because of the skew in some of the variables. For uniformity of presentation, we report the results of the Students t test except where differences in significance exist between the two methods of analysis. In those cases, we report the results of both tests. The χ^2 test was used to determine the significance of differences in proportions.

RESULTS

A total of 102 children were randomized to one of the two treatment groups. Of these, 29 (28%) were later excluded for reasons of severe infection (pneumonia, 6; impetigo, 2; septicemia, 1; otis media, 4) or the decision of the family to leave the study before completion (9 in group A and 7 in group B).

Table 2 lists the characteristics of the remaining 73 patients. The admission characteristics were

TABLE 1. Macronutrient Composition of Study Diets: Contents per 100 g (After Preparation)

Content	Soya Milk	Khitchri	Yogurt
Protein, g (% kcal)	2.0 (12)	3.3 (11)	3.1 (20)
Fat, g (% kcal)	3.6 (48)	3.1 (24)	4.0 (60)
Carbohydrate, g (% kcal)	6.6 (40)	19.0 (56)	4.0 (20)
Energy, kcal	67	118	60

TABLE 2. Patient Characteristics*

Characteristic	Group A (Soy)	Group B (KY)
No.	36	37
Age, mo†	12.2 ± 5.6	17.2 ± 8.1‡
Weight, kg†	6.5 ± 1.6	7.5 ± 1.8
MAC, cm†	11.6 ± 1.6	12.3 ± 1.6
SFT, mm†	5.0 ± 1.4	5.2 ± 1.4
Serum albumin, g/dL†	3.8 ± 0.7	4.1 ± 0.7
D-Xylose, mg/dL†	17.7 ± 10.2	14.2 ± 7.3
Nutritional status		
z Score†	−3.2 ± 1.1	−3.1 ± 1.4
Gomez classification, no. (%)		
Grade 0	...	2 (5)
Grade 1	4 (11)	3 (8)
Grade 2	18 (50)	21 (57)
Grade 3	14 (39)	11 (30)

* Abbreviations: KY, khitchri and yogurt; MAC, midarm circumference; SFT, skinfold thickness.
† Values are mean ± SD.
‡ $P < .05$, Student's t test.

similar except that children in group B were older than the children in group A (17.2 ± 8.1 vs 12.2 ± 5.6 months, mean ± SD, $P < .05$). However, there were no significant differences between the groups in degree of malnutrition, severity of diarrhea at presentation, or degree of dehydration (Table 3). The children were fed by mouth ad libitum; only 2 children required brief periods of nasogastric feeding. The mean daily intake of oral rehydration salts represented only a fraction of the daily maintenance fluid requirements for both groups during the first seven days of the study (A: 191 ± 486 [median: 14] vs B: 20 ± 42 [median: 0] mL/d, $P < .05$).

The caloric intake for the two groups was comparable during the first week: A = 110 ± 30 vs B = 107 ± 26 kcal/kg per day (Table 4). Group B, however, had lower stool volume and frequency and significantly greater weight gain. With the addition of khitchri and yogurt in the second week to group A patients, there was a significant increase in weight gain in comparison with week 1 ($P < .001$, Table 4). Because of the skew in some of the variables, nonparametric statistical analysis was also used to evaluate the data. The Wilcoxon rank sum test gave levels of statistical significance similar to those obtained by using the Student's t test for all of the outcome variables including weight gain, which had the largest range of values. The only discrepancy in the two tests was seen in evaluating the stool frequency in the second week of therapy. The difference was significant by the Student's t test but not by the Wilcoxon rank sum test.

Excluding the clinical failures and using our criteria for cessation of diarrhea, 8 (26%) of 31 children in group A continued to have diarrhea throughout the course of therapy compared with 5 (14%) of 35 in group B. Children in group B also recovered significantly faster than those in group A (4 ± 3 vs 6 ± 4 days, mean ± SD, $P < .02$).

Because the mean age of group A children was less than that of group B children and as all of the failures were 15 months of age or younger, the major outcome variables were compared for the children in the two study groups in this age category (Table 5). The pattern of caloric intake, weight gain, and stool frequency and volume was similar to the pattern for the whole group.

The major outcome variables were further analyzed to study the effect of the diets on children with varying severity of diarrhea at presentation. There was no significant difference between the two groups for stool volume and frequency during the course of the study in children with severe diarrhea at presentation (defined as stool output >10 g/kg in the initial 4-hour observation period). The trend of weight changes in the two groups was similar in the first (group A: n = 14, 21 ± 341 vs group B: n = 11, 393 ± 368 g/kg per week, $P < .02$) and second weeks (A: 549 ± 317 vs 307 ± 257 g/kg per week, $P < .05$). A comparison of the children with mild to moderate diarrhea at presentation yielded similar results for diarrheal outcome and weight gain.

To assess the effect, if any, of nutritional status on tolerance and response to the study diets, we analyzed the results according to the degree of malnutrition at presentation graded by the Gomez criteria. Table 6 compares the effect of dietary therapy in children with grade II and III malnutrition. Children with grade III malnutrition not only tolerated the diet but also demonstrated weight gain similar to that of the group as a whole during the first week. The same phenomenon was observed in

TABLE 3. Severity of Diarrhea and Dehydration at Presentation*

	Group A (Soy)	Group B (KY)
Duration, d†	42.9 ± 34.7	48.6 ± 35.6
Stool frequency, no./d†	9.2 ± 4.6	9.7 ± 4.5
Initial observation (4 h)		
Stool volume, g/kg†	8.8 ± 8.1	6.9 ± 9.5
Stool frequency, no.†	1.4 ± 1.1	1.1 ± 1.0
Stool character, no. (% of patients)		
Watery	23 (74)	22 (63)
Mucoid	6 (19)	12 (34)
Semiloose	2 (7)	1 (3)
Degree of dehydration, no. (% of patients)		
None	16 (52)	22 (63)
Mild	9 (29)	9 (26)
Moderate	6 (19)	4 (12)
Severe	...	...

* Differences between group A and group B are not statistically significant. KY, khitchri and yogurt.

† Values are mean ± SD.

TABLE 4. Comparison of Outcome Variables in Study Groups for Patients Completing Protocol*

Outcome Variable	Group A (Soy)	Group B (KY)	P Value
No.	31	35	
Caloric intake, kcal/kg/d			
Week 1	110.5 ± 29.9	107.4 ± 26	NS
	[107.8 (70.3 to 232.4)]	[105 (64.1 to 187.2)]	NS
Week 2	131.5 ± 26.2	118.8 ± 27.2	NS
	[129.3 (92.5 to 205.3)]	[118.3 (51.4 to 183.8)]	NS
Stool volume, g/kg/d			
Week 1	63.8 ± 74.9	38.3 ± 16.5	<.05†
	[45.7 (17.6 to 445.8)]	[36.3 (11.9 to 85.1)]	<.05‡
Week 2	46.5 ± 33.1	37.3 ± 19.3	NS
	[38.1 (15.0 to 206.0)]	[31.6 (8.5 to 79.2)]	NS
Stool frequency, no./d			
Week 1	6.6 ± 4.2	4.4 ± 2.0	<.005†
	[5.9 (2.4 to 24.4)]	[4.1 (1.4 to 8.6)]	<.01‡
Week 2	4.9 ± 2.5	3.7 ± 1.7	<.025†
	[4.3 (2.0 to 12.4)]	[3.6 (1.3 to 8.6)]	NS
Weight gain, g/wk			
Week 1	67.7 ± 285.7	467.7 ± 373.1	<.005†
	[150 (−750 to 540)]	[400 (−150 to 1360)]	<.001‡
Week 2	574.8 ± 408.3	189.1 ± 307.1	<.005†
	[450 (40 to 1740)]	[200 (−640 to 670)]	<.001‡

* Values are mean ± SD [median (range)]. KY, khitchri and yogurt, NS, not significant.
† Student's *t* test.
‡ Wilcoxon rank sum test.

TABLE 5. Comparison of Outcome Variables in Children ≤ 15 Months Old (Mean ± SD)*

Outcome Variable	Group A (Soy)	Group B (KY)	P Value†
No.	25	19	
Caloric intake, kcal/kg/d			
Week 1	113.6 ± 30.8	106.1 ± 19.1	NS
Week 2	133.0 ± 27.1	124.4 ± 24.6	NS
Stool volume, g/kg/d			
Week 1	70.6 ± 82.1	46.8 ± 16.5	NS
Week 2	48.9 ± 36.6	47.0 ± 17.8	NS
Stool frequency, no./d			
Week 1	6.9 ± 4.5	4.9 ± 2.2	NS
Week 2	5.0 ± 2.7	4.4 ± 1.8	NS
Weight gain, g/wk			
Week 1	80.8 ± 287.1	345.3 ± 248.6	<.005
Week 2	562.0 ± 392.6	235.3 ± 255.9	<.005

* Abbreviations: KY, khitchri and yogurt; NS, not significant.
† Student's *t* test.

group A patients after the addition of khitchri and yogurt to the diet on day 8.

To evaluate the possible effect of the retention of dietary fiber in the bowel on weight gain, we compared the rate of weight gain on the first 3 days on the khitchri and yogurt diet with the rate of weight gain for the subsequent days on the diet. The mean weight gain for the group B children in the first 3 days on the khitchri and yogurt diet was substantially greater than that during the following 11 days (13.1 ± 24.8 g/kg per day vs 3.1 ± 21.1 g/kg per day). However, the weight gain for the first 3 days of the khitchri and yogurt diet in the soy-fed group was similar to that during the next 4 days (11.7 ± 22.0 g/kg per day vs 11.4 ± 19.8 g/kg per day).

The nutritional impact of the enteral dietary therapy was quite striking. The mean *z* scores on admission were −3.1 ± 1.1 for group A and −3.1 ± 1.3 for group B. At the completion of the study, the mean *z* scores had increased by 19% in group A and 16% in group B, with the greatest change occurring in the week after introducing the khitchri and yogurt diet. Despite the relatively short study period, both groups showed some improvement in anthropometric measurements paralleling the changes in

TABLE 6. Comparison of Groups According to Modified Gomez Criteria for Malnutrition (Mean ± SD)*

	Group A (Soy)	Group B (KY)	P Value†
No.			
Grade II	14	20	
Grade III	13	10	
Caloric intake, kcal/kg/d			
Week 1			
Grade II	104.4 ± 20.4	107.3 ± 24.1	NS
Grade III	123.4 ± 43.1	114.5 ± 33.4	NS
Week 2			
Grade II	113.1 ± 16.8	116.3 ± 24.8	NS
Grade III	151.1 ± 23.7	130.4 ± 35.0	NS
Stool volume, g/kg/d			
Week 1			
Grade II	41.8 ± 14.3	36.3 ± 15.9	NS
Grade III	93.7 ± 109.5	42.7 ± 20.0	NS
Week 2			
Grade II	36.3 ± 12.1	31.5 ± 15.2	NS
Grade III	58.1 ± 49.2	45.4 ± 24.4	NS
Stool frequency, no./d			
Week 1			
Grade II	5.9 ± 2.7	4.6 ± 2.3	NS
Grade III	8.0 ± 6.4	4.1 ± 1.7	<.05
Week 2			
Grade II	4.6 ± 2.0	3.6 ± 1.8	NS
Grade III	4.7 ± 2.8	4.0 ± 1.8	NS
Weight gain, g/wk			
Week 1			
Grade II	70.0 ± 338.3	486.0 ± 327.1	<.005
Grade III	82.5 ± 178.8	584.4 ± 491.8	<.01
Week 2			
Grade II	436.7 ± 316.5	179.5 ± 287.6	<.025
Grade III	694.2 ± 510.8	291.0 ± 375.5	<.05

* Abbreviations: KY, khitchri and yogurt; NS, not significant.
† Student's *t* test.

weight. The mean change in midtriceps skinfold thickness was significantly greater for group B patients in the first week (A = 0.0 ± 0.6 vs B = 0.3 ± 0.6 mm/wk, $P < .05$), while the values for the second week were comparable (A = 0.5 ± 0.6, B = 0.3 ± 0.4 mm/wk), respectively. The midarm circumference increment in the group A children was significantly higher after the addition of khitchri and yogurt (0.5 ± 0.1 vs 0.0 ± 0.1 cm/wk, mean ± SD, $P < .01$). No clinical evidence of edema was found in any of the patients.

The mean serum albumin values for both groups were normal (Table 2) and did not change during the course of the study. Stool microscopy identified a similar low frequency of *Giardia* infections in both groups. The mean stool pH for both groups was 6.0 throughout the study. There was no significant change for the initial mean D-xylose values within the two groups over the course of the study.

There were seven clinical failures, five in group A and two in group B (Table 7). All the failures occurred in children aged 15 months or younger and the majority (6/7) occurred within the first 8 days of the study. Most of the failures were associated with high purging rates, with the exception of one child in group B who lost weight progressively without dehydrating diarrhea. The mean stool frequency of the failures was significantly higher than that of the successfully treated children in the first week (10 ± 6 vs 5 ± 3 per day, $P < .05$), but the difference in stool volume was not significant (112 ± 100 vs 50 ± 54 g/kg per day). There were no deaths in the study group during the course of the study.

DISCUSSION

Our study revealed that a locally available and culturally acceptable rice-based diet was at least as effective as soy formula used alone in treating PD. Greater improvements in weight gain and stool volume and frequency were found in the khitchri diet group than in the soy formula-fed group.

Several limitations should be considered in reviewing the data. Because of patients leaving the study for illness or family reasons, the randomiza-

TABLE 7. Clinical Failures

Variables	Patient Identification Nos						
	Group A (Soy)					Group B (KY)*	
	34	40	50	84	1	83	101
Age, mo	15	11	12	8	8	8	14
Weight, kg	7.2	6.9	5.0	5.0	7.0	4.9	7.0
Nutritional grade (Gomez)	2	2	3	2	2	3	2
Duration of study, d	8	4	7	8	3	8	11
Mean caloric intake, kcal/kg/d	105.3	47.9	114.4	137.3	99.0	116.7	88.1
Mean stool volume, g/kg/d	60.5	88.1	129.5	64.0	328.1	83.3	31.1
Mean stool frequency, no./d	6.4	14.2	9.9	4.1	20.5	4.6	7.3
Weight loss, %	8.6	2.9	8.4	6.0	7.6	1.0	4.0

* Khitchri and yogurt.

tion process was not ideal, and the mean age in group A was younger than in group B. However, the dietary intake and feeding practices of children at this age are very similar[24] and there were no significant differences in the two groups regarding historical, clinical, or laboratory presentation (Tables 2 and 3). The majority (67%) of children in the study were younger than 15 months old and similar differences in weight gain, stool volume, and frequency were seen in this important subgroup.

The size of the study and the imperfect randomization process may have played a role in the skewed distribution of some of the outcome variables. However, testing by both parametric and nonparametric methods gave similar levels of statistical significance in almost all cases.

Another important limitation is that stool cultures for bacterial pathogens were not available for the study groups. It is conceivable that certain etiological agents, particularly Shigella, can have a bearing on the tolerance of feeding during diarrhea. However, our study groups were comparable for severity of diarrhea at presentation and initial assessment, and none of our study children had bloody mucoid stools at admission.

Our study is consistent with previous studies in children with acute diarrhea, which have demonstrated the potential efficacy of enteral nutritional therapy.[25,26] The mean weight gain of 9 to 11 g/kg per day seen in our study during the recovery phase on about 125 kcal/kg per day is proportional to the rate of growth previously reported in malnourished children receiving 160 to 180 cal/kg per day) during nutritional rehabilitation.[27] Our results are consonant with the findings of Brown et al,[26] who found that weight gain can occur in acute diarrhea when the stooling rate ranges from 30 to 70 g/kg per day. These data differ from the results reported by Mann et al,[28] who suggested that enteral nutrition may not be possible with stool volumes exceeding 30 g/kg per day.

Although soy protein-based diets are the standard of treatment PD in Pakistan, soy protein intolerance has been reported in children with PD[29] and may have influenced the greater stool output in the group A patients. Rice, the predominant component of the khitchri diet, is easily tolerated by children and has rarely been associated with allergy.[13,30] In addition, the hydrolysis of the starch and protein in the khitchri diet provides cotransport molecules which may improve mucosal ion transport[13] and a greater reduction in stool volume. The rice and lentil carbohydrate and protein may also aid intestinal mucosal repair mechanisms.[31]

The dramatic improvement in *z* scores supports the role of enteral nutritional therapy for PD. Some of this weight gain may be related to retention of dietary fiber in the bowel (Brown K and MacLean W C, unpublished observations). Although increased weight of luminal contents may account for some of the weight gain associated with the khitchri and yogurt diet, we also noted modest increases in skinfold thickness and midarm circumference measurements consistent with increased body mass.

The observation of a slowing of weight gain in group B during the second week despite the continued caloric intake of about 120 cal/kg per day is intriguing. The data from this study do not provide a clear explanation for this finding. It is possible that after the rapid improvement in nutritional status over the first week, the mean weight gain of 27 g/d for group B may represent the normalization of growth velocity. Certainly, the caloric difference of about 10 cal/kg per day between the two groups

is not sufficient to account for the marked difference in weight gain. The striking improvement with the addition of the khitchri and yogurt diet to the soy formula may have occurred because of a combination of factors. In addition to those previously discussed, the addition of lactose to soy has been reported to have a beneficial effect in treating children with PD.[32]

There is no consensus about what constitutes the most suitable diet in PD. The challenge for the developing world is to identify dietary therapy suitable for use at a community level which should preferably be home based and culturally acceptable. Cereals including rice, wheat, sorghum, and maize are a staple diet in many parts of the developing world and offer a readily available source of nutritional rehabilitation diets in children. In many parts of the developing world, like Pakistan, local perceptions and traditional remedies are a major influence on the management of diarrhea in the community.[33] There are, therefore, obvious advantages to using a traditional, acceptable home-based diet for therapy. Economic considerations are also of major importance. The weekly cost of soy formulas, the majority of which need to be imported, for an average 5-kg child is about $14.00, compared with a mere $2.00 for a week's supply of khitchri and yogurt. These savings, when multiplied by the many episodes of PD each year in Pakistan, could result in immense savings. Our study indicates that an inexpensive traditional diet can safely and effectively treat children with PD.

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Nutritional management of persistent diarrhea: factors predicting clinical outcome

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In a prospective study we randomized 102 male children (age 6–36 months) with persistent diarrhea to receive a traditional rice-lentil (Khichri) diet and yogurt (K-Y) or a soy formula (alone for seven days and then in combination with K-Y for seven days). Of 73 children satisfying the study criteria, 66 were successfully treated and there were 7 treatment failures. There was poor concordance between parental accounts of severity of diarrhea or vomiting and that observed after admission. Significant risk factors associated with treatment failure included younger age ($p < 0.005$) and vomiting at presentation ($p < 0.02$). The greatest number of risk factors associated with delayed recovery (> 10 days) were identified during an initial evaluation period (the first 8 h after admission). These included greater severity of watery diarrhoea ($p < 0.01$) and increased ORS intake ($p < 0.02$). Our data suggest that an initial evaluation period, including objective observations, may identify children with persistent diarrhea who are at greatest need of hospitalization. □ *Persistent diarrhoea, dietary therapy, clinical outcome*

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The close relationship between persistent diarrhea and malnutrition has been demonstrated by a number of studies (1, 2) and in developing countries the two conditions almost universally coexist. Although the optimal form of nutritional therapy of persistent diarrhea remains uncertain, prompt and effective nutritional management is crucial for successful management of this disorder (3, 4).

Although parenteral nutrition has been widely used in the developed world in the management of persistent diarrhea (5), the enteral route may be superior (6). A variety of enteral diets have been proposed to treat persistent diarrhea including comminuted chicken (7), elemental formulae (8) and cows' milk protein and lactose-free formulae (9). The harsh economic realities in much of the developing world, however, dictate the need for an inexpensive, culturally acceptable and effective form of dietary therapy, which may also be suitable for use at the community level.

Since persistent diarrhea is thought to be a heterogeneous disorder (4), it is as yet unclear how effective local diets may be in its treatment. To date, accurate predictors of successful therapy or the need for hospitalization for children on these diets have not been identified. Such guidelines, which could identify children in need of special attention, would be of critical importance to diarrheal disease control programs in developing countries in helping them utilize their limited resources.

A number of risk factors for mortality in childhood diarrhea have been identified (10–12), but little is known about factors determining the success or failure of dietary therapy of persistent diarrhea. Two recent studies of persistent diarrhea were unable to identify clinical or histologic predictors of successful therapy (13, 14). Some of the difficulty in identifying risk factors of persistent diarrhea is related to the fact that persistent diarrhea is a heterogeneous disorder and that a variety of methodologies have been used to try to define it (15, 16).

To provide data on risk factors associated with successful outcome and early recovery from persistent diarrhea in children treated with an inexpensive, culturally acceptable diet, we evaluated historical information, admission clinical and laboratory characteristics, and data obtained from the first 8 h of hospitalization.

Materials and methods

Details of dietary composition, methodology and patient selection of the study have been described elsewhere (17). In summary, this was a collaborative

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study between the Aga Khan University Hospital, the National Institute of Child Health (NICH, Karachi) and the Combined Program in Pediatric Gastroenterology and Nutrition, Harvard Medical School (Boston).

Weaned male children (age 6–36 months) with persistent diarrhea (diarrhea lasting ≥ 2 weeks) were identified from the outpatient services at NICH for inclusion in the study. Patients with hyperpyrexia (> 39°C), severe malnutrition (weight-for-age < 50th centile of corresponding median NCHS standard) and those with peripheral edema, were excluded from the study. After a detailed history and informed consent were obtained from the parents, the children were randomly allocated to receive one of two diets. Group A was fed a soy formula (Nutrisoja, Nutrinica, Holland) alone for the first seven days followed by a combination of soy formula and Khichri and yogurt (K–Y diet) in equal amounts for the next seven days. Group B received K–Y alone in a 60:40 ratio daily for 14 days. Nutritional therapy was begun as soon as rehydration was accomplished.

Khichri of uniform composition was prepared in bulk and frozen in aliquots for distribution. Yogurt of stable and uniform composition was obtained from a single commercial source (Fine Dairy Products, Karachi). Feeds in both groups were advanced gradually to provide a minimum of 100 Cal/kg/day by day 4 of the study. All drugs were stopped prior to study initiation, and clinical dehydration, if any, was corrected using WHO oral rehydration solution. The patients were admitted for the course of the study to a research ward and accurate measurements of food and fluid intake, urine output, emesis and stool output were obtained. Daily nude weight and weekly anthropometric measurements were obtained. The growth quotient for the duration of the study was calculated according to the method of Ellerstein and Ostrov (18) as follows:

$$\frac{\text{Discharge weight} - \text{lowest weight}/\text{days from weight gain to discharge}}{\text{Normal mean daily weight gain for age}}$$

Weight gain was described as steady weight increase for ≥ 72 h and the denominator was calculated from the 5th centile of the NCHS standards (19).

Stool specimens were examined microscopically daily for the presence of ova, parasites, pus cells or red cells. Blood specimens were obtained at admission and on day 14 for a complete blood count and serum albumin estimation. One hour serum d-xylose was estimated at initiation and end of study after a 6 h fast using the method of Roe and Rice (20).

Cessation of diarrhea was defined as the achievement of semisolid stool consistency, a stool frequency of ≤ 3 per day and a stool volume of ≤ 30 g/kg/day. Clinical failure of dietary therapy was defined as persistence of diarrhea with inability to maintain hydration by the oral route, and/or weight loss for ≥ 3 consecutive days after achieving a caloric target of 100 cal/kg/day.

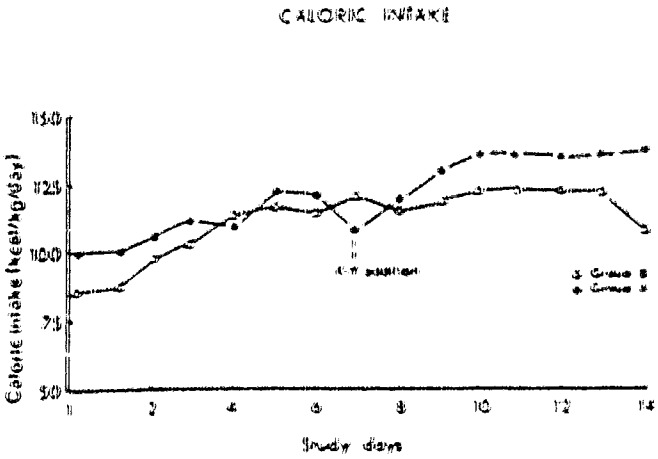

Fig. 1. Comparison of mean daily caloric intake of both groups for the duration of the study (● = group A, △ = group B). Values are significantly different ($p < 0.05$) on days 1, 12 and 14.

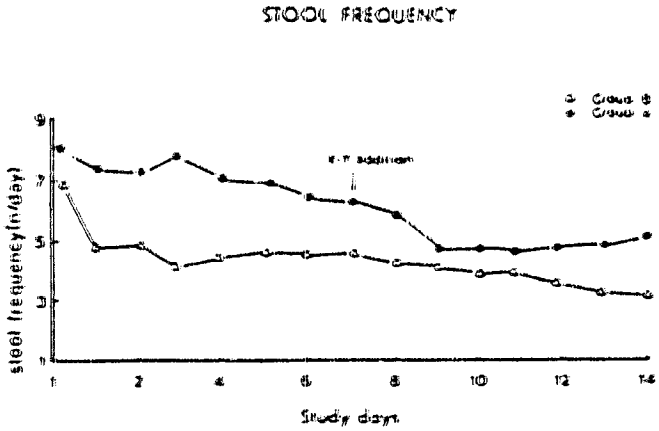

Fig. 2. Comparison of mean daily stool frequency of both groups for the duration of the study (● = group A, △ = group B).

The first 8 h after admission were chosen as an initial evaluation period to determine whether early objective observations of clinical or laboratory factors could predict outcome. During this period, the patients were rehydrated and began dietary therapy.

Data from the study were analyzed for difference between means by the two tailed Student's *t*-test. Difference between proportions was analyzed by chi square analysis with Yates correction.

Results

Clinical details of the study groups and outcome have been described in detail previously (17). Briefly, of the 102 children randomized for the study, 29 did not complete the study because of intercurrent infections

Table 1. Comparison of historical data and admission characteristics of outcomes and failures of dietary therapy. Mean ± SD and n (%)

Indices	Successfully treated	Clinical failures	p value
Number	66 (90)*	7 (10)	
Age (months)	15.1 ± 7.6	10.9 ± 3.0	< 0.001
Z-score (wt for age)	−3.1 ± 1.3	−3.5 ± 1.0	NS
Weight for length (%)	80.4 ± 10.6	80.3 ± 4.3	NS
D-xylose	15.9 ± 8.9	12.6 ± 6.4	NS
Hemoglobin (g/dl)	9.6 ± 2.0	10.5 ± 1.4	NS
Albumin (g/dl)	3.9 ± 0.7	3.7 ± 0.8	NS
Historical data			
Diarrhea duration (days)	72.0 ± 101.0	95.0 ± 104.6	NS
Stool frequency (n/day)	9.4 ± 4.5	11.4 ± 6.1	NS
Vomiting	25 (38)	4 (57)	NS
History of dysenteric stools	12 (18)	3 (43)	NS
Observed stool output (first 8 h)			
Stool volume (g/kg)	14.4 ± 13.0	31.2 ± 28.9	NS
Stool frequency (n)	1.9 ± 1.6	3.3 ± 2.7	NS
Stool character			
Watery	43 (65)	6 (86)	NS
Mucoid	20 (30)	1 (14)	NS
Semisolid	3 (5)	—	NS
Fecal white cells > 10/hpf	11 (17)	3 (43)	NS
Fecal red blood cells > 10/hpf	8 (12)	1 (14)	NS
Vomiting (n)	0.2 ± 0.6	2.3 ± 2.1	< 0.001
ORS Intake (ml/kg)	26.0 ± 32.3	34.2 ± 71.8	NS

* Numbers in parentheses are percentages.

Table 2. Characteristics of children successfully treated for persistent diarrhea (n = 66). Mean ± SD and n (%)

Indices	Recovery from diarrhea: Early recovery < 10 days n = 43	Delayed recovery > 10 days n = 23	p value
Age (months)	16.8 ± 7.9	11.5 ± 5.0	< 0.001
Z-score (wt for age)	−3.1 ± 1.3	−3.3 ± 1.3	NS
Weight for length (%)	81.8 ± 10.8	77.3 ± 9.9	0.05
D-xylose	15.4 ± 8.6	17.0 ± 9.6	NS
Hemoglobin (g/dl)	9.1 ± 1.8	10.8 ± 1.9	< 0.001
Albumin (g/dl)	4.0 ± 0.6	3.7 ± 0.9	NS
Historical data			
Diarrhea duration (days)	87.2 ± 116.9	50.7 ± 67.8	NS
Stool frequency (n/day)	9.6 ± 4.4	10.4 ± 4.7	NS
Vomiting	20 (47)*	9 (43)	NS
History of dysenteric stools	9 (20)	6 (29)	NS
Observed stool output (first 8 h)			
Stool volume (g/kg)	11.2 ± 12.2	21.8 ± 12.0	< 0.01
Stool frequency (n)	1.6 ± 1.3	2.8 ± 1.8	< 0.01
Stool character			
Watery	24 (55)	19 (90)	< 0.01
Mucoid	19 (42)	1 (5)	NS
Semisolid	2 (5)	1 (5)	NS
Fecal white cells > 10/hpf	7 (16)	4 (19)	NS
Fecal red cells > 10/hpf	7 (16)	2 (10)	NS
Vomiting (n)	0.1 ± 0.6	0.2 ± 0.5	NS
ORS Intake (ml/kg)	14.7 ± 35.9	55.8 ± 73.9	< 0.02

* Numbers in parentheses are percentages.

(n = 13) or the decision of the family to leave the study before completion (n = 16). Of the 73 children who completed the study, 66 were treated successfully and 7 (10%) were treatment failures. Fig. 1 shows the similar mean daily caloric intakes for the two study groups. With the addition of K-Y to soy milk in group A, the caloric intake improved further. Administration of the K-Y diet, either singly or in combination with soy formula, was associated with correspondingly lower stool output (Fig. 2). This was also associated with comparably greater weight gain among the children for the corresponding periods. However, the overall growth quotient for the two groups over the study period was similar (group A 8.8 ± 6.5 versus 8.6 ± 6.7 in group B).

To evaluate the accuracy of the parental history in accurately predicting the initial severity of diarrhea, data on stool volume, character, frequency and vomiting in the first 8 h after admission were analyzed. Little concordance was found between the parenteral description of the severity of diarrhea and stool volume and frequency observed. The stool frequency was less than one-third that expected from the parental history (r = 0.3, p = NS). Almost all parents (92%) described watery stools while 49 children (67%) actually had watery stools. Although 29 children were reported to have vomiting, only 12 were observed doing so in the 8 h after admission.

Table 1 compares the historical information, admission clinical and laboratory characteristics and data from the first 8 h after admission of the children who succeeded and failed the dietary therapy. No significant difference was found in the histories between the two groups for duration and frequency of diarrhea, history of blood in stools or vomiting.

Only two admission characteristics, mean age and presence of vomiting in the first 8 h, correlated with failure. Although the differences did not reach statistical significance, the children who subsequently failed dietary therapy tended to have a higher initial stool output and a greater proportion had watery stools. Stool microscopic evidence of the presence of red or white cells was no different between the groups. Although a similar number of children in both groups had mild upper respiratory infections, (none of which required antibiotic therapy), a greater proportion of treatment failures had fever ranging from 38 to 39°C during the course of the illnesses (71% versus 18%, $\chi^2 = 7.8$, $p < 0.05$).

Data from the children successfully treated were further analyzed to evaluate possible predictors associated with early or late recovery from diarrhea (Table 2). Twenty-seven (41%) children recovered in the first week and an additional 18 had recovered by day 10. Children with delayed recovery differed significantly

from those recovering early in being younger and in having a greater degree of malnutrition and initial stool output and frequency. Although no significant difference was found between the two groups for the degree of dehydration at admission, children with delayed recovery took a greater amount of ORS initially ($p < 0.02$).

Discussion

The success of dietary therapy with a traditional and inexpensive diet in nearly 90% of our children with persistent diarrhea is extremely encouraging, and indicates that this type of diet may have an important impact on nutritional rehabilitation of persistent diarrhea and malnutrition in the community (21). This is particularly important in Pakistan where persistent diarrhea is a common problem and there are limited resources for hospital management of such children.

These data also suggest that certain subgroups of children with persistent diarrhea may be identified who are at increased risk for poor outcome of therapy. Significant risk factors for failure and delayed recovery included younger age and vomiting during the first 8 h after admission. These factors have also been associated with increased failure rates in studies from Africa (9) and Brazil (22). Additional factors which predicted delayed recovery included greater degree of malnutrition, fever and passage of watery stools, greater stool frequency and volume and greater ORS intake during the observation period.

As of yet, no other data on risk factors associated with nutritional therapy using culturally acceptable diets are available. However, earlier studies of nutritional therapy for diarrhea have also indicated that malnutrition, fever, and initial severity of stooling may be linked to poorer outcome (9, 22–29). If these findings are substantiated by other studies, a clinical assessment profile may be developed which could help guide health care workers to identify children who require more supervised therapy or hospitalization.

The initial evaluation period proved to be extremely helpful in identifying children who did not tolerate therapy as well. We chose the first 8 h after admission for this period since the effect of dietary intervention should have been smallest during that time. The majority of the predictors of treatment failure or prolonged diarrhea were found during this evaluation period. If this finding is substantiated in other studies, an initial evaluation period may identify those children in greatest need of limited hospital facilities. Future studies are needed to determine whether a shorter period of objective observation may provide similar information.

Further evidence of the importance of this period was the fact that we found no clinically significant risk factors when evaluating parental history or the initial laboratory studies. As others have reported (23), we found a poor concordance between the parental accounts of severity and what was actually observed.

In summary, a traditional rice-lentil (Khichri) and yogurt diet may have considerable potential for household management of persistent diarrhea. Of the various clinical characteristics, younger age, poorer nutritional status, fever, severe watery diarrhea and vomiting were associated with a higher rate of treatment failure or delayed cessation of diarrhea. Our data suggest a poor correlation between parental accounts and observed severity of diarrhea and support the potential use of an initial evaluation period in identifying children at a higher risk of treatment failure.

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Role of cereal-based oral rehydration therapy in persistent diarrhoea in children

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A total of 2000 children aged under five and 12,500 diarrhoea episodes were studied prospectively for assessing the efficacies of R-ORS and G-ORS and for comparing them with that of a comparison area using drugs for treatment. Efficacy was evaluated in terms of ORS use rate, consumption of ORS per episode, duration of diarrhoea and rate of recovery. The data were analysed to compare the rate of persistent diarrhoea in the three areas. Mean ORS consumption was 946 ± 576 and 1236 ± 766 ml per episode of watery diarrhoea in the R-ORS and G-ORS areas respectively. The mean durations of watery diarrhoea were 3.3 ± 2.1, 5.4 ± 3.5 and 8.8 ± 5.5 days in the R-ORS, G-ORS and comparison area, respectively. The median durations for dysentery were 7, 9 and 12 days in the three areas respectively. The incidences of persistent diarrhoea following watery diarrhoea were 0.4, 3 and 12% in the R-ORS, G-ORS and comparison area respectively, and, following dysenteric episodes, 8, 18 and 40%. The results of the study suggest that R-ORS can hasten recovery from both watery diarrhoea and dysenteries, thus reducing the incidence of persistent diarrhoea. ☐ *Cumulative recovery rate, persistent diarrhoea, R-ORS, G-ORS*

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Diarrhoeal disease causes about 5 billion episodes every year with about 4 million deaths annually (1). Most of the deaths occur in the developing countries (2). Use of oral rehydration therapy has substantially reduced mortality from acute diarrhoea and dehydration. Most of the deaths due to diarrhoea are through complications resulting from the illness. A substantial percentage is also due to diarrhoeal episodes lasting for a prolonged period precipitating persistent diarrhoea and its nutritional consequences (3, 5). The cause and mechanisms of persistent diarrhoea are not yet clearly defined. While prospective research is under way, and may take some time, its management, particularly nutritional management, continues to baffle the pediatricians of developing countries. As there is no definite cause and no therapy in sight, one has to explore all possible ways of finding an alternative means of treatment or even prevention if possible for this condition.

We have analysed our data from a large, prospective field-based community study on rice-based oral rehydration therapy in rural Bangladesh and attempted to find out if rice-based oral rehydration therapy is likely to have a positive role in reducing the incidence of persistent diarrhoea. This was inspired by the impact of rice ORS in reducing the duration, frequency and stool volume, as has been observed in the past clinical and field studies (6–8).

Materials and methods

For studying the efficacy and nutritional consequences of the rice-based oral rehydration therapy, three villages in rural Bangladesh each with 600–700 children of less than five years, matched for socioeconomic variables like maternal education, morbidity, nutritional status, etc., were included in a two-year longitudinal study. One area received packets of standard glucose based ORS (G-ORS), another received packets of rice ORS (R-ORS) and a third area served as a comparison area where no ORS was distributed from the study source. Village mothers selected on the basis of predetermined criteria served as depot holders for the ORS packets. Mothers and depot holders were trained through practical demonstrations about the preparation and use of R-ORS and G-ORS in the respective study areas. The details of the preparation of R-ORS are published elsewhere (9). The comparison area was advised to continue with its practice of home ORT, available ORS packets from government sources and current practice of drug treatment for diarrhoea as decided by the families. Dietary and nutritional advice were similar in all three areas and consisted of continuation of pre-diarrhoeal feeds, including breast milk. Children's feeds consisted of mother's milk and diluted cows' milk for younger infants. For older children a local diet prepared

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with rise and lentils was made soft and served three to four times in a day. Families were advised to provide additional feeds after recovery, the amount depending on the demand by the child. No monitoring of the dietary intake was conducted. A team of health workers visited each household every week. In the case of diarrhoea a daily visit was paid until recovery. Nutritional effect of the ORT used in different treatment cells was measured by anthropometric measurements like weight and height every three months. The volume of ORS consumed was recorded daily and the duration of illness recorded according to defined criteria

The definition of watery diarrhoea was based on the passing of at least three liquid stools in 24 h. Stools of liquid or semi-liquid consistency mixed with blood and/or mucus were defined as dysenteries. Both these definitions were based on descriptions provided by the mothers. No microbiological examinations were undertaken because of practical difficulties. The drugs used for the treatment of diarrhoea consisted mainly of ampicillin, trimethoprim co-trimoxazole and metronidazole. These were obtained from non-study sources by initiatives of the families themselves. Cessation of diarrhoea was defined as the passage of two soft stools or no stools in 12 h. Episodes separated by two days of normal stools were counted as separate episodes of diarrhoea.

Results

Table 1 presents the population status and incidence of both watery diarrhoea and dysenteric episodes. The incidence of overall diarrhoeal episodes or of watery diarrhoeas and dysenteric episodes is similar in all three areas. Table 2 presents the use pattern of treatment regimens in the three cells. Use rates of ORS were 70% and 60% in the R-ORS and G-ORS areas respectively. Comparison areas used more drugs in both watery diarrhoea and in dysenteries. Dysenteric episodes used more drugs compared to watery diarrhoeas. R-ORS areas used comparatively fewer drugs and more ORS. The ORS consumption per episode of watery and dysenteric diarrhoeas is presented in Table 3. The volume of ORS consumption per episode was substantially less in the R-ORS area. ORS consumed in the comparison area was very low and thus not shown in the

Table 1. Incidence of diarrhoea during two years of study.

Types of diarrhoea	R-ORS (%)	G-ORS (%)	Comparison (%)
Total diarrhoea episode	3871 (100)	3740 (100)	4883 (100)
Incidence/Child-year	3.3	3.8	3.4
Watery diarrhoea	2399 (62)	2405 (65)	3326 (68)
Dysentery	1472 (38)	1335 (35)	1557 (32)

Table 2. Use pattern of treatment regimens

Treatment regimens	R-ORS	G-ORS	Comparison
Watery diarrhoea	$n = 2399$	$n = 2405$	$n = 3326$
ORS only	70.8*	60.1*	5.6**
Drugs alone*	2.8[a]	7.5[a]	55
ORS – drugs†	18.7*	24.7[f]	10.1
*Others	2.6	0.2	0.5
Dysenteries	$n = 1472$	$n = 1335$	$n = 1557$
ORS only	12.0	13.7	1.7**
Drugs alone†	32.2[a]	45.4[a]	78.7
ORS – drugs†	30.6	39[i]	8
*Others	3	0.07	0.4

a vs b = $p \leq 0.0001$, c vs d = $p \leq 0.0001$, e vs f = $p \leq 0.0001$, g vs h = $p \leq 0.001$, i vs j = $p \leq 0.0001$

* Multiple combinations.

** Sugar-salt solution/molasses-salt from non-study sources.

† Drugs from non-study sources.

Table 3. Volume of ORS consumed per episodes of watery diarrhoea and dysenteries (mean ± SD).

	R-ORS			G-ORS		
Treatment	n	Mean	(SD)	n	Mean	(SD)
In watery diarrhoea						
ORS only (ml)	1687	946	(576)	1433	1236	(766)
ORS – drugs (ml)	444	1127	(754)	589	1597	(913)
In dysenteries						
ORS only (ml)	174	1140	(807)	178	1252	(897)
ORS – drugs (ml)	733	1187	(790)	512	1389	(972)

Table 4. Duration of diarrhoeal episodes using major treatment regimens.

		Duration of diarrhoea (days)	
Treatment regimens	n	Median	Mean ± SD
Watery diarrhoeas			
R-ORS only	1687	3[a]	3.3 ± 2.1
G-ORS only	1433	5[b]	5.4 ± 3.5
Drugs alone	1827	7[c]	8.8 ± 5.5
R-ORS – drugs	444	4[d]	4.7 ± 3.4
G-ORS – drugs	589	7[e]	8.2 ± 5.5
Dysenteries			
R-ORS only	174	7[f]	7.5 ± 4.8
G-ORS only	178	9[g]	10.2 ± 6.2
Drugs alone	1217	12[h]	14.0 ± 6.1
R-ORS – drugs	733	8[i]	9.0 ± 5.8
G-ORS – drugs	512	12[j]	14.0 ± 8.2

a vs b = $p \leq 0.0001$; b vs c = $p \leq 0.0001$; d vs e = $p \leq 0.0001$; f vs g = $p \leq 0.001$; i vs j = $p \leq 0.0001$.

Table 5 Cumulative rate of recovery (%) from different types of diarrhoea on days 3, 7, 14 and 21 treated by different regimens

Treatment	Cumulative rate of recovery on day			
	3	7	14	21
Watery diarrhoea				
R-ORS	66	96	99.6	99.9
G-ORS	30.5	78.9	97	99.0
Comparison	6	54.6	88	95.4
Dysentery				
R-ORS	18.5	61.2	91.6	97.9
G-ORS	7.1	42.1	81.1	94.0
Comparison	2.8	21.3	59.4	83.0

Table 6 Episodes of diarrhoea lasting longer than 14 days using different treatment regimens

Treatment regimens	Watery diarrhoea		Dysentery	
	n	%	n	%
R-ORS only	1687	0.4	174	8.4
G-ORS only	1433	2.9	178	18.6
R-ORS + drugs	444	2.5	733	11.5
G-ORS + drugs	589	11.4	512	38.5
Comparison area (drugs alone)	1827	12.5	1217	40.3

Table. Duration of both watery diarrhoeas and dysenteries is presented in Table 4. The median duration of all diarrhoeas in the R-ORS area compared to either the G-ORS or comparison area was significantly shorter. The cumulative rates of recovery from watery diarrhoea and dysenteries on days 3, 7, 14 and 21 in the treatment areas are presented in Table 5. It is clear that the percentage of patients recovered on days 3, 7, 14 and 21 was substantially higher in the R-ORS area compared to the G-ORS or comparison area.

This is true for both watery diarrhoea and dysenteries. For example, on day 7 of therapy, recovery rates of watery diarrhoea were 96, 79 and 54% in the R-ORS, G-ORS and comparison area, respectively. Recovery rates for the dysentery episodes on day 7 of therapy were 61, 42 and 21% in the R-ORS, G-ORS and comparison area, respectively. The differential recovery rate continued to the end of the third week beyond which survey was not continued. The incidence of prolonged diarrhoea (longer than 14 days) is presented in Table 6. Prolonged diarrhoea was more common in dysenteric episodes than in watery diarrhoeas. Among the R-ORS treated patients the dysenteric episodes lasting longer than 14 days were 8.4% compared to 18.6% in G-ORS area. The duration of dysenteries using a combination of ORS plus drug lasted for 11, 38 and 40 days in the R-ORS, G-ORS and comparison areas, respectively.

Discussion

Oral rehydration therapy has been able to reduce the mortality of diarrhoeal disease by 40–50% and hospital admission rate by 50% (10, 11). Yet the cost of unnecessary use of drug in the treatment of acute diarrhoea is due to the fact that the present ORS fails to reduce the magnitude of diarrhoea in terms of stool volume, frequency or duration. Therefore, search for a more efficient, less costly, easily available and accessible ORT continued and resulted in the development of cereal- or food-based ORT (12–14). The results of the clinical trials naturally inspired the use of this new generation of ORS in the field of Bangladesh (15) and later in Kenya (16). It was anticipated that the ability of cereal-based ORT to reduce the stool volume may hasten the recovery from diarrhoea in the field, which in the long run will reduce the incidence of persistent diarrhoea. This prospective study, involving three areas where R-ORS, G-ORS and no ORS were used, served this objective appropriately. The superior efficacy of R-ORS, as proved in the clinical studies, was also reflected in the field condition. Both watery diarrhoea and dysenteries were studied. Improved recovery rate or decreased duration of diarrhoea resulted in the substantially smaller number of prolonged diarrhoea in the R-ORS area. Even dysenteries which usually lead to incidence of prolonged diarrhoeas responded with similar improved results to R-ORS treatment.

It is known that about 5–20% acute diarrhoeas progress to prolonged episodes which last longer than two to three weeks. Comparison of the results of this study demonstrates that if treated by R-ORS alone, the incidence of watery diarrhoea lasting longer than 14 days can be brought down to a mere 0.4% compared to 12% when treated by drugs. In a country like Bangladesh, taking this figure as the basis, the estimated incidence of persistent diarrhoea can be brought down from an estimated 340 million to only 40 million, almost 10-fold reduction. Similarly, the results of this field study also clearly demonstrate for the first time that the incidence of persistent diarrhoea following dysenteries is substantially lower with ORS treatment than with drug treatment, R-ORS being the best.

Despite the extensive literature on the possible causes and mechanisms of persistent diarrhoea, clinical management of this condition remains a difficult problem. So far, no clear line of therapy, be it dietary or antimicrobial, is in sight. While the prospective research studies are continuing, a simple, available and affordable therapy and above all one capable of reducing the incidence of persistent diarrhoea may continue to play a positive and contributory role. Having an effective

therapy at hand, it may not be ethical to allow such colossal numbers of child lives to perish, while health planners and researchers are sorting out their differences (17).

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NUTRITIONAL STUDIES

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Feeding Practices for Young Pakistani Children: Usual Diet and Diet During Diarrhoea

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Abstract

Diarrhoea is among the foremost disorders responsible for high mortality and morbidity in children of third world countries. In addition, improper feeding during diarrhoea leads to a vicious cycle of frequent episodes of diarrhoea and malnutrition in these children. In this study 595 households (200 urban and 395 rural) with 741 children who met the age criteria of 36 months or less were randomly selected for assessing the feeding practices during diarrhoea. Out of these, 276 (37%) were infants and 465 (63%) were toddlers. The majority of both breastfed and non breastfed children were also receiving solids and liquid foods. Animal milk was used by 89% of non - breastfed children. Forty six percent of breastfed and 78% of non - breastfed children were given "Khitchri" (rice cooked with lentils) as a solid diet. During diarrhoeal episodes, most mothers (70%) continued breast feeding their children. Whereas, 53% children also received solid and semi - solid diet which was either "Khitchri" or banana as mentioned by more than half of the respondents. The majority of mothers (97%) considered breast - feeding to be a good practice during childhood diarrhoea.

Key words: Diarrhoea; Diet; Feeding; Feeding practice.

Introduction

Diarrhoeal disease is a leading cause of mortality among infants and children in Pakistan and accounts for an estimated 300,000 deaths per year (1). In addition, about 39% of children under five years of age in Pakistan are below the 80th percentile in growth and development and therefore suffering from malnutrition (2). Rohde *et al.* reported that approximately 64.4% of these diarrhoea - associated deaths are due to malnutrition and growth failure (3). Therefore, an episode of diarrhoea can further diminish the nutritional status of an already malnourished child, and prompt measures are required to prevent nutritional deterioration and subsequent mortality. Diarrhoea contributes to malnutrition through many mechanisms, including loss of appetite, withholding of food, intestinal malab - sorption, and fever (4). The duration of diarrhoea is longer and it is more severe in malnourished children than in healthy children (2). The 1985 - 1987 Nutrition Survey in Pakistan indicated that the intake of fluids such as milk and tea, and foods such as "khitchri", porridge and rice pudding are increased when the child has diarrhoea, while "chapati" is given less often to children during diarrhoea (2). Therefore, dietary practices during episodes of diarrhoea are of interest in enabling us to further under - stand the relationship between diarrhoea and malnutrition.

In this study, we examined dietary practices of children aged 36 months and younger as reported by mothers in the Rawalpindi - Islamabad area. We distinguished between normal diets and those commonly given during episodes of diarrhoea. It was hoped that findings of this study would contribute to the efforts to control diarrhoea among Pakistani children.

Materials and methods

The study was conducted during the peak diarrhoea season, from June to September 1988.

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The weather was hot (35 – 45°C) and humid.

The households having children of ages up to 36 months were selected for this study. The local informants, especially children, helped in identifying households which had children of the appropriate age. This paper analyses the data collected in the household survey of 595 respondents (mothers and caretakers). The villages of eight union councils and five urban settlements were selected for the study. The headmen of the urban settlements and counsellors of union councils were approached and the purpose of the study was explained. Interviews and observations were conducted by a team of six women including two medical officers, one anthropologist and three health visitors. The survey questionnaire was developed, discussed, pretested, and redesigned by the research team. It was written in Urdu, the national language of Pakistan, but at the time of interview, questions were asked in Punjabi, the local dialect. Topics covered in the household survey included patterns of use of foods and fluids for children 36 months of age and younger, occurrence of diarrhoea, and mothers' beliefs about diarrhoea and dehydration.

Determination of sample size

The overall aim in this study was to collect the data on different aspects of socioeconomic life, environmental factors, and anthropological factors related to diarrhoeal diseases. Additional data were collected on feeding practices, nature of foods and fluids given to children (normally and during diarrhoea), mothers' perception of diarrhoea, treatment of diarrhoea, household hygiene, and use of Nimkol/ORS for treatment of diarrhoea.

The sample size for this survey was calculated by utilising the results of a pilot study in which 60 households were visited. The relative margin of errors and absolute margin of errors were pre-assumed for different important variables (of course the proportion of diarrhoeal cases was a major variable). The techniques for determination of sample size for continuous data and for proportions using proportional allocation were applied. Three different regions (near, far, slums) were treated as strata and procedure of multistage stratified random sampling was followed. In the first stage, an independent sample of union councils from near and far regions and a sample of slums was drawn at random. At the second stage the sample of villages was drawn at random from selected union councils. At the third stage (final stage) an independent random sample of households was drawn from each village/slum. The sample size for each village/slum was proportional to their population. In this way a sample of 595 households was drawn from the target population.

For statistical analysis the parameters were categorised according to suitable breakup. Two way contingency tables were constructed for mutually exclusive categories for different variables.

Results

Infants and child-feeding in Pakistan depends on old rituals and practices followed in different social groups: dietary practices are heavily influenced by older female kin (i.e. grandmothers). In this study, however, most respondents were the mothers of the children identified as 36 months of age or younger. As mothers explained their dietary practices, other female kin were present. Thus the findings represent the mothers' views as expressed within the family context.

Demographic and health characteristics

Of the 595 respondents, 570 (96%) were mothers, and 25 (4%) were other kin; the mean age of respondents was 29.5 years (range, 13 – 80). The average number of children per household was 3.68 (range, 1 – 13). Of the 595 adults, 77% were illiterate. Of the 134 (23%) categorised as literate, 101 (75%) had formal education in primary (or higher) school, and 33 (25%) could read and write Urdu.

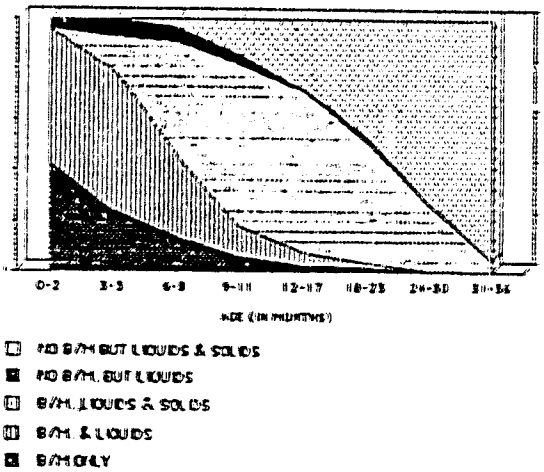
The 595 respondents were mothers or caretakers of a total of 741 children aged 36 months or younger. Of the children, 276 (37%) were under 12 months of age, and 465 (63%) were aged 13 – 36 months. The number of children who had diarrhoea at the time of the interview was 273 (37%); 113 of those with diarrhoea at the time of the interview were infants and 160 were toddlers. The mean duration of diarrhoea in infants was 8.7 days (range 1 – 60), while the mean duration for toddlers was 7.1 days (range 1 – 48). Two hundred fifty-three children (34%) resided in urban areas, and 488 (66%) lived in rural areas. The prevalence of diarrhoea was very high during the summer season among the children 36 months of age or younger.

Feeding practices

Fifty-four percent of children were breastfed. The mean age of breastfed children

was 11.8 months, and that of non-breastfed children was 23.8 months.

Figure shows the distribution of different feeding patterns among the 741 children according to the age. The majority of both breastfed and non-breastfed children were receiving both liquid and solid foods. The liquid and solid diets referred to the food given to children from that cooked for the family; children were allowed to have as much as they wanted. Liquids in the usual family diet are water, lemon water, glucose water, animal milk (especially diluted or undiluted buffalo milk), as well as canned and dried milk. Solid foods are "chapati" (a flat soft bread that is a staple food in Pakistan and that is always eaten with vegetable curry), "khitchri" (rice cooked with lentils), fruits, and yogurt.



Feeding patterns of children according to age (n = 741)

There was no statistically significant difference in the prevalence of diarrhoea by diet type. In particular, non-breastfed children were no more likely to have diarrhoea than breastfed children regardless of diet type (Table I).

Liquid diets

The usual liquid diet used for breastfed and non-breastfed children is shown in Table II. Animal milk (which included diluted and undiluted) buffalo milk, cow's milk, and goat's milk was used by 89% of non-breastfed children. Canned or dried milk was rarely used. Even in the absence of diarrhoea, about 15% of mothers used oral rehydration solution (ORS) for both breastfed and non-breastfed children. The reason given by mothers was that ORS is good for a child's health, especially in the summer.

The liquids fed to children under 36 months of age both during diarrhoea and at other times are listed in Table III. Comparison of the usual liquid diet with the one used during diarrhoea shows that almost similar fluids were used in both cases; however, mothers mentioned that during episodes of diarrhoea they used salt-sugar water (28%), albumin water (27%), and herbal liquid (40%).

It is interesting to note that 417 (97%) mothers reported that they never stopped breastfeeding during diarrhoea. In cases of current diarrhoea, mothers were asked which liquids their children were taking. Of the 245 mothers who responded to the question, only 27 (11%) said that they had given ORS on that day to children who currently had diarrhoea. Fifty-four percent of the mothers were giving their children breastmilk; 9% were giving glucose, and a few were giving sugar-salt solution (three), sugar water (two), lemonade or "skenjabeen" (six), and herbal liquids (seven).

Solid diets

The responses of mothers about the usual solid diet used for both breastfed and non-breastfed children are listed in Table II, which indicates that mothers feed the same foods for both groups. For example, 46% of breastfed and 78% of non-breastfed children were given "khitchri" as part of their normal diet.

Table III presents information on solid food given during diarrhoea. "Khitchri" and banana were mentioned by more than half of the respondents. Some mothers thought that banana thickened stools. Infants were given yogurt mixed with mashed banana. When we compared the solids given to healthy children with those given to children during diarrhoea, we found mothers considered most solid foods as part of both diets. Sixty-one percent of children had "khitchri" as part of their normal diet, and about half received it during diarrhoea. Sixty-six percent of the children were given "chapati" as part of the usual solid diet; however, fewer mothers (35%) fed it during diarrhoea. Nine mothers said they gave no solid foods during diarrhoea.

Actual solid foods reported to have been fed on the day of interview by mothers or caretakers whose children currently had diarrhoea were "chapati" 10%, banana 5%, "khitchri" 4%, rusk 3%, and yogurt 3%.

Table I. Comparison of Diets of Normal Children and Those With Diarrhoea

Health Status	No (%) with Indicated Diet					
	Only breast milk	Breast milk + liquids	Breast milk + liquids + solids	No breast milk but liquids	No breast milk but liquids + solids	Total No (%)
Diarrhoea absent	29 (6)	60 (13)	154 (33)	12 (2)	213 (46)	468 (64)
Diarrhoea present	24 (9)	35 (13)	97 (36)	8 (2)	109 (40)	273 (36)
Total (%)	53 (7.2)	95 (12.8)	251 (33.9)	20 (2.7)	322 (43.4)	741 (100)

Table II. Usual Liquid and Solid Foods of 741 Children in Pakistan

Diet	No (%) of Children		
	With Breastmilk (N = 400)	Without Breastmilk (N = 341)	Total (N = 741)
Liquids			
Water	390 (99)	338 (99)	733 (99)
Glucose water	232 (58)	229 (67)	461 (62)
Tea	180 (45)	291 (85)	471 (63)
Lemon water	133 (33)	193 (57)	326 (44)
Herbal liquid	113 (28)	66 (19)	179 (24)
Animal milk	155 (39)	303 (89)	458 (52)
Tinned milk	22 (6)	48 (15)	70 (9)
ORS	54 (14)	60 (18)	114 (9)
Solids			
Fruits	244 (61)	315 (92)	559 (75)
Chapati*	194 (48)	298 (87)	492 (66)
Khitchri§	184 (46)	267 (78)	451 (61)
Bread	141 (35)	237 (69)	378 (51)
Porridge	123 (31)	209 (61)	332 (45)
Yogurt	107 (27)	189 (55)	296 (40)
Yogurt and rice	61 (15)	127 (37)	188 (25)
Yoghurt and banana	14 (3)	31 (9)	45 (6)

Note: Data are multiple responses and thus the totals are not 100%.

* Chapati is a flat soft bread eaten with vegetable curry.

§ Khitchri is a mixture of rice and lentils (pulses) cooked together.

Discussion

Our study demonstrates that there is a moderate shift in diet during diarrhoea. Those foods considered as harmful during diarrhoea are withdrawn or stopped temporarily, but overall maintenance of normal dietary pattern persists. Banana, "khitchri", yogurt, and boiled rice, which are considered as good foods for children with diarrhoea, are added to the diet, while foods thought to be harmful (such as spices, curry, "chapati", and melon) are either totally restricted or given less often. Nutrient intake data collected from Peru and Nigeria during illness and health showed no significant difference between diet during diarrhoea and non-diarrhoea dietary intake, along with unchanged breastfeeding patterns during diarrhoea (5,6).

Continuation of feeding during diarrhoea depends on the severity of illness. This points to the fact that mothers' perception of seriousness of illness directly affects the ill child's intake of food and fluid. In our study, a great majority of mothers did not stop breastfeeding, or feeding liquid and solid food to the children during diarrhoea. Similarly, a study carried out in rural Pakistan (7) showed that most women stated that fluids of some type should be given to a child suffering from diarrhoea. Bentley *et al.* (8) found that in North India, mothers continue breastfeeding and giving fluids, although they change the diet to include softer, cooler foods. Green *et al.* (9) reported that most solid foods are restricted by Bangladeshi parents; almost two-thirds of mothers stated that they continued breastfeeding during diarrhoea, but 75% of the respondents reported that they withheld solids during diarrhoea. This statement was not the actual behaviour of the respondents because in Bangladesh (9) and North India (8), management of diarrhoeal cases was observed for several months, and the observations revealed that foods/fluids (including breastmilk) were not withheld from children with diarrhoea to the extent usually reported to interviewers.

The relation between what people say and

what they actually do is unpredictable; mothers' responses to questions about what they think is a good diet for children with diarrhoea did not reflect what they actually do in such situations. In our study it was observed that foods which mothers mentioned as being good for children with diarrhoea were not always made for their children. Mothers complained that due to poverty they are unable to buy special supplements for their children, so they preferred to give rusk, biscuits or other food items available in the house. Although the ingredients are almost always available in the home, mothers are reluctant to prepare porridge or "khichri" for their children; this reluctance deprived the children of some nutritious foods. In our survey, only 11% used ORS on the day of the interview for children with diarrhoea. In fact 15% of the total children were given ORS as a part of the normal liquid diet considering it good for health.

Table III. Liquid and Solid Foods Fed by 595 Mothers or Caretakers During Episodes of Diarrhoea

Diet	Caretakers No (%)
Liquid specific for diarrhoea	
ORS	395 (66)
Herbal liquid	239 (40)
Salt – sugar water	189 (28)
Albumin water	159 (27)
Rice water	78 (13)
Liquids used in usual conditions and during diarrhoea	
Water	578 (97)
Glucose water	356 (60)
Tea	347 (58)
Lemon water	308 (52)
Solid foods	
Fruit	388 (65)
"Khichri"*	312 (52)
Vegetables	247 (42)
Bread	238 (40)
Porridge	210 (35)
Chapati§	207 (35)
Yogurt	162 (27)
Egg and milk	112 (19)
None	99 (16)

Note: Data are multiple responses and thus the totals are not 100%.

* Khichri is a mixture of rice and pulses cooked together

§ Chapati is a flat soft bread eaten with vegetable curry

Public health programmes for control of diarrhoeal disease among children focus attention mainly on the management of episodes of diarrhoea and through oral rehydration therapy. The findings of this study reveal that mothers continue giving normal diets to their children during diarrhoeal episodes. Therefore, this aspect can be explored further by health planners for the prevention and treatment of diarrhoeal diseases in children.

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VITAMIN A STATUS OF CHILDREN IN THE URBAN SLUMS OF KARACHI, PAKISTAN, ASSESSED BY CLINICAL, DIETARY, AND BIOCHEMICAL METHODS

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Abstract. We assessed the vitamin A status of 532 children with an age range of 6–60 months who were living in slum areas of Karachi, Pakistan, using three methodologies: clinical eye examination, dietary vitamin A intake, and serum retinol level. No definite clinical signs of xerophthalmia were observed in any of these children. The mean ± SD vitamin A intake estimated from a food frequency questionnaire for the group with inadequate (low and deficient) serum retinol levels (< 20 μg/dl) was 362 ± 332 retinol equivalents (RE) compared with 431 ± 332) RE in the group with adequate serum levels ($P < 0.005$). Deficient serum retinol levels (< 10 μg/dl) were present in 12 children (2%); two of these had a healed corneal scar. Low serum retinol levels (10–19 μg/dl) were present in 46%, while 51% children had adequate levels (≥ 20 μg/dl). The mean ± SD serum retinol level for the inadequate (< 20 μg/dl) and adequate groups were 15.3 ± 2.8 and 26.6 ± 6.7 μg/dl, respectively. These results suggest that a significant number of children in these communities have low vitamin A levels and thus may constitute an at risk group. These results also suggest that the dietary intake method may be a simple and inexpensive screening tool for assessment of vitamin A status in communities.

Vitamin A deficiency is a major public health problem in many parts of the world.[1] Community surveys have estimated that 10 million new cases of xerophthalmia occur each year worldwide, and that more than 500,000 of these cases result in blindness.[2] In Bangladesh, India, and Indonesia, a high prevalence of active xerophthalmia has been clearly documented, but few data are available from many countries, including Pakistan.[3–5] In the one report from Pakistan, low levels of vitamin A were noted in 20% of males and 10% of females less than 15 years of age from an apparently healthy population of Karachi.[6] In a recent questionnaire survey conducted by UNICEF, Pakistan, 11% of health professionals reported that night blindness was common in their area, with the provinces of Sindh and Baluchistan reporting the highest incidence.[7]

While current data are conflicting, several studies have demonstrated a possible association between vitamin A deficiency and increased morbidity due to diarrhea and respiratory tract infections. An association between protracted diarrhea and existing mild xerophthalmia in children was shown in a study conducted in the slum areas of Dhaka, Bangladesh.[8] Data from Indonesia indicated that xerophthalmic children had an increased risk of developing both respiratory disease and diarrhea; children with respiratory disease and a history of diarrhea developed xerophthalmia at a higher rate than healthy controls.[9] Mortality of Indonesian children was reduced by 34% in the vitamin A–supplemented villages compared with control villages.[10] In India, mortality among preschool age children was lowered by 54% after introduction of small weekly doses of vitamin A supplement.[11] No specific cause has been attributed to the mortality of these children. However, a study in South Africa revealed that children with severe measles given a supplement recovered more rapidly from pneumonia and diarrhea than did the group receiving placebo.[12]

These findings emphasize the need to assess the vitamin A status of children in the nonindustrialized world to identify groups at risk of

developing health related complications and to determine groups who would benefit from vitamin A supplements.

Serum retinol level is regulated by several factors including dietary intake, liver stores, mobilization, use and excretion of vitamin A. Unless there is a severe depletion of liver stores, biochemical or clinical evidence of vitamin A deficiency does not occur.[13] There are several established methods available for assessment of vitamin A status, although each has its own limitations.[14-16] The finding of xerophthalmia on physical examination is an indication of advanced vitamin A deficiency and is used by the World Health Organization in community surveys.[17] However, children with a biochemical deficiency may look clinically normal, making xerophthalmia an insensitive indicator of hypovitaminosis A.[18] The measurement of serum retinol has also been used to assess vitamin A status, but it requires specialized laboratory facilities. A number of important limitations arise from using laboratory methods to assess vitamin A deficiency, including destruction of vitamin A by oxidation caused by exposure to light, interference by hemolysis, and incomplete extraction.[19] An assessment of vitamin A status can also be done by estimating dietary vitamin A intake. Long periods of direct dietary intake observation are difficult to obtain and the response to dietary questionnaires are not always accurate.[20] However, the dietary questionnaire method has frequently been used and validation of food frequency questionnaires with serum β-carotene levels have been made.[21, 22] Guidelines for the development of a simplified dietary assessment of vitamin A status have recently been produced by the International Vitamin A Consultive Group (IVACG).[23, 24]

We carried out a prospective community survey to compare the vitamin A status of the children living in slums of Karachi using clinical, dietary, and biochemical methods.

SUBJECTS AND METHODS

Study population

Random cluster sampling was performed to select 576 of the 5,592 children (age range 6–60 months) from the current record of the surveillance system of the Community Health Science Department of Aga Khan University Hospital (AKUH) in three urban slum areas in Karachi, Pakistan. Two of the areas were predominantly Muslim and one was predominantly Christian. Children less than five years of age in these areas were followed independent of the present study by the surveillance system of the Community Health Science Department of AKUH. This routine activity includes growth monitoring, immunization, and health education, which continues throughout the year. The study was approved by the Ethical Review Committees of the AKUH and Harvard University. Informed consent was obtained from the parent or guardian of each child enrolled. The study was conducted from February 1989 to March 1990.

Evaluation team

This team included the principal investigator, a pediatrician, a community health worker (CHW), a nutritionist, and an ophthalmologist. The CHWs are all women (age range 25–45 years) and have been educated up to the fifth grade of elementary school. They are low-paid ($36 American dollars per month) employees recruited from the same slum areas by the Community Health Service department of AKUH. Upon recruitment, they were formally trained by the Community Health Nurses and Doctors for 10–12 weeks. Additional training was also provided when required. Their performance was regularly evaluated by continuous assessment either by oral testing or by a demonstration of their practical work in the field. The principal investigator regularly supervised the performance of the pediatrician and CHW who were the primary data collectors. The pediatrician, along with the CHW, visited each of the households and conducted thorough physical examinations, including careful ophthalmologic examinations in the home using standard clinical criteria.[17] The CHW was trained to carry out anthropometric measurements including body weight, height, and midarm circumference of the children. The nutritionist designed the dietary vitamin A intake questionnaire and initially visited households to train the pediatrician in administering the questionnaires. During the survey period, the nutritionist visited the area at regular intervals to evaluate the dietary data collection. The ophthalmologist was a member of the AKUH staff who trained the pediatrician and CHW to recognize eye signs due to vitamin A deficiency.

Dietary assessment

A semiquantitative food frequency questionnaire was developed following the IVACG guidelines for dietary assessment of vitamin A intake.[19] The questionnaire consisted of a list of 15 food items, with specified portion sizes, which were selected after a review of foods containing retinol and carotenoid consumed by the children in the study communities. Consumption of vitamin A–containing foods in these communities is essentially the same. Mothers were asked to indicate the average frequency with which they fed each food to their child during the past month. The eight possible response categories ranged from never to four or more times per day. Food models and standard measuring devices were used to help mothers assess portion size. The retinol equivalent for each food item was calculated using food composition tables.[23, 24] The average daily intake scores for the retinol equivalent were computed by multiplying the consumption frequency for each food by the vitamin A content of the specified serving size. The product of these individual values were summed to give the average daily intake of retinol equivalents. For breast-fed children, the consumption of breast milk was estimated from published studies for the amount of breast milk consumed by children of various age groups in developing countries.[27]

Laboratory analysis

Venous blood samples (3 ml) were collected from each child. The samples were divided into an EDTA-containing tube for estimation of hemoglobin and complete blood count and a neutral tube for estimation of serum retinol, total protein, albumin, prealbumin (PA), and retinol binding protein (RBP). Both tubes were placed immediately on ice and transferred to the AKUH Clinical Laboratory in a thermos. Sera were separated, flushed with nitrogen gas, and stored at −70°C until retinol estimation was done within eight weeks of collection. Serum retinol was estimated using high-performance liquid chromatography according to the method described by Bieri and others.[28]

Quality control serum was analyzed for each set of the test sera evaluated. The coefficient of variation of the vitamin A results obtained on different days ranged from 7% to 10%. Ten duplicate samples of serum were assayed for vitamin A at the Nutrition Evaluation Laboratory, United States Department of Agriculture Nutrition Center on Aging, Tufts University (Boston, MA). There was less than a 10% difference in the mean ± SD values for the duplicate samples (45.5 ± 9.9 at AKUH and 41.1 ± 6.1 at Tufts). Serum RBP and PA were estimated using the radial immunodiffusion technique of Mancini and others.[29]

Hemoglobin, hematocrit, and other red blood cell indices were obtained on the day of blood collection using a Coulter (Hialeah, FL) S+IV autoanalyzer. Total protein, albumin, and globulin levels were measured on the day of admission using a Beckman (Fullerton, CA) Astra analyzer.

Statistical analysis

The Student's two-tailed *t*-test was used to test for differences in the mean values of the variables evaluated. The chi-square test was done to evaluate the difference in proportions of children in various age groups. The Pearson correlation coefficient was used to examine the observed strength of the association between serum retinol and other variables.

RESULTS

Complete clinical, dietary, and biochemical information was obtained on 532 (92%) of the 576 children selected for sampling. Demographic characteristics of the study families from the three study areas were tested statistically (Table 1). These areas were mostly inhabited by very low income families who have immigrated from all parts of Pakistan. The monthly income ranged from 72.00 to 94.00 United States dollars, which was significantly higher ($P < 0.001$) in one Islamic area compared with the Christian and other Islamic area. Family size and the number of living children per family were similar. Proportionately more females were studied in the Christian area than in the Islamic areas ($P < 0.01$). Mothers receiving education up to fifth grade or higher in primary school were considered educated. Overall, the rate of maternal education was low, ranging from 1.4% to 20%. In spite of these differences, the living conditions, diet, and disease burden were similar in the three areas. The clinical eye signs, dietary vitamin A intake, and biochemical measurements were compara-

TABLE 1

Demographic characteristics of the study families from the three study areas

Variables	Slum areas		
	Christian	Islamic*	Islamic*
No. of children	242	146	144
Age, months (mean ± SD)	30.8 ± 13.9	34.8 ± 14.6	32.9 ± 14.5
Sex (male : female)†	98:144	75:71	81:63
Family income/month, rupees (mean ± SD)‡	1,624 ± 898	1,669 ± 710§	2,107 ± 694§
No. of family members (mean ± SD)	6.6 ± 2.8	6.5 ± 4.5	6.3 ± 2.2
No. of live children/family (mean ± SD)	3.9 ± 2.0	4.3 ± 2.1	4.2 ± 2.0
No. (%) of mothers educated	23 (9.5)	29 (19.8)	2 (1.4)

* Two different Islamic areas were studied.
† $\chi^2 = 10.0$, $P < 0.01$.
‡ One United States Dollar = 22.30 Pakistani rupees.
§ $P < 0.001$ versus the Christian slum area.

ble in the three study areas. No differences were found in the prevalence of diarrheal or upper respiratory tract infections.

Overall, 12 children (2.3%) had serum retinol levels < 10 μg/dl, but no clinical evidence of active xerophthalmia was found (Table 2). Two children had healed corneal scars; one of them had had previous corneal trauma. None of the 6–12-month-old children had deficient serum retinol levels. The frequency of low and deficient serum retinol levels was similar in all age groups. Forty-eight percent of the children in all age groups had deficient or marginal (< 20 μg/dl) serum retinol levels, compared with 51% with adequate serum levels (Table 2). No statistical differences were obtained in the distribution of deficient, low, and adequate serum retinol levels between male and female children. In addition, there was no difference in the distribution of severe, moderate, mild, and normal nutritional status (by weight/age, weight/height, and height/age criteria) between male and female children.

Children with inadequate (< 20 μg/dl) and adequate (≥ 20 μg/dl) serum retinol levels were stratified into severe, moderate, mild, and normal nutritional status by weight for age criteria that combined acute and chronic protein energy malnutrition (Table 3). There was no statistically significant difference in the distribution of inadequate and adequate serum retinol levels in children with mild, moderate, or severe malnutrition. Children with normal nutritional status had a significantly lower rate of inadequate serum retinol levels than the malnourished children (42% versus 58%; $P < 0.05$).

Anthropometric, biochemical, and dietary measurements of the children with inadequate and adequate serum retinol levels were compared (Table 4). Significant differences were observed in the mean serum retinol, RBP, and dietary vitamin A intake ($P < 0.001$). A high percentage (67%) of the children studied were anemic (hemoglobin < 11 g/dl). Statistically significant correlations were found between serum retinol level and RBP ($R = 0.367$, $P < 0.0001$), PA ($R = 0.488$, $P < 0.0001$), and dietary retinol intake ($R = 0.108$, $P < 0.005$). There was no significant correlation between the serum retinol levels and nutritional status.

TABLE 2

Number of study children with deficient, low, and adequate serum retinol levels

Age range (months)	Deficient (< 10 μg/dl)	Low (10–< 20 μg/dl)	Adequate (≥ 20 μg/dl)	Total no.
	No. (%)	No. (%)	No. (%)	
6–12	0 (0)	23 (50)	23 (50)	46
13–24	1 (1)	53 (39)	81 (60)	135
25–36	5 (3)	67 (47)	71 (50)	143
37–48	2 (2)	67 (55)	53 (43)	122
49–60	4 (5)	37 (43)	45 (52)	86
Total	12 (2)	247 (46)	273 (51)	532

DISCUSSION

Our study found no specific clinical evidence of advanced vitamin A deficiency. The clinical results were confirmed by the biochemical find-

TABLE 3

Distribution of inadequate and adequate serum retinol levels among the children with different grades of nutritional status

Nutritional status (weight/age) % of median	Inadequate (< 20 μg/dl) No. (%)	Adequate (≥ 20 μg/dl) No. (%)	Total
Severe (<60)	8 (73)	3 (27)	11
Moderate (60–74)	68 (54)	59 (46)	127
Mild (75–89)	139 (48)	151 (52)	290
Normal (≥90)	44 (42)	60 (58)	104
Total	259 (49)	273 (51)	532

TABLE 4

*Anthropometric and biochemical data for the children with inadequate and adequate serum retinol levels**

Variables	Inadequate (< 20 μg/dl) (n = 259) Mean ± SD	Adequate (> 20 μg/dl) (n = 273) Mean ± SD
Age (months)	33.9 ± 13.8	31.3 ± 14.6
Height (cm)	86.9 ± 10.3	86.0 ± 10.4
Weight (kg)	11.2 ± 2.4	10.9 ± 2.3
MUAC (cm)	14.9 ± 1.3	14.8 ± 1.3
Serum retinol (μg/dl)	15.3 ± 2.8†	26.6 ± 6.7
RBP (mg/dl)	1.7 ± 0.6†	2.2 ± 0.7
PA (mg/dl)	14.7 ± 2.7	17.5 ± 3.6
Albumin (g/dl)	4.3 ± 0.3	4.5 ± 0.3
Globulin (g/dl)	2.8 ± 0.5	2.6 ± 0.5
Hb (g/dl)	9.6 ± 2.0	10.0 ± 1.9
Hct (%)	31.0 ± 5.0	32.1 ± 4.9
Dietary retinol intake (RE)	362 ± 271†	431 ± 332

* MUAC = midupper arm circumference; RBP = retinol binding protein; PA = prealbumin; Hb = hemoglobin; Hct = hematocrit; RE = retinol equivalence.

† $P < 0.001$.

Chi-sq under head (x2)

ings. Using the World Health Organization criteria, greater than 5% of a population having serum retinol levels < 10 μg/dl is considered to be of public health importance.[17] Only two percent of our study children had such levels. Controversy surrounding the need for vitamin A supplementation is reflected in the various standards used for assessment and the difficulty in evaluating marginal vitamin A deficiency and its consequences. For example, the Pan American Health Organization criteria for vitamin A deficiency considers 15% of a population with serum retinol levels < 20 μg/dl to be of public health significance.[30] Using this criterion, 48% of our study children would be considered deficient, although no clinical evidence for deficiency was observed.

Dietary vitamin A intake estimated from the diet questionnaires correlated well with the clinical and biochemical findings. In reviewing the dietary intake data, several important limitations must be remembered. First, we relied entirely on information collected through dietary recall during a single visit to the children in the study period. Second, current information on the amount and form of both retinoids and carotenoid in foods is of questionable quality. The methods used to measure total vitamin A activity in foods does not differentiate between the various carotene isomers, which have different biopotencies and can thus lead to a 5–10-fold overestimation of vitamin A activity of foods such as tomatoes and oranges. In addition prolonged cooking of vegetables, which is the general practice in Pakistani homes, and other food preparation practices may result in a decrease in the vitamin A activity. Thus, vitamin A intake data based on currently available food composition tables may not be a very reliable quantitative estimate of vitamin A intake. In addition, no regular surveillance was done to monitor the frequency of illness in these children.

The most important source of vitamin A intake in the children studied was breast milk, which contains 40–70 μg of retinol/dl.[31] Other important sources were liver, buffalo milk, carrots, and green vegetables. Infants in our study were mostly breast fed, and this is the most likely reason that no child less than six months old had a deficient serum retinol level. Our findings are consistent with other studies that have shown that vitamin A deficiency is rare in infants.[32]

The recommended dietary allowance (RDA) for vitamin A is 375 RE for the 0–2-year-old children and 400 RE for the 2–6-year-old children.[31] Our data show that children with inadequate serum retinol levels consumed less than the RDA values (mean ± SD 362 ± 271 RE), while those with adequate serum retinol levels consumed more than the RDA for vitamin A (Table 4). In evaluating these data, the large SD of retinol intake should be considered. The reported intakes can be greatly influenced by the consumption of a limited number of vitamin A–rich foods including mangoes, green leafy vegetables, and carrots by this population. The correlation obtained between the serum retinol level and dietary vitamin A intake ($r = 0.108$) was relatively low, indicating that reliance solely on

this methodology may not be strictly justified for quantitative estimation of vitamin A status in an individual child. However, despite these limitations, the significant positive correlation ($P < 0.005$) between dietary vitamin A intake and the serum retinol level indicates that dietary intake information may be a useful screening test for identifying populations at risk of inadequate vitamin A intake, especially in field situations in the nonindustrialized world. Similar suggestions on the usefulness of dietary assessment techniques for estimation of vitamin A intake have been provided in the IVACG guidelines.[29]

We did not find a direct correlation between the degree of malnutrition and serum retinol levels, although children with normal nutritional status had significantly higher levels than the malnourished children. These findings are similar to those reported from a study in northeastern Thailand.[33] Two laboratory measurements that were significantly correlated with mean serum retinol levels were RBP and PA. However, these tests are unlikely to be widely available in developing countries. The weak correlation between retinol and RBP observed in our study has been previously reported in preterm infants. This could be due to a zinc deficiency or increased utilization of RBP as previously suggested.[34] Approximately 80% of the children in our study were in various degrees of malnutrition (weight/age median range < 60–85%). When this high rate of malnutrition is considered, one can speculate that these children were also zinc deficient and thus, this interfered with the synthesis of RBP by the liver. In general, the serum RBP values in our study were comparatively lower than those reported in a similar age group of children.[35] Earlier studies had indicated that hemoglobin levels may correlate well with vitamin A status.[36–38]

Our findings indicate a relatively high percentage (48%) of inadequate (< 20 μg/dl) serum vitamin A levels in urban slums in Karachi, Pakistan. These results suggest that a significant percentage of children in this population have marginal vitamin A nutriture and may constitute an at risk group. These findings are generally confirmed by both the biochemical and dietary assessment methods. This study also suggests that estimation of dietary vitamin A intake may prove to be a relatively simple and inexpensive screening test for categorizing populations at risk of developing inadequate vitamin A status. Additional clinical and biochemical assessment will be necessary for estimation of the inadequate vitamin A status of individuals. Further studies will be required to confirm the predictive value of this inexpensive method for the assessment of vitamin A status.

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Effect of Antibiotics on Food Intake and Absorption of Nutrients for Children with Diarrhea Due to *Shigella*

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The effect of antibiotic therapy on intake of food and absorption of nutrients for 19 male children aged 1-5 years with suspected shigella infection was studied. The children were admitted to the hospital with acute diarrhea, high fever, abdominal pain, and ≥25 red blood cells and white blood cells per high-power field in the stool. Microbiologic diagnosis was made within 48 hours of admission. On the basis of clinical and microbiologic criteria, children were classified as having mild or severe infection. Ten children with mild infection did not receive antibiotics, whereas nine children with severe infection were treated with ampicillin. After the children were rehydrated, a 72-hour balance study was carried out during the acute stage of infection with *Shigella* and was repeated 2 weeks after recovery. The levels of consumption of food and absorption of nutrients were estimated. During the acute stage of infection, such levels were higher for the children treated with antibiotics than for the untreated group. During the recovery phase, the levels of intake of food and absorption of nutrients were equal for both groups. Thus, children who are treated with appropriate antibiotics not only may recover from infection with *Shigella* more rapidly, but they also may be able to absorb nutrients more efficiently.

Diarrheal disease is a major cause of morbidity and mortality in developing countries [1]. It has been estimated that 524,000 deaths that occur annually worldwide among children are due to *Shigella* [2, 3]. Infection with *Shigella* has a significant nutritional impact on children. Children who were hospitalized because of infection with *Shigella* had protein loss [4, 5], and stunting was observed among children aged 5–24 months who were infected with *Shigella* in rural Bangladesh [6].

The use of antibiotics for treatment of children who have less-severe infection with *Shigella* is controversial. The primary purpose of using antibiotics for the treatment of infection due to *Shigella* is to reduce morbidity and mortality as well as to prevent complications. Data from recent studies show that the duration of diarrheal disease is substantially reduced after patients are treated with effective antibiotics [7, 8]. Several studies have shown that ampicillin and trimethoprim-sulfamethoxazole are equally effective for treatment of dysentery due to *Shigella* [9, 10]. The present study assesses the effect of treatment of shigella infection with an antibiotic to which the organism is susceptible on the consumption of food and absorption of nutrients by two groups of hospitalized children.

Materials and Methods

This study was carried out in the unit for metabolic studies of the International Centre for Diarrhoeal Disease Research, Dhaka, Bangladesh, from 1985 through 1986. The research proposal was approved by the committee on human ethics, and informed consent was obtained from the patients' parents or guardians.

Male children aged 1-5 years who presented with acute bloody, mucoid diarrhea of ≤48 hours' duration, mild to moderate dehydration, abdominal pain, and fever were included in the study. Male children who had severe dehydration, severe malnutrition, high fever (>102°F), or clinical signs of other illnesses and a history of prior treatment with antibiotics were excluded from the study.

Immediately after admission to the hospital, a specimen of stool obtained from the patient's catheter was sent to the laboratory for examination and culture. The results of microscopic examination of the specimen of stool were available within 1 hour, and the results of culture, including tests of antibiotic sensitivity, were obtained within 48 hours.

Patients were provisionally diagnosed as having shigella dysentery on the basis of clinical signs and symptoms and results of microscopic examination of specimens of stool. On the basis of these criteria, patients were assigned to either of two groups, designated as mild and severe, according to their diagnosis. Children who had fever >102°F, severe abdominal pain, clinical signs of toxicity, and >20 red blood cells (RBCs) and white blood cells (WBCs) per high-power field were assigned to the severe group. These children were treated with antibiotics and were rehydrated. Ampicillin (100 mg/kg q.i.d.) was administered since this was the most effec-

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tive antibiotic used for treatment of infection with *Shigella* at the time. Patients who appeared healthier according to clinical criteria and had <20 RBCs and pus cells per high-power field in their specimens of stool and less blood and mucus in the stool were assigned to the mild group and received only rehydration therapy. After patients in both groups were initially rehydrated, they received food that was part of their staple diet.

The next morning a 1-hour D-xylose absorption test was administered following an oral dose of 5 g of pentose [11]. Twenty-four hours after admission, a 72-hour balance study was started. Patients were fed a 5-g nonabsorbable charcoal marker followed by a measured quantity of a familiar rice-based meal, which was offered ad libitum by the mothers. The first appearance of this marker in the patient's stool was considered to be the "0" hour of the study. From that point onward, the intake of food and fluids and the output of stool, urine, and vomit were recorded for 72 hours. At the end of 72 hours, a second marker was fed to the patients, and samples were collected until the second marker appeared in the patient's stool, at which time the study was discontinued.

Specimens of stool, urine, and vomit were collected at 8-hour intervals, weighed (up to 0.1 g was used for analysis), and stored at −70°C until the time of analysis. At a later date all samples of stool, food, and vomit were thawed and homogenized. Aliquot samples were analyzed for amounts of fat and nitrogen and number of calories, which were estimated with the use of standard methods [12, 13]. Samples of urine were tested to estimate the quantitative intake of food and absorption of nutrients.

The following formula was used to calculate the absorption coefficient:

$$\frac{\text{Intake} - \text{Output}}{\text{Intake}} \times 100$$

The balance study was repeated 2 weeks after the patients recovered from diarrhea.

Results

Of the 21 children included in the study, 10 were classified in the mild group and 11 were classified in the severe group. Two children were excluded from the severe group because of the deterioration of their clinical condition. Nineteen patients completed the study, and data on these patients are presented.

The clinical characteristics of the two groups at the time of admission are presented in table 1. Patients in both groups were comparable in age and body weight. Patients in the severe group had more-severe diarrhea according to clinical criteria, as indicated by the degree of fever and number of pus cells and RBCs in the stool. Eighty percent of the patients in the mild group had watery diarrhea compared with only 33% in the severe group. The volume of stool obtained daily was higher for the mild group (680 mL) than for the severe group (270 mL) ($P < .025$).

Some of the relevant results of laboratory tests performed on admission are presented in table 2. The mean number of RBCs and WBCs in the stool was higher for the severe group (77 and 83) than for the mild group (16 and 12). The electrolyte levels were similar for both groups except that the severe

Table 1. Clinical characteristics of patients with mild or severe shigella infection at the time of admission to the hospital.

Variable	Mean value ± SD or mean no. (%) of patients per indicated variable for each group: Mild (no antibiotics) (n = 10)	Severe (antibiotics) (n = 9)	P value
Age (mo)	30.0 ± 18.5	29.5 ± 18.0	...
Body weight (kg)	9.2 ± 1.7	10.4 ± 2.8	...
Diarrhea before admission (h)	9–20	5–14	...
Temperature (°F)	100.6	102.8	...
Clinical presentation			
Fever	1 (10)	5 (55)	...
Abdominal pain	1 (10)	4 (44)	...
Vomiting	2 (20)	4 (44)	...
Type of diarrhea			
Liquid with blood and mucus	8 (80)	3 (33)	...
Frank blood and mucus	2 (20)	6 (67)	...
Stool volume (mL)			
Day 1	680 ± 508	270 ± 154	<.025
Day 2	500 ± 311	235 ± 155	<.025
Day 3	494 ± 140	188 ± 98	<.001
Absorption of D-xylose	16 ± 2.5	22.5 ± 3.4	<.05

Table 2. Results of laboratory tests at the time of admission to the hospital for patients with mild or severe shigella infection.

Variable	Mean value ± SD or mean no. (%) of patients per indicated variable for each group: Mild (no antibiotics) (n = 10)	Severe (antibiotics) (n = 9)	P value
RBCs per hpf	16 ± 10	77 ± 53	<.001
WBCs per hpf	12 ± 6	83 ± 43	<.001
pH of stool	6.5 ± 1.5	9.4 ± 2.2	NS
Pathogen identified in stool culture			
Shigella flexneri	6 (60)	6 (66.7)	...
Shigella shigae	3 (30)	2 (22.2)	...
Shigella boydii	1 (10)	1 (11.1)	...
Serum electrolytes (mmol/L)			
Na^+	137 ± 4.2	128 ± 2.2	<.05
K^+	4.5 ± 1.2	3.5 ± 1.2	NS
Cl^-	102 ± 4.2	98 ± 4.0	NS
HCO_3^-	12.0 ± 2.1	14 ± 3.2	NS

NOTE. hpf = high-power field; NS = not significant.

Table 3. Intake of nutrients by patients with shigella infection who did or did not receive treatment with antibiotics.

	Mean intake of nutrients ± SD			
	Acute stage of disease		Recovery stage of disease	
Nutrient	No antibiotics (n = 10)	Antibiotics (n = 9)	No antibiotics (n = 10)	Antibiotics (n = 9)
Carbohydrates (g/[kg·d])	11.0 ± 5.0	13.0 ± 4.2	12.8 ± 5.0	15.0 ± 3.0
Fat (g/[kg·d])	3.0 ± 2.1	3.9 ± 0.8	3.3 ± 0.4	3.8 ± 0.8
Nitrogen (g/[kg·d])	0.3 ± 0.1	0.5 ± 0.3	0.9 ± 0.1	0.8 ± 0.2
Calories (kcal/[kg·d])	67.6 ± 26.8	82.7 ± 28.0	105 ± 25.5	104.7 ± 18.0

group had lower levels of serum sodium than the mild group (128 mmol/L vs. 137 mmol/L).

The consumption of carbohydrates, fat, nitrogen, and calories for the two groups is compared for the acute phase and the recovery phase of diarrheal disease (table 3). During the acute phase, intake of all nutrients was higher for the severe group than for the mild group. Because of the large standard deviation, the differences between these two groups were not statistically significant. Caloric intake for the group of children who did not receive antibiotics was 67.6 ± 26.8 kcal/(kg·d) compared with 82.7 ± 28.0 kcal/(kg·d) for the group who received antibiotics. During the recovery phase, intake of all nutrients was similar for both groups.

Table 4 shows that the severe group had a significantly higher rate of absorption of nutrients than the mild group during the acute stage of the disease ($P < .001$). During the recovery phase the rate of absorption of nutrients improved for the mild group and became almost equal to the rate for the severe group.

Discussion

Shigellosis is associated with a high case-fatality rate, and many of the deaths due to shigellosis can be attributed to malnutrition [3, 14]. In developing countries, dysentery due to *Shigella* is a major cause of chronic or persistent diarrhea. Therefore, it is important to treat a patient who is infected with *Shigella* with appropriate antibiotics.

The present study was undertaken to evaluate whether treatment of diarrhea due to *Shigella* with effective antibiotics affects the intake of food and absorption of nutrients in addition to reducing the mean duration of an episode of diarrhea [7, 8]. In this study, antibiotics were given to the group of children whose diarrheal disease was more severe according to clinical criteria; the children in the mild group, on the other hand, received only oral rehydration solution. The group of children who were treated with antibiotics had better appetites and were able to absorb nutrients more efficiently than the children in the mild group despite the fact that the children who were treated had more-severe disease.

Several studies have demonstrated that patients infected with *Shigella* have profuse protein loss, which can be prevented by the administration of antibiotics to which the organism is susceptible [6]. There is also evidence that children who suffer from invasive diarrhea also have stunted growth [5]. Therefore, it seems that treatment of invasive diarrhea with appropriate antibiotics may result in an improvement in nutritional status by increasing both appetite and absorption of nutrients.

The pathophysiologic mechanisms of growth impairment that results from invasive or chronic enteric disease have not yet been clearly established. Anorexia that results from shigellosis is associated with growth impairment. Reduction in intake of food and avoidance of food are considered major factors in the retardation of growth caused by Crohn's disease in childhood; this retardation can be reversed by providing nutritional support to children afflicted with this disease [15, 16].

The energy requirements associated with invasive enteric

Table 4. Absorption of nutrients by patients with *Shigella* who did or did not receive treatment with antibiotics.

	Mean percent absorption of nutrients ± SD					
	Acute stage of disease			Recovery stage of disease		
Nutrient	No antibiotics (n = 10)	Antibiotics (n = 9)	P value	No antibiotics (n = 10)	Antibiotics (n = 9)	P value
Carbohydrates	76.5 ± 27	91.0 ± 23.7	NS	83.3 ± 12.0	92.0 ± 5.2	NS
Fat	53.0 ± 5.9	88.0 ± 14.8	<.001	86.7 ± 5.4	84.0 ± 12.0	NS
Nitrogen	25.0 ± 5.5	37.0 ± 2.9	<.001	65.0 ± 1.6	66.0 ± 13.7	NS
Calories	67.0 ± 30.0	88.0 ± 33.0	NS	83.0 ± 12.0	89.0 ± 14.6	NS

NOTE. NS = not significant.

infection have not been studied. Many infections, however, are associated with an increase in the basal metabolic rate and a concomitant rise in energy requirements [17]. Therefore, an increase in food consumption and the administration of appropriate antibiotics will aid in treating the disease and prevent potential complications.

The type of food most suitable for a patient with invasive enteric infection needs to be determined. Future studies may be essential to select an appropriate diet from a variety of traditional and acceptable food items.

In view of the emergence of antibiotic resistance to *Shigella*, the use of alternate ways of improving nutrition and, thereby, host resistance may be the only choice for the treatment of invasive diarrhea.

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A Traditional Diet as Part of Oral Rehydration Therapy in Severe Acute Diarrhoea in Young Children

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Abstract

Recently, the role of feeding as treatment of acute diarrhoea has received increasing attention. To assess the efficacy of early feeding in acute diarrhoea, we conducted a randomised, clinical trial of a traditional legume-based weaning diet *khichri* in boys 9 to 48 months old with moderate to severe dehydration. *Khichri* is composed of rice and lentils cooked with cottonseed oil. Children were randomly allocated to 2 groups: group A received only WHO ORS but no food for the first 24 hours and then *khichri* and half-strength cow's milk formula freely; group B received *khichri* and the half-strength formula in addition to ORS after the initial rehydration period of 4 to 6 hours. The mean period of evaluation was 3 days. 69 patients were admitted into the study, 33 in group A and 36 in group B. The initial mean purging rate for the children was >200 g/kg/day. Six children did not complete the study because they developed intercurrent infections or were removed by their parents for non-medical reasons. Of the 63 patients who were evaluated, 44 (70%) were successfully treated, 21 in group A and 23 in group B. There were no significant differences in the 2 groups in mean stool output, number of stools, or weight gain, although a trend toward earlier improvement was seen in group B. These data indicate that early feeding of *khichri* and WHO/ORS may be as well tolerated as WHO/ORS alone in the first 24 hours treatment of severe acute diarrhoea in young children.

Key words: Diarrhoea; Diet; Dietary therapy; ORS; Diarrhoea management.

Introduction

Acute diarrhoea with dehydration is one of the major causes of childhood death and disability in developing countries (1). Replacement of fluid and electrolyte by oral rehydration therapy has been found to reduce diarrhoea-related deaths (2), but alone ORS has little impact on the nutritional consequences of diarrhoea (3). Though the need for feeding during diarrhoea is now widely recognised (4), there is no uniform mode and type of feeding practices have been developed (5). Despite the emphasis on feeding during acute diarrhoea, withholding of food during diarrhoea is still practised in many countries (5). In Pakistan, the standard treatment of acute diarrhoea is replacement of fluid and electrolyte while neglecting food and breast milk. This practice is based on the fear of mother that feeding will increase the volume and duration of diarrhoea (5).

Recent clinical trials have indicated that early feeding can reduce stool output and shorten the duration of diarrhoea (6,7). However, the nature of foods which can successfully be given have not been well studied. Studies of food-based oral rehydration solutions have indicated that cooked rice and lentils containing solutions may be well absorbed during diarrhoea and could be a source of calories (8-11). Rice and lentils cooked with cottonseed oil are used commonly as a weaning food called *khichri* in Pakistan and is sometimes used in adults as a treatment for diarrhoea. There have been no controlled trials in Pakistan to demonstrate the possible beneficial effect of feeding *khichri* to

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children with acute diarrhoea. The present study was carried out to assess the efficacy of this culturally acceptable, widely available, inexpensive traditional food along with half-strength cow's milk formula in the treatment of diarrhoea.

Materials and methods

This was a collaborative study between the Department of Paediatrics of the Aga Khan University Hospital and Civil Hospital, Karachi and the Combined Programme in Pediatric Gastroenterology and Nutrition, Harvard Medical School, Boston. The research protocol was approved by the Ethical Review Committees of The Aga Khan University Hospital and Civil Hospital, Karachi and Harvard University. Informed consent was obtained from the parent or guardian of the child before admitting into the study. The study was conducted in the Civil Hospital from September 1987 to September 1988 in boys between the ages of 9 to 48 months, who had acute watery diarrhoea for 72 hours or less, moderate or severe dehydration, no previous antibiotic treatment, no complications other than those directly related to dehydration and who were weaned from mother's milk. Boys were chosen for ease in the collection of stool and urine samples. Criteria for exclusion were severe systemic illness, severe malnutrition (Gomez grade III), oedema, or fever (body temperature higher than 101°F).

Children who met the inclusion criteria were admitted to the 4-bed diarrhoea study ward at Civil Hospital, Karachi. A detailed history and thorough physical examination were done by the research physicians. Continuous clinical monitoring during the study period was carried out by the full-time medical staff of the study ward.

Children with moderate dehydration were treated with oral rehydration solution (ORS) using standard WHO/UNICEF ORS. Children with severe dehydration initially received initial intravenous Ringer's lactate (130 mEq of sodium, 4 mEq potassium, 108 mEq chloride, 28 mEq lactate and 2.7 mEq calcium per litre).

The status of dehydration on admission was determined by the percentage of weight gain after rehydration. Rehydration was defined as resolution of the clinical signs of dehydration. After initial rehydration designated as hour 0 of the study, the patients were randomly assigned to one of the two treatment groups using a random number table. Boys in group A received standard WHO/UNICEF ORS but no food for the next 24-hours of study. After the 24 hour period, the group A children were fed *khichri*, and half-strength cow's milk formula. Children B received *khichri* and half-strength milk from hour 0. In this group rehydration was continued using WHO/UNICEF ORS throughout the study period.

The volume of food, fluid and, ORS intake and stool, urine and vomit, was measured and recorded by nurses and medical officers. In addition, the research staff supervised administration of the diets, water and ORS fed by the mothers. The stool output was measured by the use of pre-weighed diapers. Urine was collected separately from the stool by using disposable urine bags. The weight of vomit was measured using pre-weighed cotton wool. Measurement of stool, urine and vomit was done every four hours, and these losses were replaced with ORS on a weight for weight basis. The study was continued until cessation of diarrhoea defined as 2 successive formed stools. However, many families wished to remove their children from the study when they had clinically improved. For this reason, successful therapy was defined as maintenance of normal hydration for at least 3 days on the study diet.

The *khichri* diet was prepared by the research dietician under the supervision of the nutritionist according to the formula in Table I. Servings of 200g were stored in the freezer until used. Infant formula was prepared by the research nurses. Feedings were offered freely in pre-measured quantities. Nasogastric ORS was administered to children who were not able to drink sufficient fluids to maintain their hydration status. Laboratory investigations included haematocrit, serum osmolality, and serum electrolytes on admission and after 24 hours of treatment. These tests were performed at the Aga Khan University Hospital. Fresh stool specimens were examined by light microscopy for ova, parasites, and red and white blood cells at the pathology laboratory of Civil Hospital. Stool examination for bacterial and viral pathogens was not done.

Once oral rehydration was initiated, restarting of intravenous fluids during the study constituted clinical failure. Initiation of intravenous infusions depended on reappearance of signs of dehydration or the development of complications related to dehydration. Once declared a clinical failure, the child received continuing care in the Pediatric Ward of the Civil Hospital.

Sample Size Calculation

Previous studies of early feeding in acute

diarrhoea have demonstrated a 30% to 50% decrease in stool volume, and a similar reduction with cereal-based ORS treatment. To show a 30% difference in the 2 groups with an alpha of 0.05 and a statistical power of 80%, 35 children would be needed in each group.

Table I. Composition of 100 g Cooked *Khichri*

Content	Rice (g)	Dal (g)	Consumed oil (g)	Energy Kcal (%)
Protein	1.2	2.1	-	13 (5.1)
Fat	0.3	0.1	2.9	28 (28)
Carbohydrate	14.0	5.0	-	92 (62)

Statistical Methods

Two tailed "Students t" tests were used on the mean values of the clinical characteristics of children on admission, 24 hours after, and at discharge; and for number and volume of stool, urine output, weight gain and amount of ORS and plain water. For amount of formula and *khichri* consumed, non-parametric analysis of Kruskal-Wallis was used as the distribution was not normal. Differences in proportions were assessed by Chi-square analysis.

Results

69 children were studied, 33 in group A and 36 in group B. The admission characteristics of the children were comparable in the two groups with regard to age, weight, vomiting, purging rate, status of dehydration, and nutritional status (Table II). Six children did not complete the study because of concurrent infections or removal by their parents (2 from Group A and 4 from Group B).

Forty-four of the 63 children (70%) were successfully managed according to the protocol, 21 in group A and 23 in group B. Stool microscopy revealed the presence of *Giardia lamblia* cyst or trophozoites in 13 children in group A and 14 in group B. Faecal red blood cells were not identified in either group.

The initial (mean ± SD) purging rates of the children during rehydration was high, 9.1±5.3 g/kg/h in group A and 8.0±6.9 g/kg/h in group B. In successfully treated children, the mean ± SD stool output was less after the first 24 hours for those who received early feeding and WHO/ORS compared to those who received only WHO/ORS (195±116 g/kg in group B versus 256±157 g/kg in group A); however, this difference was not statistically significant. Similarly, mean ± SD number of stools was lower, but not significantly so, in group B after the first 24 hours (B = 17.2±7.6, A = 21.6±9.6). The introduction of feeding to the children in group A on day 2 coincided with a decrease in mean ± SD stool output from 256±157 g/kg/day to 202±223 g/kg/day, but this change was not significant. No change in the number of stool passed was noted in group A from day 1 to day 2. After the first 24 hours, when both groups received the same oral solution, the stool volumes and numbers were very similar (Table III).

Table II. Admission Characteristics of the 69 Patients

Characteristics	Group A (n = 33)	Group B (n = 36)
Age (months) (mean ± SD)	22.2 ± 11.2	25.0 ± 10.8
Weight (kg) (mean ± SD)	8.3 ± 1.6	8.6 ± 1.5
Hours of vomiting before admission (n,%)	33 (100)	31 (86)
Duration of diarrhoea (h) (mean ± SD)	39 ± 31.0	39 ± 29.3
Initial purging rate	8.3 ± 4.8	9.0 ± 6.9
Status of Dehydration		
Moderate (5% - 9%), n (%)	12 (36)	16 (44)
Severe (≥10%), n (%)	21 (64)	20 (56)
Nutritional Status (Gomez criteria)		
Normal, n (%)	12 (36)	8 (22)
Grade I, n (%)	16 (51)	18 (50)
Grade II, n (%)	5 (12)	10 (28)

The mean oral rehydration solution consumed was higher in group A in the first 24 hours than in group B. The calorie intake was significantly higher in group B only on day 1 when group A patients received no food ($p<0.05$). No significant weight gain after initial rehydration was found in the two groups during the mean 3 day duration of the study. Thirty-one of the 44 successfully treated patients (14 in group A and 17 in group B) improved their stool consistency from watery to soft during the mean 3 days of dietary treatment. Eleven children in group A and 15 in group B had continued high stool rates (≥100 g/kg/day) on day 3 but were able to maintain normal hydration on the study diet.

Nineteen (28%) of the children admitted to the study were considered treatment failures: 10 from group A and 9 from group B (Table IV).

The children who failed had some important differences from the successfully treated children in several respects. As might be expected, a higher proportion of the failure group had severe dehydration on admission (81%) than the children successfully treated (48%) ($p<0.01$). They had no appreciable fall in their stool frequency during the study compared to the reduction seen in the successes (Table III). More vomiting was uniformly found in the failures while less than half of the successes vomited ($p<0.01$).

Table III. Results of Treatment (means ± SD) After Initial Rehydration Period

Variables	Group A Success (n = 21)	Group A Failure (n = 12)	Group B Success (n = 23)	Group B Failure (n = 13)
Stool output (g/kg/day)				
Day 1	256±157	354±156	195±116	300±111
Day 2	202±223	412±183	192±153	436±102
Day 3	177±261	336±164	166±132	420±109
Stool frequency (no./d)				
Day 1	21.6±9.6	23.1±8.4	17.2±7.6	22.2±7.8
Day 2	15.6±9.9	25.0±9.2	14.4±8.2	29.0±5.8
Day 3	13.0±10.6	20.1±4.8	13.0±8.0	23.8±2.2
Vomiting [n/(%)]				
Day 1	4 (19)	10 (100)	14 (61)	8 (89)
Day 2	8 (38)	9 (100)	10 (43)	6 (46)
Day 3	7 (33)	6 (46)	12 (52)	5 (83)
ORS intake (ml/kg/d)				
Day 1	331±167	391±129	210±127	348± 98
Day 2	227±241	408±231	228±117	523±117
Day 3	202±231	340±147	190±152	460± 54

Five children developed seizure-like movement of limbs: two in group A, two in group B and one while receiving-intravenous infusion before randomisation. The mean age of these 5 children was 21 months and they were all malnourished and severely dehydrated on admission. None demonstrated signs of sepsis or dysentery during their hospitalisation. The onset of seizure-like movements occurred at 18 hours and 57 hours in the group B children and at 30 and 48 hours in the group A children. The movements were similar to twitching movements; no definite convulsions occurred.

At the time of their seizures-like movements, all of the children were moderate or severely dehydrated and had purging rates more than 265 g/kg/day; four of the five had purging greater than 300 g/kg/day. The children were treated with intravenous rehydration with Ringer's lactate solution and glucose; none received antibiotics. Unfortunately, serum chemistries were not performed at the time of these episodes because of technical difficulties. Three received intravenous diazepam, one received a glucose bolus and was given intravenous calcium gluconate. All were discharged from hospital with no recurrence of seizure-like activity.

Table IV. Results of Therapy (Means ± SD)

Variables	Group A Success (n = 21)	Group A Failure (n = 12)	Group B Success (n = 23)	Group B Failure (n = 13)
Total calorie intake (Kcal/kg/d)				
Day 1	26.5±13.4	40.7±24.0	49.7±17.1	55.0±30.6
Day 2	62.8±23.1	57.7±21.3	53.6±22.5	63.6±17.1
Day 3	66.9±24.2	56.9±15.0	58.5±23.4	58.9±11.6
Urine Output (ml/kg/d)				
Day 1	47.8±24.8	48.3±31.1	44.8±22.2	37.5±27.4
Day 2	45.0±27.1	37.3±23.1	36.7±31.4	43.1±33.1
Day 3	59.3±38.6	44.1±13.6	46.7±26.7	52.7±35.2
Weight gain (% change)				
After rehydration	7.0±3.5	9.15±3.5	7.1±4.1	8.6±2.7
24 h post-rehydration	-1.4±3.9	-	-0.6±4.8	-
72 h post-rehydration	-0.9±4.3	-	-1.0±5.0	-
Nasogastric Feeding (%)	29%	60%	30%	68%

Discussion

These results indicate that a semi-solid diet of *khichri* and half-strength milk can be tolerated as well as WHO ORS in the treatment of children with severe acute diarrhoea associated with high purging rates. This indicates that the use of a calorie rich food would offer obvious nutritional advantages over the use of ORS alone. Although the *khichri* diet has not yet been used for the treatment of young children with diarrhoea, it is a commonly-used weaning diet.

The 30% failure rates reported in this study may appear high. However, when considered in the context of the extremely high purging rates of about 250 g/kg/day, the success rate is actually similar to what has been reported

Table V. Admission Characteristics of the Patients Who Failed Therapy

Characteristics	Group A (n = 10)	Group B (n = 9)
Age in months (mean ± SD)	23.7 ± 13.4	27.2 ± 12.6
Body weight in kg (mean ± SD)	10.0 ± 2.2	9.9 ± 2.0
History of vomiting (% of patients)	100%	100%
Duration of diarrhoea in hrs (mean ± SD)	320 ± 25.9	241 ± 23.2
Initial purging rate g/kg/h (m ± SD) (during rehydration)	6.9 ± 3.7	13.5 ± 6.6
Degree of dehydration (n)		
Moderate (5% to 9%)	1	1
Severe (≥10%)	9	8
Nutritional status (Gomez criteria)		
Normal, n (%)	20%	11%
Grade I, n (%)	60%	44%
Grade II, n (%)	20%	45%

before for enteral treatment of severe diarrhoea. Sack *et al.* reported an overall mean success rate of 55% for glucose- and sucrose-based oral rehydration solutions when the purging rate exceeded 80 g/kg/8 hr (or 240 g/kg/24 hr) (12). Although earlier authors questioned whether enteral feeding could be tolerated if the volume of diarrhoea exceeded 30 g/kg/day (13), more recent studies have demonstrated the obvious benefit of feeding when the initial mean purging rate ranged between about 65 g/kg/day (14) to 160 g/kg/day (15). When compared to standard glucose ORS alone, the volume of stool and duration of diarrhoea has been similar or less in several studies (7,15). Our data, obtained from children with even higher purging rates support the efficacy of early feeding as an essential part of oral therapy.

Some important limitations should be considered in reviewing these data. The number of children studied was not sufficient to show a statistical difference in the two treatment groups. Unfortunately, the patient enrolment was severely curtailed during several civil disturbances in Karachi during the study period. The nature of the infectious agent causing diarrhoea can influence the response to enteral therapy (14-16) but microbiologic examination of stools was not available in this study. However, the great majority of our patients were admitted during a 3-month period when an epidemic of severe watery diarrhoea occurred in Karachi. The illness seen in both groups of patients was very similar to this epidemic form of watery diarrhoea.

The impact of the dietary regimens was difficult to assess as most families removed their children from the study by day 3 or 4 when the child had shown improvement. During the short duration of study, nutritional benefit of the therapy could not be demonstrated. The 24 hour period of ORS alone compared to the more calorie-dense traditional diet may be too brief a period to demonstrate nutritional advantage but early feeding may help to reduce stool volume and frequency.

Caution should be used in attempting to extrapolate these findings to the outpatient management of diarrhoea since this was a small, hospital-based study where children who could not tolerate feeding received intravenous hydration. However, since severely ill children tolerated the *khichri*, half-strength milk formula diet as well as WHO ORS, these findings indicate that this diet may well be used effectively in the great majority of diarrhoeal episodes which are less severe than the ones treated in this trial.

As might be expected, the failures as a group had evidence for more severe illness than the children who were successfully treated. This placed these children at the extreme end of the spectrum of severe illness as they had high purging rates on admission and almost all (90%) were severely dehydrated. All of the failures had a history of vomiting before enrolment in the study and all continued to vomit during the study compared to 52% of the children treated successfully ($p < 0.01$).

The five children who developed seizures had very severe diarrhoea as evidenced by their > 10% dehydration on admission and purging rates in excess of 265 g/kg/day. Because none had signs of sepsis (although one did have a fever just before the seizure) and none required antibiotic therapy in their recovery, we feel that these children most likely had electrolyte imbalance and not sepsis as the cause of their

seizures. Seizures have been described in episodes of diarrhoea associated with hypoglycemia, hypernatremia, and hypocalcemia. A combination of these factors may have played a role in these cases but the absence of laboratory data prevents establishment of a final diagnosis.

These results, although limited by the several factors mentioned above, have important potential implications for the management of acute diarrhoea in Pakistan. Appropriate early feeding may be tolerated at least as well as WHO/ORS alone and could offer better nutritional benefits, especially in a country where diarrhoea is a problem. The use of an inexpensive, culturally acceptable diet has obvious benefits when country-wide interventions are considered. Clearly, larger, community-based studies of this diet are now indicated to assess the potential for impact on health policy.

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BEHAVIORAL STUDIES

The use of ORS (Nimkol) in management of childhood diarrhoea by mothers in the suburbs of Rawalpindi-Islamabad

by

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THE USE OF ORS (NIMKOL) IN MANAGEMENT OF CHILDHOOD DIARRHOEA BY MOTHERS IN THE SUBURBS OF RAWALPINDI-ISLAMABAD

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ABSTRACT

A total of 595 respondents (200 from urban Kachi-abadis and 395 from rural communities of Rawalpindi-Islamabad) were interviewed for their knowledge about the use of ORS (Nimkol) in childhood diarrhoea. Most of the respondents were mothers with low literacy rate (23%). The prevalence of current diarrhoea among children was 36.8% on the day of interview whereas 57% of the children had history of having suffered from an episode of diarrhoea during the past two weeks. About 75% respondents claimed that they had an experience of using ORS (Nimkol). Most of them (72.1%) had used ORS (Nimkol) for childhood diarrhoea and dehydration and 28% had used it for diseases other than childhood diarrhoea or on doctor's advice. Only 11% mothers of children who were currently suffering from diarrhoea were using ORS (Nimkol) and a few mothers mentioned of giving home made fluid remedies like salt-water, salt-sugar-water or lemon-sugar-salt water for childhood diarrhoea. The use of ORS (Nimkol) was more common among the families with higher income. Regarding the preparation of ORS (Nimkol) solution, 57.8% respondents had fairly accurate knowledge. Fifty percent of the respondents had procured ORS (Nimkol) from the hospitals or clinics. (JPMA 40: 178, 1990).

INTRODUCTION

Acute diarrhoea is a major health problem among children in developing countries like Pakistan which may threaten their health and sometimes their lives[1]. The World Health Organization (WHO) introduced oral rehydration therapy (ORT) in the past decades and had made considerable investment for the promotion of oral rehydration salt (ORS)-Nimkol as the preferred treatment for acute childhood diarrhoea[2]. The concern about the extent to which ORS had been accepted by the general population had led to a series of studies in the recent past which indicated that the knowledge about ORS had been increasing gradually during the past few years[3-6]. A major increase in awareness and utility of ORS (Nimkol) occurred in the late 1980's with an evidence of increased use of ORS in 1987-88, due to extensive promotional efforts[2,7]. The Planning and Development Division, Government of Pakistan conducted a study in 1984 which showed that 32% of mothers in rural areas and 50% of mothers in urban areas reported the use of ORS[8]. PRITECH in 1989 had also reported an increase in the awareness and use of ORS by health care personnel and patients[9].

Our study was related to childhood diarrhoea among families belonging to relatively low socio-economic status in urban (kachi-abadies) and rural areas of Rawalpindi and Islamabad. The study was conducted in summer as the prevalence of diarrhoea in such families is higher in hot season[10]. In this paper we present the data on the knowledge and use of ORS (Nimkol) in childhood diarrhoea by respondents and how its use is related to their age, education and socio-economic conditions.

METHODOLOGY

The study was carried out in urban (authorised and unauthorised) working class settlements and rural and semi-rural communities located at a distance ranging between 5 to 45 kilometers from the metropolitan boundaries of Rawalpindi & Islamabad. The households which had children with ages upto 36 months were selected by stratified multistage random sampling. The selection of households was done by using union council lists or lists prepared by local guides because of the spotty and, at

times, inaccurate census records of the union councils. The local informants, especially children, helped in identifying households which had children of the appropriate age. The villages of eight union councils and five urban settlements were selected for the study. The headmen of the urban settlements and councillors of union councils were approached and the purpose of the study explained to seek their participation and cooperation. The survey was conducted from June to September 1988 when the day time temperatures ranged between 35-45°C.

The research team undertook this study as the first phase of an ongoing effort to document sociodemographically significant beliefs and practices regarding diarrhoea in these areas. For this purpose a questionnaire was utilized which was applied to 595 mothers (95.8%) and other primary caretakers of children. This questionnaire was pretested and revised and the interviews were conducted in the local dialect.

The topics covered in the survey included the diarrhoeal prevalence among children of ages upto 36 months, the practices regarding fluid intake during diarrhoea, the respondents knowledge and use of ORS (Nimkol) for acute childhood diarrhoea.

Statistical Analysis

The parameters included in this paper were categorised according to suitable breakup. Two way contingency tables were constructed for mutually exclusive categories for different variables.

The Chi-square (X^2) test was used to determine the association between variables. On the basis of Chi-square test p-values were calculated for knowing the degree of association between parameters.

RESULTS

The sample included 200 respondents from the urban settlements (Katchi-abadis) and 395 from the rural communities. They were mostly mothers (95.8%). Extended family households were 29% in urban and 57% in rural areas, with the remainder being nuclear family households.

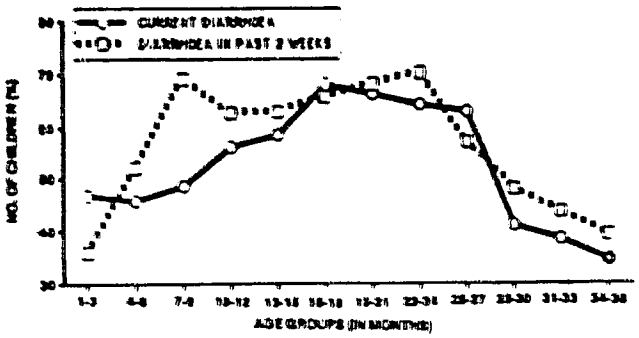

Figure 1. Age-wise distribution of current diarrhoea and diarrhoea in past 2 weeks.

Childhood diarrhoea

Out of a total of 741 children below three years of age (mean age: 18.3 months), 36.8% were experiencing an episode of diarrhoea at the time of interview, which was found to be maximum at the age of 17 months (Figure I). However, during the past 2 weeks the diarrhoeal prevalence was high and was reported in 57% children.

TABLE I. Use of ORS (Nimkol) in urban and rural areas
n = 595

Use of Nimkol	Urban (Slums)		Rural (Villages)		Total	
	n	(%)	n	(%)	n	(%)
Used	161	(80.5)	287	(72.7)	448	(75.3)
Not used	39	(19.5)	108	(27.3)	147	(24.7)
Total	200	(100)	395	(100)	595	(100)

Chi-square = 4.0 (p-value = 0.04)

TABLE II. Use of ORS (Nimkol) according to family income.
(n = 595)

Income group	Average income	Nimkol used		Nimkol not used		Total	
Rupees	Rupees	n	(%)	n	(%)	n	(%)
Up to 1000	908	301	(71.7)	119	(28.3)	420	(100)
1001-2000	1477	86	(81.9)	19	(18.1)	105	(100)
2001-3000	2640	28	(87.5)	4	(12.5)	32	(100)
> 3000	4342	33	(86.8)	5	(13.2)	38	(100)
Total	1321	448	(75.3)	147	(24.7)	595	(100)

Chi-Square = 10.7 (p = 0.01)

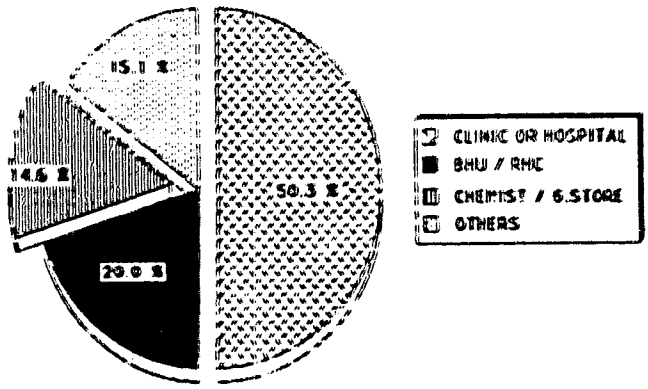

Figure 2. Sources of ORS (NIMKOL).

ORS (Nimkol) : reported use

Three quarters of the respondents reported that they had occasionally used ORS (Nimkol) (Table-I). The awareness and utility of ORS (Nimkol) was reported by a greater percentage of urban respondents and the use of ORS (Nimkol) was significantly more common among families with higher monthly income (p = 0.01) (Table-II). The literacy rate was significantly associated with proper preparation of ORS (Nimkol) (p = 0.02). Among mothers who had previously used ORS (Nimkol), 57.8% had accurate knowledge of mixing the solution, whereas some knowledge of mixing ORS (Nimkol) was found among

34.4% of respondents (1 liter for the standard packet) (Table III). The accuracy of container size used for preparation of ORS (Nimkol) was related to the level of education acquired by the respondents (Table IV). Among the respondents older than 20 years, age had a significant inverse correlation with the use of ORS (Nimkol) ($p = 0.02$) (Table V). Curiously, no relationship between the presence of radio or television in the house and the use of ORS (Nimkol) was observed thereby showing no major effect of broadcasting media in the propagation of the use of ORS (Nimkol). On the whole 30% of respondents had ORS (Nimkol) packets in the household, which were shown to the interviewers. Among those respondents who had ORS (Nimkol) packets in the house, half had acquired them from hospitals or private clinics while rest of them had obtained them from other sources (Figure 2). The number of respondents who had an experience of using ORS (Nimkol) in the past was 75.3% and out of these 72.1% used ORS (Nimkol) for diarrhoea and dehydration, while the rest had employed it for other diseases (11.7%) and on doctors' advice (16.2%).

ORS (Nimkol) and diarrhoea

Although the reported use of ORS (Nimkol) in childhood diarrhoea was high among our sample and was similar to the results obtained by the Planning and Development Division, Pakistan 1984, the actual use of ORS (Nimkol) was somewhat questionable as only 24.3% of households with children, who were currently suffering from diarrhoea, had ORS (Nimkol) packets while on the other hand 36% of households having unaffected normal children had ORS (Nimkol) packets. In cases of current diarrhoea, the mothers were asked as to what type of liquid their children were taking. Out of the 245 mothers who responded to this question, only 11% mentioned giving ORS (Nimkol) on that very day. Fifty-four percent of mothers were giving their children breastmilk, 9.0% were giving glucose water and a few mentioned salt water, salt-sugar-water and lemon-sugar-salt-water (Sikanjbeen). Nevertheless, the mothers did consider ORS (Nimkol) as a good treatment for childhood diarrhoea/dehydration. About 16% of mothers from urban areas mentioned that they used ORS (Nimkol) on the advice of physicians, and out of the mothers living in rural areas, nearly one fifth gave this very reason for the use of ORS (Nimkol) in childhood diarrhoea.

TABLE III. Knowledge for preparing ORS (Nimkol) solution according to the education of Respondents.
n = 458

Education	No Knowledge		Some Knowledge		Accurate Knowledge		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Illiterate	33	(9.7)	125	(36.8)	182	(53.5)	340	(100)
Read & write	2	(7.7)	7	(26.9)	17	(65.4)	26	(100)
Primary	0	(0.0)	12	(28.6)	30	(71.4)	42	(100)
> Primary	0	(0.0)	10	(25.0)	30	(75.0)	40	(100)
Total	35	(7.8)	154	(34.4)	259	(57.8)	448	(100)

Chi-square = 15.1 ($p = 0.02$)

TABLE IV. Size of container used for preparing ORS (Nimkol) solution according to the education level of respondents.
n = 446

Education	Wrong size		Approximately correct		correct		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Illiterate	54	(94.7)	85	(81.7)	201	(70.6)	340	(76.3)
Read & write	1	(1.8)	3	(2.9)	22	(7.7)	26	(5.8)
Primary	2	(3.5)	10	(9.6)	30	(10.5)	42	(9.4)
Above primary	0	(0.0)	6	(5.8)	32	(11.2)	38	(8.5)
Total	57	(100)	104	(100)	285	(100)	446	(100)

Chi-square = 19.8 ($p = 0.003$)

TABLE V. Use of ORS (Nimkol) according to age of respondents.
n = 595

Respondents' age (in years)	Used		Not used		Total	
	n	(%)	n	(%)	n	(%)
Up to 20	37	(69.8)	16	(30.2)	53	(100)
21-30	266	(79.9)	67	(20.1)	333	(100)
31-40	128	(71.1)	52	(28.9)	180	(100)
41-50	13	(59.1)	9	(40.9)	22	(100)
> 50	4	(57.1)	3	(42.9)	7	(100)
Total	448	(75.3)	147	(24.7)	595	(100)

Chi-square = 10.7 ($p = 0.02$)

DISCUSSION

The ORT has a well established scientific basis and its ability to save children's lives in acute diarrhoeal disease has been convincingly demonstrated[3]. The Ministry of Health, Pakistan has conducted a major effort to promote ORT use nationwide[2]. Saade (1989) reported that 30 million packets of ORS (Nimkol) were produced annually in Pakistan[9]. In our study it was observed that Pakistani mothers were gradually becoming more aware of ORS (Nimkol) as 75.3% of respondents claimed that they had the experience of using it occasionally. However, the concept varied about the purpose of ORS (Nimkol) administration in childhood diarrhoea. It was found that 72.1% respondents used ORS (Nimkol) to treat childhood diarrhoea or dehydration while about 28% used it on doctor's advice or for the treatment of other diseases. There is a need for a clear understanding of the use of ORS (Nimkol) by the general population. This would require both the use of local terminology of illnesses associated with diarrhoea and the conceptual translation of dehydration[11,12].

The findings revealed that while a majority of rural mothers were familiar with general concept of ORT, most of them were not using the therapy in an effective manner. The most frequent error was the administration of ORS (Nimkol) in inappropriately small quantities, presumably because of an inadequate understanding of the principles of water replacement in serious cases of dehydration. In

this study nearly 42% of mothers were not administering ORS (Nimkol) accurately. Such a high frequency of wrong administration of ORS (Nimkol) was mainly due to lack of education among respondents as 78% of them were found to be illiterate. Hence, there is a greater need for Pakistani mothers to become educated because they can readily learn and practice the correct use of ORS (Nimkol). Another factor affecting the use of ORS (Nimkol) among mothers was related to their age. It was found that young mothers were more likely to use ORS (Nimkol) packets as compared to their older counterparts. The use of ORS (Nimkol) among respondents below 21 years of age was 69.8%. This increased to 79.9% in the age group 21-30 years and then there was a decline in the administration of ORS (Nimkol) with increasing age. This may be due to a relatively less awareness among young girls about the health problems of children. The older women of under-developed areas had their own rigid concepts about the treatment of diarrhoea and dehydration, therefore they were not very enthusiastic about the use of ORS (Nimkol) as compared to the younger respondents.

The present study also revealed that about one-third of the respondents did not use correct-sized containers. This was particularly due to the confusion caused by the varying amount of water (half or one liter) required by different sized ORS packets for the preparation of solution. Mull & Mull reported that some Pakistani mothers mixed half a packet of ORS in 1000ml of water while others mixed one packet in 250ml of water[6].

It was also observed that the frequency of the use of ORS (Nimkol) packets was less in low income households as compared with higher income houses. When questioned about the source of obtaining ORS (Nimkol), it was found that half of the ORS (Nimkol) packets were procured from hospitals/clinics whereas only one-seventh of respondents purchased them from chemists/general stores. The likely reason was that ORS (Nimkol) packets were mainly supplied to the hospitals and clinics and no proper system of their distribution to chemists/general stores was available. Moreover, ORS (Nimkol) packets were very cheap and did not provide any significant margin of profit to the shopkeepers. Therefore, general stores and chemists were not interested in having adequate stocks of ORS (Nimkol) packets. As hospitals and private clinics were not close to all houses, so mothers sometimes gave home made salt-water solution, sugar-salt-water solution or lemon-sugar-salt solution to their children who were suffering from diarrhoea. Although such home made remedies were generally good for diarrhoea and dehydration but most of the mothers used ORS (Nimkol) packets for diarrhoeal treatment. These results highlight the observations that the awareness of ORS (Nimkol) use both among the doctors and respondents is increasing. Most of the doctors reported that a number of their childhood diarrhoea patients were already being given ORS by their mothers even before consulting them. Thus it is felt that ORS (Nimkol) should be sold at general stores besides chemists shops so that it is easily available to consumers.

It was concluded from this study that in Pakistani mothers the awareness about the use of ORS (Nimkol) was increasing. The use of ORS (Nimkol) was more common among the families with educated mothers and who had higher income, though the incidence of diarrhoea was much higher among the children of poor families. One half of the mothers had accurate knowledge about the preparation of ORS (Nimkol) solution. There is still a need to make concerted efforts to popularize the use of ORS (Nimkol) in our general population and to educate the mothers about the accurate use of ORS (Nimkol). If the mothers could learn to treat their children properly with ORS for diarrhoeal disease at an early stage, then the morbidity and mortality due to childhood diarrhoea could be reduced to a considerable extent.

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MOTHERS' FEAR OF CHILD DEATH DUE TO ACUTE DIARRHOEA: A STUDY IN URBAN AND RURAL COMMUNITIES IN NORTHERN PUNJAB, PAKISTAN

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Abstract—The investigation of cultural models of diarrhoeal illness which are employed by mothers and their emotional responses to children's illnesses is presented in a study of 193 households in urban and rural communities in Punjab, Pakistan. The household survey of mothers of children 0–36 months was complemented with in-depth interviews of a subsample of 70 mothers. Findings indicate that diarrhoea must be regarded not only as a disease but as a symptom belonging to several popular illness categories. Mothers' emotional responses to symptoms are in part shaped by the illness categories to which they assign a child's diarrhoea episode, and maternal fears that symptoms of diarrhoea may be life threatening are associated with previous experiences with death of children, with treatment choices and help-seeking. A significantly higher proportion of mothers who fear diarrhoea to be life threatening to their children than mothers with other concerns choose to use NIMKOL, the Pakistan ORS. The necessity of recognizing the complexity of interpretive and emotional processes which shape the care of children and the home treatment of childhood disease is emphasized.

Key words—Pakistan, mothers' emotions, diarrhoea, child death

INTRODUCTION

> A distraught mother in a small village in Pakistan accosted the women of the research team as they canvassed village households. She cried out for help and told the team that her child was "but hanging on to life"—a victim of recurrent diarrhoea. A tale of woe ensued as the mother related how she had sought diagnoses and treatment from neighbors, clinics, doctors, hakims ((traditional healers)) and holy shrines. Her frantic search for cause and cure had been emotionally exhausting. She feared her child would die. "What", she asked the team, "should I now do?"*

Recent debates in the anthropological literature on maternal reactions to children's illnesses and the death of their infants raise questions relevant to the study of mothers' responses to acute childhood diarrhoea. Research by Nations and Rebhun and by Scheper-Hughes on childhood disease and death in Northern Brazil highlights mothers' emotional responses and psychological states and how these influence parental efforts to affect the outcome of disease in their children [1–4]. Although these researchers disagree about the precise nature of maternal reactions to desperately ill children in a community in Brazil, their work suggests the importance of investigating how mothers interpret their children's symptoms and how this influences their emotional responses and therefore caretaking of ill children. In particular, it raises the question of how the death of children is experienced in societies with high childhood mortality, and how these experiences influence the treatment of severe illness for subsequent children.

Many studies of maternal beliefs, attitudes and behavior related to acute childhood diarrhoea have been conducted during the past decade as part of public health efforts to improve home management practices of acute diarrhoea in small children. Studies in South Asia have emphasized mothers' conceptualization of diarrhoeal disease as well as hygienic and home management practices; in particular, the acceptance and accuracy of use of manufactured or home-based oral rehydration solutions ((ORS)) have been assessed [5–12]. In Pakistan, Mull and Mull interviewed 57 rural Sindi women to "document clinically-significant maternal and child beliefs and

*This case is elaborated in the latter section on maternal concern. The women researchers were very disturbed that they had limited resources with which to assist mothers and their afflicted children. After initial forays into the field without medicines, they began to take ORS packets to distribute and examined ill children and offered instruction on appropriate home care. The physicians also referred seriously ill children to hospital diarrhoeal units for care. In this case, the woman and her son were referred to the pediatric diarrhoeal unit located in the teaching hospital associated with the PULSE research unit and the medical school. However, the researchers were gravely concerned that the apparent chronicity of the disease would not be altered, even with hospital treatment.

practices" related to childhood diarrhoea [12]; and more recently, D. Mull has explored traditional perceptions of marasmus in urban colonies in Karachi [13]. The research we report here was part of an effort (1) to build on these earlier studies in Pakistan; (2) to explore more explicitly the relationship between cultural models of diarrhoeal illnesses and mothers' emotional and behavioural responses to their sick children; and (3) to join survey and qualitative methods in that investigation.

The research was carried out in urban working class settlements and rural agricultural communities in the Rawalpindi–Islamabad area, which is in the Northern Punjab region of Pakistan. The study consisted of a household survey of 595 mothers or primary care-takers of children 36 months or less and a tape-recorded in-depth interview with a subsample of 70 of these mothers. In this paper, we report findings from the in-depth interviews and the household survey.

We explore the general hypothesis that there is not a singular maternal response to "diarrhoea", but that two kinds of factors influence mothers' evaluation and behavioral response to diarrhoeal episodes in their children: (1) the type of illness of which diarrhoea is seen to be symptomatic; and (2) a mother's previous experience with child diarrhoea and its consequences, in particular child death, which shapes mothers' emotional response to this childhood illness. We describe the cultural categories these Pakistani women use for evaluating the significance of a child's diarrhoea, and the views of cause of illness, threat to the child, and appropriate responses entailed by these categories. We then examine types of fears, worries and concerns which these mothers associate with acute childhood diarrhoea, in particular mothers' "fear of death", and the relationship of these expressed fears to previous experiences with illness in their children.

THE STUDY

The larger aims of the study on which this paper is based included documentation of mothers' descriptions of childhood diarrhoea, assessment of the extent to which diarrhoea was viewed as serious, life-threatening, or particularly distressing to mothers; analysis of the association of distress and seriousness with children's symptoms; and mothers' thoughts about causes, consequences, and treatment of various forms of diarrhoea. The study was carried out during the peak diarrhoeal disease season, from June to September 1988, when the temperature frequently reached 45°C in the summer sun.

Community settings

Research was conducted in urban and rural communities known to be at high risk for acute childhood diarrhoea because of limited sanitation and water resources, therefore they were in great need of diarrhoeal control efforts. The urban settlements included five communities, known as "colonies," three from Islamabad and two from Rawalpindi. The three communities in Islamabad, the capital city, were unauthorized, densely populated, mud-brick and clay squatter settlements located on government land. Two of these "colonies" are separated from the middle- and upper-class modern city neighbourhoods by high boundary walls. Two "colonies" had piped city water available at several sites throughout the settlements, although no homes had piped water; electricity was acquired illegally. Sewage ran through the connecting alleys and there was no formal sewage or sanitation system. The third "colony" had no community piped water supply. A river provided the water source, although some houses had wells which appeared to be tapping into the city's sewage drainage system. No sewage, electricity or garbage disposal systems were in operation. Housing was primarily mud-brick or clay, but some tent-like hay structures provided minimal shelter for the poorest families. Schools were nearby and available to the children from all three colonies. Residents were primarily manual laborers, often migrants to the region. Christian "sweepers" populated one of the colonies, and a number of Pathans and Kashmiris resided alongside their Punjabi neighbors in another.

The urban settlements in Rawalpindi contrasted with those in Islamabad; these were authorized settlements, with piped community water supplies. Twenty-three percent of homes had piped water and minimum latrine systems; 66.5% had authorized municipal electricity, and primary schools were available to the children. The majority of the houses were partially brick and cement and most of the inhabitants were laborers and low rank office staff.

The rural communities were selected from "near" villages, within a radius of 5–15 km from the municipal boundaries of Islamabad–Rawalpindi, and "far" villages, within a radius of 15–45 km of municipal boundaries. In each category, some villages were easily accessible to major highways, others were remote with difficult accessibility. The near villages, selected from four Union Councils (administrative clusters of villages), were located in the foothills surrounding the cities, and the population ranged from small landlords, farmers, government servants, shopkeepers in the city, and skilled and unskilled labourers. Housing was traditionally rural, with thick mudbrick walls. Water sources were generally shallow wells; some village compounds had deep wells, and several communities had deep community wells. Sanitation and sewage systems were non-existent. Primary schools were readily accessible.

The "far" villages, drawn from four Union Councils, included some communities which had electricity, central sewers, and educational and health institutions. Deep or shallow wells were present in 53.3% household compounds; some households

had hand pumps for the wells. As in the "near" villages, the income of the residents was derived from mixed sources, including landownership, farming, skilled and unskilled labour in the city, and from remunerations by relatives working abroad.

Urban or rural residence did not necessarily coincide with socio-economic position or women's educational status. Health and sanitation also did not necessarily improve with urban residence.

Household sample and survey

Households were equally selected from the three types of communities: 200 from the urban settlements, 200 from the "near" villages and 200 from "far" villages.* For the villages, union council lists were utilized to identify households with children 36 months or less; in addition, because of the sporadic and at times inaccurate census records of the union councils, local informants, especially children, aided in identifying households with children of the required age. For the urban settlements, no community lists existed; thus guides and informants assisted in the construction of lists of those which met the criteria. These two methods assisted the research team in the selection of appropriate households in each community, and a multi-staged random sampling for proportional allocation was employed as households were selected from the prepared lists. All but five of the women invited to participate in the household survey agreed to be interviewed, for a total of 595 respondents.

Topics covered in the household survey included incidence of diarrhoea among children 36 months and less, food and fluid practices, knowledge and use of ORS, dietary and health treatments for acute childhood diarrhoea, and maternal concerns and perceptions of childhood diarrhoea and dehydration. The survey interview, utilizing open and closed questions, was designed after a series of exploratory field studies and was pretested and revised by the research team. Responses were pre-coded indicating unprompted or prompted answers; for the open questions, responses were coded following the interviews.

The survey was complemented by the in-depth interviews conducted with a subsample of surveyed households. The 70 mothers chosen to participate in this part of the study represented each of the sampled regions in the larger survey. Mothers were asked to expand on the comments they gave during the survey on childhood diarrhoeal disease, and narratives of diarrhoeal illness episodes were recorded. Mothers also discussed causes and treatments of different types of diarrhoeal illness as well as their worries, fears and distresses. These interviews lasted approx 1–2 hr. Fifty-seven percent of the women who participated in the in-depth study had one child suffering from diarrhoea at the time of the interview.

Interviewers, all women, including four health worker-interviewers, two physicians, and an anthropologist, were trained for one month. The goal of this training was to enable interviewers to become familiar with the aims of the study and the purpose and meaning of each question. Trainees were involved in pretesting and revising the survey interview. The anthropologists participated in the process and also constructed and conducted the in-depth interviews. A woman research scientist (Bukhari) also participated in formulating and revising the survey and in-depth interviews, reviewed survey interviews for quality control, and conducted 30 of the 70 in-depth interviews.

Table 1. Characteristics of households and respondents

	Urban	Near rural	Far rural
1. Households (HH) surveyed	200	199	196
% of HH with diarrhoea	66.5	67.3	63.8
% with piped water in HH	29.5	15.0	11.8
% extended family (patrilineal or matrilineal)	29.0	56.9	55.2
2. Respondent characteristics		%	
Mother of child 0–36 months		95.1	
Other kin		4.2	
No formal schooling		83.0	
Mean age		29.4	
3. Percentage of children who had current diarrhoea by region and age		%	Total N
Total		57.0	730
Urban		42.5	155
Rural		60.0	433
0–11 months of age		47.1	238
12–36 months of age		60.4	465

FINDINGS

Our analysis focuses on maternal perceptions of diarrhoea and dehydration, on maternal fear of death associated with symptoms of diarrhoea, and on narratives about life-threatening illnesses with diarrhoea or "loose motions" as a central symptom. We report findings from the household survey of mothers ($n = 595$), from the in-depth interviews ($n = 70$), and conclude the findings with a case example.

Cultural categories of diarrhoeal diseases

Mothers in the household survey used various local terms for loose motions or diarrhoea: *dast*, *pelah*, and *paichish*. They distinguished types of diarrhoea by colour and consistency: whether stools were green, white, yellow, or multicoloured and watery; whether blood was present in the stool; whether defecation

*The communities included in the survey were selected by the research team's epidemiologist and statistician, to represent the variations in the three types of communities in the Rawalpindi–Islamabad region. Eight rural union councils and five urban communities were selected. The headmen of the urban settlements and village union councils were approached by the project director, the purpose of the study explained, and cooperation and participation gathered.

was explosive "as if some blocked drainage had suddenly opened." Fifty-three percent of those surveyed described *dast*, *pulab* or *paichah* as "frequent loose motions," 25% noted they were "coloured loose motions" and 12% simply mentioned "loose motions". Twenty mothers (3%) added indigestion, dehydration and foul smelling loose motions to their descriptions. There was no significant difference across the three types of communities in the distribution of descriptions.

Mothers also associated certain causes and degrees of severity with different types of diarrhoea. Certain diarrhoeal disorders, depending on the cause and symptoms, were viewed as life-threatening diseases for their children. Mothers noted multiple causes of loose motions in response to the survey questions of "what causes loose motions (*dast*)?" Diet, both the child's (45%) and the mother's (26%), and contaminated food and water (27.7%) were mentioned frequently. Teething was also viewed as a common cause and mentioned by 34.5%, diarrhoea associated with teething is considered as part of the normal growth process. These findings are similar to those obtained in Bangladesh, Sind, Sri Lanka, and elsewhere [5, 7, 9–13]. Some respondents mentioned poverty and dirt (16.5%) as causes of diarrhoea, and one fifth mentioned seasonal changes. One-third attributed loose motions to a variety of sources such as fallen fontanelle, evil eye, or mother's breast milk being "poisoned," "dirty," "hot" or "tired"

These "descriptive" and "etiological" elements were used to discuss the nature and significance of childhood diarrhoea. They were also joined in various ways in local illness categories. What became increasingly clear in the course of the research is that "diarrhoea" is not conceived as a single illness category in the local cultural vocabulary, but that it is a symptom present in a wide variety of distinctive illnesses. Our research began to identify the local cultural categories in which diarrhoea is an important symptom.

Illness categories are often organized primarily in "descriptive" or "etiological" terms [14–16]. Descriptive categories are those defined primarily in terms of a constellation of symptoms. Etiological categories, by contrast, are defined largely in terms of cause and may join together a variety of different "diseases" which in a given instance have a particular cause. Local illness categories often join some elements of both, providing a flexible cultural idiom for evaluating and responding to illness [14, 17]. The processual characteristics of serious and recurrent diarrhoeal episodes are often reflected in the use of multiple illness categories as mothers seek to explain the unremitting nature of a child's disease.

Descriptive and etiological characteristics of illnesses in which diarrhoea is a central symptom, as elicited in the in-depth interviews, are presented in Table 2. The popular term for the illness, its characteristics, degree of seriousness, and options

Table 2. Diarrhoeal illnesses

Name of illness	Characteristics	Seriousness	Treatment
Phooey	Linear abnormality, blisters all over the body and ear and eye infection which leads to the occurrence of green stools	Death herald, few can survive	Local medicine
Sarishna	Explores in stomach, causes weakness; eyes turned upwards; passes green watery stools with burning yellow urine	Child in the mouth of death	Amulets, knotted cords for neck, spiritual blows, injections from physicians
Loose motions	White watery stools due to indigestion, teething, mothers' and child's dirt and fallen fontanelle	Dehydration, weakness and death	Home remedies, throat and body massage, hakim's medicine and sudden sprinkle of water once the face of child
Sardawan	Frequent green watery stools with sunken eyes and weakness	Weakness	Passing the child through parallel cords at the foot end of a cot and placing some oil in nearby mosque
Malish	Inborn sickness, macerates and scavenge the child like a parasite. It causes yellow stools if it comes out of the body and results in green watery stools if remain inside the body of the child	Resides in the body; is serious for the life of child	Amulets and hakim's medicine
Saya and parchawan (shadow)	Shadow effect of dead animal (mother), ill child or of mother who had still birth or miscarriage and had not taken bath after 40 days had passed	Dangerous watery stools	Amulets, knotted cords, bath on shrines and spiritual blows
Evil eye, nazar	Jealous or admiring penetrating vision, causes green, watery stools with fever, sunken eyes, dry lips	Potentially fatal	Burning of match sticks, alum and child's longer thread, oiled knotted cords for neck and arm, amulets, spiritual blows passing the child and mother through a bunch, feeding camel's or donkey's milk to the child
Fallen fontanelle	Depressed if child falls down or becomes sad. Causes watery green stools and/or vomiting	Fatal if fontanelle does up and stools never stop	Body and throat massage, placing cauldron or ashes onto the pulse and pushing it up with index finger, sudden spray of water, fixing off egg over scalp and spiritual blows

for treatment are noted. Summaries of informants' descriptions of these disorders and brief accounts of their children's experience with what they consider to be life-threatening diarrhoeal illnesses follow.

Disorders with life threatening diarrhoea

A single direct question was not effective in eliciting mothers' explanatory models of dangerous or life-threatening diarrhoea [18]. Therefore the question was broken down into: (a) what was the colour of loose motions you observed? (b) which colour is dangerous? (c) why is it dangerous and is it caused by any supernatural or malevolent force? (d) what treatments were adopted? These related questions were asked of all participants in the in-depth interviews. Most urban mothers thought loose, watery, white, green and yellow stools were dangerous, as they caused loss of water from the body which might lead to the death of a child. Dangerous or severe diarrhoea was attributed to indigestion, buffalo's milk, over eating, excessive body heat, hot weather, dehydration, or weakness and fever. Few rural women mentioned these as life threatening indicators. Only two urban women mentioned 'saya' (a 'shadow') and only one urban woman mentioned 'sarishna' (a life-threatening stomach illness) as causes of life-threatening diarrhoea (see Table 2). In contrast to the urban women, three quarters of the rural women in the in-depth interviews said that dangerous diarrhoea was due to 'phrooey', 'maleeh,' 'saya,' 'sarishna,' 'evil eye,' 'nazar,' 'sardawan,' or 'kandi-pota' (fallen fontanelle). These diarrhoeal 'diseases' were described by rural mothers as follows.

Phrooey (an innate childhood illness). Mothers explained that *phrooey* is a childhood disease caused by an innate blood abnormality. In its early stages, blisters form over the child's body; in later stages the disease leads to infections of the ear and eye which are accompanied by green coloured stools. According to respondents, this later stage is a death herald for the child. Most mothers felt that modern medicine could not effectively treat this disease, but that local remedies may be tried. However, a few women explained that doctors had injections for *phrooey*. Mothers described that if a child dies because of *phrooey*, it will turn a black or dark blue/black colour. Mothers consider that very few children are able to survive this illness.

Maleeh (an in-born illness). Respondents described *maleeh* as an inborn sickness residing within the child. It slowly macerates the child by scavenging the body and acting as a parasite. If the disease tries to 'come out' of the child, it emerges as yellow-coloured stools. If the disease 'prefers' to remain within the body, then the consequences are green, watery stools which could kill the child. The child could turn blue to black and die. Treatment options are amulets and traditional medicines prepared by and purchased from *hakims* traditional Yunani (Galenic) physicians.

Sarishna (a diarrhoeal illness). According to the village women, when a child passes green coloured stools with burning yellow urine, the disease is *sarishna* and indicates that the child is in 'the mouth of death'. The illness evolves in the stomach. One mother who told us that her child died from *sarishna* described symptoms in addition to green stools. She said her child was weak and listless; his neck and head were floppy ("his head dropped to the side because of weakness"); he suffered stomach aches, griping pains, and finally unconsciousness. In this case, the child eventually died. Another village women said that as *sarishna* was due to endogenous poison, it should be removed from the body. If diarrhoea occurs, "let it be there as loose stools wash the poison out from the body". *Sarishna* can be cured by amulets (*taweez*) or knotted cords (*ganda*) and special breathe blown upon the child by religious ascetics (*fakir*). Some mothers said that doctors had injections for treating *sarishna*, and recounted how they had taken their children to physicians to receive those injections. These injections cured the children 'miraculously'. Some women referred to this disorder as *sarishna aur wal*. The term *wal* is also commonly used for severe stomach aches and griping pains.

Sardawan (a diarrhoeal illness). Symptoms of *sardawan* were mentioned as frequent watery green stools, sunken eyes and weakness. The disease is treated by passing the afflicted child through the parallel cords at the foot end of a *charpai* (a type of platform bed), and the child is then "completely enclosed from head to foot in tight clothing". One women described to us how she took her child who was suffering from *sardawan*, shook him vigorously, rocked him to and fro, and then tossed the child to her friend who repeated the ritual movements. She then took the child to the nearby mosque where she "lit an oil lamp" and requested that the *maulvi* (religious figure) blow "spiritual breaths" (*dum*) over child.

Saya and parchawan (illness caused by 'shadow'). The village women explained that a child could become ill if it fell inadvertently in the path of a 'shadow,' a *saya* or *parchawan*. Shadows come from different sources: a child might fall into a shadow from a woman who had a still birth, miscarriage or an abortion and who had not undergone a purifying ablution bath 40 days following the mishap. 'Shadows' might also be malevolent, cast from women who have amulets for *sarishna* and *wal* (see Table 2). If a 'shadow' of an ill child passes over a healthy child, the healthy child might also be afflicted with this disorder. These 'shadows' cause a diarrhoea which cannot easily be cured. The colour of stools associated with *saya* are not specific, and might be green, white or yellow. *Saya* or *parcharwan* may also lead to fevers or marasmus. Therapies to treat *saya* or *parcharwan* include the use of amulets and knotted cords, visiting and bathing at Islamic shrines, and purchasing spiritual breaths, which are blown over

the child by a *maulvi*, a religious healer. (See also D. Mull 1990 on *saya*; her work was published after the original submission of this text) [13].

Evil eye and nazar. Villagers recounted two dimensions of "evil eye" or *nazar*; that which includes the jealous intention by another to harm a child and that which occurs spontaneously and is religious and unintentional. In both cases, *nazar* may cause a serious and fatal diarrhoeal illness. Symptoms include green watery stools, fever, sunken eyes, dry lips, weak legs and arms. In evil eye, these symptoms may occur because of the penetrating vision of a jealous relative, neighbour, friend or anyone intentionally or unintentionally commenting on the good health or beauty of a child or its clothing. The village women explained that *nazar* may also be religious in its power. Victims of *nazar* might suffer from never-ending green watery stools which could be fatal. Symptoms from *nazar*, in addition to green watery stools, include listlessness and black circles around the child's eyes. One mother recounted how her daughter "got this *nazar*, and first she was fit as a fiddle but now she has become as weak as a dried stick". Both intentional (evil eye) and unintentional *nazar* may be removed in a similar manner, such as the burning of a length of thread measured to the length of the child, or putting sugar, chubes, alum and match sticks in a blazing fire to divine the source of the *nazar*. Amulets and oiled knotted cords blessed with blown holy verses (*gonda*) may also be placed around the child's neck. Circling the banyan tree of shrines or passing the child and/or the mother through a trench dug under the root of a banyan or inzar tree, over a period of 3 days, are also known cures. (Pathans dig a trench under the root of inzar tree; it is a peach-like tree having round reddish brown sweet edible fruit.) A final treatment resort is giving an afflicted child camel's milk or donkey's milk. However, since feeding donkey's milk to a child is thought to be a sin, this ritual should be performed by someone who is not the child's parent. If parents give the child donkey's milk, it is believed that the child on growing up would not remain obedient to them. Villagers claim that the ritual is performed when no other options remain. These cures may be lengthy processes, taking up to 1 month for treatment with camel's milk; if the child is treated with donkey's milk, considered a very strong milk, the cure may take place within 10 days.

Kandi-pota (depressed fontanelle and dropped palate). Kandi-pota, was considered to cause watery green and foul smelling stools and/or green vomiting and weakness, listlessness, crying "with or without voice." In severe cases, fallen fontanelle could eventuate in unconsciousness. If the fontanelle dries out, the disease is considered to be very dangerous and critical. If both the fontanelle (kandi) and the palate (pota) "dry out", then there will be no hope of recovery and the child is "bound to die". Respondents said they treated *Kandi-pota* by placing ashes or *catechu* (a yellow powder mixed with betel nut, "paan") on the palate, which they push up with the index finger. Sometimes an egg would be tied on the scalp of the child for an entire night, or the child would be suddenly exposed to a spray of water derived from kneaded dough of brown wheat. This ritual was thought to result in the elevation of the depressed palate. Vomiting was treated by tying a black ribbon around the elbow joint. The most commonly mentioned treatment was an oil massage of the child's flank, loin and scalp; the blowing of spiritual "breath"; and the tying of oiled knotted cords around the child's neck.

Loose motions. In the view of most urban mothers, dangerous or "life threatening" diarrhoea was simply frequent watery loose motions which might lead to dehydration and eventually to the child's death. Village mothers did not particularly fear "diarrhoea", but rather feared the diseases of *phurooey*, *maleeh*, and others noted above. These life-threatening diseases and simple loose motions were treated differently. Most white and yellow stools were considered as loose motions, believed to be caused by teething, indigestion, mother's or child's diet and were treated primarily with home remedies, body and throat massages and with modern pharmaceuticals or the traditional medicines of the hakim doctors. When we asked mothers whether they ever used amulets or carried out other spiritual rituals for simple loose motions, they bluntly replied no. Some mothers laughed at the interviewer with comments "we have not heard of such remedies for diarrhoea". In contrast, when we asked whether mothers used amulets for *sarishna* or other disorders as those noted above, the reply was not only positive but the narrative of these illness experiences were rich in detail about rituals and symptoms. Comments were often made that these traditional rituals were the only effective treatments; modern medical treatment was often viewed as unable to cure these life-threatening diseases.

MATERNAL CONCERNS

Maternal responses to various forms of diarrhoea in children ranged from those who did not become alarmed and "upset", particularly for diarrhoea that is viewed as part of the normal process of growth and development, to exceptional concern and fear of death. The term used for "upset", *praishan*, in Urdu and Punjabi, conveys emotional distress. Among the respondents to the survey, 64% reported that they always became upset when their children suffered an episode of diarrhoea, one quarter mentioned they sometimes became upset, and 12% reported not being concerned. Mothers' emotional distress and alarm in response to their children suffering from diarrhoea are associated with their interpretation of the meaning of diarrhoeal and related symptoms, their assessment of severity, cause and treatment

Table 3. Mothers' reasons for becoming upset

	Urban N = 200	Near rural N = 196	Far rural N = 199	Total N = 595
Percentage of mothers mentioned the following reasons, multiple responses				
Consequences for child				
Fear of death	26.0	14.3	14.0	18.1
Symptoms				
Weakness	20.0	3.2	25.6	26.2
Dehydration or "loss of water"	6.5	5.1	0.0	3.8
Other (child's illness)	10.0	21.4	20.0	17.0
Problems for mothers				
Additional work	14.5	13.2	18.6	15.5
Mother's illness, insomnia, anorexia, "upset"	0.5	1.5	0.0	0.6
Economic problems	3.0	8.7	8.5	6.7
Treatment problems	2.5	5.1	8.0	5.2
No response and don't know	23.5	12.2	15.0	16.6

options, their previous experiences with severe diarrhoeal illness in their children and with difficult living situations. Distress is therefore shaped by mothers' fears of the consequences of a diarrhoeal illness. Our analysis in this section examines mothers' responses to questions posed in the household survey which sought to elicit worries and concerns which led to the experience of being 'upset'.

Reasons for becoming upset

We hypothesized that symptoms associated with loose motions would be triggers for alarm and maternal distress, because of the preliminary interviews we conducted prior to designing the household survey. However, survey respondents gave us a more varied picture, including not only worries about children's symptoms but also the burden of the disease on themselves and on family resources.

Eighty-three percent of the mothers, in response to an open-ended question, mentioned at least one or more reason for becoming 'upset' when their children suffered from diarrhoea. Almost one fifth of all mothers mentioned 'fear of death' from diarrhoea as their chief concern about the illness. Symptoms associated with diarrhoea, particularly weakness, were mentioned as especially worrisome, a finding which coincides with Green's research in Bangladesh [6]. In response to this survey question, few mothers mentioned 'loss of water' or dehydration as symptoms which caused them to become upset; however, in the in-depth interviews, mothers recounted stories of how they came to recognize signs of dehydration in their children, often with the aid of female kin, neighbors and physicians and acknowledged that it could be life-threatening to the child (see case description below).

In addition to the health status of the child, mothers were concerned about the added burden this illness creates for them, in terms of extra work, financial difficulties, concerns about the cost of and access to treatment. Four women felt their children's illness could impact on their own health. Seven percent of mothers mentioned both the child's symptoms and the burdens caused in describing what most distressed them. Seventeen percent only mentioned the burden the child's illness caused for them as leading to their distress and becoming 'upset'.

Fear of death

Mothers who mentioned fear of death as their primary concern were significantly more likely to report that they always became upset (84%) when their children suffered from diarrhoea than did mothers who mentioned other reasons (70%) or who indicated they did not become upset or whose children did not have diarrhoea (14%) $P = 0.0001$. Mothers who mentioned fear of death were also more likely to have children who had diarrhoea within the past two weeks (63%) than were mothers who expressed no concern or distress (31%). Mothers who mentioned worrisome symptoms which caused them to be upset, such as child weakness, also had a higher rate of episodes of diarrhoea in their children in the last 2 weeks than did mothers who expressed no concern (62%) ($P = 0.0002$). Mothers who mentioned 'fear of death' as a source of worry were also significantly more likely to associate loose motions with dehydration than were other mothers ($P = 0.0002$).

Mothers' previous experience with death of their children was associated with their fear that diarrhoea could lead to death. Mothers who mentioned 'fear of

Table 4. Mothers' association of diarrhoea and dehydration

Response Dehydration with diarrhoea	Fear of death N = 108 %	Other concerns N = 394 %	No concerns N = 93 %	Total N = 595 %
Not found	26.8	37.3	58	38.7
Found sometimes	15	15	11.8	14.62
Found always	57.4	47.7	30.1	46.2

$\chi^2 = 16.947$, $P = 0.0002$.

Table 5. Mothers' descriptions of cause of child death and expressed concerns

Mothers	Percentage with indicated concern*		
	Fear of death $N = 108$ %	Other concerns $N = 340$ %	No concerns $N = 93$ %
No death	58	77	70.0
Death of at least one child	42	23	30.0
Reasons given			
Diarrhoea	33.3	23.3	35.7
Dehydration	11.0	8.0	3.6
Respiratory	17.8	20.0	17.9
Blue baby	17.8	23.3	32.1
Fever	20.0	25.6	10.7

*Differences by expressed concern and whether a child death was experienced were significant ($\chi^2 = 14.55$, $P = 0.0007$)

death' as a source of being 'upset' were more likely to have experienced the death of a child than were other mothers ($P = 0.01$); they were also more likely to have attributed their child's death to diarrhoea and dehydration than mothers with other concerns. Curiously, two-fifths of mothers who expressed no concerns attributed previous deaths of their children to diarrhoea or dehydration.

Mothers who mentioned fear of death were also married longer, a fact suggesting greater exposure and experience with the difficulties of childhood diarrhoea. Illiterate mothers were also more likely to mention fear of death (20% vs 11% for literate mothers) ($P = 0.053$). Respondent's age, number of children and household size were not significantly related to 'fear of death'. Mothers who lived in the urban squatter and working class settlements mentioned fear of death as the reason for becoming upset more often, whereas village mothers mentioned symptoms, the work involved and financial burden of the child's disease as sources of their distress, accurately reflecting the complexities of the burdens of childhood disease for rural women. Regional variation is presented in Table 3 above.

Maternal concern and management of diarrhoeal illness

We hypothesized that mothers' worries and concerns would have some influence on the way mothers treated diarrhoeal illness in their children. In order to address this question, we asked mothers whether they had used *Nimkol*, the Pakistan Oral Rhydration Salts, for the treatment of diarrhoea.

We also asked mothers about how they managed the most recent episode of diarrhoea experienced by their child. Mothers who mentioned fear of death as the cause of becoming upset were significantly more likely to report use of *Nimkol* to treat diarrhoea than were other mothers. However, when we examined mothers' reported treatments for recent or current episodes of diarrhoea, there was little variation by expressed concern for use of medications (anti-diarrhoeals, antibiotics purchased or prescribed by physicians), *Nimkol* or home remedies and special diets. Nearly all mothers ($n = 316$) who became 'very upset' in response to their children's diarrhoeal illness reported using medications (96%), one-fifth used *Nimkol* (19%), almost half used home remedies and special diets (49%). Fourteen percent sought help from a *hakim* (traditional physician) or spiritual treatment from a religious healer, and over one-fifth (21.5%) had physicians give their children injections and/or intravenous solutions (the substance of these injections remained undefined but were likely antibiotics). The only significant differences were that mothers who expressed fear of death or worries about symptoms such as weakness were twice as likely to have sought out intravenous treatment (23%) as mothers who expressed no specific concerns (9%); and mothers who expressed no concerns were three times as likely to seek out a *hakim* or spiritual treatment (27%) as mothers who mentioned fear of death (9%). These results from the survey interview are complemented by the accounts mothers gave in the in-depth interviews of their attempts to care for their ill children.

Table 6. Mothers' fear of death by Nimkol use

Mothers	Percentage with indicated concern		
	Fear of death $N = 108$ %	Other concerns $N = 394$ %	Not concerned $N = 93$ %
Used Nimkol	88.9	75.1	60.2
Not used Nimkol	11.1	24.9	39.8

$\chi^2 = 22.10$, $P = 0.0001$

RECALCITRANT DISEASE AND MATERNAL DISTRESS

Mothers vividly recounted their concerns and emotional distress over their children's diarrhoeal illnesses. Stories of seeking cures and treatment, of escalating distress over acute, recurring or recalcitrant diarrhoeal disease, were repeatedly conveyed in the in-depth interviews. The following case illustrates the difficulties a child's diarrhoeal illness may pose for mothers. It is not an ordered clinical history, but rather the sequence of events, interpretations, and escalating distress is presented as the mother told her story to the research team. The story is in part shaped by the team's questions.

A rural case example

As we (the research team) ventured through one village, we suddenly heard a call for help. We were approached by an ill-looking woman approx 30 years old. She lamented, crying that she required our help to save her 3 year old son. We followed her to a clean and neatly kept house, of one cement and two mudbrick rooms. Although the house was clean, we were surprised at her children's appearance. They were covered with dirt and wore dirty, rumpled clothes and no shoes. The afflicted child was sucking on a broken milk bottle which was splayed with flies and caked with dirt and old milk. The mother told us the sick child was suffering from diarrhoea. He appeared listless and withdrawn. She said that for the past 2 weeks he had been vomiting, had lost weight, and suffered from chapped lips, dried skin, sunken eyes and infected ears. His abdomen was swollen and he was refusing to eat.

The mother told us that she had been giving her son buffalo milk, but as his bouts with diarrhoea continued, she thought and was advised by neighbours that buffalow milk did not suit him. Therefore, she started giving him powdered milk (*Isomil*), but his condition failed to improve. She then changed his diet, and at the time of the interview was feeding him whatever she cooked for the family: chapatti with curry, vegetables, rice water, tea, boiled rice with sugar, water and milk. When his diarrhoea became more severe, she gave him rose water, tea and *Nimkol*, at the suggestion of a physician. The doctor had "forbidden" her to give him "hard" food (solids), but she gave her son everything he was willing to eat. She had also tried her own home remedies, and was giving her son a boiled egg every day, which she would keep in a trough of water overnight to make the egg "cold," otherwise egg is a "hot food and hot foods are not good for diarrhoea".

The mother told us she became extremely distressed and upset when none of these treatments appeared to be curing her son. Her child seemed to be but "hanging onto life", becoming increasingly "weak", "debilitated, and uninterested in his surroundings." He was so weak that he could "neither cry out loud" nor move without assistance. He was "so listless that he did not react to the heat of the blazing sun". (The child was lying in the sun in the severely hot weather during the time of the interview, and he did not move until the mother moved him.) The mother said her neighbour, on seeing her child's condition, suggested she take him to the rural health clinic (BHU). At the clinic, they advised her to take him immediately to the Hospital in Rawalpindi at several hours distance by bus. Another neighbour woman who saw her son's terrible condition suggested she go to a dispensary in a nearby village, which she did. At this clinic, they also recommended that she take the child to the hospital in the city; she did and the child was treated with injections, glucose drips and medicines. His condition began to improve, and she returned home, feeling satisfied.

Yet, once again her son had deteriorated, and the bouts of diarrhoea recurred. His "white coloured stools" increased in frequency and "wherever he sat he passed stools". The mother told us that she began to rethink what might be wrong with her son, to suspect that her son had acquired a *parchawan* (shadow). She altered her approach to treating his illness and recently took him to a holy shrine for 3 consecutive days. There, she bathed him and finally cast away his shirt, believing that through this treatment the *parchawan* (shadow) had been eliminated. She sought out a hakim who treated the child; and she burned an oiled thread of her son's height, to rid him of any evil spells which might have afflicted him and caused his illness. She told us how the thread immediately flamed, indicating that the evil spell was being driven off. She followed this ritual with another, and took seven red chilies, three pinches of soil, and some alum, which she rotated over the child. She threw these things into a burning fire; the chilies gave off a pungent odor (indicating evil eye) and the alum swelled up and reflected the face of an evil bearer. She threw the alum in the alley and beat it seven times with her slipper. Her son's condition failed to improve. After several days, she took him back to the hospital where he was readmitted. She repeated the rituals once again. The child improved.

At the time of our study, her son's health had *again* deteriorated. This mother was distraught and exhausted by these efforts to cure her child of his diarrhoea and ill health. Now she was hopeless and fearful he would die. She said she was a poor woman, who earned her livelihood by cattle and goat herding. Her husband who was working in Karachi was sending her only 100–200 rupees per month (less than U.S.$ 10). She told us that she did not know what she could now do. (See footnote on p. 1043).

DISCUSSION

The findings from this study suggest that relating analyses of local cultural models of diarrhoeal illnesses to maternal emotional responses provides a distinctive perspective on the treatment worlds of mothers and families as they care for children afflicted with diarrhoea. This approach has the potential to extend analysis beyond the traditional belief and practice models of much public health research, and builds on the innovative work of researchers such as Nations and Rehbun [1] and Farmer [17] among others. Our study highlights mothers' interpretive processes as they seek to make sense of childhood diarrhoeal episodes that appear resistant to usual treatments and loom as potentially grave and life-threatening disorders.

The importance of studying "diarrhoea" not only as a discrete disease entity but as a *symptom* of other local illness categories allows us access to these

interpretive processes. The shifting array of popular illnesses which village mothers recounted when they spoke of disorders that could threaten the lives of their children illustrate but one aspect of this process. The case accounts, short vignettes, responses to the survey questions and in-depth interviews all indicate that mothers use local illness categories in a flexible manner. As they seek to make sense of a child's symptoms, of an illness episode, of the unfolding of a disorder and of the efficacy of treatment, they adjust and reassess what diarrhoeal and associated symptoms mean and redefine what may be the cause and category of the disorder. In the case described above, the mother reacted to recommendations and 'diagnoses' of neighbors, medical practitioners, and healers, altering home treatment and medical and spiritual remedies to address each new diagnostic interpretation. As her child's illness appeared ever more grave and resistant to treatment, she began to reinterpret his disease, assigning his illness to first one category and then another, from diarrhoea caused by an inappropriate diet to *parcharwan* or 'shadow' to 'evil eye'. When interviewed, this mother was in a state of exhaustion, confused and distressed, and fearful that her son's illness now only portended death. Popular illness categories are thus best studied in *processual* terms, as part of the cultural repertoire used by mothers in responding to a child's illness.

Assigning an illness episode to a particular category may organize a mother's emotional and behavioral responses, including actions oriented toward seeking treatment and hopes for influencing illness course. In addition, such categories may be assigned retrospectively, as mothers attempt to make sense of their child's illness and to justify and explain their own actions, to themselves, to their kin and neighbors, as well as to the researchers. The presence of several generations in a household, as was the case for 56% of village families and 29% of urban families, may also shape the interpretive process. Project field researchers suggested that the wide-spread reference among villagers surveyed to 'ancient' illness categories in which diarrhoea is a symptom rather than a discrete disease (Table 2) may be explained by the intergenerational culture of the extended households within which people reside and care for children.

Maternal emotional responses to childhood illness appear at least partially formed by particular etiological and descriptive illness categories, with those illnesses associated with severity and high risk of child death most evocative of alarm and distress. However, as noted in the analysis of the survey data on maternal distress, maternal emotional response is also organized in relation to previous experiences with illness and death of children, as well as to the current life situation and the ability of the mother to respond to her child's illness in a fashion she believes will be effective. The underlying paucity of material resources at the disposal of many mothers who are attempting to raise their children and care for their families in the context of poverty and need also organizes maternal responses and levels of emotional distress.

We found that maternal experience with previous child deaths not only influenced a mother's emotional response and interpretation of diarrhoeal illness, but that such experience was associated with treatment choices and help-seeking in an interesting way. Newer treatment options, i.e. *Nimkol* (ORS), [19] were more commonly used by mothers who viewed diarrhoea as potentially life threatening *and* who had previous children die. This relationship between interpretation of childhood disease, maternal emotional responses, previous experience with life threatening illness, and mothers' help-seeking behavior and choices of treatment warrants further study and analysis. The relationship also suggests that mothers who have had previous experiences with children who died because of diarrhoeal disease and dehydration and who readily use ORS may make excellent child health workers and ORS promoters for their local communities.

These findings suggest caution and have implications for future efforts of health policy planners and researchers in child health and maternal care. Simple linear models relating maternal beliefs about 'diarrhoea' to 'home care' of an ill child may be appealing, possessing clarity and apparent usefulness to campaigns designed to educate mothers in the treatment of acute childhood diarrhoea episodes. Yet, studies such as this one suggest the necessity of recognizing the complexity of interpretive and emotional processes which shape the care of children, the existing cultural and material resources to address childhood disease, and the strengths of local knowledge as well as its limitations.

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THE EFFECT OF SOCIAL CONDITIONS ON THE INCIDENCE OF DIARRHOEA IN CHILDREN

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SUMMARY

A study was conducted in urban slums, semi-rural and rural areas around Rawalpindi/Islamabad to find out the effects of the hygienic condition of households, the education of mothers, socio-economic factors and nutritional status on the incidence of diarrhoea in children. A total of 595 caretakers of 741 children below the age of 36 months were interviewed. About 95% of the respondents were mothers. The survey revealed that about 37% children were suffering from diarrhoea at the time of interview. The overall hygienic condition of 50% households was poor. Only 10.6% urban households had latrines and about 32% of houses had community water supply in the premises. In households with poor hygienic conditions, over 51% children were suffering from diarrhoea. As far as maternal education was concerned, more than 85% children with diarrhoea had illiterate mothers. In families with low income, nearly 60% children were suffering from diarrhoea, whereas the incidence of diarrhoea in children was much less (20%) in families with higher income. It was also observed that about 60% of children with poor nutritional status belonged to those households which had poor hygienic

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conditions.

INTRODUCTION

In the developing countries diarrhoeal disease is one of the major causes of death in children. In the third world each year an estimated 75 million children suffer from diarrhoea, out of these 3-18 million children die (1,2). In these countries, diarrhoea is responsible for a quarter to half of all deaths in children under 4 years of age (3). In Pakistan, childhood diarrhoea causes an estimated 3,00,000 deaths per year (4). It is frequently associated with poverty, malnutrition, poor hygienic conditions and low socio-economic status of the families (5). Those belonging to the under-developed areas like slums and villages are more susceptible. Of the several interventions that may reduce diarrhoeal morbidity and mortality, the improvement of water supply, provision of facilities for the disposal of excreta and maintenance of good hygienic conditions are particularly important (6). Therefore for control of this scourge of developing countries, an understanding of the extent of these problems in different locations is required.

This study deals with the cultural and environmental aspects related to diarrhoea with particular emphasis on hygienic conditions in households, literacy rates among mothers/caretakers and sanitary conditions of houses in the urban and rural areas of Rawalpindi and Islamabad.

METHODOLOGY

Urban (slums) and rural (villages) communities located 5-45 kilometers from the metropolitan boundaries of Rawalpindi and Islamabad were selected for this study. This was conducted between the months of June and September 1988, as diarrhoea is more common during the hot and humid season. (the day time temperatures ranged between 30-45° C).

For the identification of families with children of the required age group, the headmen of urban settlements (slums) and members of the union councils in the rural areas (villages) were approached to obtain official records of children below 36 months of age. These records were out of date and inaccurate, so local informants especially children served as guides to identify

households having such children. The interviews were conducted in the local dialect (Punjabi or Potohari). These interviews were based on a questionnaire which dealt with hygienic conditions, current espisodes of diarrhoea, socio-economic status of households and educational status of the respondents. A total of 595 households were visited. About 95% of the respondents were mothers.

The houses were categorized as having "good" hygienic conditions, if they were found to be neat and clean with proper ventilation and drainage system. Moreover in such houses, the streets were wide and paved, the livestock was housed in proper shelters and the children were well cared for and neatly dressed. However, if the conditions were found contrary to the above mentioned criteria, the hygienic conditions were catagorized as "poor". The houses which had hygienic conditions in between these two extremes were considered as "satisfactory". The nutritional status of the children was assesed according to "Gomez classification"(7).

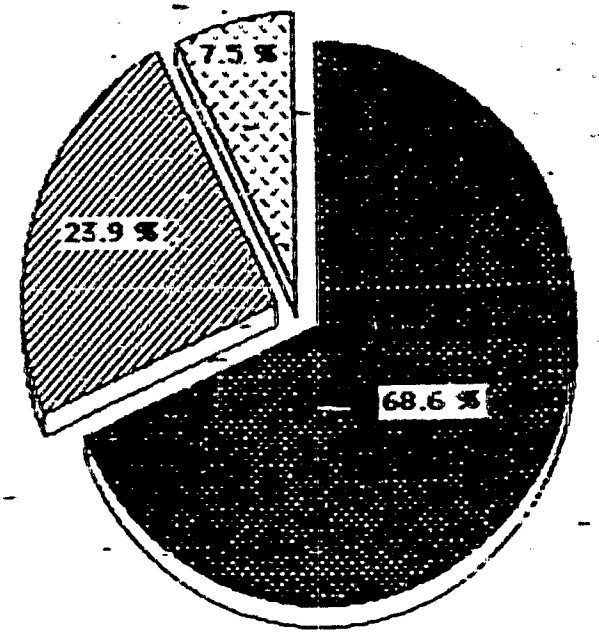
RESULTS

Five hundred and ninety five-households were surveyed, of which 200 were located in urban and 395 in rural areas. In most of the cases, the respondents were mothers (95.8%) and 77.5% of them were illiterate. Mean age of the respondents was 29.4 years (range: 13-80 years). A total of 741 children below the age of 36 months were found. The mean age was 18.3 months. More than half of them were males (56.4%). At the time of interview about 36.8% children were suffering from an episode of diarrhoea.

The hygienic conditions of almost half of the households were poor whereas 32.3% of them had staisfactory conditions and only 18% of houses had a good hygienic state. The sewerage, sanitation, water supply and toilet facilties were generally primitive, as only two of the five urban settlements of community had sewerage lines. Alleys, fields and inadequate

latrines continued to serve as the only type of toilet facility for the majority of population (Fig-I).

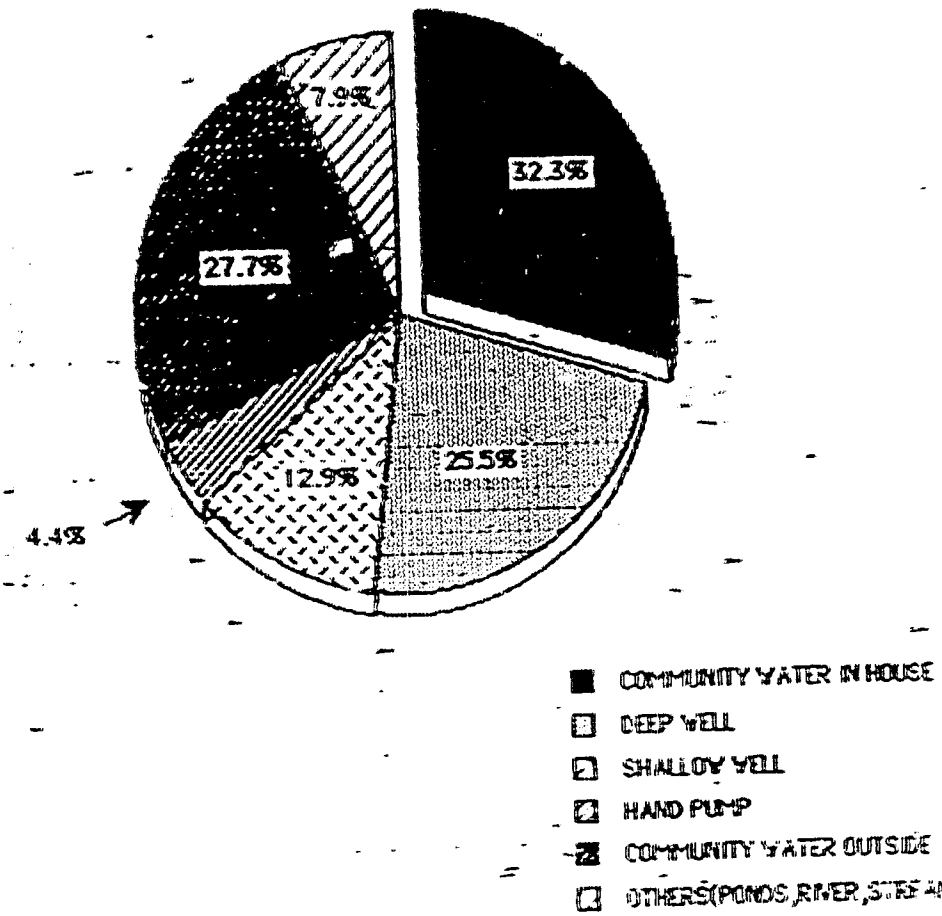
Fig 1. AVAILABLE TOILET FACILITY.



OPEN FIELD
LATRINE IN HOUSE
WATER CARRIAGE SYSTEM

The community potable water was available to one third of households, whereas 11.5% urban and 6% village households obtained water from streams, river or ponds(Fig-2).

Fig 2. AVAILABLE WATER FACILITY.



Due to poor sanitation, good hygienic conditions were difficult to maintain and a significantly higher prevalence of diarrhoea was observed in these areas. Out of 166 children with diarrhoea, over a half belonged to families having poor hygienic conditions. On the other hand, the proportion of children with diarrhoea, was markedly low (17.5%) in households with good hygienic

conditions (Table-1).

TABLE-I

DISTRIBUTION OF CHILDREN ACCORDING TO DIARRHOEA PREVALANCE AND HYGIENIC CONDITIONS OF HOUSEHOLDS

n=448

Diarrhoea	Hygienic conditions						Total	
	Poor		Satisfactory		Good			
	n	(%)	n	(%)	n	(%)	n	(%)
No	98	(30.4)	135	(41.9)	89	(27.7)	322	(100)
Yes	85	(51.2)	52	(31.3)	29	(17.5)	166	(100)
Total	183	(37.5)	187	(38.3)	118	(24.2)	488	(100)

Chi-Square = 30.0 (p=0.0001)

The respondents (mothers) education was also a significant factor affecting the child's health. The educated mothers were more aware of the benefits of good hygiene. In this study, slightly more than one-third (37%) of the children were suffering from diarrhoea. The mothers of 85.5% of these children were illiterate. There was a significant (p=0.02) inverse relation between the education of mothers and the incidence of diarrhoea in children (Table-2).

TABLE 2

RESPONDENTS EDUCATION VS DIARRHOEA AMONG CHILDREN

n=488

Respondents Education	No Diarrhoea		Diarrhoea		Total	
	n	(%)	n	(%)	n	(%)
Illiterate	240	(62.83)	142	(37.14)	382	(100)
Read & Write	19	(79.17)	5	(20.83)	24	(100)
Primary	35	(71.43)	14	(28.57)	49	(100)
Above primary	28	(84.85)	5	(15.15)	33	(100)
Total	322	(65.98)	166	(34.02)	488	(100)

Chi-square = 9.43 (p=0.02)

The family income was also one of the important factors associated with diarrhoea among children. It was found that in the low income families, 40.2% children were suffering from diarrhoea whereas middle income families had 35.1% children suffering from diarrhoea. A comparatively low frequency (20%) of diarrhoea was found among children of high income families (Table-3).

TABLE-3:

FAMILY INCOME VS DIARRHOEA AMONG CHILDREN

n = 733

Family income in rupees	Low Up to 1000		Middle 1001-3000		High >3000		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Diarrhoea absent	217	(59.8)	211	(64.9)	37	(80.0)	464	(63.3)
Diarrhoea present	146	(40.2)	114	(35.1)	9	(20.0)	269	(36.7)
Total	363	(100)	325	(100)	46	(100)	733	(100)

Chi-square = 7.7 (p=0.02)

It was also found that 54.4% of low income families had poor hygienic conditions, and a higher incidence of diarrhoea. Only 10.1% low income families had good hygienic conditions (Table-4).

TABLE- 4

DISTRIBUTION OF HOUSES ACCORDING TO HYGIENIC OBSERVATION AND THEIR FAMILY INCOME

n = 589

Hygienic observation	Income groups						Total	
	Low Up to 1000		Middle 1001-3000		High >3000			
	n	(%)	n	(%)	n	(%)	n	(%)
Poor	156	(54.4)	126	(47.0)	11	(32.4)	293	(49.7)
Satisfactory	102	(35.5)	75	(28.0)	13	(38.2)	190	(32.3)
Good	29	(10.1)	67	(25.0)	10	(29.4)	106	(18.0)
Total	287	(100)	268	(100)	34	(100)	589	(100)

Chi-square = 26.3 (p = 0.0001)

It was observed that poor hygienic conditions were also associated with an increased incidence of malnourished children in the families. Almost 60.0% of malnourished children belonged to households with poor hygienic conditions (Table-5).

TABLE- 5

DISTRIBUTION OF CHILDREN ACCORDING TO NUTRITIONAL STATUS AND HYGIENIC OBSERVATION OF HOUSEHOLDS

n = 595

Hygienic observation	Nutritional Status				Total	
	Well-nourished		Malnourished			
	n	(%)	n	(%)	n	(%)
Poor	132	(44.4)	165	(55.6)	297	(100)
Satisfactory	111	(57.8)	81	(42.2)	192	(100)
Good	79	(74.5)	27	(25.5)	106	(100)
Total	322	(54.1)	273	(45.9)	595	(100)

Chi-square = 30.0 (p = 0.0001)

These malnourished children were more prone to diseases especially diarrhoea in their early lives.

DISCUSSION

Diarrhoea is the most common illness of children in the developing countries. It is a well established fact that diarrhoeal disease in children is closely related to factors such as sanitation, hygienic conditions and socio-economic status of the households to which they belong (8,9).

The hygienic conditions play an important role in the occurrence of diarrhoea. Children of mothers who keep themselves and their children clean, properly wash the utensils and keep the house neat and tidy are less likely to develop diarrhoeal disease. This association is because of the fact, that enteropathogens which cause diarrhoea (Shigella, E. coli etc.) flourish in poor personal and domestic hygienic conditions (10). We found that 82.5% children suffering from diarrhoea belonged to households, where hygienic conditions were not good. This strongly suggests the need for a better understanding, among mothers, of the benefits of good hygiene. This can be achieved only if mothers are better educated. They will then be more inclined to learn and practise habits, which reduce diarrhoeal illness.

Other aspects, closely related to the incidence of diarrhoea, were the sanitary conditions and the water supply system. We observed that most of the houses in the study area were built close to each other and lacked proper ventilation. The streets were narrow and unpaved. There were no proper drainage and sewerage systems. In urban areas 29.5% households had water facilities within the houses, while in the villages, this facility was available to 33.6% of the houses. The toilet facilities within the houses were also scarce, as 86% of village households and 34% of urban slum houses used open fields for the purpose of easing themselves. The faecal matter lying in the open provided a source of contamination for the whole community. Various studies have shown that improvement of water supply and proper facilities for the disposal of excreta can definitely reduce the diarrhoeal morbidity and mortality rates (11-13).

The better socio-economic condition of the household was found to be an advantage. More than half of the children in families with low income were

suffering from diarrhoea, whereas only 20% children of well-off families were suffering from this disease. The number of malnourished children was more in low income households. According to Feacham this predisposes them to more severe and prolonged bouts of diarrhoea and to higher fatality rates (14). It was also observed that low income households had a greater probability of poor hygienic conditions and in such conditions about 55% childrens were malnorished. This study identifies an area of concern and calls for an immediate need for the improvement of hygienic, sanitary and overall socio-economic conditions of families belonging to underdeveloped areas.

CONCLUSION

It was concluded from this study that the incidence of childhood diarrhoea was closely related to the hygienic conditions of households and the educational status of the mothers. More than half of the children suffering from diarrhoea belonged to households which had poor hygienic conditions. About 85% children suffering from diarrhoea had illiterate mothers. Majority of malnourished children (55.6%) were found in the households which had poor hygienic conditions. Therefore, there is a need to educate the mothers about the benefits of good hygiene. The improvement of sanitary conditions and water supply system can also help to reduce the morbidity rates due to diarrhoea in underdeveloped areas.

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Effect of Antibiotics on Food Intake and Absorption of Nutrients for Children with Diarrhea Due to *Shigella*

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The effect of antibiotic therapy on intake of food and absorption of nutrients for 19 male children aged 1-5 years with suspected shigella infection was studied. The children were admitted to the hospital with acute diarrhea, high fever, abdominal pain, and >25 red blood cells and white blood cells per high-power field in the stool. Microbiologic diagnosis was made within 48 hours of admission. On the basis of clinical and microbiologic criteria, children were classified as having mild or severe infection. Ten children with mild infection did not receive antibiotics, whereas nine children with severe infection were treated with ampicillin. After the children were rehydrated, a 72-hour balance study was carried out during the acute stage of infection with *Shigella* and was repeated 2 weeks after recovery. The levels of consumption of food and absorption of nutrients were estimated. During the acute stage of infection, such levels were higher for the children treated with antibiotics than for the untreated group. During the recovery phase, the levels of intake of food and absorption of nutrients were equal for both groups. Thus, children who are treated with appropriate antibiotics not only may recover from infection with *Shigella* more rapidly, but they also may be able to absorb nutrients more efficiently.

Diarrheal disease is a major cause of morbidity and mortality in developing countries [1]. It has been estimated that 524,000 deaths that occur annually worldwide among children are due to *Shigella* [2, 3]. Infection with *Shigella* has a significant nutritional impact on children. Children who were hospitalized because of infection with *Shigella* had protein loss [4, 5], and stunting was observed among children aged 5-24 months who were infected with *Shigella* in rural Bangladesh [6].

The use of antibiotics for treatment of children who have less-severe infection with *Shigella* is controversial. The primary purpose of using antibiotics for the treatment of infection due to *Shigella* is to reduce morbidity and mortality as well as to prevent complications. Data from recent studies show that the duration of diarrheal disease is substantially reduced after patients are treated with effective antibiotics [7, 8]. Several studies have shown that ampicillin and trimethoprim-sulfamethoxazole are equally effective for treatment of dysentery due to *Shigella* [9, 10]. The present study assesses the effect of treatment of shigella infection with an antibiotic to which the organism is susceptible on the consumption of food and absorption of nutrients by two groups of hospitalized children.

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Materials and Methods

This study was carried out in the unit for metabolic studies of the International Centre for Diarrhoeal Disease Research, Dhaka, Bangladesh, from 1985 through 1986. The research proposal was approved by the committee on human ethics, and informed consent was obtained from the patients' parents or guardians.

Male children aged 1-5 years who presented with acute bloody, mucoid diarrhea of <48 hours' duration, mild to moderate dehydration, abdominal pain, and fever were included in the study. Male children who had severe dehydration, severe malnutrition, high fever (>102°F), or clinical signs of other illnesses and a history of prior treatment with antibiotics were excluded from the study.

Immediately after admission to the hospital, a specimen of stool obtained from the patient's catheter was sent to the laboratory for examination and culture. The results of microscopic examination of the specimen of stool were available within 1 hour, and the results of culture, including tests of antibiotic sensitivity, were obtained within 48 hours.

Patients were provisionally diagnosed as having shigella dysentery on the basis of clinical signs and symptoms and results of microscopic examination of specimens of stool. On the basis of these criteria, patients were assigned to either of two groups, designated as mild and severe, according to their diagnosis. Children who had fever >102°F, severe abdominal pain, clinical signs of toxicity, and >20 red blood cells (RBCs) and white blood cells (WBCs) per high-power field were assigned to the severe group. These children were treated with antibiotics and were rehydrated. Ampicillin (100 mg/kg q.i.d.) was administered since this was the most effec-

tive antibiotic used for treatment of infection with *Shigella* at the time. Patients who appeared healthier according to clinical criteria and had <20 RBCs and pus cells per high-power field in their specimens of stool and less blood and mucus in the stool were assigned to the mild group and received only rehydration therapy. After patients in both groups were initially rehydrated, they received food that was part of their staple diet.

The next morning a 1-hour D-xylose absorption test was administered following an oral dose of 5 g of pentose [11]. Twenty-four hours after admission, a 72-hour balance study was started. Patients were fed a 5-g nonabsorbable charcoal marker followed by a measured quantity of a familiar rice-based meal, which was offered ad libitum by the mothers. The first appearance of this marker in the patient's stool was considered to be the "0" hour of the study. From that point onward, the intake of food and fluids and the output of stool, urine, and vomit were recorded for 72 hours. At the end of 72 hours, a second marker was fed to the patients, and samples were collected until the second marker appeared in the patient's stool, at which time the study was discontinued.

Specimens of stool, urine, and vomit were collected at 8-hour intervals, weighed (up to 0.1 g was used for analysis), and stored at −70°C until the time of analysis. At a later date all samples of stool, food, and vomit were thawed and homogenized. Aliquot samples were analyzed for amounts of fat and nitrogen and number of calories, which were estimated with the use of standard methods [12, 13]. Samples of urine were tested to estimate the quantitative intake of food and absorption of nutrients.

The following formula was used to calculate the absorption coefficient:

$$\frac{\text{Intake} - \text{Output}}{\text{Intake}} \times 100$$

The balance study was repeated 2 weeks after the patients recovered from diarrhea.

Results

Of the 21 children included in the study, 10 were classified in the mild group and 11 were classified in the severe group. Two children were excluded from the severe group because of the deterioration of their clinical condition. Nineteen patients completed the study, and data on these patients are presented.

The clinical characteristics of the two groups at the time of admission are presented in table 1. Patients in both groups were comparable in age and body weight. Patients in the severe group had more-severe diarrhea according to clinical criteria, as indicated by the degree of fever and number of pus cells and RBCs in the stool. Eighty percent of the patients in the mild group had watery diarrhea compared with only 33% in the severe group. The volume of stool obtained daily was higher for the mild group (680 mL) than for the severe group (270 mL) ($P < .025$).

Some of the relevant results of laboratory tests performed on admission are presented in table 2. The mean number of RBCs and WBCs in the stool was higher for the severe group (77 and 83) than for the mild group (16 and 12). The electrolyte levels were similar for both groups except that the severe

Table 1. Clinical characteristics of patients with mild or severe shigella infection at the time of admission to the hospital.

Variable	Mean value ± SD or mean no. (%) of patients per indicated variable for each group: Mild (no antibiotics) (n = 10)	Severe (antibiotics) (n = 9)	P value
Age (mo)	30.0 ± 18.5	29.5 ± 18.0	...
Body weight (kg)	9.2 ± 1.7	10.4 ± 2.8	...
Diarrhea before admission (h)	9–20	5–14	...
Temperature (°F)	100.6	102.8	...
Clinical presentation			
Fever	1 (10)	5 (55)	...
Abdominal pain	1 (10)	4 (44)	...
Vomiting	2 (20)	4 (44)	...
Type of diarrhea			
Liquid with blood and mucus	8 (80)	3 (33)	...
Frank blood and mucus	2 (20)	6 (67)	...
Stool volume (mL)			
Day 1	680 ± 508	270 ± 154	<.025
Day 2	500 ± 311	235 ± 155	<.025
Day 3	494 ± 140	188 ± 98	<.001
Absorption of D-xylose	16 ± 2.5	22.5 ± 3.4	<.05

Table 2. Results of laboratory tests at the time of admission to the hospital for patients with mild or severe shigella infection.

Variable	Mean value ± SD or mean no. (%) of patients per indicated variable for each group: Mild (no antibiotics) (n = 10)	Severe (antibiotics) (n = 9)	P value
RBCs per hpf	16 ± 10	77 ± 53	<.001
WBCs per hpf	12 ± 6	83 ± 43	<.001
pH of stool	6.5 ± 1.5	9.4 ± 2.2	NS
Pathogen identified in stool culture			
Shigella flexneri	6 (60)	6 (66.7)	...
Shigella sonnei	3 (30)	2 (22.2)	...
Shigella boydii	1 (10)	1 (11.1)	...
Serum electrolytes (mmol/L)			
Na^+	137 ± 4.2	128 ± 2.2	<.05
K^+	4.5 ± 1.2	3.5 ± 1.2	NS
Cl^-	102 ± 4.2	98 ± 4.0	NS
HCO_3^-	12.0 ± 2.1	1[illegible] ± 3.2	NS

NOTE. hpf = high-power field, NS = not significant.

Table 3. Intake of nutrients by patients with shigella infection who did or did not receive treatment with antibiotics.

	Mean intake of nutrients ± SD			
	Acute stage of disease		Recovery stage of disease	
Nutrient	No antibiotics (n = 10)	Antibiotics (n = 9)	No antibiotics (n = 10)	Antibiotics (n = 9)
Carbohydrates (g/[kg·d])	11.0 ± 5.0	13.0 ± 4.2	12.8 ± 5.0	15.0 ± 3.0
Fat (g/[kg·d])	3.0 ± 2.1	3.9 ± 0.8	3.3 ± 0.4	3.8 ± 0.8
Nitrogen (g/[kg·d])	0.3 ± 0.1	0.5 ± 0.3	0.9 ± 0.1	0.8 ± 0.2
Calories (kcal/[kg·d])	67.6 ± 26.8	82.7 ± 28.0	105 ± 25.5	104.7 ± 18.0

group had lower levels of serum sodium than the mild group (128 mmol/L vs. 137 mmol/L).

The consumption of carbohydrates, fat, nitrogen, and calories for the two groups is compared for the acute phase and the recovery phase of diarrheal disease (table 3). During the acute phase, intake of all nutrients was higher for the severe group than for the mild group. Because of the large standard deviation, the differences between these two groups were not statistically significant. Caloric intake for the group of children who did not receive antibiotics was 67.6 ± 26.8 kcal/(kg·d) compared with 82.7 ± 28.0 kcal/(kg·d) for the group who received antibiotics. During the recovery phase, intake of all nutrients was similar for both groups.

Table 4 shows that the severe group had a significantly higher rate of absorption of nutrients than the mild group during the acute stage of the disease ($P < .001$). During the recovery phase the rate of absorption of nutrients improved for the mild group and became almost equal to the rate for the severe group.

Discussion

Shigellosis is associated with a high case-fatality rate, and many of the deaths due to shigellosis can be attributed to malnutrition [3, 14]. In developing countries, dysentery due to *Shigella* is a major cause of chronic or persistent diarrhea. Therefore, it is important to treat a patient who is infected with *Shigella* with appropriate antibiotics.

The present study was undertaken to evaluate whether treatment of diarrhea due to *Shigella* with effective antibiotics affects the intake of food and absorption of nutrients in addition to reducing the mean duration of an episode of diarrhea [7, 8]. In this study, antibiotics were given to the group of children whose diarrheal disease was more severe according to clinical criteria; the children in the mild group, on the other hand, received only oral rehydration solution. The group of children who were treated with antibiotics had better appetites and were able to absorb nutrients more efficiently than the children in the mild group despite the fact that the children who were treated had more-severe disease.

Several studies have demonstrated that patients infected with *Shigella* have profuse protein loss, which can be prevented by the administration of antibiotics to which the organism is susceptible [6]. There is also evidence that children who suffer from invasive diarrhea also have stunted growth [5]. Therefore, it seems that treatment of invasive diarrhea with appropriate antibiotics may result in an improvement in nutritional status by increasing both appetite and absorption of nutrients.

The pathophysiologic mechanisms of growth impairment that results from invasive or chronic enteric disease have not yet been clearly established. Anorexia that results from shigellosis is associated with growth impairment. Reduction in intake of food and avoidance of food are considered major factors in the retardation of growth caused by Crohn's disease in childhood; this retardation can be reversed by providing nutritional support to children afflicted with this disease [15, 16].

The energy requirements associated with invasive enteric

Table 4. Absorption of nutrients by patients with *Shigella* who did or did not receive treatment with antibiotics.

	Mean percent absorption of nutrients ± SD					
	Acute stage of disease			Recovery stage of disease		
Nutrient	No antibiotics (n = 10)	Antibiotics (n = 9)	P value	No antibiotics (n = 10)	Antibiotics (n = 9)	P value
Carbohydrates	76.5 ± 27	91.0 ± 23.7	NS	83.3 ± 12.0	92.0 ± 5.2	NS
Fat	53.0 ± 5.9	88.0 ± 14.8	<.001	86.7 ± 5.4	84.0 ± 12.0	NS
Nitrogen	25.0 ± 5.5	37.0 ± 2.9	<.001	65.0 ± 1.6	66.0 ± 13.7	NS
Calories	67.0 ± 30.0	88.0 ± 33.0	NS	83.0 ± 12.0	89.0 ± 14.6	NS

NOTE. NS = not significant.

infection have not been studied. Many infections, however, are associated with an increase in the basal metabolic rate and a concomitant rise in energy requirements [17]. Therefore, an increase in food consumption and the administration of appropriate antibiotics will aid in treating the disease and prevent potential complications.

The type of food most suitable for a patient with invasive enteric infection needs to be determined. Future studies may be essential to select an appropriate diet from a variety of traditional and acceptable food items.

In view of the emergence of antibiotic resistance to *Shigella*, the use of alternate ways of improving nutrition and, thereby, host resistance may be the only choice for the treatment of invasive diarrhea.

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