

## Feeding of Young Children during Diarrhea: Caregivers' Intended Practices and Perceptions

Birte Pantenburg,\* Theresa J. Ochoa, Lucie Ecker, and Joaquim Ruiz

*Institute of Social Medicine, Occupational Health and Public Health, University of Leipzig, Leipzig, Germany; Instituto de Medicina Tropical Alexander von Humboldt, Universidad Peruana Cayetano Heredia, Lima, Peru; University of Texas School of Public Health, Houston, Texas; Instituto de Investigación Nutricional, Lima, Peru; Barcelona Centre for International Health Research (CRESIB), Hospital Clínic-Universitat de Barcelona, Barcelona, Spain*

**Abstract.** Childhood diarrhea is an important cause of malnutrition, which can be worsened when caretakers limit nutritional support. We queried 390 caregivers and their children in a peri-urban community in Lima, Peru regarding general perceptions of feeding and feeding practices during diarrhea. Overall, 22.1% of caregivers perceived feeding during diarrhea to be harmful. At baseline, 71.9% of caregivers would discontinue normal feeding or give less food. Most would withhold milk, eggs, and meats. Approximately 40% of caregivers would withhold vegetables and fruits. A pilot educational intervention was performed to improve feeding during diarrhea. At follow-up survey 3 months later, none of the caregivers would recommend withholding food. Only 23.2% would recommend discontinuing normal feeding and 1.8% perceived food to be damaging. Misperceptions of the role of feeding during diarrhea pose a significant health risk for children, but a simple educational intervention might have a major impact on these perceptions and practices.

### INTRODUCTION

Globally, ~6.6 million children < 5 years of age died in 2012.<sup>1</sup> Diarrhea accounted for 9% of under-five deaths and undernutrition contributed to ~45% of all cause mortality in young children.<sup>1</sup> In Peru, diarrhea was responsible for ~4% of deaths among children < 5 years of age in 2010.<sup>2</sup> The prevalence of chronic malnutrition among young children in 2012 was between 31.9% in rural and 10.5% in urban areas, and 6.3% in Lima.<sup>3</sup> Of importance, implementing available evidenced-based interventions for diarrhea, including oral rehydration solutions, breastfeeding, and adequate case management, on a larger scale could prevent a large percentage of deaths attributable to diarrhea among young children.<sup>4,5</sup>

Malnutrition and diarrhea increase child morbidity and mortality. They may also interfere with physical and cognitive development.<sup>6–10</sup> Ingestion of nutrient-rich food early in life is associated with better school performance and earning higher wages later in life.<sup>11</sup> In a study by Checkley and others<sup>12</sup> among children in a peri-urban shantytown in Lima, poor nutritional status was associated with a higher frequency of diarrheal illness. A recent study among children < 5 years of age in rural Bangladesh revealed an association between malnutrition and more severe diarrheal illness.<sup>13</sup> In turn, intestinal infections may lead to a loss of key nutrients, damage to the intestinal mucosa, and impairment of nutrient absorption, which worsen malnutrition. Continued feeding during diarrheal episodes and continuing or increasing breastfeeding is critical for breaking the vicious cycle of diarrhea and malnutrition. Continued feeding is associated with better clinical outcomes<sup>14–17</sup> and better recovery of the intestinal function.<sup>18,19</sup> Thus, continuation of feeding during diarrheal episodes is an important component of the integrated management of childhood illness (IMCI).<sup>20</sup> Mothers and other caregivers play a central role in the effective management of childhood diarrhea. They are the first ones to manage

the illness. Correct home treatment with oral rehydration and adequate food is crucial to prevent deterioration of the child's condition. In an earlier study from a peri-urban community in Lima, however, Brown and others<sup>21</sup> noted that infants' energy intake from non-breast-milk sources decreased during diarrheal illnesses. Recent studies from other resource-poor countries showed that caregivers have limited knowledge of the importance of continued feeding during childhood diarrhea.<sup>22–24</sup> In a study from Lima, a 5-minute one-to-one counseling of mothers in a hospital setting, along with a recipe pamphlet was an effective intervention to improve nutrition of young children.<sup>25</sup>

There are few data on child feeding during diarrhea in Peru, especially in urban areas. To address this gap in knowledge, we designed a study of caregivers' practices and perceptions regarding continued feeding during diarrheal episodes. A pilot educational intervention was conducted among caregivers with the aim to improve feeding of children during illness.

### MATERIALS AND METHODS

**Study population and setting.** In December 2009, a convenience sample of 390 caregivers and their youngest child (up to 36 months of age) were enrolled by a house-by-house survey. A caregiver was defined as the person who took care of the child at the time of the study visit. The primary caregiver (see Table 1) was considered to be the person who took care of the child most of the time. Participants were recruited in three *asentamientos humanos* ("human settlements," shantytowns) in San Juan de Lurigancho, a peri-urban neighborhood north-east of downtown Lima, Peru. Socio-economic level in the *asentamientos humanos* is low. In the district of San Juan de Lurigancho, 63% of the population belong to the lowest socioeconomic levels D and E.<sup>26</sup> *Asentamientos humanos* are mainly populated by individuals, and their children, who have migrated from remote rural areas in Peru to the capital in search of a better life.<sup>27</sup> Recruitment began in José Carlos Mariátegui in blocks of houses closest to one of the main roads frequented by bus. Each fieldworker started with a different block and clockwise approached each door. After finishing with one block,

\*Address correspondence to Birte Pantenburg, Institute of Social Medicine, Occupational Health and Public Health, University of Leipzig, Philipp-Rosenthal-Str. 53, 04103 Leipzig, Germany. E-mail: birte.pantenburg@medizin.uni-leipzig.de

TABLE 1  
Study population characteristics (*N* = 390)\*

	Percent (n) or Mean ± SD (range)
Children's characteristics	
Male	50.3 (196)
Age (months)	16.5 ± 9.7 (0.5–35.8)
Age stratification	
< 6 months	15.4 (60)
≥ 6–< 12 months	23.3 (91)
≥ 12–< 24 months	34.6 (135)
≥ 24–36 months	26.7 (104)
Caregivers' demographics	
Age (years)	29.4 ± 10.1 (14–77)
Primary caregiver mother	82.8 (323)
Primary caregiver grandmother	11.3 (44)
Completed higher education	7.2 (28)
Completed secondary school	43.9 (171)
Did not complete secondary school, or education below that	43.7 (170)
Household characteristics	
Daily expenses for food (US\$)	6.8 ± 2.2 (0.7–17.6)
Access to public water inside the house	94.6 (369)
Access to public sewage system inside the house	92.6 (361)
Breastfeeding at time of enrollment	
< 6 months ( <i>N</i> = 60)	100 (60)
≥ 6–< 12 months ( <i>N</i> = 91)	90.1 (82)
≥ 12–< 24 months ( <i>N</i> = 135)	69.6 (94)
≥ 24 months ( <i>N</i> = 104)	28.9 (30)
Introduction of other foods	
Age when breastfeeding was stopped ( <i>N</i> = 124, months)	12.3 ± 7.1
Age when other milk was introduced ( <i>N</i> = 304, months)	6.0 ± 4.9
Age when solid food was introduced ( <i>N</i> = 337, months)	5.7 ± 1.2
Diarrheal episodes	
Children with diarrhea during previous 7 days, including day of the study visit, at enrollment ( <i>N</i> = 390)	16.2 (63)
Children with diarrhea during previous 7 days, including day of the study visit, at follow-up ( <i>N</i> = 356)	23.6 (84)

\*SD = standard deviation.

the fieldworker walked to the adjacent one. This way, the neighborhood was covered as completely as possible, including areas not accessible by larger motorized vehicles. Recruitment of participants continued in a similar way in Juan Pablo II and Jesús de Nazareth. Deliberately, a number of participants were recruited from the closest hilly outskirts of the neighborhoods. As the dwellings there are not arranged blockwise, fieldworkers approached the neighboring dwelling after finishing with the previous one. Written informed consent was obtained from all caregivers. The study was reviewed and approved by the Institutional Ethics Committee of the Universidad Peruana Cayetano Heredia.

**Questionnaire.** Baseline data on child feeding were collected by trained field-workers during a home visit using a structured questionnaire. The questionnaire addressed socio-demographics, previous diarrheal episodes, breastfeeding, feeding in the absence and presence of diarrhea, caregivers' perceptions of the effect of food during diarrhea, and the source of advice regarding child feeding during diarrhea. Food items were chosen by the authors based on typically available local food in an attempt to comprehensively cover the food items most likely to be fed children in this setting. To assess whether a child had experienced diarrhea at baseline and/or at follow-up, caregivers were asked whether the child had "3 or more loose stools per day" (original question: 3 o más caquitas sueltas al día) during the previous 7 days, including the day of the study visit, and for how many days. If the child had experienced diarrhea during the previous 7 days but not on the day of the study visit the diarrheal episode was considered "completed." If the child

still experienced diarrhea on the day of the study visit it was considered "ongoing."

Regular feeding of specific food items in the absence of diarrhea was evaluated at baseline by asking how many times the child had received a certain food item during the previous week or, in case the child had experienced diarrhea, how often the food item had been given the week before.

At baseline, feeding practices during diarrheal episodes were evaluated for the child's last diarrheal episode. If the child did not experience diarrhea, caregivers were asked how they intended to feed their child. As the majority of children did not recently experience diarrhea the term "intended feeding practices" will be used throughout the manuscript. Caregivers were asked whether they intended to give specific food items, breast milk or cow's milk "not at all," "less," "more," or "at the same quantity." In addition, caregivers were asked whether they intended to give solid food "not at all," "less," "more," "the same food as usually" or a "special diet." "Special diet" was not specified but comprised any quantity or quality of food that differed from the regular one given in the absence of diarrhea.

At follow-up, caregivers were asked about feeding of specific food items during diarrhea the same way as at baseline. To assess feeding of cow's milk and solid food during diarrhea, caregivers were asked about the feeding recommendations they would give a neighbor or family member regarding a child > 6 months with diarrhea, who is still breastfed, but also receives cow's milk and solid food. To assess feeding of breast milk during diarrhea caregivers were asked about their recommendations regarding an exclusively breastfed

child < 6 months and a child > 6 months who is still breastfed, but also receives cow's milk and solid food. Answer options were the same as at baseline. The use of oral rehydration solutions was reported previously.<sup>28</sup>

**Pilot intervention and follow-up.** To investigate the feasibility of improving caregivers' practices, a pilot educational intervention was performed. The educational intervention was designed by the authors, based on the IMCI guidelines for child feeding during diarrhea.<sup>20</sup> After the interview the trained field-worker conducted a 10-minute one-to-one educational intervention with the caregiver, consisting of an in-depth explanation of a leaflet on age-appropriate feeding and breastfeeding in the absence and presence of diarrhea for children < 6 months who are exclusively breastfed, and for children > 6 months (or those who already receive solid food). The leaflet also included advice in case the child vomited after feeding, information on oral rehydration, and a list of signs of dehydration that should prompt immediate medical attention. The leaflet included pictures and text. Questions were addressed by the fieldworker during the visit, and the leaflet was left with the caregiver. The educational intervention was supervised by one of the authors (BP) ensuring that the intervention was standardized. At follow-up 3 months later 83.6% ( $N = 326$ ) of the original participants were available. Using a similar questionnaire, regular feeding practices and diarrheal episodes were briefly analyzed, and caregivers' practices, recommendations, and perceptions regarding child feeding during diarrhea reassessed.

**Data analysis.** Baseline data (characteristics of the study population and reported feeding practices in the absence of diarrhea) were analyzed for all 390 caregivers. Analysis of caregivers' perceptions and intended feeding practices during diarrhea were limited to data from caregivers who could be reached twice ( $N = 326$ ). Comparison of means was performed by the student  $t$  test. Comparison of proportions was done by the  $\chi^2$  test or, if cell number was < 5, by the Fisher's exact test. Where appropriate, analysis was stratified according to the age of the child. Statistical analysis was conducted with Stata 10.0 for Macintosh (StataCorp LP, College Station, TX).

## RESULTS

**Characteristics of the study population.** The baseline study population's characteristics are detailed in Table 1. In 85.6% of cases, the mother was the person who was interviewed. At baseline, fewer children had experienced diarrhea during the previous week compared with the time of follow-up ( $P = 0.011$ , see Table 1). Mean duration of diarrheal episodes completed by the day of the study visit at baseline was  $3.5 \pm 2.1$  days ( $N = 61$ ), and similar at follow-up ( $3.1 \pm 2.5$  days,  $N = 78$ , data not shown in table). When asked for the source of advice that caregivers usually sought regarding management of diarrhea, 49.1% mentioned a family member, a friend, or neighbor; 36.8% a physician; 9.3% no one; and < 2% a health worker or nurse, pharmacist, or other, respectively (data not shown in table).

**Caregivers' reported feeding practices at baseline in the absence of diarrhea.** Of all children < 6 months ( $N = 60$ ), 56.7% were exclusively breastfed. Of children  $\geq 6$  months

TABLE 2  
Feeding practices in the absence of diarrhea at baseline (caregivers of children introduced to solid food,  $N = 337$ )

Food item	Reported regular feeding in absence of diarrhea	
	Times/week food item is consumed Median (IQR*)	
Animal products		
Chicken	5	(2-8)
Eggs	4	(2-7)
Milk products	3	(0-7)
Chicken liver	2	(0-4)
Fish	2	(1-3)
Beef/pork	0	(0-2)
Carbohydrates		
Rice	14	(7-14)
Potatoes	12	(7-14)
Bread	7	(2-7)
Cereals	6	(2-7)
Noodles	2	(0-2)
Fruits, vegetables, and others		
Vegetables	7	(4-14)
Fruits	7	(7-7)
Soups	7	(3-12)
Mazamorra	5	(2-7)
Legumes	3	(2-4)

\*IQR = interquartile range.

( $N = 330$ ), 62.4% were still breastfed. Further information on breastfeeding and introduction of other food items are detailed in Table 1.

Solid food had been introduced to 11.7% ( $N = 7$ ) of children before the age of 6 months, whereas all children  $\geq 6$  months received solid food. The regular diet (in the absence of diarrhea) of all 337 children introduced to solid food is detailed in Table 2. It consisted mainly of rice, potatoes, bread, vegetables, soups, and fruits.

For children  $\geq 6$  to < 12 months ( $N = 91$ ) "mazamorra," a starch-flour based local pudding prepared with water, fruit juice, and some pieces of fruit, was also an important food item (median times/week 7, interquartile range [IQR] 4-7, data not shown in table). The most important sources of protein for children  $\geq 6$  to < 12 months were chicken liver, chicken meat, and eggs (median times/week 3 for all three food-items, IQR 2-6, 0-6, and 1-4, respectively). For children  $\geq 12$  months ( $N = 239$ ) the main sources of protein were chicken meat (median times/week 6, IQR 4-8), milk products, eggs, and legumes (median times/week 4 for all three food-items, IQR 2-7, 2-7, and 2-4, respectively, data not shown in table).

**Intended feeding of solid food during diarrheal episodes at baseline.** When caregivers of children already eating solid food were asked how they intended to feed their child during diarrhea, 46.6% of caregivers would give a "special diet," 25.3% would feed "less," and 2.1% would give "no" food (see Table 3). Answers did not differ significantly between caregivers whose children did or did not experience diarrhea during the previous 7 days (data not shown).

Feeding of specific food items during diarrhea is detailed in Table 4. At baseline, only "mazamorra" (49.1%), soups (46.3%), potatoes (40.2%), and rice (37.4%) would be given by the majority of caregivers in the "same amount" as in the absence of diarrhea. Legumes (83.3%) and beef/pork (80.4%) were most often eliminated from a child's diet as well as milk products (72.6%) and eggs (70.8%). Few caregivers

TABLE 3

Intended feeding practices at baseline and recommended feeding practices at follow-up during diarrhea (caregivers of children introduced to solid food)

	Solid food	
	At baseline* (N = 281)	At follow-up (N = 311)
	% (n)	% (n)
More	6.4 (18)	34.7 (108)
Same food	18.2 (51)	42.1 (131)
Less	25.3 (71)	2.3 (7)
Special diet	46.6 (131)	20.9 (65)
None	2.1 (6)	0
Don't know	1.4 (4)	0

\*Difference between baseline and follow-up statistically significant ( $P < 0.05$ ).

would give "more" of certain food items during diarrhea, predominantly soups (13.2%).

**Use of breast milk and cow's milk during diarrhea at baseline.** The use of breast milk and cow's milk during diarrhea is detailed in Table 5. At baseline, 11.8% of caregivers of children < 6 months and 11.7% of caregivers of children  $\geq$  6 months would give "less" breast milk. Two percent of caregivers of children < 6 months and 4.5% of caregivers of children  $\geq$  6 months would give "no" breast milk. Among caregivers of children  $\geq$  6 months introduced to milk other than breast milk 9.4% would give "less" and 79.6% would give "no" cow's milk.

**Caregivers' perceptions of the effect of food during diarrhea at baseline.** Caregivers' perceptions of the effect of breast milk, cow's milk, and food on a child with diarrhea are detailed in Table 6. Overall, 4.6% of caregivers perceived breast milk to harm the child, 21.5% of caregivers perceived it to be neither harmful nor helpful to the child. Sixty-one percent perceived ingesting cow's milk during diarrheal episodes to be harmful.

While 22.1% of caregivers perceived solid food to be harmful, 12.3% of caregivers perceived food to neither harm nor help the child to get well. The main reasons why care-

givers perceived food to be harmful at baseline were that it "increases diarrhea or vomiting" (30.1%), that "food is too heavy for the weak stomach" (29%), and that food contributes to "worsening the child's condition" (25.8%) (data not shown in table).

**Intended and recommended feeding practices during diarrhea after the pilot intervention.** Caregivers' intended and recommended feeding practices at follow-up were significantly different from those at baseline (see Tables 3–5). A lower percentage of caregivers recommended giving a "special diet" or "less" food than caregivers intended to feed at baseline (20.9% versus 46.6%; and 2.3% versus 25.3%, respectively) (see Table 3). A higher percentage of caregivers recommended giving "the same" or "more" food than caregivers intended to feed at baseline (42.1% versus 18.2%; and 34.7% versus 6.4%, respectively). Answers did not differ significantly between caregivers whose children did or did not experience diarrhea during the previous 7 days (data not shown).

Changes in feeding of specific food items are shown in Table 4. For all food items caregivers' answers at follow-up differed significantly from those at baseline. At follow-up, a higher percentage of caregivers intended to feed food items at "the same amount." For all food items a lower percentage of caregivers intended to eliminate food items or to give "less" with the exception of legumes, for which a higher percentage of caregivers intended to give "less" at follow-up. For all food items the percentage of caregivers intending to give "more" had increased.

Caregivers' recommendations for breast milk and cow's milk at follow-up are detailed in Table 5. Among caregivers of breastfed children  $\geq$  6 months of age, use of breast milk differed significantly from the time of enrollment. A lower percentage recommended giving "less" or "no" breast milk as compared with baseline (2.2% versus 11.7% and 0.6% versus 4.5%, respectively). Similarly, recommended practices regarding cow's milk differed significantly from baseline among caregivers of children already introduced

TABLE 4

Intended feeding practices during diarrhea at baseline and at follow-up (caregivers of children introduced to solid food)

Food item	Caregivers who <i>eliminate</i> (food item) during diarrhea % (n)		Caregivers who give <i>less</i> (food item) than in absence of diarrhea % (n)		Caregivers who give <i>the same amount</i> of (food item) as in absence of diarrhea % (n)		Caregivers who give <i>more</i> (food item) than in absence of diarrhea % (n)	
	At baseline (N = 281)	At follow-up (N = 311)	At baseline (N = 281)	At follow-up (N = 311)	At baseline (N = 281)	At follow-up (N = 311)	At baseline (N = 281)	At follow-up (N = 311)
<b>Animal products</b>								
Chicken*	44.5 (125)	11.3 (35)	24.9 (70)	7.4 (23)	28.5 (80)	75.9 (236)	1.1 (3)	5.5 (17)
Eggs*	70.8 (199)	27.3 (85)	8.5 (24)	6.1 (19)	18.5 (52)	58.8 (183)	0.4 (1)	7.7 (24)
Milk products*	72.6 (204)	28.9 (90)	7.8 (22)	5.5 (17)	17.1 (48)	53.7 (167)	1.1 (3)	11.9 (37)
Chicken liver*	63 (177)	29.9 (93)	11.7 (33)	7.1 (22)	22.4 (63)	60.1 (187)	0.7 (2)	2.6 (8)
Fish*	67.6 (190)	31.5 (98)	12.5 (35)	7.4 (23)	17.1 (48)	54.7 (170)	0.7 (2)	6.4 (20)
Beef/pork*	80.4 (226)	48.9 (152)	6.8 (19)	5.8 (18)	10.7 (30)	43.4 (135)	0.4 (1)	1.9 (6)
<b>Carbohydrates</b>								
Rice*	27.8 (78)	6.8 (21)	32.4 (91)	9.7 (30)	37.4 (105)	71.7 (223)	1.1 (3)	11.9 (37)
Potatoes*	29.9 (84)	5.5 (17)	26.3 (74)	8.4 (26)	40.2 (113)	73.6 (229)	2.1 (6)	12.2 (38)
Bread*	50.5 (142)	16.4 (51)	12.8 (36)	7.1 (22)	33.5 (94)	74 (230)	1.1 (3)	2.6 (8)
Cereals*	54.5 (153)	20.3 (63)	15.7 (44)	7.4 (23)	26 (73)	68.8 (214)	1.8 (5)	3.5 (11)
Noodles*	66.2 (186)	18.3 (57)	12.8 (36)	6.1 (19)	18.2 (51)	64 (199)	0.7 (2)	11.6 (36)
<b>Fruits, vegetables, and others</b>								
Vegetables*	39.9 (112)	10 (31)	24.2 (68)	10.9 (34)	31 (87)	73.6 (229)	3.2 (9)	5.5 (17)
Fruits*	43.8 (123)	11.6 (36)	18.9 (53)	8.4 (26)	31 (87)	67.2 (209)	4.3 (12)	12.9 (40)
Soups*	12.5 (35)	8.4 (26)	26.7 (75)	7.7 (24)	46.3 (130)	66.6 (207)	13.2 (37)	17.4 (54)
Mazamorra*	13.2 (37)	5.5 (17)	24.9 (70)	5.8 (18)	49.1 (138)	63 (196)	11.4 (32)	25.7 (80)
Legumes*	83.3 (234)	37.6 (117)	6.8 (19)	14.2 (44)	7.1 (20)	44.7 (139)	1.4 (4)	3.5 (11)

\*Difference between groups at baseline and at follow-up statistically significant ( $P < 0.05$ ), percentages may not add up to 100% as "do not know" answers are not shown.

TABLE 5  
Caregivers' intended feeding practices during diarrhea at baseline and recommended feeding practices at follow-up

	Breast milk				Cow's milk	
	Caregivers of breastfed children < 6 months		Caregivers of breastfed children ≥ 6 months		Caregivers of children ≥ 6 months, receiving other milk*	
	At baseline (N = 51)	At follow-up (N = 26)	At baseline† (N = 179)	At follow-up (N = 181)	At baseline† (N = 235)	At follow-up (N = 245)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
More	41.2 (21)	50 (13)	36.9 (66)	43.1 (78)	1.3 (3)	9.4 (23)
Same amount	45.1 (23)	50 (13)	46.9 (84)	54.1 (98)	8.5 (20)	47.8 (117)
Less	11.8 (6)	0	11.7 (21)	2.2 (4)	9.4 (22)	26.9 (66)
None	2 (1)	0	4.5 (8)	0.6 (1)	79.6 (187)	14.7 (36)
Do not know	0	0	0	0	1.3 (3)	1.2 (3)

\*Milk other than breast milk.

†Difference between groups at baseline and at follow-up statistically significant ( $P < 0.05$ ).

to milk other than breast milk. A lower percentage of caregivers recommended elimination of cow's milk (14.7% versus 79.6%), whereas a higher percentage of caregivers recommended giving "the same amount" or "less" as compared with baseline (47.8% versus 8.5% and 26.9% versus 9.4%, respectively).

**Change in caregivers' perceptions of the effect of food during diarrheal episodes.** Caregivers' perceptions of the effect of breast milk, cow's milk, and solid food during diarrheal episodes differed significantly between baseline and follow-up (see Table 6). A lower percentage of caregivers perceived breast milk to be harmful compared with baseline (1.2% versus 4.6%), whereas a higher percentage of caregivers perceived breast milk to help the child get well (82.5% versus 67.8%). Results were similar for cow's milk.

A higher percentage of caregivers perceived solid food to help the child to get well compared with baseline, whereas a lower percentage of caregivers perceived solid food to be harmful (79.5% versus 59.8%; and 1.8% versus 22.1%).

## DISCUSSION

During childhood diarrheal episodes continued feeding with nutritious food is key to prevention of malnutrition. By contrast, this study documented that at baseline approximately three-quarters of the caregivers intended to either discontinue normal feeding, to give less, or to provide no food at all. The majority of caregivers intended to eliminate most protein-rich animal products from the diet. Over 40% of caregivers intended to withhold vegetables and fruits. Caregivers intended to give only soups and mazamorra at the same amount as usually. Both have high water content.

Chronic malnutrition may develop in the context of diarrhea, especially if the child does not receive nutrient-rich food during a diarrheal episode but only after diarrhea is

over, and the time between two episodes is too short for the child to recuperate. A survey by the Peruvian National Institute of Statistics and Informatics revealed that in 2012 11.6% of children in the Lima region experienced diarrhea in the 2 weeks before the survey,<sup>3</sup> which is somewhat lower than the results obtained in this study. Of note, in the present study significantly more children had experienced diarrhea during the 7 days before follow-up than at enrollment. This is likely the result of a seasonal effect (a peak of diarrheal illnesses occurs in the warmer months of January to May).<sup>12</sup>

Several studies have investigated child feeding during diarrhea in the Peruvian highlands<sup>29-31</sup>: Bentley and others<sup>29</sup> noted that mothers did not withhold food during diarrhea. Instead, mothers were more likely to encourage their children to eat, especially liquid and semi-solid food.<sup>29</sup> Similarly, in the present study, caregivers often continued to feed mazamorra and soups. Although feeding liquid and semi-liquid food is better than feeding no food, feeding solid food is better than feeding liquid and semi-liquid food. Therefore, caregivers should encourage their children to eat solid food during illness.

Huffman and others<sup>31</sup> found that although mothers reported to have altered their child's diet during the last diarrheal episode, the types of food given to children with or without diarrhea did not differ. As food quantities were not measured in that study, no conclusion could be drawn on whether changes occurred in the amounts of food consumed.<sup>31</sup> As the present study did not compare food items actually given to sick and healthy children, we cannot comment on whether caregivers' intended feeding practices differed from actual feeding practices.

More than a third of caregivers perceived food as potentially harmful or neither harmful nor helpful to the child's recovery. It would be understandable if caregivers were reluctant to feed their sick child the usual diet if they perceived food to have no effect at best or to be harmful. Caregivers' main

TABLE 6  
Caregivers' perceptions at baseline and at follow-up (N = 326)

	Breast milk		Cow's milk		Solid food	
	At baseline*	At follow-up	At baseline*	At follow-up	At baseline*	At follow-up
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Harmful	4.6 (15)	1.2 (4)	60.7 (198)	37.7 (123)	22.1 (72)	1.8 (6)
Helps	67.8 (221)	82.5 (269)	9.2 (30)	19.3 (63)	59.8 (195)	79.5 (259)
No difference	21.5 (70)	14.7 (48)	17.5 (57)	35.9 (117)	12.3 (40)	18.4 (60)
Do not know	6.1 (20)	1.5 (5)	12.6 (41)	7.1 (23)	5.8 (19)	0.3 (1)

\*Difference between groups at baseline and at follow-up statistically significant ( $P < 0.05$ ).

fear associated with giving food was that it could worsen the illness. The fact that eating during diarrhea may indeed increase stool output as compared with fasting underlines the importance of educating caregivers about the benefits of giving (solid) food even if symptoms may seem to worsen. In the setting of this study, however, an association between caregivers' perceptions and feeding practices remains speculative.

Nearly 14% of caregivers of breastfed children < 6 months and ~16% of caregivers of breastfed children ≥ 6 months intended to stop or decrease breastfeeding during diarrhea at baseline. Breast milk is the optimal food for children < 6 months of age and an important "oral rehydration solution." It is non-contaminated, contributes to preventing dehydration,<sup>32</sup> and may decrease stool frequency.<sup>33</sup> Caregivers who are still breastfeeding should be strongly encouraged to continue or increase breastfeeding during illness. As the percentage of children exclusively breastfed during the first 6 months of life is lower in urban than in rural areas of Peru,<sup>2</sup> promotion of breastfeeding in the presence and absence of diarrhea may be of special importance in urban areas of the country.

Similarly, the majority of caregivers intended elimination of cow's milk during diarrhea at baseline. A meta-analysis concludes that the vast majority of young children with acute diarrhea can be successfully managed with continued feeding of lactose-containing formulas.<sup>34</sup> Temporary lactose-free diets may benefit children with severe dehydration or malnutrition,<sup>34</sup> and children with severe rotavirus infection.<sup>35-37</sup> However, in low-income countries, lactose-free milk is expensive and difficult to obtain. Cow's milk is an important source of protein and calcium. Thus, it may be detrimental for the child's health if their caregiver routinely withholds milk during diarrheal episodes.

Educational programs can lead to improved child nutrition, in the absence and presence of diarrhea.<sup>38,39</sup> To shed light on whether an educational intervention could improve caregivers' intended practices, we piloted a brief educational intervention. The intervention was similar to those previously used in other projects, such as home visits by field-workers and distribution of educational leaflets.<sup>40,41</sup> At follow-up, significantly more caregivers recommended to continue feeding as usual, and perceived that food helps the child recover. These results indicate that the educational intervention might improve feeding of children during diarrhea.

This study has several limitations. Participants were enrolled in a non-random manner and the sample may not be representative of the study site's population. As fewer individuals were recruited in the less accessible, hilly parts of the study site predominantly populated by individuals of lower socioeconomic status, poorer members of the population may be underrepresented. A non-intervention or unrelated-intervention control group was not included. At baseline, caregivers were asked to describe their feeding practices in relation to the last diarrheal episode of their child. Therefore, recall bias cannot be ruled out. Furthermore, recommended feeding practices at follow-up were compared with intended feeding practices at baseline. Although the wording of questions was modified in an effort to minimize bias caused by social desirability, social desirability cannot be ruled out in studies that rely on self-reported data. Modification of the follow-up questions may also have led to an over- or underestimation of the

effect of the intervention. Follow-up data were collected by the same field-worker who did the baseline interview and administered the educational intervention, which may also be a source of bias. As follow-up was conducted only at 3 months, we have limited data on the sustainability of this pilot intervention. Weight and height measurements were not performed and a child's nutritional status could not be correlated to the caregiver's reported or intended feeding practices and perceptions.

However, the present intervention was intended as a pilot intervention, and it will help us develop and implement more comprehensive programs with longer term follow-up. Several studies point out that "right" knowledge does not necessarily translate into "right" practices.<sup>42,43</sup> Further research on the issue of feeding during diarrhea is needed to elucidate if and why caregivers may change the diet of their children during illness. Multifaceted programs, including projects to improve knowledge on feeding during diarrhea, are required to promote adequate child feeding during diarrheal illness. These programs should target whole communities as most caregivers sought advice on child feeding from family, friends, and neighbors. Victora and others<sup>44</sup> stress the importance of implementing interventions equitably to ensure that all children in need can benefit from them.

Penny and others<sup>45</sup> conducted an effective educational intervention to improve child feeding in a peri-urban community in Trujillo, Peru. Certain approaches and elements may also be useful for the setting of the present study such as making optimal use of available and existing resources, including food and health service infrastructure. Simple, standardized, age-appropriate messages were developed by Penny and others and used by field workers and health care staff alike, which is crucial to reinforce consistent messages.

In conclusion, the present study documented that caregivers' practices and perceptions were not aligned with optimal feeding of children during diarrheal episodes. The study provides evidence that caregivers' practices and perceptions may be improved through a brief educational intervention. Multifaceted educational interventions targeting whole communities and taking into account factors other than knowledge should be studied and their effects on caregivers' feeding behaviors and on child nutrition investigated.

Received May 2, 2013. Accepted for publication March 6, 2014.

Published online August 4, 2014.

Acknowledgments: We thank all caregivers and children who participated in this study. We thank Mery Ortega, Juanita Cuscano, and Gladys Andrade for their excellent work. We also thank A. C. White, Jr. for thoroughly reviewing the manuscript.

Financial support: BP received funding from the International Academy of Life Sciences. TJO and JR were funded by the Agencia Española de Cooperación Internacional para el Desarrollo (AECID), Spain, Programa de Cooperación Interuniversitaria e Investigación Científica con Iberoamérica (D/019499/08, and D/024648/09). JR also has a fellowship from the program I3, of the ISCIII (grant no.: CES11/012).

Disclaimer: All authors gave their approval to the final version of the manuscript.

Authors' addresses: Birte Pantenburg, Institute of Social Medicine, Occupational Health and Public Health, University of Leipzig, Leipzig, Germany, E-mail: birte.pantenburg@medizin.uni-leipzig.de. Theresa J. Ochoa, Instituto de Medicina Tropical Alexander von Humboldt, Universidad Peruana Cayetano Heredia, Lima, Peru,

and University of Texas School of Public Health, Houston, TX, E-mail: Theresa.J.Ochoa@uth.tmc.edu. Lucie Ecker, Instituto de Investigación Nutricional, Lima, Peru, E-mail: lecker@iin.sld.pe. Joaquim Ruiz, Centre de Recerca en Salut Internacional de Barcelona, Barcelona, Spain, E-mail: joruz@clinic.ub.es.

## REFERENCES

- UNICEF, WHO, The World Bank, UN-DESA Population Division, 2013. *Levels and Trends in Child Mortality, Report 2013*. Available at: [http://www.who.int/maternal\\_child\\_adolescent/documents/levels\\_trends\\_child\\_mortality\\_2013.pdf](http://www.who.int/maternal_child_adolescent/documents/levels_trends_child_mortality_2013.pdf). Accessed November 2013.
- UNICEF, INEI, 2011. *Estado de la Niñez en el Perú*. Available at: [http://www.unicef.org/peru/spanish/Estado\\_Ninez\\_en\\_Peru.pdf](http://www.unicef.org/peru/spanish/Estado_Ninez_en_Peru.pdf). Accessed November 2013.
- INEI, 2013. *Encuesta Demográfica y de Salud Familiar 2012*. Available at: <http://proyectos.inei.gob.pe/web/biblioineipub/bancopub/Est/Lib1075/index.html>. Accessed November 2013.
- Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS, 2003. How many child deaths can we prevent this year? *Lancet* 362: 65–71.
- Bhutta ZA, Das JK, Walker N, Rizvi A, Campbell H, Rudan I, Black RE, 2013. Interventions to address deaths from childhood pneumonia and diarrhea equitably: what works and at what cost? *Lancet* 381: 1417–1429.
- Berkman DS, Lescano AG, Gilman RH, Lopez SL, Black MM, 2002. Effects of stunting, diarrheal disease, and parasitic infection during infancy on cognition in late childhood: a follow-up study. *Lancet* 359: 564–571.
- Guerrant RL, Oriá RB, Moore SR, Oriá MO, Lima AA, 2008. Malnutrition as an enteric infectious disease with long-term effects on child development. *Nutr Rev* 66: 487–505.
- Lorntz B, Soares AM, Moore SR, Pinkerton R, Gansnedter B, Bovbjerg VE, Guyatt H, Lima AM, Guerrant RL, 2006. Early childhood diarrhea predicts impaired school performance. *Pediatr Infect Dis J* 25: 513–520.
- Patrick PD, Oriá RB, Madhavan V, Pinkerton RC, Lorntz B, Lima AA, Guerrant RL, 2005. Limitations in verbal fluency following heavy burdens of early childhood diarrhea in Brazilian shantytown children. *Child Neuropsychol* 11: 233–244.
- Richard SA, Black RE, Gilman RH, Guerrant RL, Kang G, Lanata CF, Mølbak K, Rasmussen ZA, Sack RB, Valentiner-Branth P, Checkley W, 2013. Diarrhea in early childhood: short-term association with weight and long-term association with length. *Am J Epidemiol* 178: 1129–1138.
- Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R, 2008. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adult. *Lancet* 371: 411–416.
- Checkley W, Gilman RH, Black RE, Lescano AG, Cabrera L, Taylor DN, Moulton LH, 2002. Effects of nutritional status on diarrhea in Peruvian children. *J Pediatr* 140: 210–218.
- Ferdous F, Das SK, Ahmed S, Farzana FD, Latham JR, Chisti MJ, Ud-Din AI, Azmi IJ, Talukder KA, Faruque AS, 2013. Severity of diarrhea and malnutrition among under five-year-old children in rural Bangladesh. *Am J Trop Med Hyg* 89: 223–228.
- Brown KH, Gastañaduy AS, Saavedra JM, Lembcke J, Rivas D, Robertson AD, Yolken R, Sack RB, 1988. Effect of continued oral feeding on clinical and nutritional outcomes of acute diarrhea in children. *J Pediatr* 112: 191–200.
- Dugdale A, Lovell S, Gibbs V, Ball D, 1982. Refeeding after acute gastroenteritis: a controlled study. *Arch Dis Child* 57: 76–78.
- Hjelt K, Pærrgaard A, Petersen W, Christiansen L, Krasilnikoff PA, 1989. Rapid versus gradual refeeding in acute gastroenteritis in childhood: energy intake and weight gain. *J Pediatr Gastroenterol Nutr* 8: 75–80.
- Sandhu BK, Isolauri E, Walker-Smith JA, Banchini G, Van Caillie-Bertrand M, Dias JA, Guandalini S, Hoekstra JH, Juntunen M, Kolacek S, Marx D, Micetic-Turk D, Razenberg MC, Szajewska H, Taminiou J, Weizman Z, Zanacca C, Zetterström R, 1997. A multicentre study on behalf of the European Society of Paediatric Gastroenterology and Nutrition Working Group on Acute Diarrhea. Early feeding in childhood gastroenteritis. *J Pediatr Gastroenterol Nutr* 24: 522–527.
- Isolauri E, Juntunen M, Wiren S, Vuorinen P, Koivula T, 1989. Intestinal permeability changes in acute gastroenteritis: effects of clinical factors and nutritional management. *J Pediatr Gastroenterol Nutr* 8: 466–473.
- Levine GM, Deren JJ, Steiger E, Zinno R, 1974. Role of oral intake in maintenance of gut mass and disaccharide activity. *Gastroenterology* 67: 975–982.
- WHO, UNICEF, 2008. *IMCI Chart Booklet - Standard*. Available at: [http://www.who.int/maternal\\_child\\_adolescent/documents/IMCI\\_chartbooklet/en/index.html](http://www.who.int/maternal_child_adolescent/documents/IMCI_chartbooklet/en/index.html). Accessed November 2013.
- Brown KH, Peerson JM, Lopez de Romaña G, de Kanashiro HC, Black RE, 1995. Validity and epidemiology of reported poor appetite among Peruvian infants from a low-income, periurban community. *Am J Clin Nutr* 61: 26–32.
- Bachrach LR, Gardner JM, 2002. Caregiver knowledge, attitudes, and practices regarding childhood diarrhea and dehydration in Kingston, Jamaica. *Rev Panam Salud Publica* 12: 37–44.
- Bani IA, Saeed AA, Othman AA, 2002. Diarrhea and child feeding practices in Saudi Arabia. *Public Health Nutr* 5: 727–731.
- Othero DM, Orago AS, Groenewegen T, Kaseje DO, Otengah PA, 2008. Home management of diarrhea among under fives in a rural community in Kenya: household perceptions and practices. *East Afr J Public Health* 5: 142–146.
- Jacoby ER, Benavides BM, Bartlett JC, Figueroa D, 1994. Effectiveness of two methods of advising mothers on infant feeding and dietetic management of diarrhea at an outpatient clinic in Peru. *J Diarrhoeal Dis Res* 12: 59–64.
- INEI, 2008. *Perfil Sociodemográfico de la Provincia de Lima, Perú*. Lima, Peru: Instituto Nacional de Estadística e Informática.
- Riofrío G, 2003. *Understanding Slums: Case Studies for the Global Report 2003, The Case of Lima*. Available at: [http://www.ucl.ac.uk/dpu-projects/Global\\_Report/pdfs/Lima.pdf](http://www.ucl.ac.uk/dpu-projects/Global_Report/pdfs/Lima.pdf). Accessed November 2013.
- Pantenburg B, Ochoa TJ, Ecker L, Ruiz J, 2012. Use of commercially available oral rehydration solutions in Lima, Peru. *Am J Trop Med Hyg* 86: 922–924.
- Bentley ME, Stallings RY, Fukumoto M, Elder JA, 1991. Maternal feeding behavior and child acceptance of food during diarrhea, convalescence, and health in the central Sierra of Peru. *Am J Public Health* 81: 43–47.
- Bentley ME, Elder J, Fukumoto M, Stallings RH, Jacoby E, Brown K, 1995. Acute childhood diarrhea and maternal time allocation in the northern central Sierra of Peru. *Health Policy Plan* 10: 60–70.
- Huffman SL, Lopez de Romaña G, Madrid S, Brown KH, Bentley M, Black RE, 1991. Do child feeding practices change due to diarrhea in the Central Peruvian Highlands? *J Diarrhoeal Dis Res* 9: 295–300.
- Faruque AS, Mahalanabis D, Islam A, Hoque SS, Hasnat A, 1992. Breast feeding and oral rehydration at home during diarrhea to prevent dehydration. *Arch Dis Child* 67: 1027–1029.
- Khin MU, Nyunt NW, Myo K, Mu MK, Tin U, Thane T, 1985. Effect on clinical outcome of breast feeding during acute diarrhea. *Br Med J (Clin Res Ed)* 290: 587–589.
- Brown KH, Peerson JM, Fontaine O, 1994. Use of nonhuman milks in the dietary management of young children with acute diarrhea: a meta-analysis of clinical trials. *Pediatrics* 93: 17–27.
- Beattie RM, Vieira MC, Phillips AD, Meadows N, Walker-Smith JA, 1995. Carbohydrate intolerance after rotavirus gastroenteritis: a rare problem in the 1990s. *Arch Dis Child* 72: 466.
- Szajewska H, Kantecki M, Albrecht P, Antoniewicz J, 1997. Carbohydrate intolerance after acute gastroenteritis—a disappearing problem in Polish children. *Acta Paediatr* 86: 347–350.
- Trounce JQ, Walker-Smith JA, 1985. Sugar intolerance complicating acute gastroenteritis. *Arch Dis Child* 60: 986–990.
- Caulfield LE, Huffman SL, Piwoz EG, 1999. Interventions to improve intake of complementary foods by infants 6 to 12 months of age in developing countries: impact on growth and on the prevalence of malnutrition and potential contribution to child survival. *Food Nutr Bull* 20: 183–200.
- Salehi M, Kimiagar SM, Shahbazi M, Mehrabi Y, Kolahi AA, 2004. Assessing the impact of nutrition education on growth

- indices of Iranian nomadic children: an application of a modified beliefs, attitudes, subjective-norms and enabling-factors model. *Br J Nutr* 91: 779–787.
40. Bhandari N, Bahl R, Mazumdar S, Martines J, Black RE, Bhan MK, 2003. Effect of community-based promotion of exclusive breastfeeding on diarrheal illness and growth: a cluster randomized controlled trial. *Lancet* 361: 1418–1423.
  41. Pahwa S, Kumar GT, Toteja GS, 2010. Performance of a community-based health and nutrition-education intervention in the management of diarrhea in a slum of Delhi, India. *J Health Popul Nutr* 28: 553–559.
  42. Lee RG, Garvin T, 2003. Moving from information transfer to information exchange in health and health care. *Soc Sci Med* 56: 449–464.
  43. Mwangome M, Prentice A, Plugge E, Nweneka C, 2010. Determinants of appropriate child health and nutrition practices among women in rural Gambia. *J Health Popul Nutr* 28: 167–172.
  44. Victora CG, Wagstaff A, Schellenberg JA, Gwatkin D, Claeson M, Habicht JP, 2003. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet* 362: 233–241.
  45. Penny ME, Creed-Kanashiro HM, Robert RC, Narro MR, Caulfield LE, Black RE, 2005. Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children: a cluster-randomized controlled trial. *Lancet* 365: 1863–1872.