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Do Social Factors Predict Appropriate Treatment of Child Diarrheal Disease in Peru?

Kathryn Volpicelli[1] · **Alison M. Buttenheim**[2]

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Abstract *Objectives* Diarrheal disease is a significant cause of morbidity among children in Peru. Oral rehydration therapy (ORT) is a cost-effective evidence-based approach to treat diarrhea in young children, yet many Peruvian children in poorer households do not receive this life-saving treatment. This study investigates the social determinants of care-seeking behavior and utilization of appropriate home treatment for diarrheal episodes. *Methods* We used the nationally-representative 2008 Peru Demographic and Health Survey to: (1) describe the burden of non-bloody diarrheal disease among children <5 years old; and (2) identify socioeconomic correlates of care-seeking behavior and utilization/appropriateness of treatment among mothers of children with recent non-bloody diarrheal episodes (N = 1365). For the former, we reported descriptive statistics; for the latter, we utilized logistic regression to generate odds ratios. *Results* 2-week period prevalence of diarrheal disease was almost twice as high among poor (17 %) compared with wealthier (10 %) children, higher among children aged 12–23 months old (22 %), and higher among children from households that do not have an improved source of drinking water (16 %) compared with those that have an improved source (12 %). Interestingly, rural residence was a significant predictor of seeking care for diarrhea. Furthermore, although widely available, few mothers (15 %) used appropriate treatment for a recent diarrheal episode. Water source, mother's education, and wealth were significant predictors of appropriate home treatment. *Conclusions* Mothers in rural areas—typically with less access to care—were more likely to seek care for diarrheal disease in their children, even when adjusting for other variables. However, this increase in care seeking behavior did not extend to appropriate home treatment. Innovative behavior change strategies to reduce barriers to access and appropriate home treatment for diarrheal disease are important, especially given effective and affordable treatment strategies. Future studies should elucidate specific barriers to seeking and utilizing ORT and other appropriate home treatments.

Keywords Diarrhea · Child health · Peru · Demographic Health Survey (DHS) · Prevalence · Infectious disease · Malnutrition

Significance Statement

What is already known on this subject? Oral rehydration therapy is a low cost, effective treatment of diarrheal disease—a major cause of malnutrition and death in young children worldwide. In the developing world, too few children receive this potentially life-saving therapy when indicated. Socioeconomic disparities and other barriers to rehydration care have been identified in many middle-income countries in South America, but Peru has garnered little focus.

What this study adds? The burden of non-bloody diarrheal disease in young Peruvian children is substantial. Surprisingly, mothers residing in rural areas were more likely to seek care for their affected children. The rate of

✉ Kathryn Volpicelli
kate.volpicelli@gmail.com

Alison M. Buttenheim
abutt@nursing.upenn.edu

[1] Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

[2] School of Nursing, University of Pennsylvania, Philadelphia, PA, USA

oral rehydration therapy use was low (15 %). Policies, programs, and interventions should incorporate behavior change strategies to reduce barriers to access to care and appropriate treatment for diarrheal disease.

Introduction

Diarrhea is a significant cause of childhood morbidity and mortality. It is the second leading cause of death and the leading cause of malnutrition among children under five worldwide (UNICEF 2009). More than 700,000 child deaths annually are due to diarrhea (World Health Organization (WHO) 2015). The World Health Organization (WHO) recommends oral rehydration therapy (ORT) plus continued feeding to treat symptoms associated with diarrheal disease and to prevent dehydration. ORT is the administration of a simple sugar and salt solution to prevent dehydration, and it has been considered the standard in treating diarrheal disease since the 1970s (World Health Organization (WHO) 2015). Appropriate treatment with ORT prevents an estimated 15 % of all deaths in children under 5 years of age worldwide and 93 % of deaths linked to diarrheal disease (Munos et al. 2010; UNFPA 2007).

Although ORT is a low cost, effective treatment for diarrheal disease (UNICEF 2009), uptake is suboptimal and therefore remains a major global public health problem. Only about 39 % of children in developing countries receive recommended ORT when it is indicated. Additionally, there are socioeconomic disparities in ORT receipt—children from rural settings and poorer households are less likely to receive the recommended treatment (UNICEF 2009).

Diarrheal Burden in Peru

An estimated 4.5 % of deaths in children under 5 years of age in Peru are due to diarrheal disease, and it remains a significant cause of childhood morbidity (Institute for Health Metrics and Evaluation 2010). While predictors of diarrheal disease are available for other middle-income countries in South America, few studies have focused on Peru (Sastry and Burgard 2005). Despite significant morbidity, only 60 % of children with diarrhea in Peru receive the appropriate treatment (UNICEF 2009). Additionally, disparities exist among wealth categories: recent data on ORT use in Peru suggest that 52 % of children from the poorest households receive the recommended treatment compared with 75 % of children from the wealthier households (UNICEF 2009). A study exploring barriers to ORT use in Peru found that caregivers did not know about this effective, low-cost treatment (Pantenburg et al. 2012). Little is known about the relationship between socioeconomic status, wealth or location, and treatment-seeking behavior. One study of health-seeking behavior among caregivers of sick children in two urban communities of Peru found that—despite all children in both communities qualifying for free health care and essential medications—the poorest caregivers sought treatment less often; caregivers who qualified for free care also reported being asked to pay at the point of service (Kristiansson et al. 2009).

The Peru Ministry of Health established the Seguro Integral de Salud (SIS) state health insurance program as part of a national initiative to reduce the rates of maternal and infant mortality by expanding access to essential health services among low-income and rural populations—including access to ORT to treat diarrheal disease. In the context of widespread access to ORT through Peru's national health insurance program, this study aims to contribute to the evidence on diarrheal disease in Peru by investigating social determinants of care-seeking behavior and appropriate home treatment for diarrheal episodes in a nationally-representative sample of mothers. Using the 2008 Demographic and Health Survey for Peru, we:

1. Describe the burden of non-bloody diarrheal disease among children under 5 in Peru, and
2. Identify socioeconomic correlates of care-seeking behavior and utilization/appropriateness of treatment among mothers of children with recent non-bloody diarrheal episodes.

To our knowledge, this is the first study to examine the burden of diarrheal disease and utilization of appropriate treatment in Peru using a nationally-representative dataset. Understanding social gradients in care-seeking or appropriate home treatment is critical to the development of effective interventions.

Methods

Data

We used data from the 2008 Peru Demographic and Health Survey (DHS). The DHS is a series of standardized, nationally-representative surveys implemented in over 90 countries since 1984. The DHS is approved by the Office of Research Compliance Macro Institutional Review Board, and then reviewed and approved by an in-country ethical review board, such as the Ministry of Health. The DHS focuses primarily on women of reproductive age (15–49 years) who are interviewed by a team of trained interviewers. The DHS data used in this study were collected between January 2007 and October 2008. Sampling weights were applied in all analyses to account for the

complex sampling scheme of the DHS (Rutstein and Rojas 2006).

Sample

Forty-one thousand six hundred forty-eight women ages 15–49 years completed the Peru 2008 DHS survey. We excluded women who (1) reported no children or children older than 5 years of age in the household (N = 32,269) and (2) reported an index child (their youngest) to have had bloody diarrhea in the 2 weeks prior to survey completion (N = 287). Bloody diarrhea is often indicative of dysentery (World Health Organization (WHO) 2015), which is treated differently than diarrhea without blood (UNICEF 2009). Notably, cases of bloody diarrhea are far less common in Peru than cases of diarrheal disease that can be treated with ORT (Ochoa et al. 2011). Further, we limited our sample to the index (i.e., youngest) child in the household so as to not inflate prevalence rates of this highly contagious disease. The remaining respondents (N = 9092) comprise our first analytic sample for assessing burden of disease among index children.

A second analytic sample excluded respondents who reported no diarrheal episodes in the index child in the 2 weeks prior to survey completion (N = 7727). This second analytic sample (N = 1365) was used to explore care-seeking behavior and appropriate use of treatment for diarrheal disease in children under 5. The final samples obtained for analyses are shown in Fig. 1.

Outcome Measures

To determine the prevalence of recent non-bloody diarrheal cases, we counted an index child as having had a diarrheal disease if the mother responded "Yes" to the question, "Has [name of child] had diarrhea in the last 2 weeks?" but "No" to the follow-up question, "Was there any blood in the stools?".

We considered a respondent to have sought advice or treatment for the diarrheal episode if, conditional on the mother reporting a recent diarrheal episode, she responded "yes" to the question, "Did you seek advice or treatment for the diarrhea from any source?" We categorized the

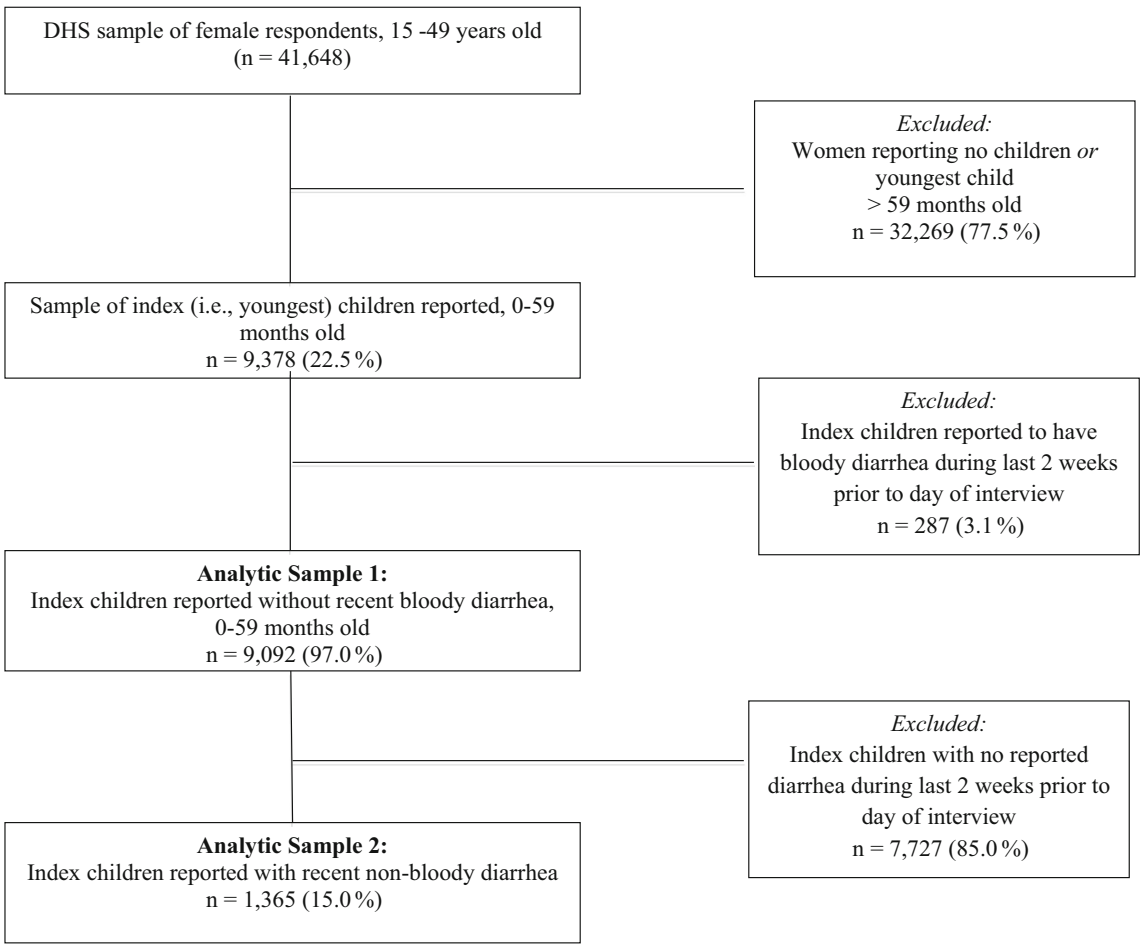

Fig. 1 Flow chart of analytic samples

source of advice or treatment into public sector, private sector, or other (i.e., traditional healer, friend).

Respondents whose index child had a recent diarrheal episode were also asked the following questions:

1. Was [name of child] given much less than usual to drink, somewhat less than usual, about the same amount, more to drink, or nothing to drink?
2. When [name of child] had diarrhea, was he/she given much less than usual to eat, somewhat less than usual, about the same amount, more than usual, or nothing to eat?
3. Was he/she given any of the following [WHO recommended treatment options] to drink at any time since he/she started having diarrhea?

To determine whether appropriate treatment was given to the index child during the diarrheal episode, we used the WHO standard of care for acute watery diarrhea: oral rehydration solution (homemade or commercial) plus continued feeding (World Health Organization (WHO) 2015). Appropriate care was therefore defined as being given any WHO recommended treatment (a "yes" response to one or more options in Question 3 above) and continued feeding (responding "the same amount" or "more than usual" in Question 1 and Question 2 above). This definition of appropriate care is consistent with a previous study (Jha et al. 2006).

Predictor Variables

Number of children, sex of child, age of child, mother's ethnicity, urbanicity, water source, mother's education, and wealth quintiles were included as predictor variables in our analysis. Wealth quintiles are calculated a priori by Measure DHS for all respondents (Rutstein and Johnson 2004); therefore, the analytic sample used in this study is not evenly distributed into wealth quintiles. For analysis, we combined the two wealthiest groups and coded this variable ordinally as: lowest (poorest); second; third; highest (richest). The rationale for doing so was sparse data in the wealthiest quintile.

Statistical Analysis

For dichotomous and categorical variables, we generated frequencies and calculated proportions. We calculated point-prevalence (hereafter, "prevalence") of diarrheal disease as the proportion of survey respondents who reported non-bloody diarrheal disease among the index child (analytic sample two). We further calculated prevalence stratified by each of the following predictor variables: wealth status, mother's education, mother's age, number of children in the household, sex of child, age of child, mother's ethnicity, urbanicity, and water source. Using logistic regression, we calculated bivariate associations between each of the predictors and the following outcomes, considered separately: care-seeking behavior and appropriateness of treatment. Further, we estimated the association between predictors and each outcome using multivariate logistic regression, thereby generating odds ratios with 95 % confidence intervals. All analyses were completed in STATA version 12.0 (StataCorp, College Station, TX). This study was considered exempt from review by the University of Pennsylvania's institutional review board.

Results

Sample Characteristics

Of the sample of 9092 children between the age of 0 and 59 months, maternal respondents were mainly Spanish speaking (88.0 %), lived in urban settings (62.2 %), and had access to an improved source of drinking water (76.3 %) (Table 1). Mothers reported a high level of education with more than half (63.7 %) completing up to a secondary level or higher. About half of the children in this sample were males (50.2 %) and about a quarter of the children (23.4 %) were between the ages of 12–23 months old.

Prevalence of Diarrheal Disease

The 2-week prevalence of non-bloody diarrhea in the index child reported by mothers interviewed was 15.0 % (N = 1365) (Table 2). Bivariate analysis revealed significant group differences in diarrheal disease prevalence by age of index child, mother's age, water source, and wealth. Prevalence was highest among index children aged 12–23 months old (21.8 %) and declined with age. Similarly, risk of diarrhea decreased with mother's advancing age—prevalence was higher among younger mothers (15.1 %) compared with older mothers (11.2 %). Access to an improved source of drinking water in households, such as water bottles or piped water, was associated with a 28.5 % reduction in odds of diarrhea (16.3 % prevalence for index children who used a non-improved source of drinking water vs. 12.2 % for those with access to an improved source). A steep wealth gradient was also observed, with prevalence higher among index children from the poorest wealth category (17.1 %) compared with the richest wealth category (10.4 %).

Care-Seeking Behavior

Of the mothers who reported diarrhea during the 2-week period, 40.0 % reported seeking care. Source of care included: public sector (69 %), private sector (20 %), and

Table 1 Demographic characteristics of analytic samples 1 and 2

	Sample 1: All index children, 0–59 months old[a] ($N_{unweighted} = 9092$)	Sample 2: Index children, 0–59 months, with diarrheal disease[a] ($N_{unweighted} = 1365$)
	Weighted proportion (%)	
Number of children at home		
1	32.9	33.6
2	25.4	22.9
3+	41.7	43.5
Sex of child		
Male	50.2	52.6
Female	49.8	47.4
Age of child, in months		
<6	11.2	8.2
6–11	12.2	16.7
12–23	23.4	38.5
24–35	19.9	21.0
36–47	17.5	9.0
48–59	15.9	6.5
Mother's ethnicity		
Spanish speaking	88.0	89.6
Quechua/Aymara/other	12.0	10.5
Residence		
Urban	62.2	59.4
Rural	37.8	40.6
Source of drinking water		
Not improved	23.7	29.3
Improved	76.3	70.7
Mother's age, in years		
15–29	52.3	59.6
30+	47.7	40.4
Mother's education		
No education/primary	36.3	38.3
Secondary	40.6	42.9
Higher	23.1	18.8
Wealth status		
Lowest	12.0	15.5
Second	23.9	25.8
Third	23.7	27.0
Highest	40.4	31.7

[a] Weighted percentages (see methods). Unweighted Ns cannot be back calculated

other, such as traditional healers (11 %). Bivariate analysis identified three factors significantly associated with seeking care: age of index child; mother's ethnicity; and urbanicity (Table 3). As the child's age increased, the odds of seeking care decreased by almost half when compared with 12–23 month old children. Additionally, those who identified as indigenous (Quechua, Aymara, or other) had 1.8 times higher odds of seeking treatment compared with Spanish speakers. Finally, rural households had 1.6 times higher odds of seeking treatment.

In the multivariate model, effects of age and ethnicity were attenuated and no longer significant (Table 3); however, rural residence remained significantly associated with seeking treatment. Additionally, mothers aged 30 years and older had 1.5 times the odds of seeking treatment compared with mothers younger than 30 years old. Adjusting for

Table 2 Prevalence of non-bloody diarrhea

	Diarrhea prevalence[a] ($N_{unweighted} = 1365$) Weighted proportion (%)	Bivariate model—diarrhea odds ratio ($N_{unweighted} = 1365$) Odds ratio (95 % CI)
Total sample (N = 9092)	15.0 (1365)	
Number of children at home		
1	13.5	Ref.
2	11.9	0.87 (0.68–1.12)
3+	13.8	1.03 (0.83–1.26)
Sex of child		
Male	13.8	Ref.
Female	12.6	0.89 (0.76–1.05)
Age of child, in months*		
< 6	9.7	0.38 (0.29–0.51)
6–11	18.1	0.78 (0.61–1.00)
12–23	21.8	Ref.
24–35	14.0	0.62 (0.50–0.76)
36–47	6.8	0.30 (0.23–0.40)
48–59	5.4	0.22 (0.15–0.30)
Mother's ethnicity		
Spanish speaking	13.4	Ref.
Quechua/Aymara/other	11.5	0.84 (0.66–1.06)
Residence		
Urban	12.6	Ref.
Rural	14.2	1.15 (0.96–1.37)
Source of drinking water*		
Not improved	16.3	Ref.
Improved	12.2	0.71 (0.60–0.88)
Mother's age, in years*		
15–29	15.1	Ref.
30+	11.2	0.71 (0.60–0.84)
Mother's education		
No education/primary	13.9	Ref.
Secondary	14.0	1.00 (0.82–1.22)
Higher	10.7	0.74 (0.58–0.95)
Wealth status*		
Lowest	17.1	Ref.
Second	14.2	0.80 (0.65–0.99)
Third	15.1	0.86 (0.66–1.11)
Highest	10.4	0.56 (0.17–0.25)

Prevalence and odds ratio of having non-bloody diarrhea during 2 weeks preceding the survey, by selected demographic and socioeconomic variables

* Significant at $p < 0.05$

[a] Weighted percentages (see methods). Unweighted Ns cannot be back calculated

other factors, a wealth gradient also emerged, but was not statistically significant.

Appropriate Treatment

Of the mothers who reported diarrhea during the 2-week period, 15.0 % reported appropriate use of home treatment during a recent diarrheal episode (Table 4), again defined as oral rehydration solution (homemade or commercial) plus continued feeding (World Health Organization (WHO) 2015). Bivariate analysis identified age of child, mother's education, and wealth as statistically significant positive predictors of appropriate home treatment. The odds of appropriately treating diarrhea was 1.22 times

Table 3 Factors associated with seeking care for treatment of non-bloody diarrhea

	Bivariate models—sought any treatment Odds ratio (95 % CI)	Multivariate models—sought any treatment Odds ratio (95 % CI)
Number of children at home		
1	Ref.	Ref.
2	1.06 (0.69–1.62)	0.94 (0.60–1.46)
3+	1.06 (0.75–1.48)	0.70 (0.46–1.07)
Sex of child		
Male	Ref.	Ref.
Female	0.94 (0.70–1.26)	0.92 (0.67–1.25)
Age of child, in months[a]		
< 6	0.68 (0.39–1.17)	0.70 (0.40–1.23)
6–11	1.04 (0.65–1.69)	1.10 (0.68–1.78)
12–23	Ref.	Ref.
24–35	0.59 (0.39–0.88)	0.61 (0.41–0.90)
36–47	0.54 (0.30–0.98)	0.51 (0.27–0.95)
48–59	0.64 (0.32–1.27)	0.92 (0.33–1.27)
Mother's ethnicity[a]		
Spanish speaking	Ref.	Ref.
Quechua/Aymara/other	1.83 (1.18–2.84)	1.49 (0.91–2.42)
Residence[a,b]		
Urban	Ref.	Ref.
Rural	1.59 (1.15–2.19)	1.84 (1.21–2.78)
Source of drinking water		
Not improved	Ref.	Ref.
Improved	0.92 (0.66–1.28)	0.91 (0.61–1.36)
Mother's age, in years[b]		
15–29	Ref.	Ref.
30+	1.22 (0.88–1.68)	1.52 (1.04–2.21)
Mother's education		
No education/primary	Ref.	Ref.
Secondary	0.81 (0.57–1.15)	0.91 (0.62–1.34)
Higher	0.74 (0.47–1.17)	0.75 (0.43–1.30)
Wealth status		
Lowest	Ref.	Ref.
Second	1.02 (0.68–1.53)	1.22 (0.77–1.93)
Third	0.74 (0.46–1.19)	1.40 (0.78–2.51)
Highest	0.86 (0.54–1.34)	1.89 (0.94–3.78)

Among the sample of mothers who reported a recent case of non-bloody diarrhea in the index child (N = 1365), 40.0 % sought care (N = 546)

[a] Bivariate models, significant at $p < 0.05$ based on F-tests for the joint significance of categorical variables

[b] Multivariate models, significant at $p < 0.05$ based on F-tests for the joint significance of categorical variables

higher among 36–47 month old children compared to 12–23 month old children. For mothers with education beyond secondary school, the odds of appropriate treatment were 5.5 times greater than that of mothers with little or no education. Mothers from the highest wealth category had 5.3 times higher odds of appropriately treating diarrheal disease compared to caregivers in the poorest wealth category.

Bivariate analysis identified number of children at home, mother's ethnicity, and residence as statistically significant negative predictors of appropriate home treatment. There was a 51 % reduction in the odds of appropriately treating diarrhea among mothers who reported three or more children in the household compared to mothers who reported one child in the household. Additionally, both those who identified as indigenous and those

Table 4 Factors associated with appropriate home treatment of non-bloody diarrhea

	Bivariate models Odds ratio (95 % CI)	Multivariate models Odds ratio (95 % CI)
Number of children at home[a]		
1	Ref.	Ref.
2	0.94 (0.52–1.68)	0.90 (0.46–1.72)
3+	0.49 (0.29–0.82)	0.75 (0.37–1.50)
Sex of child		
Male	Ref.	Ref.
Female	0.83 (0.55–1.23)	0.71 (0.44–1.14)
Age of child, in months[a]		
<6	0.04 (0.01–0.19)	0.03 (0.01–0.15)
6–11	0.44 (0.20–0.98)	0.52 (0.22–1.21)
12–23	Ref.	Ref.
24–35	0.85 (0.49–1.47)	0.69 (0.38–1.23)
36–47	1.22 (0.58–2.59)	1.20 (0.53–2.74)
48–59	0.51 (0.25–1.04)	0.49 (0.22–1.08)
Mother's ethnicity[a]		
Spanish speaking	Ref.	Ref.
Quechua/Aymara/other	0.25 (0.06–1.00)	0.66 (0.16–2.70)
Residence[a]		
Urban	Ref.	Ref.
Rural	0.25 (0.15–0.44)	0.73 (0.36–1.48)
Source of drinking water[b]		
Not improved	Ref.	Ref.
Improved	1.45 (0.90–2.34)	0.51 (0.28–0.95)
Mother's age, in years		
15–29	Ref.	Ref.
30+	0.88 (0.55–1.40)	1.21 (0.64–2.30)
Mother's education[a,b]		
No education/primary	Ref.	Ref.
Secondary	5.66 (2.95–10.85)	3.53 (1.92–6.50)
Higher	5.49 (2.63–11.47)	2.44 (1.04–5.70)
Wealth status[a,b]		
Lowest	Ref.	Ref.
Second	0.82 (0.33–2.00)	0.63 (0.25–1.59)
Third	3.07 (1.35–6.94)	2.16 (0.82–5.70)
Highest	5.31 (2.30–12.29)	3.15 (1.00–9.87)

Among the sample of mothers who reported a recent case of non-bloody diarrhea in the index child (N = 1365), 15.0 % used appropriate home treatment (N = 205)

[a] Bivariate models, significant at $p < 0.05$ based on F-tests for the joint significance of categorical variables

[b] Multivariate models, significant at $p < 0.05$ based on F-tests for the joint significance of categorical variables

from rural settings were associated with a 75 % reduction in the odds of appropriately treating diarrhea.

The significant effects of mother's education and wealth remained when adjusting for factors in a multivariate model. Source of drinking water was also significantly associated with appropriate treatment. Households with an improved source of drinking water were associated with lower odds of appropriately treating diarrheal disease.

Discussion

While diarrheal disease is recognized as a significant cause of childhood mortality and morbidity among children under 5, there is limited evidence from Peru and similar middle-income countries of the social patterning of diarrheal disease. Using a large, nationally-representative dataset, we compared the socioeconomic correlates of

diarrheal disease prevalence, health-care seeking, and the important health behavior of appropriate home treatment.

Our prevalence findings were largely consistent with current literature. The 12–23 month age group is most nutritionally vulnerable as they wean from breastfeeding and begin eating more solid foods (Saha et al. 2013). A higher prevalence in areas where there is little to no access to an improved water source is consistent with the epidemiology of diarrheal disease, which is most commonly caused by bacteria in fecal matter which can drain directly into non-improved water sources (UNICEF 2009). The higher prevalence we found among the poorest children confirms findings from other studies that poorer households are more likely to have poorer health outcomes overall (Rutstein and Rojas 2006).

Our study found few socioeconomic differences in care-seeking behavior, with the exception that mothers in rural areas were more likely to seek care than mother in urban areas. Prior literature has found that socioeconomic inequalities in access to care drive differences in care-seeking behavior between higher vs. lower educated mothers, and between higher vs. lower wealth mothers (Okeke and Okeibunor 2010). Our results suggest otherwise: mothers in rural areas, whom we would expected to have less access to care, were more likely to seek care, even when adjusting for other variables. This could be explained by the SIS program, which focused health service expansion efforts on low-income and vulnerable mothers in rural regions, thus eliminating access barriers within these groups (Rutstein and Rojas 2006). As a result, mothers living in rural regions may understand the importance of seeking treatment for disease. However, this increase in access and care seeking does not extend to appropriate treatment at home; for this population of rural and/or low-income mothers, lack of knowledge or confidence in appropriate home treatment may actually increase treatment-seeking—in other words, mothers know what they don't know, and seek care outside the home to compensate. Results suggest that interventions to eliminate access barriers should be coupled with a strong educational component to ensure that caregivers not only seek treatment, but seek the appropriate treatment.

Results for appropriate home treatment reveal a number of other socioeconomic correlates, including maternal education and water source. Mothers who reported an education level of secondary school or higher were associated with higher odds of treating diarrheal disease appropriately. This group may have more ability to access, process, and use information about child health from multiple sources with more efficacy and confidence compared to mothers with less education. Additionally, results from the multivariate analysis show that households with an improved source of drinking water were associated with lower odds of appropriately treating diarrheal disease. It could be that caregivers with an improved water source do not think they need to give ORT as treatment (commercial or homemade). However, more research is needed to further investigate this finding.

In light of these findings, public health insurance schemes promoting treatment opportunities should work in conjunction with prevention strategies, such as hand washing or improving toilet facilities, to reduce the incidence of disease (Eisenberg et al. 2007). Also, policies, programs, and interventions should incorporate innovative behavior change strategies. One novel approach to consider in reducing socioeconomic inequalities associated with care-seeking behavior and appropriate use of treatment includes implementing mobile health (mHealth) technologies. Through a mobile device, mothers can receive targeted, real-time messages about appropriate diarrheal treatment as well as send messages about the health status and treatment outcome of the child. Reaching underserved populations through the integration of mobile technology and public health has been beneficial in disease surveillance efforts as well as health education and promotion (Curioso et al. 2005). However, mHealth and other innovative behavioral health interventions need to be assessed in this particular setting to determine impact, scalability, and sustainability. Future research should focus on whether such mHealth approaches are appropriate for certain indigenous persons and those living in rural communities.

Our study has some important limitations. First, given the cross-sectional nature of this work, associations between predictors and outcomes cannot be considered causal. Second, when using survey instruments to collect self-report data, recall bias can be an issue. Mothers may not accurately recall a diarrheal episode or recall how they ended up treating their child. Additionally, mothers may misclassify the type of diarrheal disease. Third, given our inclusion of only index children, we were unable to determine prevalence and examine predictors in non-index children. Finally, this analysis did not explore mechanisms to healthcare-seeking behavior and appropriate use of treatment.

More research is needed to provide support for targeted policies and interventions. First, future research should investigate differences in sources of care for diarrheal disease. Results from this study indicate that the majority of caregivers sought care in the public sector, but specific correlates of care-seeking behavior by source of care were not examined. Also, future studies should explore the urban vs. rural differences in care-seeking behavior. As mentioned, results showed that caregivers from rural communities were more likely to seek care, which is contrary to other findings, so that deserves further exploration. Finally, future studies should examine the barriers to seeking

treatment and should examine the knowledge gap surrounding appropriate treatment.

Conclusions

In the context of widespread access to ORT through Peru's national health insurance program, this study aims to contribute to the evidence on diarrheal disease in Peru by investigating social determinants of care-seeking behavior and appropriate home treatment for diarrheal episodes in a nationally-representative sample of mothers. Results suggest that mothers in rural areas, whom we would expect to have less access to care, were more likely to seek care, even when adjusting for other variables. However, this increase in access and care seeking does not extend to appropriate treatment at home. In light of these findings, policies, programs, and interventions should incorporate innovative behavior change strategies to reduce barriers to access to care and appropriate treatment for such illnesses as diarrheal disease in which there are effective and affordable strategies for home treatment. Additionally, results may suggest need for more culturally- and linguistically-appropriate information, and use of indigenous community health workers when implementing interventions to improve health outcomes for children under 5 in rural communities.

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