Many social science researchers make use of survey data that measure acute children's health symptoms from maternal reports, particularly child fever, child cough, and child diarrhea; often these reports are used as a direct measure of individual sickness and population level prevalence. However, there is considerable debate over the validity and reliability of maternal reports of child health in the developing world. I review the previously uncollected literature on self-reported health in the developing world, stretching across epidemiology, social science, medicine, and health economics. I use data from 35 recent Demographic and Health Surveys to show how probability of reporting child illness are positively correlated with maternal health knowledge, indicating that maternal knowledge plays some role in maternal-reported illness. The effect varies considerably across countries, however, shedding light on the seemingly contradictory findings from previous single country studies. Caution in the use and interpretation of these kinds of survey findings is discussed, as are implications for theories of perceived health.

There is considerable debate over the validity of self-reported health in the developing world. Many researchers hold that self-reports of health or maternal reports of child health are reliable and valid measures of morbidity. This view is stated explicitly by studies that attempt to validate self-reports or maternal reports of health (Subramanian et al. 2009). Though many studies do not explicitly tackle the question of validity of self-reports, the measures are implicitly assumed valid and reliable in the many studies that use survey self-reports of health as measures of prevalence of symptoms like diarrhea, fever, or cough (Woldemicael 2001; Yohannes, Streatfield, and Bost 1992; Ryland and Raggers 1998; Kandala and Madise 2004; Filmer 2005; Kandala et al. 2009; Sastry and Burgard 2005; Olango and Aboud 1990; El Samani, Willett, and

Ware 1989; Hill and Upchurch 1995), and still that others use self-reported health measures as dependent outcomes in models looking at the predictors of health (Filmer 2005). This body of research takes self-reports of health at face value as objective, unbiased measures of both individual level illness and population level prevalence.

An opposing camp of researchers argues that self-reported health is not a reliable or valid measure of objective health status, and this is particularly of concern in the developing world. There are several arguments and pieces of evidence these scholars use to support their position. One line of arguments holds that the poor or less educated are less aware of illness, particularly chronic illness, and are therefore less likely to self-report sickness as compared to the rich or more educated population who are more likely to be aware of their illnesses (Das and Hammer 2008). A related set of arguments takes this one step farther. These scholars, including Amartya Sen (2002), hold that self-reported health is fundamentally disconnected from objective measures of health because self-reported health is largely conditioned by an individual's social experience and related expectations of health. In this case, it is not just a person's lack of knowledge, but the lack of knowledge combined with social experiences that creates certain expectations of health as normal. For instance, a person with little knowledge about medical illness living in an area with a high disease burden might consider disease symptoms normal. These scholars' sentiments have been echoed by political scientists who argue that self-reported health is akin to other complicated concepts such as political freedom or efficacy and is variable based on one's experiences and perceptions. They hold that anchoring questions are needed to control for these biases when measuring something as complicated as self-reported health (King et al. 2003; Salomon, Tandon, and Christopher J L Murray 2004).

In response to these theories, a small body of research has sprung up examining the merits of maternal and self-reported health in the developing world. A few studies have directly looked at gradients in health by measures of socioeconomic status. Child mortality data, considered the most un-biased estimates of well-being, consistently shows that higher socioeconomic status, usually measured by wealth, income, or parental education, is related to lower child mortality (Van de Poel, O'Donnell, and Van Doorslaer 2007). Researchers look for discrepancies in morbidity patterns, as compared to these well-documented mortality patterns, to validate self-reports of morbidity. Manesh et al. (2008) used Demographic and Health Surveys data from Iran as well as dozens of other countries and found that maternal reported child morbidity was *higher* among literate mothers than illiterate mothers. The authors use this finding as evidence that self-reports of morbidity in developing world surveys should be used very cautiously. In contrast, both Stanton et al. (1987) and Subramanian et al. (2009) found no evidence of reporting bias; the former examined the relationship between maternal education and maternal reported health in Bangladesh, and the latter examined the relationship between one's own education and self-reported health in India. These questions are of particular importance to demographers, as demographers have both an interest in and tradition of studying child morbidity and its predictors (Hill and Upchurch 1995; Mosley and Chen 1984; Corman and Kaestner 1992; Reichman, Corman, and Noonan 2004; Desai and Alva 1998; Haas 2007).

RELATED CONCERNS ABOUT SELF- AND MATERNAL-REPORTED HEALTH

A parallel literature in the medical field has examined how self-reports of symptoms align with objective measures of those symptoms, including two of social scientists most often used symptoms: fever and cough. Although social scientists routinely use maternal reports of child health as measures of prevalence of child-well being, this literature assessing the reliability of maternal reports has been largely unnoticed. A number of clinical studies have focused on reporting of fever in the developing world. Einterz and Bates (1997) first reported on inaccuracy in fever reporting in sub-Saharan Africa, using clinical data from 1606 children in Cameroon that compared child patients' recorded temperature and caregivers' assessment of whether the child presently had a fever. They found that overall, 92% of respondents that reported a child did not have a fever were correct. However, only 28% of those who reported a child having a fever were correct[1]. This work spawned a set of studies examining clinical data to determine how well sub-Saharan African patients and caregivers (overwhelmingly mothers) identify fever. In rural Uganda, Morgan et al. (1997) found only 15.3% of patients correctly reported the presence of fever. Hans Verhoef and colleagues in Kenya found a declaration of fever to be correct in only 22% of cases. Kofoed et al. (1998) in Guinea-Bissau studied only children with malaria, and found that 39% of maternal reports of fever within the preceding 12 hours were incorrect. Lastly, Dunyo, Koram, and Nkrumah (1997) study of 130 children in Ghana has the most optimistic results, showing that only 24% of fever reports were incorrect. Across these five studies, 70% of patients with reported fevers were not febrile. Unrelated research in Zambia by Whybrew, Murray, and Morley (1998) found consistent results.

Additionally, some clinical research has looked at patient reports of cough. This clinical research is by and large from the developed world, but still provides insight into accuracy of reported symptoms. Several clinical studies have found that patients' reports of cough were at best only moderately correlated and at worst very weakly correlated with objective measures of cough (Archer and Simpson 1985; Falconer, Oldman, and Helms 1993). Unfortunately, this

[1] This proportion rises to 46% in children under age five.

research has not yet been fully recognized in the social science literature, and most studies using survey data use maternal reports at face value to calculate prevalence and incidence of fever.

The last set of concerns about self-reports of health are related to reporting bias. Cognitive psychologists have shown that the farther back events occurred, the more people forget them, particularly for less memorable events (Sudman, Bradburn, and Schwarz 1996). In the case of children's health in the developing world, we may expect that common conditions such as child diarrhea are not particularly memorable. A few studies have specifically examined problems with reports of symptoms based on recall. With regards to diarrhea, Alam, Henry, and Rahaman (1989) found that asking about diarrhea in the week preceding the survey underestimated severe diarrhea by 20-22%, and mild diarrhea by 42-44%. This finding was replicated by Boerma et al. (1991), who found that asking mothers about diarrhea more than two to three days in the past leads to underreporting. If underreporting is correlated with any components of socioeconomic status (for example, if mothers with more formal education are more likely to remember and therefore report their children's diarrhea), then again these reports are not reliable. Though there is no data on this relationship, it is certainly plausible that SES is related to recall. Mothers who encounter child sickness or symptoms such as diarrhea on a more frequent basis are likely less apt to recall such events because they are more commonplace.

THE RESEARCH GAP

Overall, the evidence from clinical researchers suggests that scholars in social science and public health should be at least cautious using self-reports or maternal reports of health status as objective measures of health. Furthermore, there is conflicting evidence on whether self-reports of health are conditioned upon social factors such as education, environment, or health knowledge. While some studies report clear inconsistencies, other studies do not. Large-scale examination of self-reports across a large number of countries could shed light on how social factors may impact reported sickness symptoms.

Teasing out the two separate processes of illness and reporting illness is a difficult task. Demographic data has traditionally relied upon maternal reports as objective measures of children's illness symptoms, and therefore the data do not include separate measures of objective health status and health self- or maternal-reports. Thus, researchers wanting to disentangle the two processes at work are faced with a difficult task. Given that most demographic data relies on maternal reports of children's symptoms, researchers should be interested in if maternal reports are not reliable or valid.

One way researchers may triangulate the differences between likeliness of correct reporting and actual symptoms is to examine factors that may affect only one of the two processes. One possible measure available on many surveys is women's knowledge of various health topics. In particularly, following the reasoning of Das and Hammer (2008) and Sen (2002), it is likely that in developing countries, disadvantaged women may have sicker children but be less likely to report their symptoms as abnormal because in their experience the symptoms may actually be common. For example, mothers who see many loose stools on a regular basis may not consider three loose stools in a 24-hour period to be diarrhea, even though this is the clinical definition. However, women with specific health knowledge may have a better understanding of what symptoms, though common, may be problematic and indeed illness.

The literature has shown that in the clear case of mortality, high SES is protective and predicts lower mortality. In cases of sickness that require self-reporting, however, the evidence is mixed on the impacts of SES. This is likely because SES is working in two conflicting ways:

high SES likely reduces objective sickness (such as the number of loose stools children have), but likely increases at least some kinds of sickness *reporting*, either because the more well off recognize symptoms better or consider a lower level of discomfort acceptable. Given the possible pathways, one possibly causing lower sickness and the other possibly causing higher reporting, it is reasonable that in the aggregate there are conflicting results about the impact of SES on child well-being.

In contrast to SES, maternal health knowledge may be a cleaner indicator of how social experience impacts health reports. Health knowledge could conceivably have a similar pair of conflicting impacts. Increased health knowledge could help mothers prevent sickness in their children if health knowledge is translated into healthier behaviors, but health knowledge is of course not perfectly correlated with health behaviors (e.g. Kenkel 1991; Nayga 2000). In terms of recognizing and reporting symptoms, health knowledge likely has a much more direct role, as mothers with more health knowledge are likely more knowledgeable about what constitutes symptoms, and are therefore more apt to recognize and report symptoms. While further research on this would be needed to test these assumptions, health knowledge is one factor that likely is more directly impacting recognition and reporting of symptoms.

In this paper, I aim to tease out if maternal reports of children's symptoms are conditioned upon mother's own experience, and in particular the association between mother's health knowledge and reporting children's symptoms. This is a useful case for two reasons. First, the relationship or lack of relationship between health knowledge and reporting symptoms can speak to the larger debate on the validity and reliability of self-reports of health in the developing world, a debate that has conflicting evidence, and further theories of the nature of self-reported sickness. Second, this work can more practically improve social science research that uses maternal reports of health as objective health measures by suggesting if these measures are valid and reliable or not.

DATA AND METHODS

I use data from 35 recent Demographic and Health Surveys. The surveys included were selected because they include questions of maternal health knowledge on oral rehydration, tuberculosis, or both. A sample of women ages 15-49 are asked many questions about their reproductive histories and their current living children. For all living children under the age of five, mothers were asked questions about the child's recent health. They were asked if the child, in the two weeks preceding the interview, had had a fever, a cough, or diarrhea. Table 1 shows the countries, suvey years, sample size, and proportions of children reported to have diarrhea, cough, and fever.

Unfortunately, as with previous studies, this data has only one outcome, which is the mother's report of illness, with no separate objective measure of child fever, cough, or diarrhea (such as a child's temperature, the number of times a child coughed at night, or the number of loose stools over a certain period). Therefore, throughout the analysis it is important to remember that our outcome is really a combination of two separate processes: those that produce objective health and those that produce reports of health. Predictors and coefficients may reflect one or both of these processes. Care must be taken in interpreting results, and indeed one of the important takeaways from this paper is the need for such care.

As the variable of interest, I use maternal health knowledge. Following the line of theory and evidence arguing that reported sickness is socially conditioned, I hypothesize that women with more knowledge of sickness will be more likely to notice and report sickness symptoms than women with less knowledge of sickness. In the DHS interviews women were asked a few questions about their knowledge of oral rehydration, a simple treatment for diarrhea. The oral rehydration question (in English) is as follows: "Have you ever heard of a special produce called [LOCAL NAME FOR ORAL REHYDRATION PACKET] you can get for the treatment of diarrhoea?" If the woman has never heard of oral rehydration, the interviewer then showed a commercial and government oral rehydration packet and asked: "Have you ever seen a packet like one of these before?" Admittedly, this is perhaps the most basic possible health knowledge question, as it is simply asking women if they have ever seen an oral rehydration packet[2].

In addition to the question about oral rehydration, in some surveys women were asked about their knowledge of tuberculosis and/or AIDS. Unfortunately, very few countries included these questions, and only the measure of oral rehydration knowledge is included in order to achieve the largest possible sample of both countries and women, as well as to provide the most comparable analyses across countries. Since oral rehydration is a particular treatment for one of the three symptom reports used, diarrhea, it is likely that knowledge of oral rehydration therapy will be more closely linked with diarrhea reporting than either cough or fever reporting. For both cough and fever reporting, the relationship between oral rehydration knowledge and the symptoms is less direct; however, it is plausible that knowledge of oral rehydration is a proxy for other health knowledge and therefore still a useful (if less direct) measure of health knowledge in these models.

A standard set of covariates that are often related to health status was included across countries: urban residence, wealth, maternal education, mother's age, short preceding birth

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[2] Ideally we could distinguish between women who recall hearing of oral rehydration and those who simply recognize the packet, as recalling the name likely indicates a greater familiarity than simply having seen the packet before. Unfortunately, the data recorded does not distinguish between the two.

interval, if the child was female, the bith order of the child, if the household head is female, if the home has a safe toilet, and if the home has safe water.

I ran separate models for each of the 35 countries, regressing reports of a child having diarrhea, a fever, or a cough on knowledge of oral rehydration and the control variables. In addition to the country-specific models, a fixed-effects model combining all of the countries was run.

As a methodological note, there are a huge number of tests being run throughout these analyses, and as such it is important to be sensitive to p-values. There are literally thousands of coefficients, and so the number of coefficients significant at the 0.05 or even 0.01 level due to pure chance is not minimal. As such, no one coefficient should be given too much credence in making conclusions, but rather consistent patterns should be given more importance.

RESULTS

Descriptive

As seen in table 1, there is wide variation by country in the percent of children reported to have had each of the three acute symptoms. The percentages reporting cough and fever are often considerably higher than the percentages reporting diarrhea. Figure 1 shows kernel density plots for the level of reported symptoms across countries. Overall, diarrhea has the lowest reported levels, followed by cough, and finally fever, although the cough distribution is wider than the fever distribution.

Country by country

For each of the three outcomes, a logistic regression was run for each country. Mother's knowledge of oral rehydration was included, along with the set of control variables. Table 2 shows the oral rehydration knowledge coefficients for each outcome and each country. For efficiency in presentation, the coefficients from the larger set of control variables is not shown, although these controls are included in the models that produce all of the coefficients shown in table 2.

Knowledge of oral rehydration therapy was significantly *positively* related to a mother reporting her child had diarrhea in 18 of the 35 countries; significantly positively related to reporting a child had cough in 12 of the 35 countries; and related to reporting a child had a fever in 12 of the 35 countries. For each of the outcomes, health knowledge was significantly *negatively* related to reporting a child sick in only one country. Often, knowledge predicted reports of more than one symptom in the same country; in 12 countries, mothers' oral rehydration knowledge is positively predictive of two or more of the acute symptoms. These models suggest that health knowledge does matter in some contexts. The variation across countries is noticeable. Unfortunately it is outside the scope of this work to examine *why* these between country differences exist, although the seeming consistencies of country-specific variation in the impacts of health knowledge deserves further study.

There do not appear to be any regional effects, as all regions except for the Middle East and North Africa (which each have only two countries in the analysis), include countries where maternal health knowledge matters and countries where maternal health knowledge does not matter.

Full model

After running separate models for each country, I include all countries in one fixed effects model for each dependent variable outcome with each country having its own fixed effect. I also included interactions of health knowledge with the independent variables of interest. Only interactions that were significant are discussed in this section. The results from these fixed effect models are shown in Table 3.

For each of the three reported symptoms, mother's knowledge of oral rehyrdration positively predicts her reporting the child has the symptom, showing that mother's with health knowledge are *more likely* to report that their child had diarrhea, a fever, or a cough in the two weeks before the survey. Many of the background characteristics are significant in the expected direction for predicting child illness, although the outcome is actually the mother's *report* of a child's illness. In particular, more household wealth, more maternal eduation, older mother's age, female child, and short preceeding birth intervals are related to lower probabilities of a child being reported sick. Higher birth order and being in a female headed home are related to higher probabilities of a child being reported sick.

Looking more closely at the health knowledge, I interacted health knowledge with the full set of independent varaibles. A few robust findings emerged. First, knowledge of oral rehydration is a stronger predictor of reporting a child sick among those with piped water than among those without piped water. This suggests that the impact of health knowledge is less among mothers with more or more often sick children.

Various other interactions suggest that indeed reports of sickness are conditional upon many factors, including social conditions, reference, and health knowledge. The wealth by health knowledge interaction is significant for both reports of fever and cough; the impact of health knowledge is less as household wealth increases. This may suggest that those in wealthier households are more apt to recognize particular illness symptoms in their children regardless of health knowledge, while mothers in poorer households are less apt to either recognize or report illness symptoms, and health knowledge contributes to an increased recognition or reporting of these symptoms. The education results are less robust, with borderline p-values, particularly given the power of the model with such large sample sizes.

Overall, the full models suggest that across developing countries, mothers with more health knowledge are more likely to report their children having acute symptoms of diarrhea, fever, and cough. There are considerable country fixed effects, indicating that the probability of a mother reporting her child sick varies considerably from country to country; again, it is unclear if this is a function of levels of actual illness versus levels of *reporting* illness. Future work may take up the country-level questions that are suggested by these findings, such as why some countries have higher or lower levels of each of the reported outcomes.

CONCLUSIONS

There are several important conclusions to be drawn from this work. First and most practically, these results suggest maternal reports of children's health should not be taken as objective measures of incidence or prevalence at the population level or even as objective measures of health at the individual level. The evidence for this is two-fold. First, these results show that one particular factor, maternal health knowledge, is a significant predictor of a reported child illness symptom.   In particular, the effect of health knowledge is stronger for the most disadvantaged women in terms of wealth, suggesting that reports of symptoms increase when poorer women have better health knowledge. Previous research and logic suggest that mother's having knowledge of oral rehydration does not actually *cause* children's sickness;

rather, it is more likely that mothers with more health knowledge are more apt to recognize illness or symptoms of illness and therefore report their child sick. This may have implications for public health, as mothers who recognize and report children's symptoms may be more likely to seek medical care for their children and thus prevent further complications.

In a related vein, this paper coves the rather substantial clinical literature in medical journals that has directly examined how accurate mother's reports of their children's sickness are, particularly in the developing world. This literature has gone largely unnoticed by social scientists and demographers, who often treat maternal reports as valid and reliable measures of children's illness. This is particularly problematic when these reports are used as a dependent variable and family and individual characteristics are cited as significant or not significant predictors of children's *illness*. With survey research, it is important for researchers to remember that they are in fact using a *mother's answer to a survey question*, and not an independent assessment by a doctor using a standard diagnostic test.

There are several specific findings that deserve further investigation. In particular, this study revealed large differences in the relationship of health knowledge and reports of children's symptoms across countries. Since theories of self-reported health suggest that it is both experience and context specific, further work could examine what specific country or context-level factors are associated with positive correlations between maternal health knowledge (or other social indicators) and to self- or maternal-reports of health. This study also suggests that conflicting findings on the validity of self-reported or maternal-reported health in the developing world may in fact be due to differences across countries.

For demographic researchers interested in either the outcome of child health or the predictive power of child health on other outcomes, what are possible avenues to go, given the possible lack of validity or reliability in mother's reports of child illness? There are several simple answers to this question. First, demographic researchers can rely on the more objective measures of child health available in many demographic studies, such as height-for-age (and its dichotomous corollary of stunting) and weight-for-height (and its dichotomous corollary of wasting). In addition, researchers interested in particular health measures can rely on newer studies that include biomarkers such as anemia or levels of stress hormones.

More fundamentally, demographers and other social scientists may want to re-visit questions of health, equality, and development raised by the human development approach (Sen 1999, 2002; Drèze and Sen 2002; Deneulin and Shahani 2009). In particular, there may be much to be learned and gained from examining not just objective measures of development or health, but also subjective measures indicated by approaches to development that include human capabilities and changes in subjective status. This work lends support to theories of self-reported health that argue that self-perception and –reporting of symptoms and sickness is conditional upon much more than simply being sick. Rather, sickness and symptom reports are likely conditional upon an individual's own knowledge and social environment.

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TABLES AND FIGURES

Table 1: Demographic and Health Surveys data used in the analysis

Country	Year	N	Percent reporting…		
			diarrhea	cough	fever
Asia					
Indonesia	2007	48467	10%	26%	26%
India	2005-2006	15374	9%	17%	15%
Nepal	2006	5397	12%	18%	18%
Philippines	2003	6822	11%	30%	25%
Pakistan	2006-2007	8373	22%	30%	30%
Latin America and the Caribbean					
Bolivia	2003	9699	23%	37%	30%
Colombia	2005	12877	15%	40%	25%
Dominican republic	2007	10413	17%	29%	22%
Honduras	2005-2006	6448	17%	35%	19%
Haiti	2005-2006	5470	22%	46%	26%
Peru	2000	2633	17%	39%	26%
Middle East and North Africa					
Egypt	2005	12924	18%	18%	21%
Jordan	2007 (2002)	10157	16%	13%	12%
Sub-Saharan Africa					
Benin	2006	14469	10%	21%	29%
Cameroon	2004	5665	17%	31%	26%
Chad	2004	4856	25%	24%	32%
Congo Democratic Republic	2007	7821	16%	36%	33%
Ethiopia	2005	8911	17%	16%	18%
Ghana	2003	3446	17%	24%	22%
Guinea	2005	5490	15%	23%	33%
Kenya	2003	5279	16%	40%	42%
Lesotho	2004	1827	15%	34%	28%
Liberia	2007	4976	21%	32%	34%
Madagascar	2003-2004	4943	9%	21%	21%
Malawi	2004	9714	23%	39%	38%
Mozambique	2003	8887	13%	23%	26%
Namibia	2000	4438	13%	18%	17%
Niger	2006	8037	21%	28%	27%
Nigeria	2003	5065	18%	24%	32%
Rwanda	2005	7598	14%	35%	26%
Senegal	2005	9527	22%	26%	30%
Swaziland	2006-2007	2398	14%	29%	30%
Tanzania	2004-2005	7014	14%	28%	28%
Uganda	2006	7334	27%	45%	42%
Zambia	2007	5716	16%	25%	18%

Table 2: Maternal health knowledge coefficients from country specific regressions of child reported to have an acute symptom on control variables (control variable coefficients not shown)

	Diarrhea		Cough		Fever		
Country	Coef	SE	Coef	SE	Coef	SE	N
Asia							
India	0.47 ***	0.05	0.18 ***	0.03	0.16 ***	0.03	48467
Indonesia	0.29 **	0.10	0.16 *	0.07	0.23 **	0.07	15374
Nepal	-0.10	0.25	-0.04	0.24	0.28	0.25	5397
Pakistan	2.51 ***	0.07	0.61 ***	0.06	0.66 ***	0.06	6822
Philippines	0.05	0.14	0.02	0.10	-0.05	0.1	8373
Latin America and the Caribbean							
Bolivia	0.14 *	0.06	0.22 ***	0.06	0.17 **	0.06	9699
Colombia	0.48 ***	0.10	0.36 ***	0.06	0.27 ***	0.07	12877
Dominican Republic	-0.10	0.09	0.05	0.07	-0.11	0.08	10413
Haiti	-0.36 *	0.16	0.16	0.15	-0.20	0.16	6448
Honduras	0.61 *	0.26	0.21	0.17	0.14	0.21	5470
Peru	-0.03	0.12	-0.20 *	0.10	-0.05	0.1	2633
Middle East and North Africa							
Egypt	0.00	0.10	-0.07	0.10	-0.03	0.09	12924
Jordan	0.17	0.12	0.20	0.13	0.36	0.15	10157
Sub-Saharan Africa							
Benin	0.19 **	0.06	0.18 ***	0.05	0.20 ***	0.04	14469
Cameroon	0.16 *	0.08	0.17 **	0.06	0.13 *	0.07	5665
Chad	0.01	0.08	0.10	0.08	0.02	0.08	4856
Congo Democratic Republic	0.30 ***	0.08	0.09	0.06	0.03	0.06	7821
Ethiopia	0.31 ***	0.06	0.08	0.06	0.09	0.06	8911
Ghana	-0.12	0.14	-0.01	0.13	0.13	0.13	3446
Guinea	-0.19	0.11	0.15	0.10	0.01	0.09	5490
Kenya	0.15	0.09	0.00	0.06	0.05	0.06	5279
Lesotho	-0.11	0.20	0.24	0.16	0.17	0.17	1827
Liberia	0.40 **	0.13	0.02	0.11	0.17	0.11	4976
Madagascar	0.06	0.11	—†		-0.19 *	0.08	4943
Malawi	0.72 ***	0.13	0.12	0.09	0.21 *	0.09	9714
Mozambique	0.27 *	0.12	0.33 **	0.10	0.43 ***	0.09	8887
Namibia	1.05 ***	0.21	0.28 *	0.14	0.17	0.14	4438
Niger	0.08	0.07	-0.03	0.06	-0.11	0.06	8037
Nigeria	0.10	0.08	-0.14	0.07	0.01	0.07	5065
Rwanda	-0.18	0.09	-0.25 ***	0.07	-0.05	0.08	7598
Senegal	0.08	0.05	0.08	0.05	0.09	0.05	9527
Swaziland	2.09 *	1.02	0.12	0.35	0.30	0.36	2398
Tanzania	0.36 *	0.19	0.03	0.13	0.32 *	0.14	7014
Uganda	0.24 **	0.09	0.29 ***	0.07	0.52 ***	0.08	7334
Zambia	0.20	0.17	0.02	0.14	0.16	0.16	5716

Note: All models control for urban residence, wealth, maternal education, mother's age, short preceding birth interval, if the child was female, the bith order of the child, if the household head is female, if the home has a safe toilet, and if the home has safe water

* p<0.05, ** p<0.01, *** p<0.001

†Model does not converge

Table 3: Coefficients from fixed effect logistic regression models of maternal reports on health knowledge and background variables

	Diarrhea				Fever				Cough			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE	Coef	SE
Knows of oral rehydration	0.29 ***	0.02	0.37 ***	0.04	0.12 ***	0.01	0.15 ***	0.03	0.09 ***	0.01	0.15 ***	0.03
Background												
Urban residence	0.02	0.01	0.02	0.01	-0.04 **	0.01	-0.03 **	0.01	0.04 ***	0.01	0.04 ***	0.01
Wealth	-0.16 ***	0.01	-0.13 ***	0.03	-0.08 ***	0.01	0.00	0.02	-0.06 ***	0.01	0.03	0.02
Mother has no education	-0.01	0.01	-0.09 **	0.03	-0.14 ***	0.01	-0.18 ***	0.02	-0.19 ***	0.01	-0.24 ***	0.02
Mother has primary education [REFERENCE]												
Mother has secondary education	-0.08 ***	0.02	-0.16 ***	0.04	-0.02	0.01	-0.06	0.03	0.03 *	0.01	-0.01	0.03
Mother has higher education	-0.27 ***	0.03	-0.52 ***	0.11	-0.18 ***	0.02	-0.28 ***	0.08	-0.09 ***	0.02	-0.26 ***	0.08
Female headed home	0.04 **	0.01	0.04 **	0.01	0.07 ***	0.01	0.07 ***	0.01	0.04 ***	0.01	0.05 ***	0.01
Mother's age	-0.02 ***	0.00	-0.02 ***	0.00	-0.01 ***	0.00	-0.01 ***	0.00	-0.01 ***	0.00	-0.01 ***	0.00
Short preceding birth interval	-0.05 ***	0.01	-0.05 ***	0.01	-0.08 ***	0.01	-0.08 ***	0.01	-0.06 ***	0.01	-0.06 ***	0.01
Female child	-0.10 ***	0.01	-0.10 ***	0.01	-0.04 ***	0.01	-0.04 ***	0.01	-0.04 ***	0.01	-0.04 ***	0.01
Birth order	0.03 ***	0.00	0.03 ***	0.00	0.03 ***	0.00	0.03 ***	0.00	0.01 ***	0.00	0.01 ***	0.00
Unsafe toilet	0.03	0.02	0.03	0.02	0.04 *	0.02	0.04 *	0.02	0.06 ***	0.02	0.06 ***	0.02
No piped water	0.04 *	0.02	0.20 ***	0.04	0.04 **	0.01	0.13 ***	0.03	-0.01	0.01	0.10 ***	0.03
Interactions of oral rehydration knowledge with…												
Wealth			-0.04	0.03			-0.10 ***	0.02			-0.12 ***	0.02
Mother has no education			0.10 **	0.03			0.06 *	0.03			0.07 **	0.03
Mother has secondary education			0.10 *	0.05			0.05	0.04			0.04	0.04
Mother has higher education			0.26 *	0.11			0.12	0.08			0.18 *	0.08
No piped water			-0.19 ***	0.04			-0.11 ***	0.03			-0.14 ***	0.03
Constant	-2.08 ***	0.04	-2.15 ***	0.05	-1.62 ***	0.04	-1.65 ***	0.04	-1.29 ***	0.03	-1.34 ***	0.04
N	298619		298619		298338		298338		298453		298453	
pseudo R-sq	0.028		0.028		0.03		0.03		0.036		0.036	

Note: All models include country fixed effects as well as controls for the month of the year the survey was conducted

* p<0.05, ** p<0.01, *** p<0.001

Figure 1: Kernel density plots for country-level reports of child diarrhea, cough, and fever, with global means for each respectively