Water Quality Awareness and Breastfeeding: Evidence of Health Behavior Change in Bangladesh

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Abstract

Decades of nation-wide campaigns regarding water safety in Bangladesh have cautioned households about the dangers of water-borne diseases from surface water and, more recently, arsenic contamination from certain tubewells. In addition to switching to uncontaminated well water, mothers can also protect their young children by breastfeeding longer. We study whether mothers modify their behavior in response. We exploit geographic variation in exposure to arsenic and time variation in whether children were born before or after the most recent campaign. In addition, we exploit geographic variation in the cost of switching to an arsenic-free well, namely the distance to nearby uncontaminated wells. We find that mothers breastfeed their children longer in contaminated areas and that this change is driven by households that have less access to clean wells. We also find that very young children in contaminated areas are more likely to be exclusively breastfed. This behavior change is consistent with the separate spheres model of intra-household bargaining where men have authority over certain decisions (which well to use), but women are able to influence other decisions (how to feed their children). Consistent with this breastfeeding response, we find suggestive evidence of relatively lower mortality rates and incidence of diarrhea for infants in more contaminated areas.

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1. Introduction

Water-related diseases pose a major global health problem, particularly in the developing world. According to the World Health Organization, water and hygiene-related causes account for more than 3.5 million deaths each year, almost all in developing countries (Prüss-Üstün et al. 2008). Despite an extensive literature on how to encourage better water practices, eliciting behavior change remains a challenge, in part due to low willingness to pay for clean water.[2] In this paper, we provide evidence of a particular sort of behavior change in response to water quality concerns in Bangladesh: increased breastfeeding duration and longer periods of exclusive breastfeeding. Breastfeeding can protect infants from contaminants in drinking water, such as arsenic or those causing potentially-fatal diarrheal illnesses (Habicht, DaVanzo, and Butz 1988).

Bangladesh has had a tortuous history of water quality concerns. The first water safety efforts began in the 1970s when millions of shallow tubewells were built to combat the spread of water-borne diseases through surface water. In the 1990s, high levels of arsenic were discovered in water from many tubewells and about 35 million people were thought to be drinking contaminated water (British Geological Survey and Department of Public Health Engineering 2001). In response, the Bangladesh government began testing wells, painting contaminated wells red, disseminating information on arsenic, and encouraging households to switch to clean wells. These efforts began in 1999; by 2004, 84% of households had heard of arsenic and only 8% were drinking arsenic-contaminated water (BDHS data, authors' tabulations).

One way mothers can respond to concerns about water quality, both due to arsenic contamination and other water-borne pathogens, is by breastfeeding. A large literature has established that breastfeeding protects infants from contaminated food and water. While switching to an arsenic- (and pathogen-) free water source would protect the entire household, breastfeeding may provide an easier way for mothers to protect their children. In a setting where few women work for pay, breastfeeding is a relatively cheap way to feed a baby. The decision to breastfeed longer may also be a more personal one, allowing mothers to take measures to protect their children without having to negotiate intra-household arrangements regarding water sources with their spouses or inter-household arrangements with neighbors who own an arsenic-free tubewell. Arsenic does pass through breast milk, but the concentration in breast milk is very low relative to the mothers' exposure (Fängstrom et al. 2008). While it is unlikely that mothers knew

[2] See Ahuja, Kremer and Zwane (2010) for a review of recent randomized evaluations.

that breastfeeding protects children from arsenic specifically,[3] previous nation-wide promotions have emphasized the value of breastfeeding for protection from other contaminants.

To study this question, we take advantage of time variation in whether a child was born before or after the information campaign and geographic variation in arsenic contamination using a differences-in-differences (DID) strategy. Using a sample of children born each year from 1995 to 2007, we find that children born after the information campaign are breastfed longer and more likely to be exclusively breastfed in arsenic contaminated areas relative to uncontaminated areas. The geographic variation we rely on is sufficiently local that we are able to include cluster (similar to village) fixed effects, which account for many possible omitted variables, as well as district-specific linear trends.[4] Our identifying assumption is that, conditional on village, birth year, and district trends, breastfeeding patterns were not changing differentially in more contaminated villages relative to less contaminated villages other than for reasons related to the water safety campaign. An event study specification confirms our result and provides support for our identifying assumption: prior to the information campaign, breastfeeding patterns in contaminated areas are indistinguishable from those in uncontaminated areas.

Of course, the behavior change most commonly used to avoid arsenic, switching to an uncontaminated well, protects the whole household from both arsenic and microbial pathogens. In fact, if a household switches to a clean well, there is arguably no need to adjust breastfeeding behavior. We look for differential responses to the information campaign with respect to the cost of switching to a clean well, by exploiting variation in the geographic distribution of uncontaminated wells and estimating a triple difference. We first verify that households that live farther from an uncontaminated well are less likely to drink from a clean well; they either drink arsenic-contaminated well water or surface water. Regardless of which potentially contaminated water source they choose, these mothers can protect their youngest children from both arsenic

[3] Based on the campaign documentation, we do not believe information on breastfeeding was disseminated to households. Most of the papers documenting that breastfeeding protects against arsenic were not published until after the campaign ended. In addition, the arsenic-related information was often provided at the well site during the arsenic test by NGO workers who were most often men. Since Bangladesh is predominantly Muslim, we believe it is unlikely these men spoke to local women or men about breastfeeding. However, it is certainly possible that NGO workers spoke at the village level about other water-related public health efforts and mentioned breastfeeding as a way to protect children from water-borne pathogens. This would affect our interpretation of the results only regarding whether women made the mental leap from contaminated water to breastfeeding on their own or not. Either way, the water-safety information campaign still induced behavior change among mothers of young children.

[4] Figure 1 presents a map of the wells used to calculate our measure of contamination, shaded by the level of arsenic in 1998 (BGS and DPHE 2001). Wells that tested above 10 µg/L, the WHO's guideline for contamination, are shaded grey and those that tested above 50 µg/L, the Bangladesh government's standard, are shaded white.

and water-borne diseases by breastfeeding. We first show that the DID effect described above is driven by households who are not using clean wells. Next, acknowledging the endogeneity of water source, we find that the DID effect is driven by mothers who live far from uncontaminated wells.

In addition to bolstering our identification strategy, this triple difference result supports our interpretation that women breastfeed more to protect their children from contaminated water. Specifically, it helps rule out alternative explanations for our finding, such as improved health due to reduced arsenic exposure, since women closer to clean wells should experience a greater health improvement. We are unable to fully rule out other explanations such as a substitution towards breastfeeding because of an increase in the time cost of fetching water or a change in the value of the mothers' time, but we argue below that these are unlikely.

Finally, we look for heterogeneous effects by age and find that the exclusive breastfeeding result is driven by children younger than 12 months. Supporting our claim that this behavior is in response to water concerns, we find that these children are less likely to be given water to drink. We also find evidence of lower mortality rates, lower incidence of diarrhea and greater weight for these children (but not older children).[5]

Our paper contributes to the literature on health behavior change by demonstrating that in response to new information about water quality, mothers in Bangladesh breastfed their children longer and more exclusively.[6] In Section 6, we argue that the motivation behind this behavior change is likely to be concern for child well-being. However, our results evoke two puzzles. First, why are some women protecting just their infants by breastfeeding instead of the entire family by switching to an arsenic-free tubewell?[7] Protection for the entire family seems worth

[5] While exclusive breastfeeding can explain these effects, we cannot claim this is the causal effect of breastfeeding and not partly the effect of reduced arsenic exposure. However, there is little evidence that children show arsenicosis symptoms.

[6] We focus on health behavior in our discussion, but another strand of related literature analyzes how people adapt to a changing climate. This growing literature focuses on household adaptation strategies, particularly in agriculture, and studies socioeconomic factors that influence adaptation decisions in response to climate change (Adejuwon et al. 2012, Dinar et al. 2012, Frumkin et al. 2008). In the context we study, breastfeeding can be considered a way of adjusting behavior in response to environmental dangers.

[7] Closely related is another unintended consequence of the campaign documented by Field, Glennerster and Hussam (2011): a substantial increase in under-five mortality from diarrheal diseases among households whose closest well is contaminated. Some possible explanations are a) households switched back to surface sources, despite the risks, b) storage time increased and water was contaminated with pathogens during storage or c) low arsenic shallow wells have higher rates of pathogens, such as E. coli, that cause diarrhea than high arsenic shallow wells (van Geen et al. 2011; Wu et al. 2011). Our findings complement these earlier results: their mortality effects are robustly estimated

the cost of walking to a slightly farther well. The "separates spheres" model of intra-household bargaining (Lundberg and Pollak 1993) and ethnographic research on access to arsenic-free water in Bangladesh (Sultana 2009, 2011) provide some resolution for this puzzle: men and women exercise control over different parts of the process of collecting water. Sultana (2009, 2011) describes a hierarchical household structure that gives the male household head authority over most decisions, including the time allocation of household members. The youngest women usually collect water, but the patriarch determines the source. Travelling far to collect water involves a reputation cost as well as a time cost, both because exposing women to public spaces violates traditional social norms and because it suggests that the men are not able to provide for their family by digging a safe tubewell. Installing tubewells is primarily the men's responsibility because of financial and legal requirements. When women do collect water from a neighbor's well, they are required to negotiate complex socio-economic hierarchies, generating additional social and emotional stress (Sultana 2009, 2011). Inauen et al. (2013) survey households with access to different safe water options (piped water, deep wells, well-sharing, etc.) and find that well-sharing has one of the lowest satisfaction levels on dimensions such as taste, time to collect water and whether users felt others approved or disapproved.

Thus, one explanation is that women respond by breastfeeding longer because switching to an arsenic-free well is outside their sphere of influence.[8] Section 7A discusses heterogeneity among women in the two responses to the campaign that are consistent with this theory. First, we find that women with greater participation in social and economic clubs are more likely to be using arsenic-free tubewells. This could be an indicator of better social skills or a more permissive household culture, which facilitates well-sharing arrangements. Second, more educated women are more likely to respond on both dimensions. They may have a greater ability to understand the information provided and make the connection with breastfeeding[9] as well as more control over whether the household switches to an arsenic-safe well (either due to greater decision-making power or different preferences on the part of the patriarch). Women who

for older children, while our mortality and diarrhea results are only evident for the youngest children, those who are more likely to be exclusively breastfed. We compare our strategies and results in Section 5.

[8] The empirical rejection of the unitary model of the household (Thomas 1990, 1992, Duflo 2003, Qian 2008, Miller and Mobarak 2013) suggests that information may have different impacts depending on who receives it (mothers or fathers) and what options are available to each parent. In our context, it could also be that breastfeeding their children is a response women can conceal from their spouses (see Ashraf, Field and Lee 2014).

[9] Dupas (2011b) discusses the complementarities between education and information provision in the health behavior change literature.

participate in more household decisions are more likely to breastfeed their children longer, a behavioral response more likely to be within their sphere of influence. This last finding suggests that women have decision-making power about breastfeeding; otherwise, our results would also be consistent with a patriarch dictating all household decisions (a unitary household) in an environment where women are essentially barred from public spaces.

The second puzzle is that while recent studies find that inducing behavior change is difficult, there is a growing literature on the success of the arsenic mitigation campaign in Bangladesh in increasing knowledge of arsenic and reducing use of contaminated wells (Ahmed et al. 2006, Chen et al. 2007, Opar et al. 2007, Jakariya 2007, Madajewicz et al. 2007, Bennaer et al. 2013). Why was the Bangladesh program able to elicit behavior change in general? Dupas (2011a) reviews the literature on health behavior change and concludes that providing information can impact behavior, but it depends on the recipient's characteristics (such as gender as in Meredith et al. 2013) and the content. For example, comprehensive information on relative risks may be more effective than limited information focusing on risk-avoidance (Dupas 2011b, Duflo et al. 2014). Ahuja, Kremer and Zwane (2010) review the literature specifically on clean water access. They conclude that the willingness to pay for clean water is low (Kremer et al. 2011) and that information dissemination has only a modest effect (Jalan and Somanathan 2008, Luoto, Levine and Albert 2011). However, they discuss evidence that behavioral biases may play a role in explaining household decisions about water (Madajewicz et al. 2007,Bennaer et al. 2013). In Section 7B, we discuss distinctive features of the campaign that might have contributed to its success, such as providing comprehensive information, providing a visual, repeated reminder and using a communal design.

The paper is organized as follows. The following section provides background on water quality, arsenic mitigation efforts and the benefits of breastfeeding in Bangladesh. Section 3 describes the empirical strategy, including the data and the specifications. Section 4 documents the impact of the information campaign on breastfeeding patterns. Section 5 presents the effect of the information campaign on child health. Section 6 provides a discussion of alternative motivations while Section 7 addresses the two puzzles described above providing suggestive explanations for this particular behavioral response. Section 8 concludes.

2. Background

Arsenic is naturally present at unsafe levels in the groundwater of many regions around the world. Chronic arsenic exposure through drinking water is associated with many health conditions (Saha et al. 1999). While the body can process low doses of arsenic, chronic exposure can lead to major health problems. In the short run, the symptoms of chronic exposure are relatively mild: for example, skin rashes and irritation, weakness, diabetes, edema, and respiratory problems. After a decade of exposure, however, arsenic is linked to increased risk of skin and internal organ cancers, many of which are fatal. There is little evidence that arsenic exposure is related to ill physical health among such young children (Field, Glennerster and Hussam 2011), although there is some evidence of diminished motor function, lung capacity and intellectual function among 10-year-old children (Parvez et al. 2011, Wasserman et al. 2007, Wang et al. 2007). Pitt, Rosenzweig and Hassan (2012) examine the economic consequences of arsenic poisoning and find that it has long-term negative effects on cognition, schooling and earnings for young men and on productivity in home production by women. There is no known treatment for arsenic poisoning; experts recommend avoiding arsenic as the only solution (Smith, Lingas and Rahman 2000).

2.A. Water safety efforts in Bangladesh

In the late 1970s and 1980s, public health concerns regarding water safety in Bangladesh focused on water-borne infections. Millions of shallow tubewells were built across the country, primarily by individual households, to access clean drinking water and to prevent morbidity and mortality from gastrointestinal diseases (Smith, Lingas and Rahman 2000). This movement, partly driven by UNICEF, other international aid agencies and various NGOs, was successful at publicizing the dangers of surface water through nationwide campaigns: 95% of rural households began drinking protected groundwater (Caldwell et al. 2003).

In the late 1980s, however, geologists found naturally-occurring arsenic in this groundwater. Soon afterwards, the skin lesions characteristic of chronic arsenic poisoning were identified and diagnosed as arsenicosis. However, the magnitude of the problem was not clearly understood until 1998 when the British Geological Survey (BGS) began the first nation-wide survey to investigate the extent of contamination, systematically testing samples from 3534 tubewells across 61 of the 64 districts in Bangladesh (BGS and DPHE 2001). The survey found that water from 27% of the shallow tubewells (i.e. depths of <150 meters) exceeded the

Bangladesh standard for arsenic in drinking water (>50 µg/L).[10,11] The report estimated that 35 million people were exposed to dangerous levels of arsenic (BGS and DPHE 2001).

After the BGS confirmed the extent of the problem, the Department of Public Health Engineering of Bangladesh (DPHE) initiated the Bangladesh Arsenic Mitigation Water Supply Program (BAMWSP) in 1999, a comprehensive screening of all shallow wells in contaminated regions, with the assistance of UNICEF and partly funded by the World Bank. The project was carried out in most villages in the more contaminated districts. Through the project, 55% of nearly 8.5 million wells around the country were tested for arsenic using field test kits. As part of the screening effort, tubewells were labeled to clearly indicate the amount of arsenic in the water: if the arsenic content fell below the government threshold of 50 µg/L, the spout of the tubewell was painted green. If not, the spout was painted red (UNICEF 2008). The program also dug new wells, increasing access to arsenic-safe water for 2-2.5 million people (World Bank 2007).

UNICEF also launched the National Arsenic Communication Strategy and Campaign in 1999 by hiring a social marketing firm to design and implement ways to disseminate information on the dangers of arsenic exposure. These messages were spread by various kinds of workers, including DPHE engineers conducting the arsenic tests, teachers, religious leaders, NGO staff and health care workers. These workers dispelled popular misconceptions, presented physical evidence of contamination and explained the color-coding of the wells (UNICEF 2008).[12]

Overall, UNICEF's information campaign, along with other similar efforts, raised awareness of the need to stop drinking arsenic-contaminated water (Jakariya 2007). In the late 1990s, less than ten percent of the population knew that tubewell water could be contaminated with arsenic. According to a UNICEF report in 2008, this number had risen to eighty percent. Seventy percent of informed households claimed to be avoiding contaminated water. The most common response was collecting water from a safe well, often owned by a neighbor or relative (van Geen et al. 2002, UNICEF 2008). However, it is likely the information campaign affected a number of water-related behaviors. The color-coding was aimed at getting households to switch

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[10] 46% of the wells exceeded the WHO guideline value of 10 µg/L.

[11] Arsenic contamination levels in groundwater vary widely in Bangladesh by soil depth and sediment geology. The highest levels of arsenic are concentrated (i) within medium depth soils, i.e., 10-150m below the surface (Kaufmann et al. 2001), and (ii) where the surrounding sediment was derived from the Bengal Delta Plain during the Holocene Age (Mukherjee and Bhattacharya 2001). Groundwater from depths greater than 150 meters usually contains less arsenic (Harvey et al. 2002). Only 1% of deep tubewells in the BGS sample had arsenic levels greater than 50 µg/L.

[12] The literature on the information campaign suggests that no particular demographic group was targeted when warning the public about arsenic-contaminated water.

to clean wells, but Field, Glennerster and Hussam (2011) document that some households were encouraged to switch to surface water. In addition, the greater distance from the primary water source may have resulted in an increase in water storage time, which often causes water to become contaminated (Wright, Gundry and Conroy 2004), or a decrease in the amount of water people drink (Prüss et al. 2002). All of these mechanisms are likely to have health effects.

2.B. Breastfeeding and arsenic exposure

The health benefits of breastfeeding are well-documented and especially relevant in developing countries. Breast milk protects infants against infections in two ways: first, breast milk inactivates pathogens, such as those causing diarrhea, or prevents them from attaching to the gastrointestinal tract (Isaacs 2005, Morrow et al. 2005) and second, mechanically, breastfed children are less likely to consume contaminated food and water. This feature helps protect them in areas with poor sanitation (Habicht, DaVanzo, and Butz 1988), particularly if they are exclusively breastfed (not fed anything besides breast milk, even plain water). Exclusively breastfed children are also protected from the adverse effects of arsenic (Concha et al. 1998, Samanta et al. 2007, Fängstrom et al. 2008). Fängstrom et al. (2008) found a positive relationship between arsenic concentrations in a mother’s blood and her breast milk, but the concentration in breast milk was relatively low despite high maternal exposure. Multiple studies have found negative correlations between breastfeeding and infant mortality (Betran et al. 2001, Chen, Yu and Li 1988, Briend, Wojtyniak and Rowland 1988).

Breastfeeding is nearly universal in Bangladesh: in 1999, 97% of children under the age of five had been breastfed (NIPORT 2001). Haider, Kabir and Ashworth (1999) report that Bangladeshi women were well-informed about the benefits of breastfeeding and commonly reported protection from illness as a benefit. However, despite several national breastfeeding campaigns, exclusive breastfeeding rates remain low. UNICEF and the WHO (2010) recommend that children be exclusively breastfed for the first six months of life, but supplementary feeding starts at a very early age in Bangladesh. The median duration of any breastfeeding (i.e. exclusive and non-exclusive combined) was 30 months in 1999, but the median duration of exclusive breastfeeding was only 1.8 months (NIPORT 2001) and stayed constant as of 2007 (NIPORT

2009).[13] Around half of infants under six months of age are exclusively breastfed (NIPORT 2009); instead, many infants in this age group are fed foods such as honey, sugar water, mustard oil, milk (cow, goat, powdered or condensed), rice, wheat and barley gruels (Greiner 1997).

3. Empirical strategy

3.A. Identification strategy

Our identification strategy relies on geographic variation in arsenic levels and variation over time in villagers' knowledge about these levels. The campaign was nation-wide, but households near contaminated wells would have been the most affected. Households whose own well tested positive for arsenic would have to decide whether to continue using their contaminated well, find a new, clean well or switch to surface water. Regardless of whether they chose a clean water source, water safety would have been more salient to them after the campaign. Even households whose well tested negative may be concerned about water safety if, for example, they do not trust the test or have updated their prior beliefs on the possibility of water dangers yet to be discovered. Our hypothesis is that women in more contaminated areas would be more likely to alter their breastfeeding behavior in response to the campaign.

We interact this geographic variation with temporal variation in whether a child was born before or after the information campaign in a differences-in-differences (DID) strategy, which accounts for many possible biases. The strategy might be biased, however, if there were confounding variables, such as land quality or wealth, correlated with arsenic contamination and if these characteristics changed over time differentially in places with high and low levels of arsenic contamination. The local variation created by the biogeochemical sources of arsenic has been found to be uncorrelated with common observable characteristics at the local level (Yu, Harvey and Harvey 2003),[14] although it has been found to be correlated with some village-level

[13] According to Haider, Kabir and Ashworth (1999), 99% of mothers reported having received advice about breastfeeding, and 97% claimed to understand what exclusive breastfeeding entails. However, many women incorrectly believed that exclusive breastfeeding meant a child consumed water in addition to breast milk.

[14] According to van Geen et al. (2002), blanket testing of wells covering a 21 km^2 region found that the vast majority (88%) of contaminated wells are situated within 100 meters of an uncontaminated well. Analysis of another dataset that includes 4.5 million wells across contaminated regions of the country shows that only 4.4% of 48,000 villages have zero wells with arsenic levels below 50 μg/L, while in 87% of the villages, more than 10% of the wells have arsenic levels below the threshold (the average percent of wells contaminated is 34%) (BAMWSP data, authors' tabulations). Villages are very small (likely smaller than one square kilometer), thus confirming that most Bangladeshis, even in contaminated regions, live within walking distance of a clean well.

characteristics.[15] We include village fixed effects and district-specific trends over time to deal with possible omitted variables.[16]

Village-specific trends correlated with arsenic contamination could still be a problem for our strategy. If less contaminated villages were experiencing greater improvements in child health outcomes than more contaminated villages, this would actually work against our findings. However, it is not clear which way the bias would go with respect to breastfeeding trends. Similarly, while the fixed effects and trends absorb any variation in breastfeeding preferences that is time-invariant or linearly time-varying by district, our strategy would be vulnerable to a concurrent breastfeeding promotion campaign correlated with arsenic exposure, for example. We have found no evidence of any such campaign targeting contaminated areas. In fact, UNICEF reports that breastfeeding was not a substantial part of their nutrition profile in Bangladesh over this period (UNICEF 2009). In addition, the variation we use in arsenic contamination is sufficiently local that it would be unusual for such campaigns to operate in one village but not in a nearby village.[17] Below we discuss alternate specifications where we include either village-

[15] Even local variation may be suspect if migration is frequent. However, migration is not very common in Bangladesh. Ninety percent of the men and seventy-five percent of the women in the BDHS have lived in the same residence for more than 5 years and this did not change from 1999 to 2007.

[16] Madajewicz et al. (2007) show that across 54 villages in Araihazar District in Bangladesh, households with uncontaminated wells were richer than households with contaminated wells prior to the campaign. This positive correlation between water quality and wealth disappears when village fixed effects are included and the authors suggest a geological relationship between arsenic levels and soil types as a possible explanation. However, Field, Glennerster and Hussam (2011) find the opposite correlation in their study district, Barisal District: arsenic contamination is higher in richer villages. We believe our cluster fixed effects and district-specific time trends should account for most omitted variable bias, but we also confirm that our results are robust to controlling for mother’s education and father’s education, and allowing these variables to have a different effect for each cohort. The results are also robust to a time trend interacted with dummies for each level of maternal and paternal schooling. A wealth index is only available for a subset of our data (2004 and 2007), but we confirm that the regressions we can run with this data are robust to including interactions between wealth and cohort dummies. Thus, we do not believe secular trends not due to the arsenic campaign are biasing our results. At the same time, the campaign itself could have affected property values due to changes in the availability of clean water, as Hornbeck and Keskin (2014) found in mid-twentieth century North America. Field, Glennerster and Hussam (2011) find that households with contaminated wells report lower home values in Barisal district, Bangladesh, but we believe it is unlikely that this mechanism is driving our results. We discuss this mechanism further in Section 6.

[17] In results available upon request, we examine the BDHS’ community survey that included questions on some types of NGO activity, such as Grameen Bank and mothers’ clubs. Such activity is not correlated with arsenic contamination in 2004 and this did not change over time. As we discuss in Section 7, mothers who participate in such clubs are not more likely to breastfeed in response to the campaign. We also find no evidence that mothers with TVs or radios, or mothers with more exposure to public health campaigns (as proxied by whether they recall receiving family planning messages by various media) breastfed more in response to the campaign. Finally, we find that breastfeeding behavior in Bangladesh is uncorrelated with many demographic characteristics, such as mother’s education, father’s education, gender of the child and whether the mother works outside the home, when we condition on cluster fixed effects and district trends. We also show that these (non-existent) relationships do not change much from 1999 to 2007, and certainly not in a differential way in more contaminated relative to less

specific trends in birth year or village X birth year fixed effects and find similar results, effectively eliminating many concerns about village-level trends.

We also respond to these concerns by looking for variation in the cost of switching to a clean water source and implementing a triple difference strategy, further exploiting the nonlinear geographic variation in where contaminated and uncontaminated wells are located. While all households for whom the campaign was salient are likely to be more concerned about water quality, mothers that use a clean water source would not need to modify their breastfeeding behavior in order to protect their children from water-borne diseases. Certainly, they should modify their breastfeeding behavior less than in households using contaminated water sources. Since a household's water source is endogenous, we exploit variation in the cost of switching: in particular, the distance to a clean well. We first estimate a triple difference with whether the household is sourcing water from a clean well: if not, these households are either using a contaminated well or surface water.[18] Recall that breastfeeding protects children from both arsenic and water-borne pathogens. Next, we estimate a triple difference with distance from an uncontaminated well as the third difference. Opar et al. (2007) confirms that distance to the nearest arsenic-safe well affected whether a household changed its source of drinking water.

Our measures of contamination and distance to clean wells, calculated from the BGS data collected before the campaign began, are at the village-level. This alleviates some endogeneity and reverse causality concerns about a household's choice of water source, but likely introduces measurement error. We discuss this further below. While we cannot prove that the geographic variation we use is exogenous, the fact that this pre-existing nonlinear pattern of distances to contaminated and clean wells predicts breastfeeding responses supports our strategy.

3.B. Data

The household data are from the 1999, 2004 and 2007 Bangladesh Demographic and Health Surveys (BDHS). The BDHS is a nation-wide survey conducted by the National Institute

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contaminated areas. The only demographic characteristics consistently related to breastfeeding patterns are whether the mother is Muslim (the 10% non-Muslim minority breastfeeds approximately 2 months longer) and mother's age (older mothers breastfeed longer), but these relationships do not change over time. Therefore, we think it very unlikely that secular changes in breastfeeding trends are responsible for our results.

[18] These regressions only use a subset of the data as only one BDHS round (2004) tested for arsenic. We focus on a household's current water source, as it is not possible to construct an accurate measure of switching between water sources from the BDHS data. The BDHS does not ask for previous water sources, making it impossible to know a household's water source before the campaign.

of Population Research and Training (NIPORT). In each year, a sample of approximately 10,000 households is chosen from about 360 villages (clusters). The survey is then administered to all ever-married women, aged 10-49, and a subset of men in each household. In addition to standard demographic information, the women's questionnaire contains a module on all births in the past five years, with questions on the child's current health, how long the child was breastfed, and foods provided to the child in the past 24 hours. Thus, the data includes observations for approximately 20,000 children born each year between 1995 and 2007.[19]

The BDHS also includes a section on the source of the household's drinking water and water used for other purposes (dishwashing, hand washing, etc.). In 2004, the respondent was also asked about her knowledge of arsenic. In addition, the household's drinking water was tested for arsenic, source wells were inspected and any markings (red or green) were noted.

The BDHS also collected GPS data for the 360 clusters in each round, but not for each household. GPS coordinates are displaced up to two kilometers in urban areas and five kilometers in rural areas, with 1% of rural locations displaced up to 10 km. One data challenge is that the clusters are not the same across survey rounds. In our specifications, we either include cluster fixed effects (where the clusters are survey-year specific) or, if not possible, we match the clusters from 1999 and 2007 to the closest 2004 cluster using the GPS coordinates.

3.B.1 Measures of arsenic contamination

Our main measures of arsenic contamination are from the British Geological Survey (BGS). In 1998 and 1999, the BGS tested the arsenic levels of 3,534 wells across the country and recorded the GPS location of each tested well.[20] Using the locations of the wells and the BDHS clusters, we calculate various measures of arsenic contamination for each cluster. Recall that the cluster's GPS coordinates only approximate a household's location (in part because they are displaced, but also because they mark the closest enumeration area and not the household's own location). Thus, our preferred measure is the probability that a BDHS household lives within one mile (a 15-20 minute walk) of a BGS-tested contaminated well, conditional on the household living within five miles (eight kilometers) of the cluster, weighted by the inverse of the distance

[19] Children born in 1994 were excluded because of a very small sample size.
[20] The BGS tested a geographically representative sample of wells, subject to a few practical considerations such as proximity to roads. We drop around 300 children from the three districts that the BGS did not survey.

from the cluster's GPS coordinates.[21] We choose an eight kilometer radius to allow the true location of the cluster to be displaced up to five kilometers from the GPS coordinates and the household to be located even farther.[22] We weight this measure because the actual location of the cluster and the household are more likely to be closer to the center of the circle, because of the amount of displacement (*up to* five kilometers) and assuming that population density is higher at the actual location of the enumeration area.[23] For expositional ease, we will refer to this measure as follows: a value of 0.07 will be called a cluster with 7% contamination. More straightforward measures, such as the number and percent of contaminated wells within five miles of each cluster's GPS location or the average contamination level of these wells, are not as accurate because they do not take into account the geographic distribution of contaminated wells around the GPS location of the cluster. For example, if all the contaminated wells are clustered in a small part of the cluster's catchment area, the fraction of households exposed to contaminated wells would be different than if the contaminated wells were spread out. Figure 2 depicts two clusters with the same number of BGS-tested contaminated and uncontaminated wells, but households in Cluster A are more likely to be exposed to arsenic contaminated drinking water than households in Cluster B. Nevertheless, the various measures are highly correlated with each other.

There are advantages and disadvantages to using this village-level variable. A household-level variable would provide more precision, but might be endogenous. For example, the 2004 BDHS tested each household's water for arsenic but using that as a measure of contamination is problematic since it is based on the water source the household chose after the information campaign, which would likely be correlated with many omitted variables. Ideally, we would want the contamination level of the well the household used before the discovery of arsenic, or the well closest to the household's exact location before the campaign, but neither is available in

[21] While people in Bangladesh do not generally walk 15-20 minutes to collect water, we are limited by the number of wells tested by the BGS (3,534). We discuss this issue below and provide numerous checks that our measures are picking up local variation in arsenic exposure.

[22] Our results are robust to dropping clusters that we suspect are displaced a great distance. The BDHS records the household's district of residence, which we can compare to the district of the cluster's GPS location using a GIS shape-file of Bangladesh. Our results are robust to dropping 64 clusters (out of 1080, across three rounds) for which the GPS location of the cluster is more than one kilometer outside the household-reported district's boundaries and to dropping the 174 clusters for which the GPS location of the cluster is not in the household-reported district at all.

[23] In practice, we calculate this probability by generating a grid of approximately 10,000 points within five miles of the cluster's GPS coordinates, determining whether these points are within one mile of a BGS-tested contaminated well, and then calculating a weighted average over all the points.

any BDHS round. Our village-level measure is as close as we can get to the latter. One strength of our measure is that the BGS ended the same year the BAMSWP began, which avoids reverse causality concerns about new wells being built in contaminated areas.

Unfortunately, the BGS only tested a small fraction of the wells in the country. Figure 1 indicates that the geographic coverage of this sample is quite respectable. More than 90% of the children in our sample have at least three tested wells within five miles of their cluster and 74% have five or more tested wells. In addition, our results are robust to dropping those clusters with very few nearby wells. Nevertheless, it is possible that our use of village-level measures introduces measurement error. Classical measurement error would simply suggest that our results are biased towards zero, but it is important to verify that our preferred measures of contamination are picking up something real. Table 1 presents estimates from regressions of the household-level data on arsenic contamination (from the 2004 survey) on the village-level measures (our preferred measure is shown in the top row). For each combination of measures, the correlation is positive and strongly significant (at 1%). The first column shows that households in more contaminated areas are more likely to have heard of arsenic, regardless of which measure we use, providing support for our assumption that these are the villages where the campaign was most salient. Columns (2) to (5) use variables that depend on the household's choice of water source, which is likely to introduce bias, but it is reassuring that the village-level measures of contamination predict whether households are still using contaminated water sources in 2004.[24]

We can provide similar support for our measures of access to clean wells. Given the difficulty in predicting who switches to a clean well, we calculate a few different measures of access. Our first measure parallels our measure of contamination: the probability that a BDHS household lives within 1 mile of a BGS-tested uncontaminated well, conditional on living within

[24] We also have access to data from the Bangladeshi government, collected as part of the BAMWSP itself, with arsenic levels for approximately 4.5 million wells across contaminated regions of the country (BAMWSP 2004). We do not use this data as our primary data for multiple reasons. The main reason is that this data does not include GPS coordinates for each well, which makes it difficult to generate local measures of arsenic exposure and access to uncontaminated wells. The data does indicate the mouza the well is in (an administrative unit just above village). Matching this information with GIS data on mouzas (CEGIS 2002) allows us to generate reasonable measures of contamination and access to clean water that strongly support our BGS measures. In the Online Appendix, we describe this data in detail, compare measures from both data sources and reproduce our results with these data. Our DID results are robust to using these new data – in fact, the magnitudes are remarkably similar – but there is limited variation in access to clean wells conditional on contamination, due to the lack of GPS coordinates. Thus, we are only able to replicate our triple difference results using a combination of BGS and BAMWSP measures. Other reasons we do not focus on the BAMWSP data are i) we do not know when the wells were built or whether wells built as part of the BAMWSP campaign are included and ii) the data does not cover the entire country.

five miles of the cluster. Our second measure is the average distance from the closest uncontaminated well, conditional on living within five miles of the cluster.[25] We also weight these measures by the inverse of the distance from the cluster. Table 2 demonstrates that this local geographic variation in arsenic contamination and access to clean wells does predict household behavior: we regress whether a household drinks arsenic-contaminated water or surface water (i.e. is not using an arsenic-free well, from the 2004 BDHS) on our preferred measure of contamination, a measure of access to clean wells, the interaction of the two (all regressors are calculated from the BGS data) and district fixed effects. The interaction term is statistically significant and of the expected sign, regardless of which measure of access we use. For example, in Columns (1) and (2), people who live in more arsenic contaminated areas are less likely to be using contaminated water, the greater the probability that they have a clean well within 1 mile (the interaction term is negative and significant). The main effect of contamination is positive and statistically significant: people living in more contaminated areas with no access to a clean well are likely to still use contaminated sources. In Columns (3) and (4), people who live in more contaminated areas are more likely to be still using contaminated water, the farther they have to travel in order to reach an uncontaminated well (the interaction term is positive and significant). Here the main effect of contamination is negative, but not statistically significant at the 5% level: people with easy access to a clean well are not more likely to still be using contaminated water even if they live in more contaminated areas.[26]

Figure 4 predicts use of contaminated water non-parametrically: we plot a kernel-weighted local polynomial of the relationship between access to clean wells from the BGS data and whether a household drinks contaminated water or surface water (i.e. is not using an arsenic-free well) from the 2004 BDHS survey, with cluster-bootstrapped 95% confidence intervals. As expected, the more access to clean wells people living within 5 miles of a cluster's GPS location

[25] Since both our measures of arsenic exposure and access to clean wells are derived from BGS wells and matched by cluster to the BDHS, one might ask whether access to clean wells is simply the negative of exposure to contaminated wells. This is not the case. The two measures are negatively correlated, but variation in contamination explains a tiny fraction of the variation in access to clean water. The R-squared ranges from 0.0014 to 0.0604 depending on the measure used. We are exploiting the nonlinear geographic variation in the location of clean and contaminated wells within a cluster, as can be seen in Figure 3 which depicts two clusters with the same level of contamination (the same number and placement of sampled contaminated wells) but different levels of access to clean wells (in this case, the same number but different placement of sampled uncontaminated wells).

[26] These results are stronger if we redefine the dependent variable to be whether the household drinks arsenic-contaminated water but we keep the definition as is because mothers who use arsenic-contaminated wells and mothers who use surface water should respond similarly on the breastfeeding dimension.

have, the fewer households in that cluster choose to drink unclean water. Figure 5 plots this relationship separately for clusters with greater than 0% contamination and 0% contamination, and for households who have heard of arsenic and households who have not (without the confidence intervals for the sake of readability). While having heard of arsenic is not necessarily exogenous, the negative relationship between access to clean wells and drinking contaminated water is driven by households who have heard of arsenic in more contaminated regions, supporting our view that this relationship is related to the information campaign.

3.B.2 Summary statistics

Table 3 presents the means of various demographic, outcome and contamination variables separately for areas with lower and higher than median arsenic exposure. Data from 1999, prior to the information campaign, are presented in Columns (1) and (2). Column (3) presents the differences between contaminated and uncontaminated areas, conditional on district fixed effects, and indicates whether these differences are significant when standard errors are clustered by BDHS cluster.[27] Reassuringly, there is only one statistical difference among the control variables and the outcomes (in weight-for-height z-score); multiple comparisons logic suggests this is not surprising since we are comparing 25 different variables. As expected, arsenic exposure is significantly different in the two sets of clusters.[28]

Columns (4) to (6) repeat this exercise for the 2007 survey. Note that all these children were born after the information campaign. The main result of our paper can be observed in this table by computing the simple DID estimate for the months breastfed outcome. The average number of months a child was breastfed in uncontaminated areas increased by 0.64 months from 1999 to 2007. In contaminated areas, the number of months a child was breastfed increased by 1.21 months, more than half a month more. In our empirical work, we bolster this result by exploiting more variation in time and arsenic exposure and including various control variables.

[27] We are unable to include cluster fixed effects when comparing means across more and less contaminated areas since our arsenic measures are at the cluster level (although we can in our regressions since we interact exposure with whether the child was born after the campaign). All standard errors presented in this paper are clustered by BDHS cluster. The results do not change when we cluster by district.

[28] Arsenic measures in all years are from the BGS, but since clusters differ for each survey round, the measures of arsenic contamination differ as well. We present unweighted OLS regressions, although we confirm that our results are robust to using the sample weights. When we use the weights to compare summary statistics, one of the 10 breastfeeding outcome variables is significant at the 10% level, as one would expect given the multiple comparisons.

3.C. Empirical model

To see how mothers' respond to the new information about the quality and safety of their drinking water, we run the following regression:

$$B_{ijkst} = \alpha_{js} + \alpha_t + \alpha_k t + \beta A_{js} \cdot post_t + \gamma X_{ijkst} + \varepsilon_{ijkst} \qquad (1)$$

where B_{ijkst} is a measure of how long child i living in cluster j district k, born in year t and surveyed in year s was breastfed, A_{js} is a measure of arsenic exposure for (survey s-specific) cluster j and $post_t$ is a dummy variable for being born in 2002 or later.[29] We include fixed effects for BDHS cluster (α_{js})[30] and birth year (α_t), as well as district-specific trends ($\alpha_k t$). The set of control variables, X_{ijskt}, includes the current age of the child (we assign age at death for children who died) and a dummy variable for whether the child died, depending on the choice of dependent variable.[31] Our preferred measure of breastfeeding is the number of months a child is breastfed but this dependent variable imposes a functional form assumption about the effect of the campaign and is right censored for children who died and those still being breastfed. We assign the age at death for those who died and the child's current age for those still being breastfed. We also address these issues by considering two other dependent variables: whether a child was breastfed for at least 12 months and whether a child is currently exclusively being breastfed.[32] Finally, we discuss various checks to deal with the right censoring in Section 4A.

The identifying assumption for this DID is that breastfeeding trends were not correlated with arsenic exposure, conditional on BDHS cluster, other than because of the information campaign. The district-specific trends strengthen the validity of this assumption: our estimates are identified off deviations from pre-existing district trends. Nevertheless, it is possible that

[29] Although the program was in place from 1999 to 2006, its completion report indicates that progress was very slow for the first 2.5 years (World Bank 2007). The report also states "With acquired knowledge, unsafe wells painted, and availability of arsenic-safe water sources, most people in project areas use arsenic-safe sources for drinking. All achieved during 2002/2003." Thus, we define the post period from 2002.

[30] Due to the BDHS' design, this regression will be estimated primarily off of the 2004 data, since only clusters surveyed in that year will have children born before and after 2002. (The 1999 sample includes children born between 1995 and 2000, and the 2007 sample includes children born between 2002 and 2007, making $A_{js} \cdot post_t$ collinear with α_{js} in these years.) Our results are robust to using just the data from 2004. However, we continue to include the 1999 and 2007 samples because we need variation in treatment status when we split the sample by age (all 4-year-olds in 2004 will be 'untreated' regardless of cluster). For example, when we estimate diarrheal incidence among infants, $post_t$ does not vary within survey round and, in turn, within survey-specific cluster: $A_{js} \cdot post_t$ is collinear with α_{js}. In those regressions, we include fixed effects for the closest 2004 cluster and for survey year.

[31] While whether a child has died is endogenous, excluding children who died results in an endogenously-selected sample.

[32] The natural log of months breastfed gives us similar results (results available upon request).

breastfeeding was trending differently in areas with greater arsenic exposure for other reasons. We provide support for our parallel trend assumption with an *event study* specification where we interact arsenic exposure with dummy variables for each birth year. Specifically, we estimate:

$$B_{ijkst} = \alpha_{js} + \alpha_t + \alpha_k t + \sum_{l=1996}^{2007} \beta_l A_{js} \cdot d_l + \gamma X_{ijkst} + \varepsilon_{ijkst} \qquad (2)$$

where d_l for $l \in [1996{,}2007]$ are indicator variables for birth year and everything else is as defined in equation (1). With this specification, we can test whether areas with more or less arsenic exposure were experiencing differential trends in breastfeeding duration by examining the coefficients, β_l, for children born before the information campaign.[33]

We also strengthen the validity of the exclusion restriction by focusing on those who should be most responsive, that is, households that continue to use arsenic contaminated wells and those that drink surface water. These mothers should choose to breastfeed longer to protect their children from arsenic and water-borne diseases, while those who have already switched to a clean water source (a well not contaminated with arsenic) do not need to. We estimate this with the following specification:

$$B_{ijkst} = \alpha_{js} + \alpha_t + \alpha_k t + \delta_1 A_{js} \cdot post_t + \delta_2 A_{js} \cdot post_t \cdot D_{ijkst} + \gamma X_{ijkst} + \varepsilon_{ijkst} \qquad (3)$$

where D_{ijkst} is an indicator variable for whether the water tested in the household contained arsenic or was surface water. Recall that only the 2004 survey has this information. According to our hypothesis, the coefficient δ_1 should be zero because women who are drinking clean water should not change their breastfeeding behavior and the coefficient δ_2 should be positive. As noted above, a household's choice of water source may be correlated with other household characteristics, potentially biasing our results. To deal with this, we re-estimate specification (3) using predictors of whether the household is using clean well water, namely measures of access to an uncontaminated well.[34]

[33] Another threat to our strategy would be if the composition of mothers has changed due to the information campaign. While there is no consensus on arsenic's effect on reproductive health, epidemiological studies suggest that prolonged maternal exposure can cause elevated rates of neonatal and infant death (Hopenhayn-Rich et al. 2000). Exposure to arsenic has been linked to higher rates of spontaneous abortion, stillbirth, and pre-term birth (Ahmad et al. 2001; Milton et al. 2005; Rahman et al. 2010). However, we find no evidence that the campaign and subsequent reduction in arsenic exposure affected the probability of getting pregnant or of a pregnancy terminating in a miscarriage, abortion or stillbirth (results available upon request).

[34] While it may seem like we should use these geographic measures as instruments for drinking unclean water in equation (3), we proceed with the reduced form regressions instead because the instruments are not available at a disaggregated level. The endogenous variable (drinking from unclean sources) varies at the household level, while the instrument varies at the cluster level.

4. Response to information regarding arsenic exposure

4.A. Breastfeeding practices

Table 4 presents results from specification (1), estimating how breastfeeding practices responded to the campaign. The dependent variable in Panel A is the number of months the child is breastfed. The coefficient on the interaction term is positive and strongly significant for all children (Column 1); moving from an area with 0% to 10% contamination (from the 25th to the 75th percentile, equivalent to one standard deviation) would lead a mother to breastfeed an additional 0.6 months.[35] From 1997 to 2007, the average number of months breastfed only increased by 0.6 months in less contaminated areas and 1.2 months in more contaminated areas, so the campaign can explain much of this difference. Column (4) includes district-specific trends, relying on less stringent identifying assumptions, and this hardly changes the estimate.

We next divide the sample into urban households (Columns 2 and 5) and rural households (Columns 3 and 6). The result is driven by rural areas (although the coefficients are usually not statistically distinguishable).[36] We focus on rural areas for the remainder of the paper.

It is worth noting that our dependent variable is right-censored by children who are still being breastfed and children who died while still being breastfed. In Table 4, Panel B, we consider a different outcome variable that suffers less from this problem: whether or not a child was breastfed for at least 12 months conditional on having lived at least 12 months. While the coefficient on the interaction term is not significant for the entire sample, it is positive and significant for rural children when we include district-specific linear trends (Column 6).[37] Appendix Table A3 shows that the result is not sensitive to the choice of breastfeeding duration; in fact, the coefficient gets substantially larger as we increase the duration. Moving from the 25th to the 75th percentile in the arsenic distribution increases the probability a child is breastfed for at least 12 months by an additional 1.1 percentage points and the probability a child is breastfed for at least 36 months by an additional 4.5 percentage points, or 12.6% evaluated at the mean.

[35] In Appendix Table A1, we test the robustness of this result to different measures of arsenic exposure and find supportive results.

[36] In Appendix Table A2, we further divide the sample into households or villages with and without access to piped water. These estimates indicate that the results are driven by people in rural areas, without access to piped water.

[37] Recall that when focusing on a particular age, there is little to no variation in the 2004 sample and we include fixed effects for the nearest 2004 cluster instead of survey-year specific cluster fixed effects. Months breastfed is our preferred measure for this reason, as well as because it exploits more of the variation in breastfeeding duration.

In Table 4, Panel C, we consider a third dependent variable: whether or not the child is exclusively breastfed.[38] The BDHS does not ask whether children are exclusively breastfed explicitly, but it does ask for the types of foods and liquids given to the child. We define a child as exclusively breastfed if they are currently being breastfed and have not received any liquids, even plain water, in the past 24 hours. Out of the 10,000 children still being breastfed in our sample, less than 12% are exclusively breastfed.[39] Fifty percent of children younger than 6 months are exclusively breastfed, but only 5% of children aged 6 – 14 months are. We see the same behavior change with this outcome variable: children born in contaminated areas after the information campaign are more likely to be consuming only breast milk. Moving from the 25th to the 75th percentile in the distribution of arsenic contamination would increase the probability of being exclusively breastfed by an additional 2.84 percentage points, a 24% increase when evaluated at the mean (Column 6).

Given the variation in exclusive breastfeeding by child age, we look for heterogeneous effects by age in Table 5. Since we are dividing the sample by age, we include fixed effects for the nearest 2004 cluster instead of the survey year-specific clusters. The dependent variable in Panel A is whether or not the child is still being exclusively breastfed and the sample is divided up by age range: younger than 6 months, 6 to 14[40] months and older than 12 months. The effect on exclusive breastfeeding is stronger for younger children, exactly where we would expect the most variation in this variable. A one standard deviation increase in arsenic exposure increases the probability a child is exclusively breastfed by an additional 8.5 percentage points for children younger than six months and 3.6 percentage points for children between six and 14 months. The effect is substantially smaller and not statistically significant for children older than 12 months.

Even if a mother is not exclusively breastfeeding, she may choose to give her children milk or other non-water based liquids in response to the information campaign. In Panel B of Table 5, we use whether a child consumed plain water in the past 24 hours as the dependent

[38] This dependent variable also addresses the censoring, except that here only living children are included. In Appendix Table A4, we test whether the results are robust to different assumptions regarding the censored dependent variable. We estimate the regression just using children who are no longer being breastfed, or assigning children who are still being breastfed the max in the data (59 months). We assign children who have died the max in the data or the age they would have been had they not died. The results are robust to these alternate assumptions.

[39] Among rural children who are not being exclusively breastfed, 96% have had plain water in the past 24 hours, 5% have had baby formula, 9% have had sugar water, 30% have had cow's or goat's milk, and 10% have had other liquids. The numbers for children who are not being breastfed at all are similar (BDHS data, authors' tabulations).

[40] We are unable to use 12 or 13 months because the variance matrix is highly singular. The coefficients are of similar magnitudes, but we could not calculate standard errors.

variable. Here the effect is striking: A 10% increase in contamination leads to a 12 percentage point decline in whether a child under six months of age is given water, a 30% decline, and a 7.3 percentage point decline in whether a child between six and 14 months is given water. The effect is not statistically significant for older children, which is as expected since these children are not likely to be getting enough hydration through other sources.

As described in section 3.C, we provide support for the exclusion restriction with an event study. Figure 6 plots the coefficients on the interaction between birth year and arsenic exposure for each cohort, β_l where $l \in [1996{,}2007]$, after estimating specification (2) with months breastfed as the dependent variable. The coefficients for the cohorts born before the information campaign are small and not statistically significant. Starting in 2002, however, the coefficients are positive and more or less increasing. By 2005, they are positive and statistically significant. We test and strongly reject the hypothesis that the average of the coefficients from 1996-2001 is equal to the average of the coefficients from 2002-2007 (p-value 0.003).[41]

We present two further checks to address the possibility of village-level trends in Appendix Table A5. First, we reproduce the results from Table 4 with village trends instead of district trends. Cluster trends eliminate a lot of power when our specifications involve age-specific samples (since clusters differ by survey), but the increase in breastfeeding duration is robust to this new specification. Second, in the 2004 data, we use whether the household has heard of arsenic as the measure of contamination. This measure provides household-level variation in contamination and is arguably less endogenous than measures based on the household's choice of water source. Even in villages with zero contaminated wells, however, more than half the respondents had heard of arsenic; therefore, we split the sample into villages with below and above average contamination. We run these regressions with our usual set of controls (including cluster fixed effects and district trends) and also with cluster X birth year fixed effects, effectively eliminating any village X birth year idiosyncrasies. Our results are robust to these specifications in more contaminated villages: mothers who have heard of arsenic breastfeed their children longer. It is also reassuring that the point estimate does not change much when cluster X birth year fixed effects are included (in fact, it rises), suggesting that village-level trends are not biasing our results upwards.

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[41] The statistically significant coefficient for 1996 seems to be spurious because 1997 is back to 1995 levels; the F-test comparing the average of the coefficients from 1997-2001 and 2002-2007 also rejects equality (p-value 0.007).

4.B. Heterogeneity in the response with respect to access to a clean well

To strengthen the validity of the identifying assumption that secular trends in breastfeeding behavior are not correlated with arsenic contamination, we estimate a triple difference (specification 3) using variation in the ease of switching to a clean well. Households that live very close to an uncontaminated well should find it very easy to switch water sources and therefore mothers would not need to modify their breastfeeding choices. Table 6 presents the two coefficients of interest. In Column (1), we estimate the effect of the information campaign separately for those who are using clean well water and those who are either using arsenic contaminated wells or surface water.[42] We find no evidence that those who are drinking clean well water alter their breastfeeding duration after the information campaign (top row), but the triple difference suggests that that the response differs significantly (at 1%), and is positive, for those who do not use clean wells, supporting our hypothesis.

In Columns (2) to (5), we address the endogeneity of water source by replacing the triple difference measure with proxies for the cost of switching to a clean well. Given the difficulty in predicting which households would switch water sources, we use four different measures of access to an arsenic-safe well. In Column (2), we use the probability of living within one mile of an uncontaminated well, conditional on living within five miles of the cluster. The coefficient on the two-way interaction is the effect for households with no nearby clean wells. As expected, women in these households breastfeed longer. The triple interaction is significant and negative, as predicted: as more households are within one mile of a clean well, the breastfeeding response falls. At the mean value of prevalence of clean wells, 0.15, the effect is still positive and significant, but the effect is not significantly different from zero for clusters where the probability of being within one mile of a clean well is 20% or more. Column (3) uses the weighted measure. The main effect for those with no nearby clean wells is positive and significant and the triple interaction is not significant, but it is negative and non-trivial in magnitude: the effect of the information campaign is no longer significant for households in clusters where the probability of being within one mile of a clean well is more than 25%.

[42] In results available upon request, we separate households that are using arsenic-contaminated water and households that are using surface water and find that this result is driven by both groups. We interpret this to mean that mothers are responding to both arsenic contamination and diarrhea-causing pathogens.

Column (4) measures the difficulty of switching to a clean well with the average distance to the closest uncontaminated well. Again, the signs of the coefficients are as expected. Clusters where the average household is zero miles from an uncontaminated well do not alter their breastfeeding behavior (the two-way interaction is not statistically significant), but as the average household gets farther away from an uncontaminated well (the triple-interaction), mothers breastfeed significantly longer. When we use the weighted measure (Column 5), the triple interaction term is not statistically significant (although it is close with a p-value of 0.128), but the effect of the information campaign for a cluster where the average household is 2 or more miles away from an uncontaminated well (the median of the distribution in access to clean wells) is positive and statistically significant.[43] When we jointly test all four triple interaction terms across Columns (2) to (5), the p-value is 0.0146. Thus, while not every triple interaction term is statistically significant at conventional levels, taken together these results strongly suggest that there is heterogeneity in the breastfeeding response to the information campaign and that our differences-in-differences results are driven by those mothers still drinking contaminated water.

These triple difference results strengthen our causal argument. In Table 4, the identifying assumption was that no omitted determinants of breastfeeding trends are correlated with arsenic exposure, conditional on the controls. While district-specific trends take out some secular trends, one could still argue that places with more arsenic exposure are trending differently, and these differential trends may be changing over time. Including birth year dummies interacted with maternal education, paternal education and a wealth index does not alter our results. In addition, Table 6 provides additional evidence: to bias our results, these omitted variables would have to affect just households with little access to clean wells.

5. Health effects

We next turn to the health consequences of the information campaign (including the subsequent reduction in arsenic exposure and increase in breastfeeding practices). Table 7 presents estimates of specification (1) with health outcomes as dependent variables. As in Table 5, we include fixed effects for the nearest 2004 cluster. In Panel A, the dependent variable is a

[43] The results are similar when we use breastfed for longer than 12 months as the dependent variable, in fact the triple interaction in Column (5) is also significant (results available upon request). While the triple interactions are not always significant when we use exclusive breastfeeding, the signs of the coefficients are the same. Recall that we have less power when studying exclusive breastfeeding as we only have data on whether children are *currently* exclusively breastfed and only infants are likely to be affected.

dummy variable for whether the child died before the age of 6, 12, 24, or 36 in Columns (1) to (4), respectively. The information campaign has a negative and strongly statistically significant effect on child deaths before the age of 6 months and a marginally significant effect on deaths before the age of 12 months. The magnitude of the effect is not trivial: a cluster with a one standard deviation higher contamination level would experience a 1.1 percentage point greater decline in infant mortality as a result of the campaign. The point estimates for older ages are also negative but not statistically significant.

Note that we cannot identify the mechanism behind this health effect. It could be the effect of increased rates of exclusive breastfeeding, which the health literature suggests can have a large impact on infant survival in an area with poor sanitation (see, e.g., Habicht, DaVanzo and Butz 1988). Recall that our point estimates on the increase in exclusive breastfeeding of infants suggested large effects. If infants are more likely to be exclusively breastfed and not given water, they are less likely to suffer from water-borne diseases that can be especially fatal at that age. At the same time, we saw no increase in exclusive breastfeeding for children older than 12 months (only 2% of whom are exclusively breastfed) and no health impacts either. For this reason, we believe our results complement, not contradict, the findings in Field, Glennerster and Hussam (2011). Their results are estimated most robustly for older children, while our results are only for the youngest children, the ones most likely to be exclusively breastfed and for whom breast milk is a good substitute for water.[44]

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[44] The statistically significant evidence of an increase in *infant* mortality that Field, Glennerster and Hussam (2011, henceforth FGH) find is primarily from their study region of 155 villages in Barisal district. When they look for nationwide confirmation, they only find statistically significant evidence for older children, and not for infants. We believe the discrepancy in our results is due to district-specific differences in the response to the campaign and find empirical evidence to support this explanation that confirms both our findings and their results. Note that the implications for diarrheal incidence and mortality depend not only on the household's new water source but also on whether mothers breastfeed their children more. For example, mothers who switch to an arsenic-safe shallow well (for clarity, call these Type A households) do not breastfeed longer (as our triple difference evidence confirms) thinking their water is safe from arsenic and pathogens. However, van Geen et al. (2011) and Wu et al (2011) suggest that these children (of all ages) suffer higher rates of diarrhea because low arsenic shallow wells have higher rates of diarrhea-causing pathogens than high arsenic shallow wells. An increase in diarrheal incidence is also possible for children of all ages in households that switched to surface water (Type B households), but here mothers are more likely to exclusively breastfeed their infants, protecting them (but only them) from these pathogens. Children in households that continue to use arsenic-contaminated shallow wells (Type C households) should experience no change in diarrhea incidence unless their mothers are more likely to breastfeed exclusively. Thus, without accurate information about a household's initial and new water source, the estimated effects are a weighted average that depends on the relative proportions of mothers in each category. In fact, FGH write that Barisal district had a particularly high rate of switching away from contaminated water sources by 2004 relative to other districts. In this case (many Type A households), we might expect infant and child mortality to rise. In results available upon request, we divide districts into those with higher and lower rates of using arsenic-safe wells and find that the

However, it could also be that the information campaign improved child survival rates by reducing exposure to arsenic. We argue that reducing arsenic exposure should have affected older children as well, but we concede that these health effects could be the combined effects of all changes in health behaviors, including reduced arsenic exposure and increased breastfeeding. We also note that one reason these health effects are concentrated among the youngest children could be that parents have less control over what older children drink than what infants drink, regardless of whether the infant is breastfed.

We also find corroborating evidence in the impact on other health outcomes. In Panel B, we divide the sample by age (0-12, 12-24, 24-36 and 36-48 months) and examine the effect of the information campaign on the incidence of diarrhea. There is a strongly statistically significant reduction in diarrhea incidence among children in their first year of life, but no significant effect in future years. Again, exclusive breastfeeding is likely to protect infants from diarrheal diseases. We also find that weight for height is greater for children younger than 12 months (and marginally for children aged 12-24 months), but no effect on height for any age group.

6. Alternative mechanisms

Our principal finding is that mothers improve their breastfeeding practices in arsenic contaminated areas after a water-safety information campaign and that this change is greater when households have less access to clean wells. Our interpretation is that this is a conscious choice to protect children from contaminated water (arsenic or pathogens), but there are at least three alternate explanations. First, it could be a positive productivity shock due to reduced arsenic exposure: drinking clean water may improve a mother's health, thereby increasing her ability to breastfeed or her efficiency at other tasks. Second, the change in water source may affect the time required to fetch water, affecting how a woman allocates her time. Finally, there may be other reasons women breastfeed longer in response to the campaign besides child health, such as birth spacing. The information campaign could also affect property values or marriage markets and consequently, change the composition of mothers of young children and their preferences with respect to breastfeeding.

increase in months breastfed is driven by districts with low rates of using clean wells (many Type B and C households). We find evidence of a *reduction* in diarrheal incidence and mortality for infants and an *increase* in diarrheal incidence and mortality for older children in districts with fewer clean well users.

6.A. Productivity shock due to reduced arsenic exposure

It is possible that the campaign improved mothers' health due to reduced arsenic exposure. This productivity shock could improve their ability to breastfeed and their efficiency in other work. It could also affect the relative prices of these activities but the direction is ambiguous. It is not obvious where women will expend this increased productivity. If the two effects impact breastfeeding in the same direction, women closer to clean wells, who are more likely to experience the health improvement, should exhibit a bigger increase in breastfeeding. Our results prove otherwise.[45,46]

It could be, however, that the change in the relative prices favors other activities, such as household tasks or market work. If the productivity shock and the change in relative prices have opposite effects on breastfeeding, one could argue that something else, such as a secular trend in breastfeeding, could explain our findings. This alternative explanation is unlikely.[47] First, the more serious adverse health consequences of arsenic poisoning are long-term effects and, to the best of our knowledge, there is no evidence of a biological link to improved milk supply. It is possible that short-run symptoms such as weakness and respiratory problems may affect breastfeeding or other activities, but these effects are likely to be small. Second, while we know individuals substitute from home production towards market work, few women in Bangladesh work outside the house. It seems unlikely that women would forego breastfeeding to spend more time on other household production, such as cooking and cleaning, especially given the lack of affordable and high-quality substitutes for breast milk.[48]

6.B. Time to fetch water

[45] Only women who switched from contaminated wells to clean wells would experience this health improvement. Women who continued to use contaminated wells or were not initially using contaminated wells would not experience any change in arsenic exposure. Given the local variation in contamination, we assume that the share of women in the first group is higher closer to clean wells. If this assumption is not true, we would still expect no change in breastfeeding for mothers close to clean wells (as we find), but it would not rule out the health channel.

[46] While researchers believe that arsenic exposure has little impact on morbidity or mortality among young children, another possible mechanism is that reduced arsenic exposure (either prenatal or postnatal) may improve a child's ability to nurse. Our triple difference results preclude this possibility in a similar manner: children more likely to switch to a clean well will experience a greater health gain.

[47] The BDHS does not have time use data, which would be necessary to test this alternate explanation. We do have data on labor force participation, but only 18.7% of the children have mothers who work outside the home.

[48] The literature on time allocation in the household is thin, but one study using the American Time Use Survey shows that better health is associated with only certain types of home production, such as lawn care and grocery shopping, but not childcare for one's own children, housework or food preparation (Podor and Halliday 2012).

A second alternative explanation is related to households using water from a more distant source. Since most water gatherers in Bangladesh are female (Crow and Sultana 2002), this could affect a woman's breastfeeding choices. This increase in the time cost of getting water reduces the time available to breastfeed, but it also increases the mother's comparative advantage in breastfeeding. Thus, one explanation for our results is that women substitute away from getting water and towards breastfeeding not because of arsenic, but because water is more expensive in terms of time. This explanation seems unlikely because the increased time cost was fairly small: multiple studies have documented an increase of about 4-18 minutes per day for those who chose to switch to an arsenic-safe well (Madajewicz et al. 2007, Sultana 2006, Ahmad et al 2003, Bangladesh Bureau of Statistics and UNICEF 2007), suggesting a smaller increase (if any, potentially due to crowding) for those who continued to use their previous water source.

A simpler version of this explanation could also be that since water is more expensive, infants are given less water and therefore breastfed more exclusively and for longer: this would differ from our interpretation because infants are breastfed more because water is more expensive, not because mothers are concerned about the health effects of contaminated water. This explanation seems unlikely because of the small increase in time cost discussed above, but also because the water intake required for an infant is small relative to the household's water needs in general. According to WHO (2004), a non-breastfed infant needs only 800-1200 mL of water per day in addition to liquid intake from other forms of food.

6.C. Motives for breastfeeding

Another explanation is that women choose to breastfeed longer to take advantage of breastfeeding's contraceptive effects after the campaign. This could be because of more salient concerns about child health or because of lower desired fertility if the cost of raising children rises. Jayachandran and Kuziemko (2011) show that breastfeeding patterns in India respond to this contraceptive effect and reflect fertility preferences.[49] We find no evidence that the campaign affected the desired total number of children, actual birth spacing or desired birth spacing (measured by whether women respond they want another child, but only after 2 years).

[49] Jayachandran and Kuziemko (2011) find that mothers breastfeed their sons longer than their daughters. We find larger effects of the arsenic campaign on breastfeeding for boys, but the difference is not statistically significant.

A related explanation is that the composition and breastfeeding preferences of mothers of young children might change as a result of the campaign, perhaps due to changes in property values (Field, Glennerster and Hussam 2011) or marriage markets. Qualitative work by Hassan et al. (2005) suggests that women with skin lesions may have difficulty in arranging a marriage, but Pitt, Rosenzweig and Hassan (2012) do not find statistical evidence of marital sorting by arsenic absorption. We believe this is unlikely to explain the changes in breastfeeding because breastfeeding preferences in Bangladesh are not strongly correlated with demographic characteristics and this did not change over time. In addition, we find no evidence of differential changes in exogenous variables such as mother's age at first marriage or at first birth, father's age, or mother's or father's education (results available upon request).

In conclusion, our results suggest that the breastfeeding response we document is evidence of behavior change. We posit that women are choosing to breastfeed more to protect their children from arsenic and water-borne pathogens. Mothers are not likely to be fully informed about how breastfeeding affects infants' arsenic exposure. However, as a consequence of past breastfeeding promotions, they may naturally assume that their own breast milk is safe, even if they drink contaminated water. The fact that they are less likely to give their youngest children water and that these children's health improved helps support this hypothesis, but we cannot rule out other explanations such as changes in the value of the women's time.

7. Provision of information and health behavior change

In this section, we discuss the two puzzles generated by this evidence of behavior change. We argue that mothers choose to breastfeed longer instead of switching to an arsenic-safe well which would protect more members of the family because breastfeeding is within their sphere of influence while the choice of water source is not.[50] We discuss ethnographic evidence on intra-household decisions from Bangladesh and provide evidence of heterogeneous responses among women in our sample that support this explanation. Second, we discuss features of the

[50] Since the most serious effects of arsenic poisoning appear either at older ages or after extended exposure, it does not seem rational to prioritize infants over other household members for protection from arsenic, especially since infants will start to drink contaminated water once they stop being breastfed exclusively. That said, it is not surprising that mothers would try to protect their infants if it is the only option available to them. They may also hope to find an arsenic-free water source by the time they stop exclusively breastfeeding their infants. The breastfeeding strategy makes more sense for households that switch to surface water – infants are more vulnerable to diarrheal diseases than older children and adults – but we find the breastfeeding response among both mothers who use arsenic-contaminated water and mothers who use surface water (results available upon request).

information campaign that may explain why the Bangladesh information campaign was able to elicit behavior change, while many other interventions have had little success.

7.A. Spheres of influence and heterogeneous effects.

Ethnographic research conducted by Farhana Sultana (2009, 2011) describes a household structure where men and women are both responsible for providing safe drinking water, but in distinct ways. Sultana studied 18 villages between 2003 and 2005 in four districts that were acutely affected by arsenic. She describes the practice of well-sharing in detail and how geographic variation in access to safe water affected power dynamics between households. Within the household, even though women do most of the water collection, male heads own the tubewells and assume responsibility for providing a tubewell with arsenic-safe water. Men expressed anxiety about not being able to purchase a deep tubewell to provide safe water. When unable to provide safe water within the household, men still exert authority over where the women (usually the youngest) collect water. Traditional social norms frown on women travelling into public spaces, and for some men (and also older women), these norms outweighed the need for safe water. Even the young women reported social and emotional stress when they had to fetch water from sources that did not belong to them, and navigate social hierarchies and power relations. Many women reported both verbal and physical conflicts that are exacerbated when safe water sources are overcrowded. Sultana also notes that pre-existing social networks play an important role in well-sharing. Owners of safe wells restrict use of their wells even among relatives, although they do feel some obligation to share water, especially for uses such as drinking or cooking and especially to mothers.

In such a setting, it is not surprising that women may resort to other means to avoid arsenic-contaminated water when available, such as breastfeeding for young children. There is a large literature suggesting that women choose to allocate more resources to child health and nutrition, relative to their husbands (Duflo 2003, Qian 2008, Miller and Mobarak 2013). We present heterogeneity among women in the two responses to the campaign that are consistent with the idea that women respond by breastfeeding more because switching to an arsenic-free well is outside their control (Table 8). Specifically, we demonstrate differential impacts of the campaign by measures of maternal social capital, education and autonomy.

The top panel of Table 8 repeats the exercise in Table 2 – predicting which households continue to use arsenic-contaminated water or drink surface water using measures of arsenic levels and access to clean wells – but with triple interactions between arsenic, access to clean wells and maternal characteristics.[51] Column (1) looks at whether mothers who participate in voluntary organizations such as Grameen Bank or mother's clubs organized by the Bangladesh Rural Advancement Committee are differentially responsive to the campaign on these two dimensions (using arsenic-safe water and breastfeeding longer). Panel A shows that women who participate in such clubs (25% of the mothers in the sample) are more likely to be using an arsenic-safe water source (the coefficient is negative because they are less likely to be using arsenic contaminated or surface water). Women who participate in such clubs are likely to have stronger social networks, either because they are better at maintaining relationships or because their households allow them to socialize outside the home. Either way, this is consistent with Sultana's documentation of the social challenges in accessing arsenic-safe water. Panel B of Table 8 replicates our main result from Table 4 – estimating how much longer mothers breastfeed their children after the campaign in contaminated areas using the DID strategy – but with triple interaction terms between "post," contamination and maternal characteristics.[52] Participation in clubs does not affect the breastfeeding response to the campaign.

Column (2) of Table 8 demonstrates heterogeneity in both responses with respect to maternal education, although the coefficients are statistically significant only at the 10% level. Panel A shows that mothers with any formal education (60% of mothers) are more likely to use clean water sources. This result could be due to greater decision-making authority on the part of the women, better social skills to facilitate well-sharing or the fact that more educated women are likely to have married into households with different preferences. It could also be that more educated women are better able to internalize the health related information provided by the campaign (Grossman 1972, Schultz 1975, Rosenzweig 1995). Dupas (2011b) also discusses the complementarity between information provision and education, noting that behavior change will

[51] We present just the results using the weighted measures of contamination and access to clean wells (distance from the closest uncontaminated well) in the interest of space. Thus, Panel A extends Column (4) of Table 2. We also include cluster fixed effects in Panel A of Table 8, which we were unable to do in Table 2 because contamination and access to clean wells are measured at the cluster level. The other difference is that in Table 2, the unit of observation is the household, whereas in Table 8, the unit of observation is the child, in order to define the maternal characteristic and compare the results to breastfeeding in Panel B.
[52] Specifically, Panel B extends Table 4 Panel A Column 6, but we focus just on children in the 2004 survey in order to compare the results with those on water source from Panel A.

be difficult if people are unable to process the information. Much of the evidence for this health-cognition gradient is from developed countries (see Grossman 2000, De Walque 2004 about smoking and Rosenzweig and Schultz 1989 about contraception in the U.S.), but there is a small, growing literature from developing countries (for example, see De Walque 2007 about HIV/AIDS prevention in Uganda).

Similarly, one would expect that educated women are more likely to make the connection between arsenic and protection provided by breastfeeding on their own if, indeed, the campaign did not mention it. The fact that breastfeeding provides protection for infants in areas with poor sanitation is not new information in Bangladesh, but educated women may be more likely to have processed it. Panel B Column (2) shows that more educated women were also more likely to breastfeed for longer periods after the information campaign.

At the same time, in order to change their breastfeeding practices to protect children from contaminated water, these mothers would have to have some decision-making ability. Measuring decision-making authority within the household is notoriously difficult. Our measure is based on the question: “Who in your family usually has the final say on the following decisions: your own health care, making large household purchases, making household purchases for daily needs, visits to family, friends, or relatives and what food should be cooked each day.” Women can either respond: themselves, just their husband, themselves together with their husband, someone else, or themselves together with a third person. We add up the number of areas in which the respondent feels that she has some say and then divide the sample into women with above and below average decision-making ability. While this could measure decision-making ability within the household, it could also measure decision-making ability in general: whether women feel they have control over things that happen to them and their families. Column (3) shows that women who self-report that they are involved in more decisions are more likely to increase breastfeeding duration in response to the campaign (Panel B). This finding supports the hypothesis of multiple decision-makers and separate spheres: otherwise, our results would be consistent with an explanation where men make all household decisions including how much their wives breastfeed and the breastfeeding response is preferred (by men) to using a clean well only because of the taboo against women in public spaces. These women are not more likely to be using a clean well (Panel A), but this is not entirely surprising given Sultana’s description since the choice of well is outside the women's sphere of influence. Interestingly, this measure of autonomy is not strongly correlated with education.

Finally, in Column (4), we include interactions with all three maternal characteristics to ensure that our results are not driven by correlations between the characteristics. Our results persist, but we acknowledge that we cannot claim definitely that these heterogeneous effects are not picking up differences in responses due to unobservable characteristics correlated with participation in clubs, formal education or decision-making ability.

7.B. Distinctive features of the National Arsenic Communication Strategy Campaign

Finally, we describe some aspects of the water quality information campaign that might partly explain its success, in light of recent empirical evidence of slow changes in health behavior in other contexts. The campaign was surprisingly effective at generating awareness and appreciation of the severity of arsenicosis, particularly since most symptoms appear in the long run. Mobarak et al. (2012) point out that despite the well-publicized health risks of indoor air pollution, 76% of respondents claimed that smoke from traditional cook stoves is less harmful than arsenic-contaminated drinking water. They also document a relatively high willingness to pay for arsenic-free water access compared to other important goods and services, including electricity connection, clean cook stoves or sanitary latrines. One explanation we cannot test is that arsenic poisoning is more frightening than other health risks, for some reason. Another explanation is that some feature of this campaign made it particularly effective, such as comprehensive information provision, a constant visual reminder, or a communal design.

1. *Comprehensive Information:* Unlike many health campaigns in developing countries, the campaign in Bangladesh gave villagers comprehensive information. For example, instead of focusing on one type of preventative behavior, the DPHE, UNICEF and local governments identified many different mitigation methods (Inauen et al. 2013), aided by the blanket testing and labelling of tubewells. Importantly, the different mitigation methods varied in cost and included some with relatively small financial costs, such as well-sharing, in addition to more costly methods (installing a deep tubewell). Recall that many studies estimate a small time cost for switching sources. Providing comprehensive information has proven to be more effective in other contexts as well. Duflo et al. (2014) found that when an HIV prevention campaign focused only on abstinence, young women got married earlier. Dupas (2011b) concluded that informing

girls about the relative riskiness of partners by different age was more effective in reducing early pregnancies.

2. Visual and Continual Reminders: The color-coding of the wells provided a visual and lasting reminder that men and women saw every day and throughout the village. Previous research has also found visual reminders to be effective in preventative health campaigns. In a randomized control trial in Kenya, Luoto (2009) shared information on fecal contamination near drinking water sources with households while providing free water treatment products. Some households were asked to make a public commitment to treat their drinking water and given a poster as a visual reminder. Luoto found that this intervention increased water treatment.[53] Visual reminders are being increasingly used in the design of large-scale public health interventions in developed countries. Kessler and Zhang (2014) summarize recent studies in behavioral and health economics on this issue and discuss how visual cues can affect individual's health related decisions.

3. Communal Persuasion: The National Arsenic Communication Strategy Campaign disseminated information mostly through public forums, instead of individual household visits. For example, testing a well takes approximately 30 minutes and tubewell testers generally spent that time providing information about arsenic. Thus, users were aware of the messages that other households received. Combined with the public, visual color-coding of wells, it is possible that sourcing water from a red-painted well developed its own stigma. Kremer et al. (2009) offer similar evidence that a community meeting design might be more successful than household visits in increasing treatment of household drinking water with chlorine disinfectant.

8. Conclusion

Despite some studies that show promise, the literature on whether information campaigns elicit health behavior change has found disappointing results. Water safety, particularly for children, is one area where relatively easy precautions can dramatically reduce the burden of disease in the developing world, and yet persuading households to treat their drinking water remains a challenge. In this context, the arsenic awareness campaign in Bangladesh poses a puzzle: many papers, including this one, have found that this campaign had success in motivating behavior change (even including some changes with adverse consequences). This could be

[53] Luoto did not have the sample size to separately identify the impact of the visual reminders and the commitment.

because of a particular aspect of the campaign, such as the comprehensive size, the visual continuous reminder or the communal design, or because of some feature of arsenic poisoning, such as the characteristic skin rashes or visceral reactions to arsenic poisoning. We leave this important question to future work.

In this paper, we provided evidence of a simple change that mothers in Bangladesh made in response to new information about the dangers in drinking water: they breastfed their children longer. We also found that they were more likely to exclusively breastfeed infants and that this may have had some beneficial health effects: infants had lower mortality rates and lower diarrhea incidence. Our results are strongest for mothers who have less access to uncontaminated wells, supporting our view that this behavior change is a conscious response to concerns about water quality and its effect on child health. To address the puzzle of why mothers breastfeed longer, protecting just their youngest children, instead of switching to an arsenic-safe well and protecting the entire household, we point to ethnographic evidence that mothers may not have decision-making authority in the household to switch water sources, even if they are the primary water gatherers (Sultana 2009, 2011). Collecting water from a distant well comes with both a time cost and a social reputation cost for the household. We demonstrate heterogeneity among women in how they respond to the campaign, with respect to maternal characteristics, that are consistent with this interpretation. Our results suggest that public health campaigns may be more successful if they address the reality of households made up of multiple decision-makers, each with his or her own set of preferences as well as his or her own set of socially acceptable behavioral responses.

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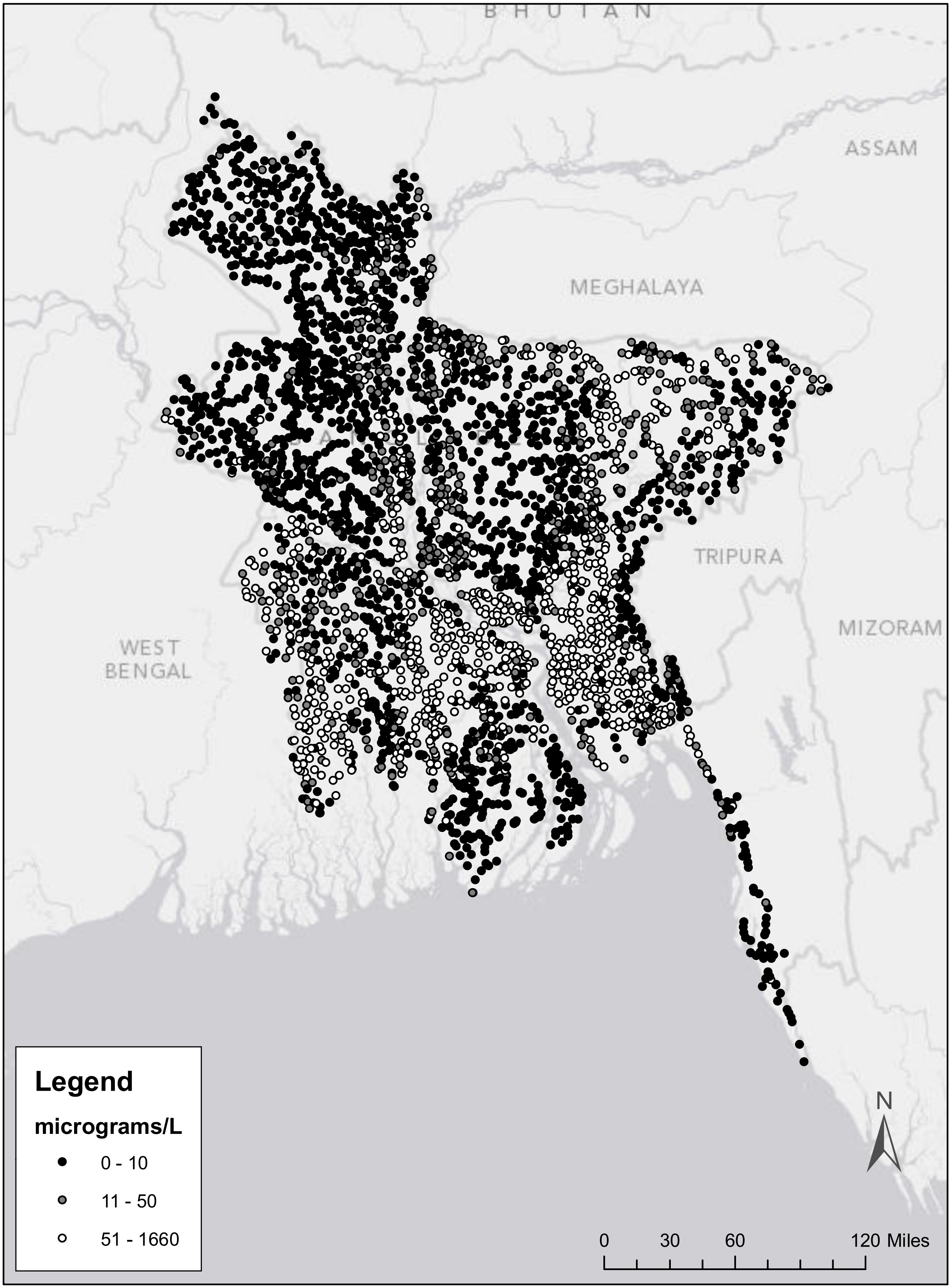
Figure 1: Arsenic Contamination Levels from BGS Survey in Bangladesh

Each point represents one well



Note: The Bangladesh government considers wells containing over 50 μg/L of arsenic to be contaminated, while the W.H.O. considers wells containing over 10 μg/L contaminated. Source: British Geological Survey.

Figure 2: Calculation of Preferred Contamination Measure

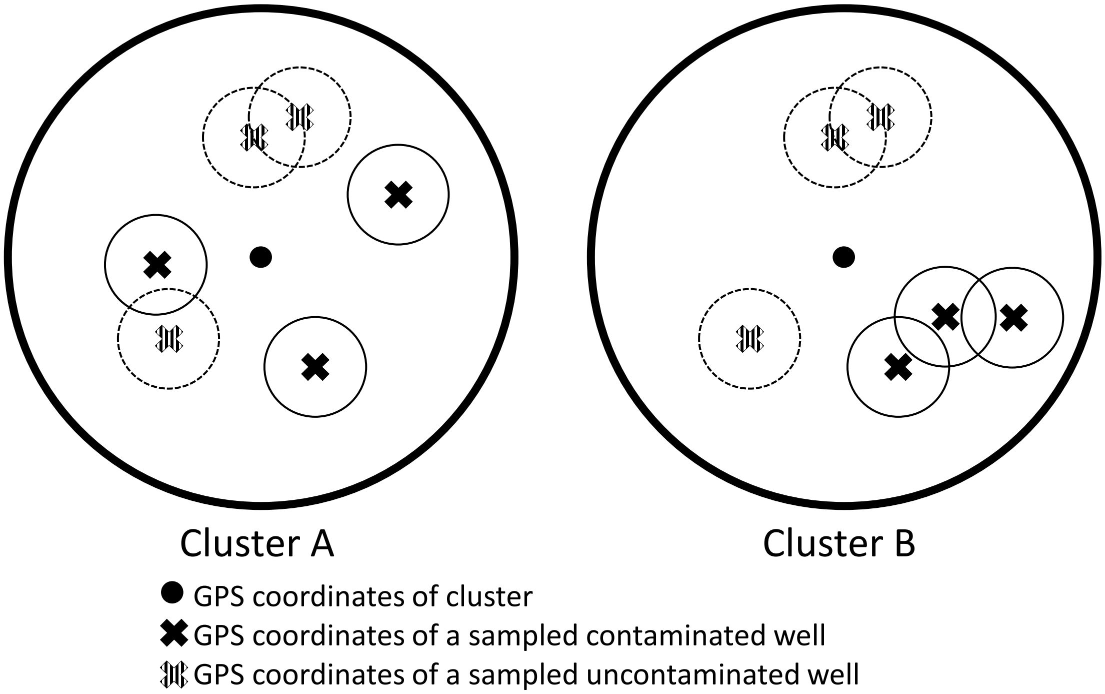


Figure 3: Variation in Access to Uncontaminated Wells, conditional on Contamination Level

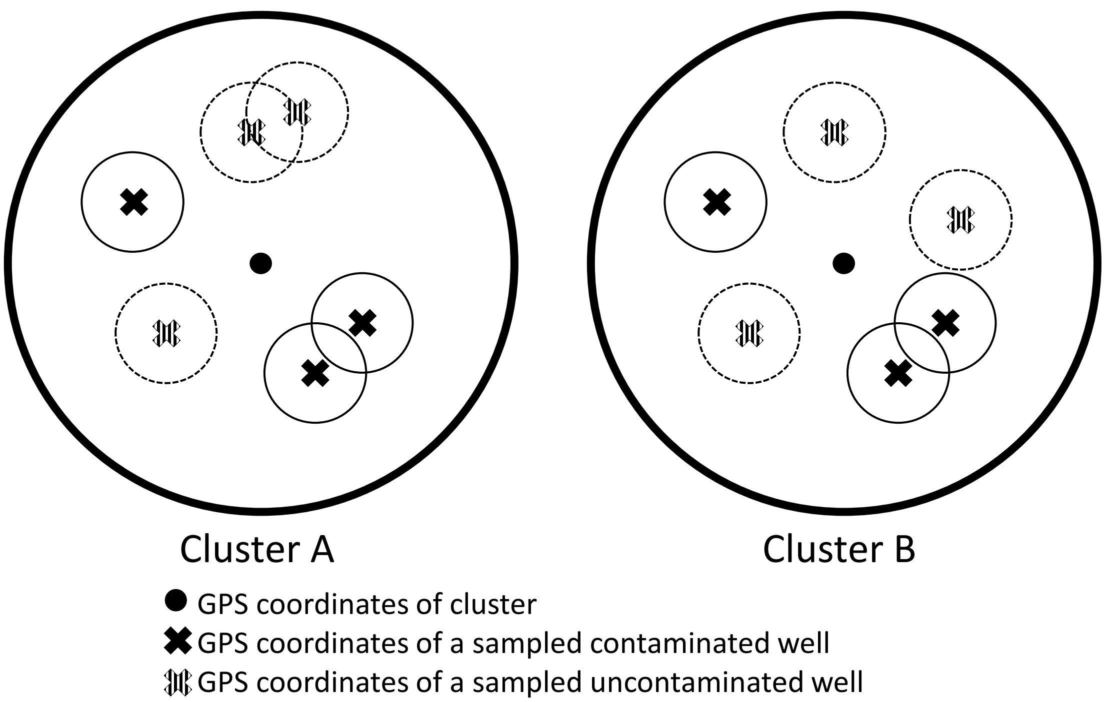
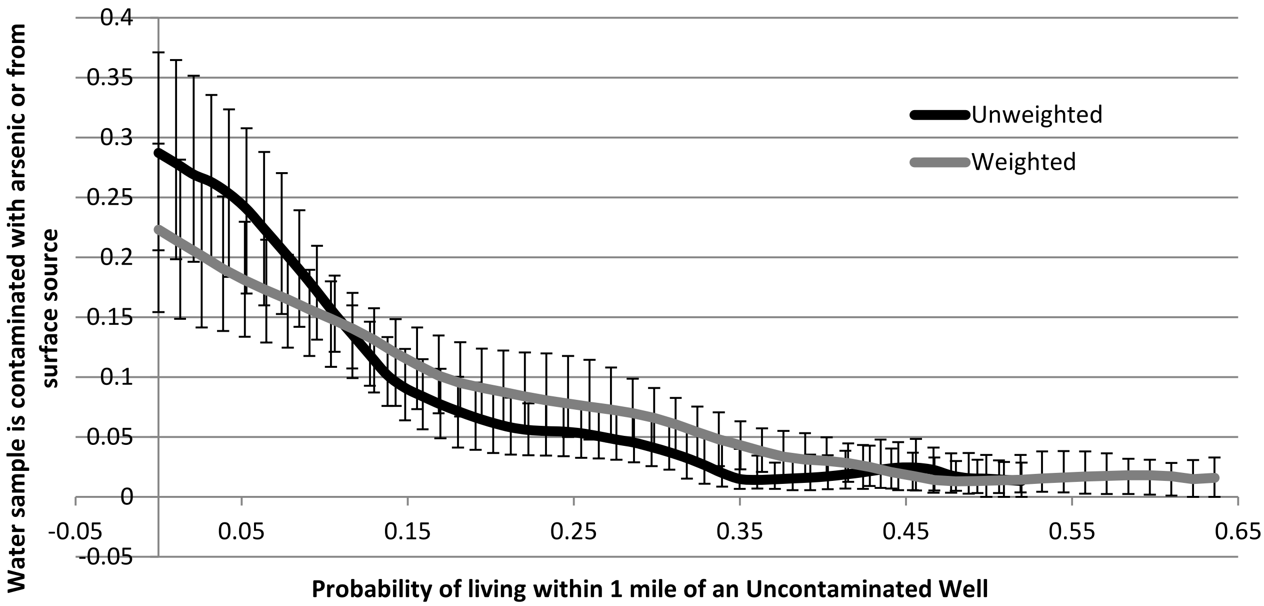
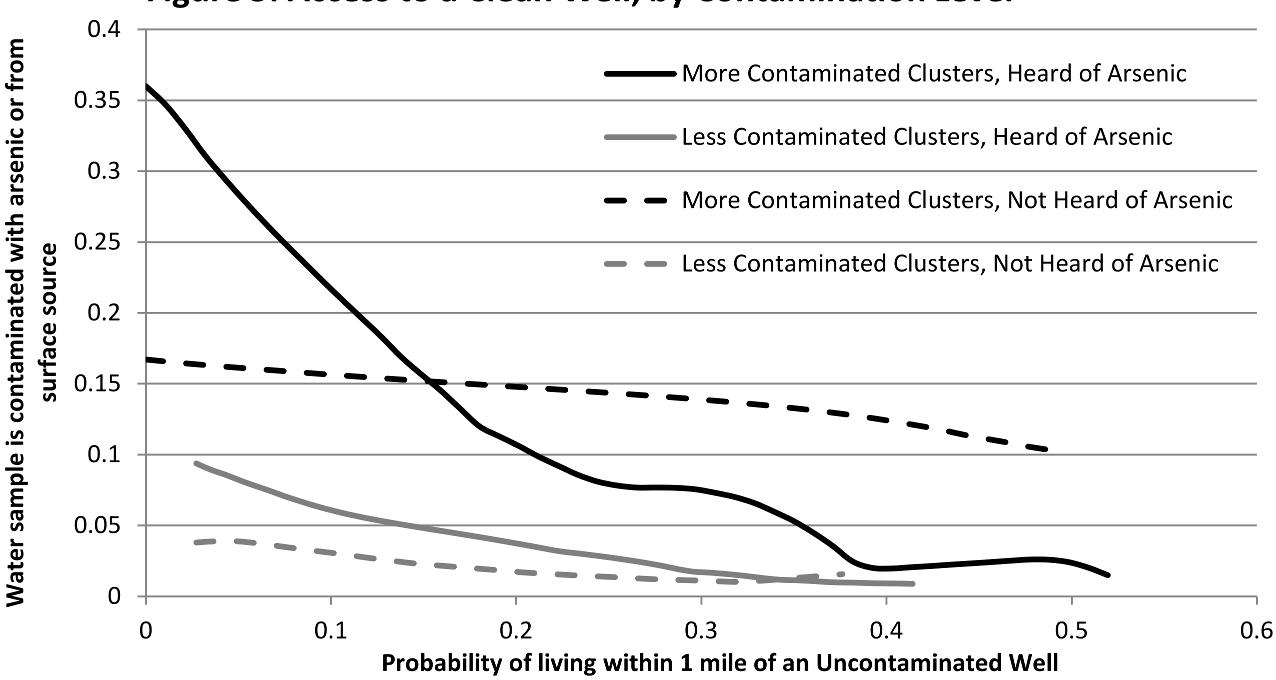


Figure 4: Access to a Clean Well

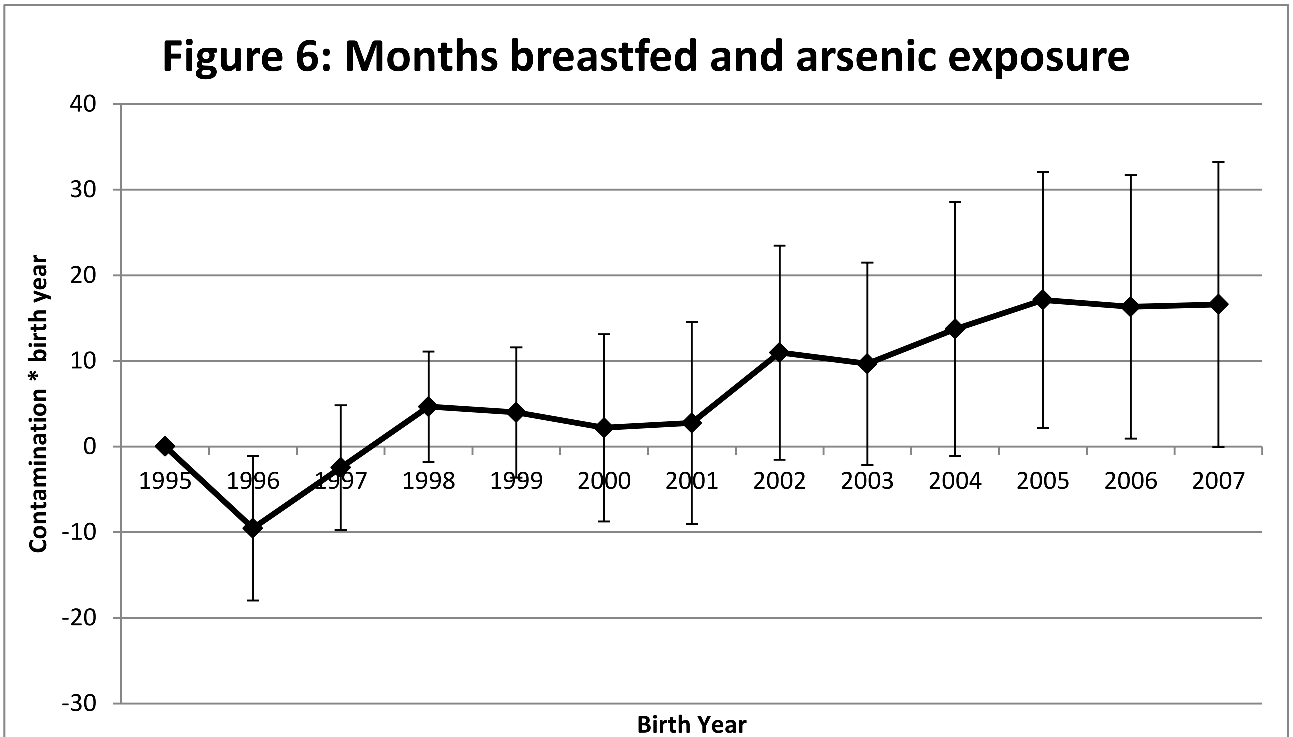


Note: This figure plots a Kernel-weighted local polynomial of the relationship between a household's access to a clean well (weighted and unweighted) and whether a household gets water from a contaminated well or a surface source, with cluster-bootstrapped 95% confidence intervals. The plots use an epanechnikov kernel.

Figure 5: Access to a Clean Well, by Contamination Level



Note: This figure plots a Kernel-weighted local polynomial of the relationship between a household's access to a clean well and whether a household gets water from a contaminated well or a surface source. We exclude clusters with zero tested wells. The plots use an epanechnikov kernel.



Note: This figure plots the coefficients on the interactions between birth year dummies and arsenic exposure in a regression similar to those in Table 4. Only rural areas are included in this figure. The error bars are 95% confidence intervals, after clustering on BDHS cluster.

Table 1. Various measures of exposure to arsenic contamination

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Heard of arsenic	Level of arsenic in HH water source (μg/L)	Level of arsenic > 50 (μg/L)	HH well painted red	HH well painted
Probability of living within 1 mile of a contaminated well (weighted)	0.718***	176.1***	0.880***	0.931***	1.279***
	(0.0685)	(39.66)	(0.137)	(0.189)	(0.159)
Probability of living within 1 mile of a contaminated well (unweighted)	0.929***	238.9***	1.117***	1.185***	1.664***
	(0.0840)	(55.03)	(0.177)	(0.250)	(0.177)
Fraction of wells contaminated within 5 mi	0.246***	80.46***	0.366***	0.417***	0.529***
	(0.0274)	(17.41)	(0.0494)	(0.0723)	(0.0521)
Number of wells contaminated within 5 mi	0.0324***	8.485***	0.0395***	0.0411***	0.0589***
	(0.00305)	(2.043)	(0.00669)	(0.00918)	(0.00640)
Average arsenic level of wells within 5 mi (g/L)	0.780***	313.2***	1.358***	1.589***	1.335***
	(0.0963)	(79.57)	(0.220)	(0.284)	(0.208)
Mean dependent variable	0.843	15.17	0.0813	0.170	0.315

Note: This table shows the relationship between the cluster-level measures of arsenic contamination (calculated from the BGS-tested wells matched to each cluster) and the household-level measures of arsenic contamination and information dissemination available in the 2004 wave of the BDHS. Each cell is from a separate regression of the household-level variable on the cluster-level measure of arsenic exposure. Standard errors, clustered by BDHS cluster, are in parentheses. *** indicates significance at the 1% level.

Table 2: Predicting which households continue to use arsenic-contaminated water or drink surface water

	(1)	(2)	(3)	(4)
Measure of access to clean well	Probability of living within 1 mile of an uncontaminated well	Probability of living within 1 mile of an uncontaminated well (weighted)	Average distance to closest uncontaminated well	Average distance to closest uncontaminated well (weighted)
Probability of living within 1 mile of a contaminated well (weighted)	0.996***	0.836***	-0.534*	-0.234
	(0.298)	(0.294)	(0.297)	(0.270)
Access to clean well	-0.165	-0.131**	0.00151	0.000985
	(0.104)	(0.0662)	(0.00442)	(0.00435)
Contamination *access to clean well	**-3.148*** **	**-1.546***	**0.408*** **	**0.312*** **
	(1.159)	**(0.867)**	**(0.114)**	**(0.107)**
Number of observations	10373	10373	10373	10373
R-squared	0.259	0.253	0.269	0.262

Note: This table shows the relationship between whether a household drinks arsenic-contaminated water or surface water from the 2004 BDHS (the dependent variable) and the cluster-level measures of arsenic contamination, access to clean wells (calculated from the BGS-tested wells matched to each cluster) and the interaction term. The measure of contamination used is the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster while the measure of access to clean wells is different in each column. All regressions include district fixed effects. Standard errors, clustered by BDHS cluster, are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 3. Descriptive statistics in 1999 (before the campaign) and in 2007 (after the campaign)

	(1)	(2)	(3)	(4)	(5)	(6)
	Survey year 1999			Survey year 2007		
Contamination level	Low	High	Conditional difference	Low	High	Conditional difference
Control variables						
Child's age (in months)	27.18	26.367	-0.754	28.17	28.302	0.222
Muslim	0.893	0.89476	-0.00865	0.911	0.91926	0.0314
Mother's age (in years)	25.69	25.911	0.199	25.81	25.677	-0.0487
Mother's years of education	2.987	3.296	-0.0779	4.775	4.942	-0.0159
Father's years of education	3.938	4.16	-0.0374	4.836	4.761	-0.194
Mother works outside home	0.196	0.1442	0.00812	0.260	0.2162	-0.00911
Household has electricity	0.333	0.33286	-0.0209	0.477	0.46715	0.0131
Urban area	0.273	0.2475	0.0623	0.362	0.321	0.0272
Drinking water source:						
Piped water	0.0978	0.0328	-0.0427	0.0920	0.0224	-0.00597
Tubewell	0.868	0.9216	0.0297	0.858	0.9278	0.00570
Surface water	0.0220	0.0406	0.0138	0.0218	0.0391	0.0124
Mother's weight-for-height z-score	-1.564	-1.564428	-0.0148	-1.233	-1.2212	0.0251
Outcomes						
Months breastfed	19.31	18.618	-0.573	19.95	19.828	0.0671
Breastfed for longer than:						
6 months	0.953	0.95652	0.00400	0.964	0.964266	0.000266
12 months	0.932	0.931403	0.000711	0.933	0.94008	-0.00321
18 months	0.868	0.87306	0.00909	0.871	0.8822	0.0112
24 months	0.768	0.7574	-0.00135	0.766	0.76834	0.0189
36 months	0.390	0.3336	-0.0250	0.345	0.3208	-0.0242
Exclusively breastfed	0.129	0.13808	-0.00455	0.0931	0.0969	-0.0101
Exclusively breastfed for children:						
Less than 6 months old	0.533	0.5469	-0.00775	0.434	0.4679	-0.0267
6-14 months old	0.0902	0.0467	-0.0434	0.0269	0.03563	-0.0130
Older than 12 months	0.0104	0.01438	0.0110	0.0193	0.0037	-0.0295***
Child died	0.0757	0.07326	0.0133	0.0589	0.05729	-0.00844
Height for age z-score	-1.811	-1.81429	-0.0620	-1.548	-1.5293	-0.000379
Weight-for-height z-score	-0.984	-0.897	0.0755**	-1.150	-1.0508	0.144***
Arsenic measures based on BGS-tested wells						
Probability of living within 1 mile of a contaminated well (weighted)	0.00122	0.13622	0.101***	0.00177	0.14077	0.112***
Probability of living within 1 mile of a contaminated well	0.00221	0.12021	0.0860***	0.00322	0.12522	0.0955***
Fraction contaminated in 5 mi	0.00845	0.48445	0.372***	0.0127	0.4707	0.381***
Num. wells contaminated in 5 mi	0.0531	3.2161	2.293***	0.0714	3.3324	2.532***
Avg. As contamination in 5 mi (g/L)	0.00559	0.10489	0.0536***	0.00654	0.09754	0.0661***
Number of observations	3147	3478		3124	2952	

Note: This table shows summary statistics separately for clusters with lower and higher than median exposure to arsenic (as measured by the weighted probability of being within 1 mile of a contaminated well). Columns (3) and (6) show the difference between areas, conditional on district fixed effects. The standard errors used to indicate significant differences are clustered by BDHS cluster. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4. The information campaign's effect on breastfeeding patterns

	(1)	(2)	(3)	(4)	(5)	(6)
				With district trends		
Areas included	All	Urban	Rural	All	Urban	Rural
Panel A: Dependent variable: Months breastfed						
Post*contamination	5.948***	3.566	7.020***	5.659***	1.420	6.163***
	(2.139)	(4.196)	(2.480)	(1.970)	(3.932)	(2.200)
Number of observations	19420	5811	13609	19420	5811	13609
R-squared	0.611	0.561	0.633	0.618	0.570	0.641
Mean dependent variable	19.42	18.95	19.63	19.42	18.95	19.63
Mean contamination	0.0713	0.0698	0.0720	0.0713	0.0698	0.0720
Panel B: Dep var: Breastfed for 12 or more months, among children 12 months & older						
Post*contamination	0.0673	0.0944	0.0579	0.0548	-0.0750	0.109**
	(0.0450)	(0.125)	(0.0483)	(0.0534)	(0.146)	(0.0539)
Number of observations	14689	4448	10241	14689	4448	10241
R-squared	0.0453	0.0669	0.0449	0.0563	0.0870	0.0619
Mean dependent variable	0.939	0.912	0.950	0.939	0.912	0.950
Mean contamination	0.0708	0.0684	0.0718	0.0708	0.0684	0.0718
Panel C: Dependent variable: Exclusively breastfeeding						
Post*contamination	0.236**	0.116	0.283**	0.173*	-0.0543	0.284***
	(0.0973)	(0.184)	(0.114)	(0.0966)	(0.192)	(0.106)
Number of observations	9929	2873	7056	9929	2873	7056
R-squared	0.350	0.339	0.357	0.366	0.364	0.376
Mean dependent variable	0.112	0.0940	0.120	0.112	0.0940	0.120
Mean contamination	0.0699	0.0712	0.0694	0.0699	0.0712	0.0694

Note: This table shows the relationship between breastfeeding patterns and exposure to arsenic contaminated wells after the information campaign. The dependent variable is the number of months the child was breastfed in Panel A, an indicator variable for whether a child 12 months old or older was breastfed for at least 12 months in Panel B, and an indicator variable for whether the child is currently exclusively breastfed in Panel C. The independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We also include fixed effects for BDHS cluster in Panels A and C, for the nearest 2004 DHS cluster in Panel B, and the child's year of birth in all panels. Additional control variables are the child's current age (or age at death) in months; a dummy for whether the child had died in Panel A; and survey year and the arsenic measure's main effect in Panel B. Columns (4)-(6) also include district-specific linear trends. Columns (1) and (4) include all children, while the other columns divide the sample by urban or rural location. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5. Heterogeneous effects on exclusive breastfeeding by age

	(1)	(2)	(3)
Ages included	< 6 m	6 - 14 m	> 12 m
Panel A: Dependent variable: Breastfeeding exclusively			
Post*contamination	0.849*	0.358**	0.0267
	(0.476)	(0.162)	(0.0557)
Number of observations	1351	1839	4332
R-squared	0.384	0.261	0.107
Mean dependent variable	0.506	0.0527	0.0180
Mean contamination	0.0766	0.0719	0.0667
Panel B: Dependent variable: Had plain water in past 24 hours			
Post*contamination	-1.219***	-0.734***	0.0955
	(0.421)	(0.222)	(0.0662)
Number of observations	1469	1894	7848
R-squared	0.432	0.271	0.0780
Mean dependent variable	0.410	0.921	0.962
Mean contamination	0.0753	0.0722	0.0717

Note: This table shows the relationship between exclusive breastfeeding patterns or being given plain water at different ages and exposure to arsenic contaminated wells after the information campaign. The independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We include fixed effects for the nearest 2004 BDHS cluster in both panels. We also include fixed effects for the child's year of birth and survey year, as well as district-specific linear trends. Additional control variables are the child's current age in months and the arsenic exposure main effect. Panel B also includes a control variable for whether the child had died. The dependent variable in Panel A is a dummy for whether the child is exclusively breastfed and in Panel B is a dummy for whether the child has consumed plain water in the last 24 hours, but the sample is restricted to children under 6 months, between 6 and 14 months and more than 12 months, respectively. Only childen living in rural areas are included. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 6. Differential responses with respect to water source or access to uncontaminated wells

	(1)	(2)	(3)	(4)	(5)
		Measure of access to uncontaminated well			
Triple difference measure	Water sample is contaminated with arsenic or from surface source	Probability of living within 1 mile of an uncontaminated well	Probability of living within 1 mile of an uncontaminated well (weighted)	Average distance to closest uncontaminated well	Average distance to closest uncontaminated well (weighted)
Dependent variable: Months breastfed					
Post*contamination	2.571	11.50***	8.205**	-1.347	1.352
	(2.850)	(3.435)	(3.393)	(4.350)	(3.967)
Post*contamination *triple difference measure	12.98***	-41.28**	-13.43	2.485**	1.660
	(4.959)	(19.02)	(15.55)	(1.202)	(1.088)
Number of observations	4769	13609	13609	13609	13609
R-squared	0.680	0.641	0.641	0.641	0.641
Mean months breastfed	19.60	19.63	19.63	19.63	19.63
Mean contamination	0.0740	0.0720	0.0720	0.0720	0.0720

Note: This table shows the relationship between breastfeeding patterns and exposure to arsenic contaminated wells after the information campaign differentially with respect to different measures of the household's use of and access to uncontaminated wells. The specification is identical to the one in Table 4, except for the triple interaction and all relevant main effects and two-way interactions. The dependent variable is the number of months the child was breastfed. The independent variables of interest are the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster, and the triple interaction between this variable and an indicator for households that did not source water from a clean well (Column 1) or a measure of the distance to an uncontaminated well (Columns 2-5). We also include fixed effects for BDHS cluster, the child's year of birth, as well as district-specific linear trends. Additional control variables are the measure of the distance to an uncontaminated well, its interactions with post and with arsenic exposure, the child's current age (or age at death) in months, and a dummy for whether the child had died. Column 1 only includes data from 2004. In all columns, only children living in rural areas are included. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 7: Health effects by age

	(1)	(2)	(3)	(4)
Panel A: Child died before the age of ...				
Age in months	6	12	24	36
Post*contamination	-0.108**	-0.120*	-0.0413	-0.126
	(0.0502)	(0.0628)	(0.0877)	(0.106)
Number of observations	12238	11004	8309	5513
R-squared	0.0390	0.0437	0.0539	0.0865
Mean dependent variable	0.0557	0.0646	0.0749	0.0778
Mean contamination	0.0716	0.0715	0.0711	0.0702
Panel B: Health status of children				
Ages included	0 - 12 m	12 - 24 m	24 - 36 m	36 - 48 m
Incidence of diarrhea in previous two weeks				
Post*contamination	-0.426***	0.0807	-0.0690	0.121
	(0.157)	(0.224)	(0.186)	(0.167)
Weight for height Z-Score				
Post*contamination	1.225**	1.488*	0.0781	-0.481
	(0.620)	(0.826)	(0.617)	(0.591)
Height for age Z-Score				
Post*contamination	0.292	1.098	0.275	-0.386
	(0.808)	(0.963)	(0.721)	(1.098)
Number of observations	2769	2567	2562	2493
Mean incidence of diarrhea	0.0849	0.122	0.0749	0.0513
Mean weight-for-height Z-score	-0.544	-1.381	-1.124	-1.035
Mean height-for-age Z-score	-1.065	-1.992	-1.889	-2.105
Mean contamination	0.0748	0.0728	0.0738	0.0701

Note: This table shows the relationship between various health outcomes and exposure to arsenic contaminated wells after the information campaign. The independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We include fixed effects for the nearest 2004 BDHS cluster in both panels. We also include the arsenic exposure main effect, fixed effects for the child's year of birth and survey year, as well as district-specific linear trends. In Panel A, we also include the child's current age or potential age, had the child died. Additional control variables in Panel B are the child's current age or age at death in months and a dummy for whether the child had died. The dependent variable in Panel A is a dummy variable for whether the child died before the age of 6, 12, 24, or 36 months; we include in the sample only children who have attained the respective ages by the date of the survey. The dependent variables in Panel B are the incidence of diarrhea in the previous two weeks, weight for height or height for age for children aged 0-12 months, 12-24 months, 24-36 months, or 36-48 months. Only children living in rural areas are included. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 8: Heterogeneous responses to the information campaign

	(1)	(2)	(3)	(4)
Panel A: Water sample is contaminated with arsenic or from surface source				
Contamination * access to clean well	-0.206***			-0.231***
* participation in any clubs	(0.0781)			(0.0761)
Contamination * access to clean well		-0.132*		-0.157**
* any education		(0.0701)		(0.0696)
Contamination * access to clean well			0.0444	0.0765
* decision-making			(0.0523)	(0.0518)
Number of observations	4776	4776	4771	4771
R-squared	0.565	0.563	0.563	0.567
Panel B: Months breastfed				
Post*contamination	6.913**	0.920	0.411	-2.083
	(2.675)	(3.374)	(3.220)	(3.891)
Post*contamination	-5.520			-5.903
* participation in any clubs	(4.354)			(4.415)
Post*contamination		6.801*		5.995*
* any education		(3.501)		(3.445)
Post*contamination			7.966**	7.932**
* decision-making			(3.814)	(3.821)
Number of observations	4772	4772	4767	4767
R-squared	0.681	0.681	0.681	0.682

Note: This table explores heterogeneity among women in the two responses to arsenic contamination and the information campaign: using arsenic-safe wells for drinking water and breastfeeding longer. Panel A presents regressions similar to those in Table 2 (Column 4), except for the inclusion of triple interactions between arsenic contamination, access to clean wells and maternal characteristics. Please see the notes from Table 2 for more details. The only other differences are that Panel A also includes cluster fixed effects, which Table 2 does not include, and the level of the observation is the child, not the household as in Table 2. Panel B presents regressions similar to those in Table 4 (Panel A Column 6), except for the inclusion of triple interactions between arsenic contamination, being born in 2002 or later and maternal characteristics. The only other difference is that we focus on data from 2004 in order to compare the results with Panel A. Please see the text for more details on how the maternal characteristics are calculated. Standard errors, clustered by BDHS cluster in Panel A, are in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A1. Testing robustness to different measures of arsenic exposure

	(1)	(2)	(3)	(4)	(5)	(6)
Areas included	All	Urban	Rural	All	Urban	Rural
Panel A: Months Breastfed						
Post*probability contaminated	7.205***	3.569	8.853***	6.778***	2.334	7.147***
(unweighted)	(2.432)	(5.509)	(2.682)	(2.260)	(5.152)	(2.422)
Post*fraction contaminated	1.894**	0.110	2.691***	1.473**	0.121	1.788**
	(0.770)	(1.762)	(0.844)	(0.705)	(1.657)	(0.731)
Post*number contaminated	0.230**	0.0595	0.302***	0.219***	0.0164	0.247***
	(0.0890)	(0.202)	(0.0983)	(0.0815)	(0.188)	(0.0869)
Post*average As level (g/L)	7.375**	1.368	9.844***	4.593	-0.310	5.833*
	(3.141)	(6.603)	(3.613)	(2.991)	(6.410)	(3.281)
Panel B: Breastfed for 12 or more months, among children 12 months and older						
Post*probability contaminated	0.0443	0.0764	0.0358	0.0318	-0.0951	0.0956*
(unweighted)	(0.0476)	(0.140)	(0.0506)	(0.0563)	(0.182)	(0.0547)
Post*fraction contaminated	-0.00555	-0.00849	-0.00280	-0.0163	-0.0441	0.0152
	(0.0130)	(0.0474)	(0.0135)	(0.0158)	(0.0626)	(0.0159)
Post*number contaminated	0.000270	0.00109	-0.0000015	-0.000862	-0.00548	0.00186
	(0.00179)	(0.00513)	(0.00200)	(0.00212)	(0.00635)	(0.00222)
Post*average As level (g/L)	0.0610	0.0780	0.0570	0.0329	-0.157	0.111*
	(0.0471)	(0.168)	(0.0471)	(0.0592)	(0.209)	(0.0602)
Panel C: Exclusive Breastfeeding						
Post*probability contaminated	0.264**	0.0768	0.321**	0.177	-0.0755	0.269**
(unweighted)	(0.123)	(0.234)	(0.141)	(0.121)	(0.246)	(0.132)
Post*fraction contaminated	0.102**	0.0497	0.111**	0.0499	-0.0201	0.0657
	(0.0408)	(0.0857)	(0.0472)	(0.0374)	(0.0815)	(0.0421)
Post*number contaminated	0.00894**	0.00157	0.0113**	0.00591	-0.00342	0.00960**
	(0.00410)	(0.00767)	(0.00481)	(0.00421)	(0.00851)	(0.00458)
Post*average As level (g/L)	0.247	-0.0464	0.311	0.0179	-0.317	0.0810
	(0.197)	(0.397)	(0.214)	(0.167)	(0.302)	(0.179)

Note: This table tests the robustness of the results in Table 4 to different measures of arsenic exposure. Each number is from a separate regression, determined by the sample (columns) and measure of arsenic exposure (rows). The dependent variable is the number of months the child was breastfed in Panel A, a dummy variable for whether a child 12 months or older was breastfed for at least 12 months in Panel B and a dummy variable for whether the child is exclusively breastfed, defined as having not received any liquids in the past 24 hours, in Panel C. The independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and various measures of arsenic exposure. We also include fixed effects for BDHS cluster in Panels A and C, for the nearest 2004 DHS cluster in Panel B, and the child's year of birth in all panels. Additional control variables are the child's current age (or age at death) in months, and a dummy for whether the child had died in Panel A. Panel B in includes survey year fixed effects and main effect for arsenic. Columns (4)-(6) also include district-specific linear trends. Columns (1) and (4) include all children, while the other columns divide the sample by urban or rural location. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A2. The information campaign's effect on breastfeeding patterns, broken up by piped water access

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Urban		Rural	
Piped water access	Yes	No	Yes	No	Yes	No
Panel A: Individual access to piped water						
Post*contamination	20.06	5.699***	19.01	-1.199	753.0	6.438***
	(15.99)	(2.014)	(16.43)	(4.177)	(2129.0)	(2.247)
Number of observations	1209	17600	1134	4476	75	13124
Mean months breastfed	17.94	19.59	17.95	19.26	17.76	19.70
Mean contamination	0.0341	0.0733	0.0306	0.0789	0.0870	0.0714
Panel B: Village-wide access to piped water						
Post*contamination	0.860	6.139***	-0.461	0.738	.	5.971**
	(12.59)	(2.059)	(13.11)	(4.520)	.	(2.309)
Number of observations	926	11908	905	3189	21	8719
Mean months breastfed	19.21	19.69	19.11	19.22	23.38	19.87
Mean contamination	0.0398	0.0736	0.0408	0.0801		0.0712

Note: This table shows the relationship between breastfeeding patterns and exposure to arsenic contaminated wells after the information campaign, for households or areas with and without access to piped water. The dependent variable is the number of months the child was breastfed and the independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We also include fixed effects for BDHS cluster and the child's year of birth as well as district-specific linear trends. Additional control variables are the child's current age (or age at death) in months, and a dummy for whether the child had died. The sample in each column is divided by area (all, urban and rural) and by piped water access. In Panel A, we define piped water access according to whether the household has piped water. In Panel B, we define piped water access according to whether the village has piped water; due to data availability, we only use the 2004 and 2007 surveys in Panel B. The small number of children in rural areas with village-level access to piped water (21) precludes any results in Panel B, Column (5). Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A3. Testing robustness to different breastfeeding durations

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Breastfeeding for longer than ... months				
	6	12	18	24	36
Post*contamination	0.119***	0.109**	0.233***	0.293**	0.450**
	(0.0351)	(0.0539)	(0.0856)	(0.128)	(0.189)
Number of observations	11498	10241	8788	7648	5061
R-squared	0.0590	0.0619	0.0651	0.0895	0.172
Mean dependent variable	0.971	0.950	0.891	0.778	0.358
Mean contamination	0.0719	0.0718	0.0715	0.0713	0.0702

Note: This table shows the relationship between breastfeeding patterns at different ages and exposure to arsenic contaminated wells after the information campaign. As in Table 4, the independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We include fixed effects for the nearest cluster in the 2004 DHS survey. We also include fixed effects for the child's year of birth and survey year, as well as district-specific linear trends. Additional control variables are the child's current age (or age at death) in months and the arsenic exposure main effect. The dependent variable is a dummy variable for whether the child was breastfed for at least 6, 12, 18, 24 or 36 months, respectively; we include in the sample only children who have attained the respective age by the time of the survey. The sample size drops considerably for longer lengths because survival status until age 36 months, for example, will not be known for children born within 3 years of the survey date. Only children living in rural areas are included. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A4. Testing robustness with respect to right-censored dependent variable

	(1)	(2)	(3)
Panel A: Right-censoring due to still breastfeeding			
Post*contamination	19.05***	7.830*	
	(6.459)	(4.131)	
Number of observations	5266	13609	
R-squared	0.301	0.592	
Panel B: Right-censoring due to child death while breastfeeding			
Post*contamination		5.016*	5.590**
		(2.943)	(2.371)
Number of observations		13610	13610
R-squared		0.438	0.538

Note: This table tests the robustness of the results in Table 4 Panel A to different assumptions regarding the right-censoring of the dependent variable, months breastfed. In Column (1), we include only children who have already stopped breastfeeding. In Column (2), we replace months breastfed with the max in the data for those who are still breastfeeding, in Panel A, and for those who died, in Panel B. In Column (3), we replace months breastfed with the age the child would have been at the time of the survey (which is the greatest number of months breastfed that would have been possible had the child not died, given the timing of the survey). As in Table 4, the independent variable of interest is the interaction between "post," defined as being born in 2002 or later, and the weighted probability of living within 1 mile of a contaminated well, conditional on living within five miles of the BDHS cluster. We also include fixed effects for BDHS cluster and the child's year of birth, as well as district-specific linear trends. Additional control variables are the child's current age (or age at death) in months (in Panel A), the child's potential age at the time of the survey had she or he not died (in Panel B), and a dummy for whether the child had died. Only childen living in rural areas are included. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table A5. Robustness checks regarding village trends

	(1)	(2)	(3)
	With cluster trends		
Areas included	All	Urban	Rural
Panel A: Dependent variable: Months breastfed			
Post*contamination	3.907	-3.766	7.083**
	(3.453)	(8.587)	(3.587)
Number of observations	19420	5811	13609
R-squared	0.661	0.616	0.679
Mean months breastfed	19.42	18.95	19.63
Mean contamination	0.0713	0.0698	0.0720

	(1)	(2)	(3)	(4)	(5)	(6)
				With cluster X birth year F.E.		
		Contamination level			Contamination level	
Areas included	All	Low	High	All	Low	High
Panel B: Dependent variable: Months breastfed						
Post*heard of arsenic	0.0836	-0.601	4.616***	0.365	0.0850	4.862**
	(0.566)	(0.601)	(1.407)	(0.840)	(0.900)	(2.399)
Number of observations	4812	3249	1507	4812	3249	1507
R-squared	0.681	0.686	0.680	0.755	0.761	0.741
Mean months breastfed	19.58	19.98	18.75	19.58	19.98	18.75
Mean contamination	0.0739	0.0110	0.210	0.0739	0.0110	0.210

Note: This table provides robustness checks for Table 4, providing support for the identifying assumption that cluster-level trends are not driving the results. The regressions in Panel A are similar to those in Panel A of Table 4, except that we include cluster-specific linear trends instead of district-specific linear trends. The regressions in Panel B are similar to those in Panel A of Table 4 as well, except that the measure of arsenic contamination we use is whether or not the household responded that they had heard of arsenic. We also restrict the sample in Panel B to rural households. Since many households have heard of arsenic, even in relatively uncontaminated areas, we break up the sample into less and more contaminated regions in Columns (2), (3), (5) and (6). Columns (4) to (6) also include cluster X birth year fixed effects, focusing entirely on intra-village variation in arsenic knowledge. We acknowledge that whether a household had heard of arsenic (and remembered) is endogenous, but this change allows us to include cluster X birth year fixed effects. The dependent variable is the number of months the child was breastfed. Standard errors, clustered by BDHS cluster, are shown in parentheses. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.