Water Quality Awareness and Infant Health:
The Role of Breastfeeding

Pinar Keskin, Gauri Kartini Shastry and Helen Willis[1]

Wellesley College

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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. 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. 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 greater when households have less access to clean wells. We also find that very young children in contaminated areas are more likely to be exclusively breastfed. Consistent with this finding, we find suggestive evidence of relatively lower mortality rates and incidence of diarrhea for infants in more contaminated areas.

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 families to adopt better water practices, such as water treatment, eliciting behavior change remains a challenge, in part due to very low willingness to pay for clean water.[2] In this paper, we provide evidence of a particular sort of behavior change in response to recent concerns about water quality in Bangladesh: increased breastfeeding duration and longer periods of exclusive breastfeeding. Breastfeeding can provide a less pecuniary way for mothers to protect their children from water-borne diseases, such as diarrheal illnesses, in their first years of life when these diseases are particularly severe and potentially fatal (Habicht, DaVanzo, and Butz 1988).

Bangladesh has a long history of water quality concerns and safety measures. The first water safety efforts began in the 1970s when millions of shallow tubewells were built across the country 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 and lasted until 2006 (Atkins, Hassan and Dunn 2007); by 2004, 84% of households had heard of arsenic contamination and only 8% were drinking contaminated water (BDHS data, authors' tabulations).

In addition to switching to arsenic-free water sources, mothers can also respond to increased concerns about water quality, both due to arsenic contamination and other water-borne pathogens, by further utilizing the protective aspects of breastfeeding. A large literature has established that breastfeeding protects children from contaminated food and water, and while arsenic does pass through breast milk, the concentration in breast milk is very low relative to the mothers' exposure (Fängstrom et al. 2008). If mothers think breastfeeding is a way of limiting the amount of dangerous water they feed their children, they may choose to breastfeed longer.

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

While it is unlikely that mothers knew that breastfeeding protects children from arsenic,[3] numerous nation-wide promotions have emphasized the value of breastfeeding.

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 difference-in-difference (DID) strategy. We use three waves of the Bangladesh Demographic Health Survey (BDHS 1999, 2004 and 2007) to compile a sample of children born each year from 1995 to 2007 across contaminated and uncontaminated areas. We assume that the information would be most salient for households near contaminated wells, making them most likely to modify their breastfeeding choices. The geographic variation we rely on is sufficiently local that we are able to include BDHS cluster (similar to village) fixed effects, which account for many possible omitted variables correlated with arsenic contamination, 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. Using this strategy, 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. An event study specification confirms this finding and provides support for our identifying assumption: prior to the information campaign, breastfeeding patterns in contaminated areas are indistinguishable from those in uncontaminated areas. Unsurprisingly, the results are driven by rural areas where piped water is less common.

Of course, breastfeeding is just one dimension on which households can respond to new information on water quality. The more important dimension, switching to an uncontaminated well, clearly dominates since it protects the whole household from both arsenic and microbial pathogens. In fact, if a household switches to a clean well, one could argue that there is 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

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[3] Based on the campaign documentation, we do not believe information on breastfeeding was disseminated to households as part of the campaign. The arsenic-related information was often provided at the well site during the arsenic test by engineers who were most often men. Since Bangladesh is predominantly Muslim, we believe it is unlikely these engineers spoke to local women or men about breastfeeding.

[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.

households that live farther from an uncontaminated well are less likely to switch to a clean well; they either continue to drink arsenic-contaminated well water or switch to surface water sources. Regardless of which potentially contaminated water source they choose, these mothers can protect their youngest children from both arsenic and bacterial contamination by breastfeeding. We show that the DID effect described above is driven by households who are not using clean wells. Next, acknowledging the endogeneity of the choice 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 results, 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 results are 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 drink water in the past 24 hours. We also find evidence of lower mortality rates, lower incidence of diarrhea and greater weight for these children (but not older children). While exclusive breastfeeding can explain these effects, we cannot claim that this is the causal effect of breastfeeding and not partly the effect of reduced arsenic exposure, even though there is little evidence that children show arsenicosis symptoms.

Our paper contributes to the understanding of the consequences of this massive environmental tragedy and related mitigation efforts. Pitt, Rosenzweig and Hassan (2012) examine the consequences of arsenic poisoning and find that it has negative effects on cognition, schooling and earnings for young men as well as on productivity in home production by women. Various papers study the impact of the mitigation efforts, documenting that knowledge increased and use of contaminated wells fell (Jakariya 2007, Madajewicz et al. 2007, Bennaer et al. 2013). The closest paper to ours, Field, Glennerster and Hussam (2011), documents a substantial increase in under-five mortality from diarrheal diseases among households whose closest well was contaminated with arsenic. One likely explanation is that households that switched water

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sources often switched back to surface sources, despite the well-known risks. This finding speaks to unintended adverse consequences of the arsenic mitigation efforts, while our paper demonstrates similarly unintended but positive consequences. Our findings complement these earlier results: their mortality effects are strongest for older children, while ours are strongest for the youngest children, who are more likely to be exclusively breastfed.

More broadly, our paper relates to the question of whether and how people change their health behaviors in response to information. Ahuja, Kremer and Zwane (2010) provide a review of randomized trials on water quality, which show mixed results. They conclude that programs to improve access to water require more study. They also describe recent evidence that the willingness to pay for clean water is low (see, for example, Kremer et al. 2011) and that information dissemination has only a modest effect (Jalan and Somanathan 2008, Luoto, Levine and Albert 2011), but that behavioral biases may have a role to play in explaining household decisions about water (Madajewicz et al. 2007, Tarozzi et al. 2009). The impact of information on other health behaviors has also been studied extensively but shows mixed results (see, for example, Dupas 2011, Gallant and Maticka-Tyndale 2004, Hayes et al. 2005, on sexual health education and HIV in Africa; Downs, Loewenstein and Wisdom 2009, Davis et al. 2009 on diet and smoking in the US). Our contribution to this literature is providing evidence of behavior change: in response to new information about water quality, mothers breastfed their children longer and more exclusively. In Section 6, we discuss the motivation behind this behavior change and argue that it is likely to be concern for child well-being.

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 explanations. Section 7 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 human

health conditions (Saha et al. 1999).[5] While the liver can process some ingested arsenic, chronic exposure for 6 months or longer can lead to accumulation in the body and, eventually, 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.[6] Since there is no known treatment for arsenic poisoning, experts recommend drinking arsenic-free water as the only way to avoid arsenic related diseases (Smith, Lingas and Rahman 2000). At the same time, however, there is little evidence that arsenic exposure is related to ill health among children (Field, Glennerster and Hussam 2011).

2.A. Water safety efforts in Bangladesh

In the late 1970s and 1980s, public health concerns regarding water safety in Bangladesh were focused on water-borne viral and parasitic infections. Millions of shallow tubewells were built across the country by UNICEF and other international aid agencies to provide pathogen-free drinking water and to prevent morbidity and mortality from gastrointestinal diseases (Smith, Lingas and Rahman 2000). These agencies were successful at publicizing the dangers of surface water through nationwide campaigns: 95% of rural Bangladeshis began drinking protected groundwater (Caldwell et al. 2003).

In the late 1980s, however, geologists found traces of arsenic in this very same groundwater.[7] 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 due to the lack of appropriate testing facilities (Carson, Koundouri and Nauges 2011). In 1998 and 1999, the British Geological Survey (BGS) carried out the first nation-wide survey to investigate the extent of the contamination problem, systematically testing

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[5] Although arsenic exposure can occur by ingestion through cooking or crops irrigated with contaminated water, the major exposure pathway from groundwater to human beings has been linked to drinking water (Kapaj et al. 2006).

[6] Although no consensus has been reached about 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). Arsenic can cross the placental barrier and adversely affect fetal development. 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). 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 in our data.

[7] Most scientists believe that the mechanism behind arsenic contamination of groundwater in Bangladesh is oxidation. Specifically, as the water table recedes—as it has during the past few decades in Bangladesh—atmospheric gases seep further below the surface. When sediment with arsenic deposits is exposed to oxygen, the two react, releasing the arsenic into the surrounding soil and water (Nahar 2009).

samples from 3534 tubewells across 61 of the 64 districts in Bangladesh (BGS and DPHE 2001).[8] The survey found that water from 27% of the shallow tubewells (i.e. those that tap into aquifers at depths of less than 150 meters) exceeded the Bangladesh standard for arsenic in drinking water (>50 µg/L).[9,10] The BGS report estimated that 35 million people were exposed to dangerous levels of arsenic through their drinking water (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), a comprehensive screening of all shallow wells in contaminated regions, in 1999 with the assistance of UNICEF and partly funded by the World Bank. The project was carried out in the majority of 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. While the project was not officially completed until 2006, the majority of the testing was done by 2003. 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 walls of the tubewell were painted green. If not, the walls were painted red (UNICEF 2008). The program also dug new wells (including deep wells) and increased access to arsenic-safe water for 2-2.5 million people (World Bank 2007).

In December 1999, UNICEF also launched the National Arsenic Communication Strategy and Campaign by hiring a social marketing firm to design and implement ways to disseminate information on the dangers of drinking arsenic-contaminated water. These messages were spread by various kinds of workers, including teachers, religious leaders, and health care workers. DPHE engineers conducting the arsenic tests were particularly effective at sharing basic facts about arsenic to the tubewell users while running the half-hour long test. They dispelled popular misconceptions, presented physical evidence of contamination and explained the color-

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[8] While this is only a small fraction of the millions of tubewells in the country, the BGS tested a geographically representative sample of wells, subject to a few practical considerations such as proximity to roads and the lack of a nationwide directory of wells.

[9] 46% of the wells exceeded the WHO guideline value of 10 µg/L.

[10] Arsenic contamination levels in groundwater vary widely in Bangladesh. Researchers attribute this phenomenon to the fact that the concentration of arsenic is itself a function of many variables. Two are of particular relevance in Bangladesh—soil depth and sediment geology. Scientists have found that 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 drawn 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.

coding of the wells (UNICEF 2008).[11]

Overall, UNICEF's information campaign, along with other similar efforts, raised awareness about Bangladesh's arsenic problem and villagers understood the need to stop using arsenic-contaminated water (Jakariya 2007). In the late 1990s, less than ten percent of the population knew that tubewell water could be contaminated by arsenic. According to a UNICEF report in October 2008, this number had risen to eighty percent. Seventy percent of informed households claimed that they were taking some sort of action to avoid consuming contaminated water (UNICEF 2008).

It is likely the information campaign affected a number of water-related behaviors. The color-coding was aimed at getting households to switch to clean wells, but the findings in Field, Glennerster and Hussam (2011) suggest that many households increased their risk of diarrheal diseases, possibly by switching to surface water. In addition, the greater distance from the primary water source may have resulted in an increase in water storage time, when water often becomes 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 have been well-documented in numerous studies and are especially relevant in developing countries. There are biological benefits because breast milk protects infants against infections in two ways: first, by inactivating pathogens, such as those causing diarrhea, or preventing them from attaching to the gastrointestinal tract (Isaacs 2005, Morrow et al. 2005). Second, mechanically, breastfed children are less likely to consume contaminated food and water, which helps protect them in areas with poor sanitation (Habicht, DaVanzo, and Butz 1988). This protective feature has been found both for exclusively breastfed children (in which children are not fed anything besides breast milk, even plain water), and for children who consume other foods as well (Prentice 1991). 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). On the negative side, HIV can be transmitted through breast milk. However, even HIV-positive mothers without access to antiretroviral drugs

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

are encouraged to breastfeed for the first six months (World Health Organization 2010).

Breastfeeding is nearly universal in Bangladesh: in 1999, 97% of children under the age of five had been breastfed (NIPORT 2001). However, despite several national breastfeeding campaigns since 1989, exclusive breastfeeding rates remain low. Although UNICEF and the WHO recommend that children be exclusively breastfed for the first six months of life, 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 roughly constant until 2007 (NIPORT 2009).[12] Around half of infants under six months of age are exclusively breastfed (NIPORT 2009). A large fraction of 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).

A study conducted in Bangladesh by Fängstrom et al. (2008) suggests that infants who are exclusively breastfed are protected from the adverse effects of arsenic. The study finds a positive and significant relationship between arsenic concentrations in a mother's blood and her breast milk. Yet, arsenic concentrations in breast milk were relatively low despite high maternal exposure. Studies in arsenic-contaminated regions of other countries confirm these findings (Concha et al. 1998, Samanta et al. 2007).

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 that tested wells and disseminated information on arsenic contamination 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, uncontaminated 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 own well tested negative may be concerned about water safety if, for example,

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[12] According to Haider, Kabir and Ashworth (1999), 99% of mothers reported hearing breastfeeding messages or receiving advice, and 97% claimed to understand the idea of exclusive breastfeeding. However, many women incorrectly believed that exclusive breastfeeding meant a child consumed water in addition to breast milk.

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 households in more contaminated areas would be most likely to alter their breastfeeding behavior in response to the arsenic campaign.

We interact this geographic variation with over time variation in whether a child was born before or after the information campaign in a difference in difference (DID) estimation strategy, which accounts for many confounding stories. 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),[13] although it has been found to be correlated with some village-level characteristics (Madajewicz et al. 2007).[14] We include village fixed effects and district-specific trends over time to deal with possible omitted variables.[15]

If there were village-specific trends correlated with arsenic contamination, that could still cause a problem for our strategy. If less contaminated villages were richer (as Madajewicz et al. 2007 found in one subdistrict) and 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. We have found no evidence of any campaign targeting contaminated areas. In fact, UNICEF reports that breastfeeding was not a

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[13] According to van Geen et al. (2003), the vast majority (88%) of contaminated wells are situated within 100 meters of an uncontaminated well.

[14] Even local variation may be suspect if migration is frequent, and worse if it is due to the campaign. 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.

[15] Madajewicz et al. (2007) show that across 54 villages in Araihazar District in Bangladesh, households with uncontaminated wells are significantly richer than households with contaminated wells. 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 with cohort dummies.

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.

Nevertheless, we 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 in each village. While all households for whom the campaign was salient are likely to be more concerned about water quality, households that switched to 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 households unable to change their water source. Since whether a household switches water sources to a clean well is endogenous, we exploit variation in the cost of switching: in particular, the distance to a clean well. Despite the endogeneity concern, we first estimate a triple difference with whether the household is not sourcing water from an uncontaminated well: these households are either using a contaminated well or surface water.[16] Note that breastfeeding would protect children both from arsenic as well as from water-borne pathogens. Next, we estimate a triple difference with whether the household is far from an uncontaminated well as the third difference.

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 these issues below after describing the data. 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 uncontaminated wells predicts breastfeeding responses supports our identification strategy.

3.B. Data

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[16] We are only able to use a subset of the data for this regression as only one BDHS round (2004) tested for arsenic. Note that 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. This is partly due to concerns about recall bias and misreporting. More importantly, the BDHS does not ask for previous water sources, making it impossible to know what sources households switched from. Finally, even if a household did not switch sources, living in a highly contaminated area might make concerns about water more salient after the campaign.

The household data are from the 1999, 2004 and 2007 Bangladesh Demographic and Health Surveys. The BDHS is a nation-wide survey conducted by the National Institute 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.[17]

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, this section included questions on arsenic. The household's drinking water was tested for arsenic, the well (if the source was a well) was inspected and any markings (red or green) were noted. In addition, the respondent was questioned about her knowledge of arsenic.

The BDHS also collected GPS data for the 360 clusters.[18] One data challenge is that the clusters are not the same across years. In our specifications, we either include cluster fixed effects (where the clusters are survey-year specific) or 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. In 1998 and 1999, the BGS tested the arsenic levels of 3,534 wells across the country.[19] Using the GPS coordinates of each well, we calculate various measures of arsenic contamination for each BDHS 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 actual location). Thus, the most straightforward measures, such as the number and percent of wells within five miles of each cluster that are contaminated (greater than or equal to 50 µg/L As) or the average contamination level of these wells, are not the best

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[17] Children born in 1994 were excluded because of a very small sample size.
[18] GPS coordinates are displaced up to 2 km in urban areas and 5 km in rural areas, with 1% of rural locations displaced up to 10 km.
[19] We drop around 300 children from the three districts that the BGS did not survey.

measures. Specifically, these measures do not take into account the geographic distribution of contaminated wells around 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 differ than if the contaminated wells were spread out. Therefore, we calculate the probability of being within one mile of a sampled contaminated well, conditional on being within five miles of the cluster. Our preferred measure is weighted by the inverse of the distance from the cluster, assuming that a household has a higher probability of being closer to the center of the five-mile radius. For expositional ease, we will refer to this measure as follows: a value of 0.07 (the mean) will be called a cluster with 7% contamination. This measure is highly correlated with the simpler measures listed above.

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 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 and we note that 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 and distance to clean wells 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 of arsenic exposure (our preferred measure is shown in the final 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.

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. Our first measure parallels our measure of contamination: the probability of being within 1 mile of an uncontaminated well, conditional on being within 5 miles of the cluster. Our second measure is the average distance from the closest uncontaminated well, conditional on being within five miles of the cluster.[20] We also weight these measures by the inverse of the distance from the cluster. Figure 3 plots a kernel-weighted local polynomial of the relationship between our preferred measures of access to clean wells and whether the household drinks contaminated water or surface water (i.e. is not using an arsenic-free well) from the 2004 survey. As expected, the more households are close to clean wells, the fewer drink unclean water. Figure 4 plots this relationship, separately for clusters with higher than median contamination and lower than median contamination, and for households who have heard of arsenic and households who have not. 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 2 presents the means of various demographic, outcome and contamination measures 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)

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[20] 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. While the two measures are negatively correlated, 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 2 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).

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.[21] 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.[22]

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.

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_j is a measure of arsenic exposure for cluster j and $post_t$ is a dummy variable for being born in 2002 or later.[23] We include fixed effects for BDHS cluster (α_{js})[24] and birth year (α_t), as well as district-specific trends $(\alpha_k t)$. The set of control variables,

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[21] We are unable to include cluster fixed effects (which we do in our regressions) since our arsenic measures are at the cluster level. All standard errors presented in this paper are clustered by BDHS cluster. The results do not change when we cluster by district.

[22] We present unweighted OLS regressions in this paper, although we confirm that our regression 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.

[23] Although the mitigation 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.

[24] Because of the BDHS' design, this regression will be estimated primarily off the 2004 clusters, since only those clusters 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.) 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

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X_{ijskt}, includes the current age of the child (we assign the age at death for children who died) and a dummy variable for whether the child died, depending on the choice of dependent variable.[25] Our preferred measure of breastfeeding is the number of months a child is breastfed but this dependent variable imposes a functional form assumption that the effect of the campaign be linear and is right censored for children who died and children who are still breastfeeding. We address these issues by considering two other dependent variables as well: whether a child was breastfed for at least 12 months and whether a child is currently exclusively breastfeeding.[26] Finally, we discuss various checks to deal with the right censoring in Section 4A.

The identifying assumption for this DID regression is that trends in breastfeeding behavior 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 breastfeeding behavior was trending differently in areas with greater arsenic exposure for other reasons. As usual, we are unable to provide definitive evidence for the parallel trend assumption, but we can estimate 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.

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 who drink surface water. These households 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:

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status when we split the sample by age (all 4-year-olds in 2004 will be 'untreated' regardless of cluster). In those regressions, we include fixed effects for the closest 2004 cluster and for survey year.

[25] While whether a child has died is endogenous, excluding children who died results in an endogenously-selected sample. We only include it for one breastfeeding measure.

[26] The natural log of months breastfed gives us similar results (results not reported).

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

(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 data. According to our hypothesis, the coefficient δ_1 should be zero and the coefficient δ_2 should be positive.

As noted above, whether or not a household switches to a clean well 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 as the third difference, namely measures of the distance to an uncontaminated well.[27]

4. Response to information regarding arsenic exposure

4.A. Breastfeeding duration

Table 3 presents results from specification (1), estimating the number of additional months mothers breastfeed children born after the information campaign. The dependent variable we use 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% contamination to 10% contamination (from the 25th to the 75th percentile in the distribution, also equivalent to one standard deviation) would lead a mother to breastfeed an additional 0.6 months.[28] 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). In Appendix Table A2, we further divide the sample into households with and without access to piped water. Since whether a household has piped water is endogenous, we divide the sample by whether or not the village has access to piped

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[27] 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.

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

water. These estimates indicate that the results are driven by households in rural areas, without access to piped water. Thus, 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. For months breastfed, we simply assign these children their current age or age at death. In Table 3, Panel B, we consider a different outcome variable that suffers less from this problem: whether or not a child 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).[29] 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.

In Table 3, Panel C, we consider a third dependent variable: whether or not the child is exclusively breastfed.[30] 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 breastfeeding and have not received any liquids, even plain water, in the past 24 hours. Note that this is quite restrictive: Out of the 10,000 children still breastfeeding in our sample, less than 12% are exclusively breastfed.[31] Fifty percent of children younger than 6 months were exclusively breastfed, but only 5% of children aged 6 – 14 months are exclusively breastfed. We see the same behavior change with this outcome variable: children born in contaminated areas after the information campaign are more likely to

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[29] Recall that when focusing on a particular age, there is no variation in the 2004 sample and we include fixed effects for the nearest 2004 cluster instead of survey-year specific BDHS 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.

[30] This dependent variable also addresses the censoring issue, 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 breastfeeding, or assigning children who are still breastfeeding the max in the data (59 months). We then 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.

[31] Among children in rural areas who are not exclusively breastfeeding, 96% have had plain water in the last 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. Among children in rural areas who are not breastfeeding at all, 85% have had plain water in the past 24 hours, 5% have had baby formula, 8% have had sugar water, 27% have had cow's or goat's milk, and 10% have had other liquids (BDHS data, authors' tabulations).

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 age, we next look for heterogeneous effects by age in Table 4. Since we are dividing the sample by age, we include fixed effects for the nearest 2004 cluster. 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[32] months and older than 12 months. The effect on exclusive breastfeeding is strongest 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. We also note that most of the variation behind exclusive breastfeeding is whether a child is given water to drink. In Panel B of Table 4, we use whether a child consumed plain water in the past 24 hours as the dependent 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 can provide support for the exclusion restriction with an event study. Figure 5 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.[33] Starting in 2002, however, the coefficients are positive and more or less increasing. By 2005, they are positive and statistically

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[32] 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.
[33] The coefficient on 1996 interacted with arsenic exposure is statistically significant and negative, but does not seem to indicate a trend since 1997 is back to 1995 levels.

significant. To provide a more formal test, 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. The F-statistic of this hypothesis test is 8.9 while the p-value is 0.003.

4.B. Variation in the cost of switching to a clean well

To strengthen the validity of the exclusion restriction, 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 would not need to modify their breastfeeding choices. Table 5 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. 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 did not switch to 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. 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 also 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 version of this variable. 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%.

Column (4) uses a different variable to capture the difficulty of switching to a clean well: 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 for longer. When we use the weighted measure (Column 5), neither coefficient is statistically significant, but the effect of the information campaign for a cluster where the average household is 2 or more miles away from an uncontaminated well is positive and statistically significant.[34]

These triple difference results strengthen our causal argument. In Table 3, the identifying assumption was that no omitted determinants of breastfeeding trends are correlated with arsenic exposure, conditional on the controls. While the district-specific trends take out some secular trends, one could still argue that places with more arsenic exposure could be trending differently from places with less arsenic exposure, and these trends could be changing differently over time, which would cause omitted variable bias. As described above, including birth year dummies interacted with maternal education, paternal education and a wealth index does not alter our results. In addition, Table 5 provides additional convincing evidence, because 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 consequences of the information campaign and breastfeeding response for infant health. Table 6 presents estimates of specification (1) with health outcomes as dependent variables. As in Table 4, we include fixed effects for the nearest 2004 cluster. In Panel A, the dependent variable is a dummy variable for whether the child died before the age of 6, 12, 24, 36 or 48 months in Columns (1) to (5), 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 one standard deviation increase in contamination would mean that the

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[34] 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. The effect of the campaign is no longer positive and significant for clusters where the probability of being within one mile of a clean well is 22-27%. When we use the average distance to the closest uncontaminated well to measure clean water access, we find that the effect of the campaign is only positive and significant for clusters where the average household is more than 1.455-1.58 miles from a clean well.

probability of an infant dying would fall by 1.1 percentage points more than it would have otherwise. 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 breastfeeding. In fact, the impact on child survival for the youngest children fits well with the impact on exclusive breastfeeding and consumption of water. Recall that 50% of children younger than 6 months are exclusively breastfed and only 2% of children older than 12 months are exclusively breastfed. 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 for infants. For this reason, we believe our results complement, not contradict, the findings in Field, Glennerster and Hussam (2011). Their results are strongest for older children, while our results are strongest for the youngest children, the ones most likely to be exclusively breastfed and for whom breast milk is a good substitute for water.

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 our health results are likely to be the combined effects of all changes in health behaviors, including reduced exposure to arsenic-contaminated drinking water and increased breastfeeding. We also note that one reason these health effects are concentrated among the youngest children could be that parents have much 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 range (0-12, 12-24, 24-36 and 36-48 months) and examine the effect of the information campaign on changes in 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 children 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). Finally, we find no effect on height for any age group.

6. Discussion and alternative mechanisms

Our principal finding is that mothers improve their breastfeeding practices in arsenic contaminated areas after a nation-wide 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 breastfeed more in order to protect children from contaminated water (either water contaminated with arsenic or with 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 chooses to allocate her time. Finally, there may be other reasons women choose to breastfeed longer besides child health, such as greater birth spacing.

6.A. Productivity shock due to reduced arsenic exposure

It is possible that the campaign improved mothers' health due to reduced arsenic exposure. On one hand, this productivity shock would improve their ability to breastfeed and their efficiency in other work. On the other hand, the productivity shock would affect the relative prices of these two activities, but the change is ambiguous. It is not obvious where women will expend this increased productivity. If the two effects impact breastfeeding in the same direction, we would expect women closer to clean wells, who are more likely to experience the health improvement, to exhibit a bigger increase in breastfeeding. Our results prove otherwise.[35,36]

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.[37] 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

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[35] 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 how much local variation there is 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 evidence of increased breastfeeding for mothers close to clean wells (which we confirm), but it would not rule out the health channel.

[36] 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 postpartum) may improve a child's ability to breastfeed. 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.

[37] This alternate explanation is testable with time use data, which unfortunately the BDHS does not have. We do have data on labor force participation, but only 18.7% of the children have mothers who work, and only 16% of those who work do so seasonally otherwise we could have used this variation in the value of the women's time to distinguish among these explanations (BDHS data, authors' tabulations).

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 economists often expect individuals to substitute towards market work at the expense of home production, few women in Bangladesh work outside the house. Here the decision is likely to be between child care and other types of home production, such as cooking and cleaning. While we know little about time allocation decisions in this context, it seems unlikely that women would forego breastfeeding in order to spend more time on other household production, especially given the lack of affordable and high-quality substitutes for breast milk.[38]

6.B. Time to fetch water

A second alternative explanation relates to the fact that households may now fetch water from a more distance 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, leading her to breastfeed more. Thus, one explanation for our results is that women substitute away from getting water and towards breastfeeding not because of arsenic contamination, 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 (Madajewicz et al. 2007, Sultana 2006, Ahmad et al 2003, Bangladesh Bureau of Statistics and UNICEF 2007).

6.C. Motives for breastfeeding

In addition to child health benefits, breastfeeding also has a contraceptive effect. Women may choose to breastfeed longer to lengthen the time between subsequent children (birth spacing) after the campaign. This could be because of more salient concerns about child health or because of lower desired fertility if the cost of feeding and monitoring children rises. Jayachandran and Kuziemko (2011) show that breastfeeding patterns in India respond to this

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[38] The literature on this question is thin, but one study using the American Time Use Survey shows that better health is associated with only certain types of household production (Podor and Halliday 2012). In particular, they find no significant effect of health on childcare for one's own children, housework or food preparation, although people spend more time on lawn and garden care, consumer goods purchases, grocery shopping, travel, and caring for non-household children at the expense of leisure.

contraceptive effect and reflect fertility preferences.[39] 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 that they want another child, but only after 2 years).

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, but this is speculative. Mothers are not likely to know that arsenic is not fully transmitted in breast milk. 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. 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 tremendous success in motivating behavior change (even including some changes with adverse consequences). It is not clear whether this is because of a particular aspect of the campaign, such as the massive size, or because of some feature of arsenic poisoning, such as the characteristic skin rashes or connotations of 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,

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[39] Jayachandran and Kuziemko (2011) find that mothers breastfeed their sons longer than their daughters, providing another explanation for gender gaps in child health. We find larger effects of the arsenic information campaign on breastfeeding for boys, but the difference is not statistically significant.

supporting our view that this behavior change is not a biological response due to improved maternal or child health but instead, a conscious response to concerns about water quality.

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Figure 1: Arsenic Contamination Levels from BGS Survey in Bangladesh

Each point represents one well

Legend

micrograms/L

- 0 - 10
- 11 - 50
- 51 - 1660

0   30   60   120 Miles
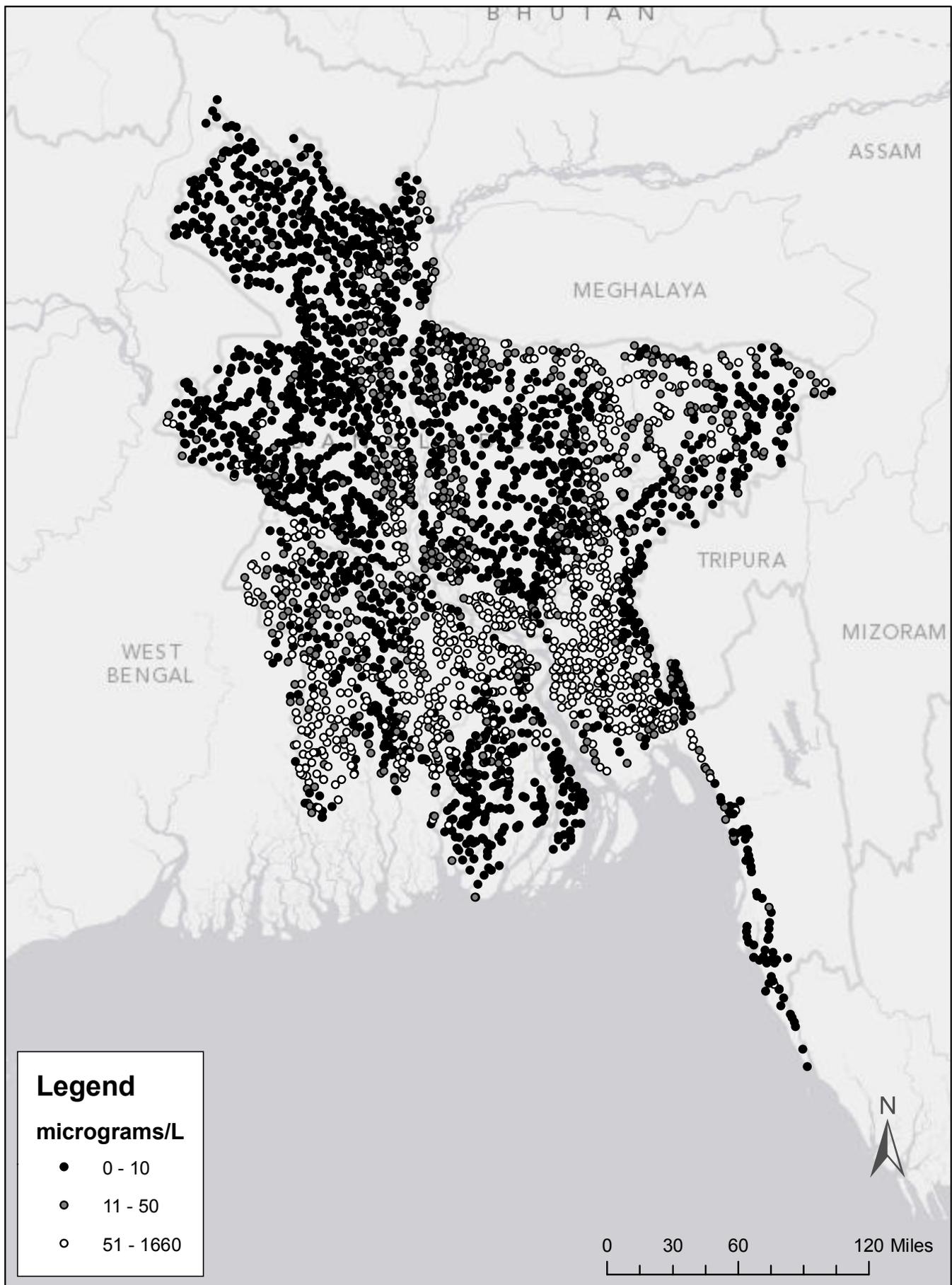
Note: The Bangladesh government considers wells containing over 50 µg/L of arsenic to be contaminated, while the W.H.O. considers wells containing over 10 µg/L contaminated. Source: British Geological Survey.

Figure 2: Variation in Access to Uncontaminated Wells, conditional on Contamination Level

Cluster A   Cluster B

● GPS coordinates of cluster
✖ GPS coordinates of a sampled contaminated well
▓ GPS coordinates of a sampled uncontaminated well
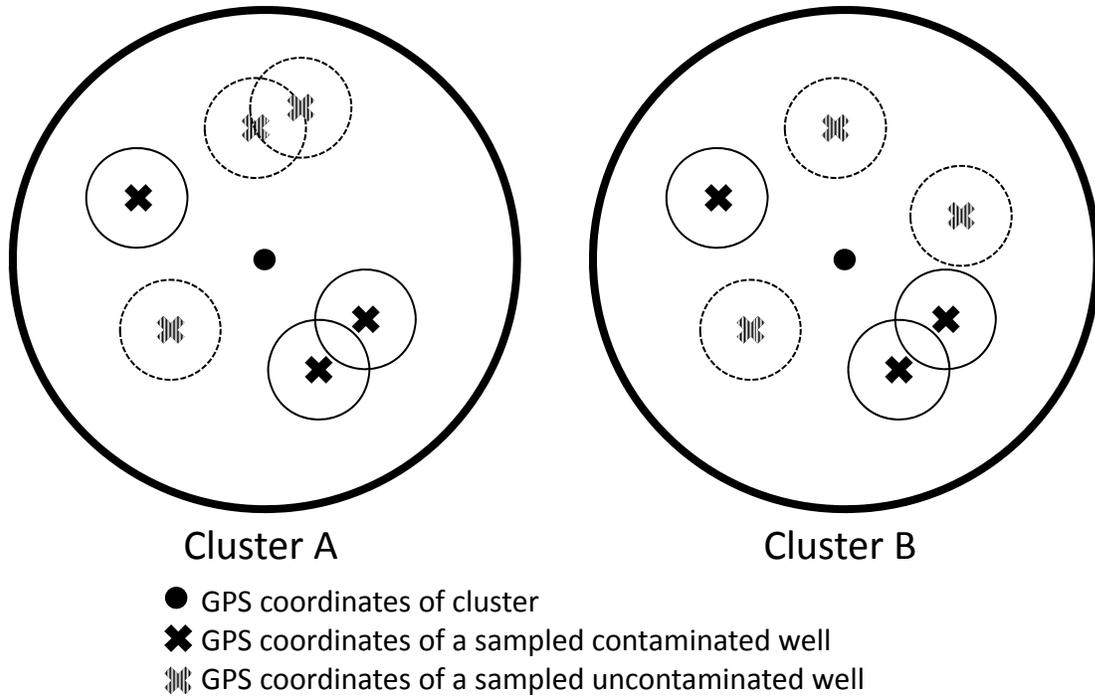
Figure 3: Access to a clean well
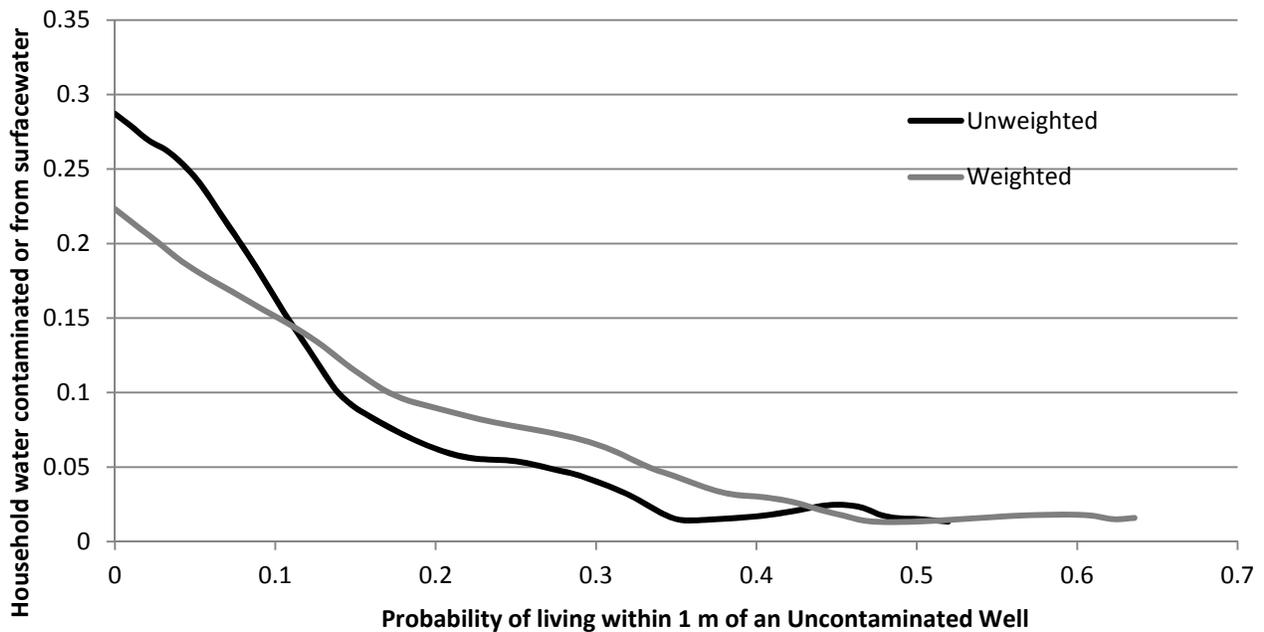
Note: This figure plots a Kernel-weighted local polynomial of the relationship between a household's access to a clean well and whether a household gets water from a contaminated well or surface sources. The plots uses an epanechnikov kernel and bandwidth 0.05.

Figure 4: Access to a clean well
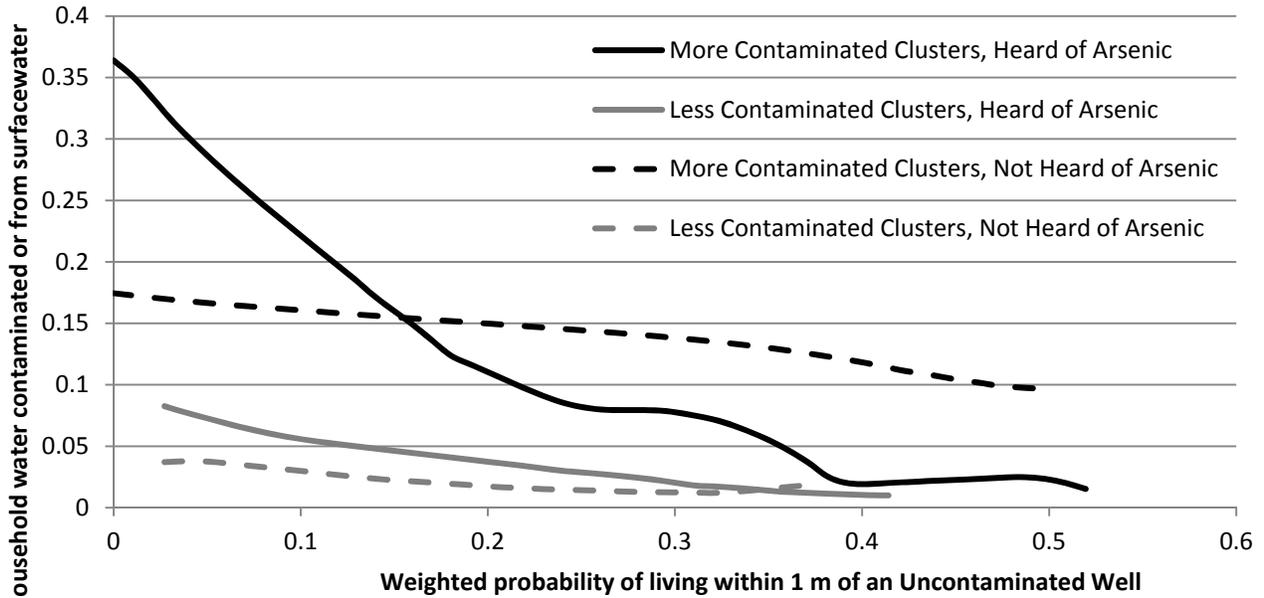
Note: This figure plots a Kernel-weighted local polynomial of the relationship between a household's access to a clean well and whether a household gets water from a contaminated well or surface sources. We exclude clusters with zero tested wells. The plots uses an epanechnikov kernel and bandwidth 0.05.

Figure 5: Months breastfed and arsenic exposure
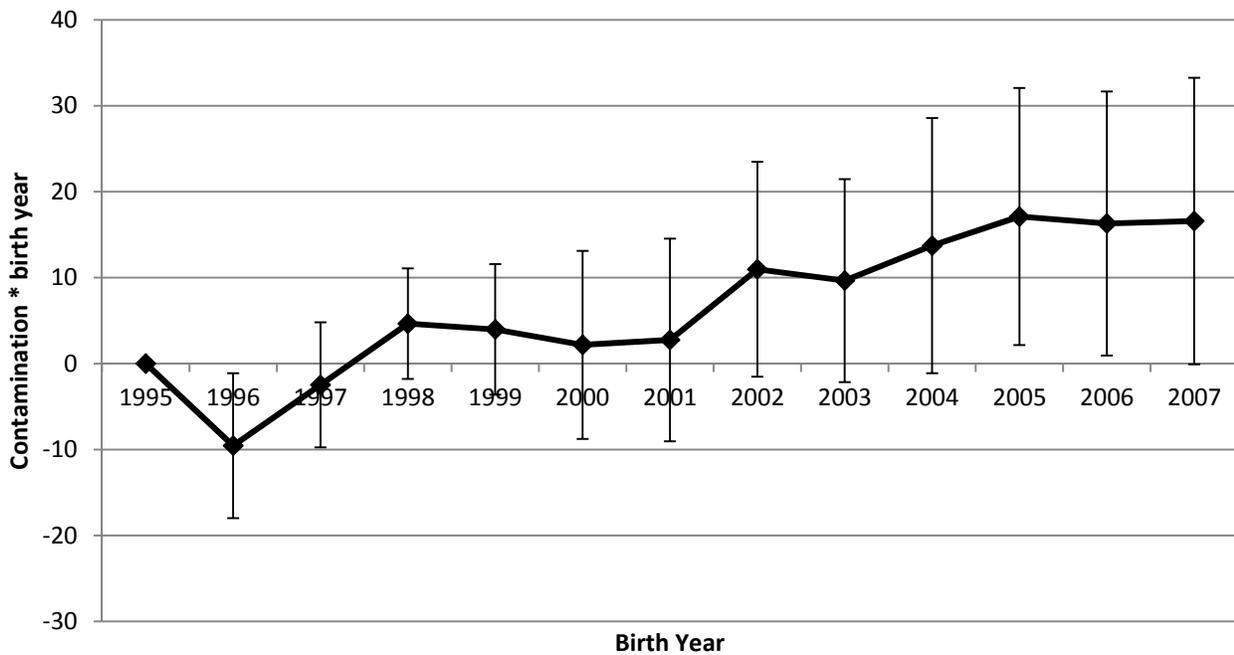
Note: This figure plots the coefficients on the interactions between birth year dummies and arsenic exposure in a regression similar to those in Table 3. Only rural areas are included in this figure. The error bars are 5% confidence intervals, after clustering on BDHS cluster.

Table 1. Various measures of exposure to arsenic contamination

	(1) Heard of Arsenic	(2) Level of arsenic in HH water source	(3) HH water source contaminated	(4) HH well painted red	(5) HH well painted
% of wells contaminated within 5 mi	0.00246*** (0.000274)	0.805*** (0.174)	0.00366*** (0.000494)	0.00417*** (0.000723)	0.00529*** (0.000521)
# of wells contaminated within 5 mi	0.0324*** (0.00305)	8.485*** (2.043)	0.0395*** (0.00669)	0.0411*** (0.00918)	0.0589*** (0.00640)
Avg. arsenic level within 5 mi	0.000780*** (0.0000963)	0.313*** (0.0796)	0.00136*** (0.000220)	0.00159*** (0.000284)	0.00134*** (0.000208)
Probability of living within 1 mile of a contaminated well	0.929*** (0.0840)	238.9*** (55.03)	1.117*** (0.177)	1.185*** (0.250)	1.664*** (0.177)
Probability of living within 1 mile of a contaminated well (weighted)	0.718*** (0.0685)	176.1*** (39.66)	0.880*** (0.137)	0.931*** (0.189)	1.279*** (0.159)
Mean	0.845	15.26	0.0818	0.170	0.317

Note: This table shows the relationship between the BGS wells matched with each cluster (the basis for our preferred arsenic measures) 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, ** at the 5% level, and * at the 10% level.

Table 2. Descriptive statistics in 1999 (before the campaign) and in 2007 (after the campaign)

Contamination Level	(1) Survey Year 1999 Low	(2) High	(3) Conditional Difference	(4) Survey Year 2007 Low	(5) High	(6) 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						
Percent contaminated in 5 mi	0.845	48.455	37.18***	1.267	47.117	38.06***
Num. wells contaminated 5 mi	0.0531	3.2161	2.293***	0.0714	3.3324	2.532***
Avg. As contamination in 5 mi	5.594	104.924	53.57***	6.543	97.493	66.14***
Probability of living within 1 mile of a contaminated well	0.00221	0.12021	0.0860***	0.00322	0.12522	0.0955***
Probability of living within 1 mile of a contaminated well (weighted)	0.00122	0.13622	0.101***	0.00177	0.14077	0.112***
Number of Observations	3147	3478		3124	2952	

Note: This table shows summary statistics for all variables used in this paper, 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 3. 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 months breastfed	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 and 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 breastfed for 12 months	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 exclusively breastfed	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 being close 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 4. 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 exclusively breastfed	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 had plain water	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 being close to arsenic contaminated wells after the information campaign. As in Table 3, 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. 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 5. Differential responses with respect to water source or distance to uncontaminated wells

Triple difference measure	(1) Water sample is contaminated with arsenic or from surface source	(2) Probability of living within 1 mile of an uncontaminated well	(3) Probability of living within 1 mile of an uncontaminated well (weighted)	(4) Average distance to closest uncontaminated well	(5) Average distance to closest uncontaminated well (weighted)
		Measure of distance to uncontaminated well			
Dependent Variable: Months Breastfed					
Post*contamination	2.457	11.50***	8.205**	-1.347	1.352
	(2.839)	(3.435)	(3.393)	(4.350)	(3.967)
Post*contamination	13.10***	-41.28**	-13.43	2.485**	1.660
*triple difference measure	(4.951)	(19.02)	(15.55)	(1.202)	(1.088)
Number of observations	4765	13609	13609	13609	13609
R-squared	0.681	0.641	0.641	0.641	0.641
Mean months breastfed	19.60	19.63	19.63	19.63	19.63
Mean contamination	0.0741	0.0720	0.0720	0.0720	0.0720

Note: This table shows the relationship between breastfeeding patterns and being close 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 3, 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. 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 6: Health effects by age

	(1)	(2)	(3)	(4)	(5)

Panel A: Child died before the age of …

Age in months	6	12	24	36	48
Post*contamination	-0.108**	-0.120*	-0.0413	-0.126	-0.151
	(0.0502)	(0.0628)	(0.0877)	(0.106)	(0.160)
Number of observations	12238	11004	8309	5513	2753
R-squared	0.0390	0.0437	0.0539	0.0865	0.143
Mean dependent variable	0.0557	0.0646	0.0749	0.0778	0.0741
Mean contamination	0.0716	0.0715	0.0711	0.0702	0.0707

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 being close to arsenic contaminated wells after the information campaign. As in Table 3, 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 not 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, 36 or 48 months; we include in the sample only children who have attained the respective ages. 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 A1. Testing robustness to different measures of arsenic exposure

Areas included	(1) All	(2) Urban	(3) Rural	(4) All	(5) Urban	(6) Rural
Panel A: Months Breastfed						
Post*percent contaminated	0.0189**	0.00110	0.0269***	0.0147**	0.00121	0.0179**
	(0.00770)	(0.0176)	(0.00844)	(0.00705)	(0.0166)	(0.00731)
Post*avg contamination	9.825	0.00137	0.00984***	0.00459	-0.000310	0.00583*
	(0.00314)	(0.00660)	(0.00361)	(0.00299)	(0.00641)	(0.00328)
Post*# wells 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*probability contaminated (unweighted)	7.205***	3.569	8.853***	6.778***	2.334	7.147***
	(2.432)	(5.509)	(2.682)	(2.260)	(5.152)	(2.422)
Panel B: Breastfed for 12 or more months, among children 12 months and older						
Post*percent contaminated	-0.0000555	-0.0000849	-0.0000280	-0.000163	-0.000441	0.000152
	(0.000130)	(0.000474)	(0.000135)	(0.000158)	(0.000626)	(0.000159)
Post*avg contamination	0.0000610	0.0000780	0.0000570	0.0000329	-0.000157	0.000111*
	(0.0000471)	(0.000168)	(0.0000471)	(0.0000592)	(0.000209)	(0.0000602)
Post*# wells 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*probability contaminated (unweighted)	0.0443	0.0764	0.0358	0.0318	-0.0951	0.0956*
	(0.0476)	(0.140)	(0.0506)	(0.0563)	(0.182)	(0.0547)
Panel C: Exclusive Breastfeeding						
Post*percent contaminated	0.00102**	0.000497	0.00111**	0.000499	-0.000201	0.000657
	(0.000408)	(0.000857)	(0.000472)	(0.000374)	(0.000815)	(0.000421)
Post*avg contamination	0.000247	-0.0000464	0.000311	0.0000179	-0.000317	0.0000810
	(0.000197)	(0.000397)	(0.000214)	(0.000167)	(0.000302)	(0.000179)
Post*# wells 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*probability contaminated (unweighted)	0.264**	0.0768	0.321**	0.177	-0.0755	0.269**
	(0.123)	(0.234)	(0.141)	(0.121)	(0.246)	(0.132)

Note: This table tests the robustness of the results in Table 3 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)
N	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)
N	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 being close 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

Dependent Variable	(1)	(2)	(3)	(4)	(5)
		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 being close to arsenic contaminated wells after the information campaign. As in Table 3, 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, respecitvely; we include in the sample only children who have attained the respective ages. 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 3 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 3, 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.