Information Campaign on Arsenic Poisoning: Unintended Consequences in Marriage Market

Shyamal Chowdhury* Prachi Singh†

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Abstract

Arsenic contamination of ground water, which has been the main source of drinking water in rural Bangladesh since 1970s has caused a major health emergency owing to multiple health problems associated with it, ranging from skin lesions to various types of cancers. However, until mid 1990s, the contamination remained largely unknown and became public knowledge only later through a nationwide information campaign. We study the impact of the information campaign on marriage patterns in Bangladesh. Using difference-in-difference model, we analyse the age at marriage (for males and females) and the bride price agreed at the time of marriage and find that both of them reduce in arsenic affected areas in comparison to non-arsenic affected areas in response to the information campaign. However, no effect is found on dowry payments. The effect on the age at marriage is primarily driven by younger cohorts who get married earlier. Additionally, we find that for females the likelihood of having the first child by early ages (between 16 to 20 years) increases. Using our analysis, we show that such information campaigns can have unintended social consequences.

Key words: Arsenic Contamination, Health Shock, Information Campaign, Age at First Marriage, Bride Price, Age at First Birth, Bangladesh

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*School of Economics, University of Sydney, email: shyamal.chowdhury@sydney.edu.au

†Environmental Defense Fund, NY email: prachi.singh1987@gmail.com

1 Introduction

Arsenic contamination of drinking water is a major public health problem in many parts of the world. While it is fairly widespread, having being detected in at least 70 countries (Ravenscroft et al., 2009), it is especially severe in South Asia (Mukherjee et al., 2006), and in particular in Bangladesh where more than 30 percent of its population has been affected by the contamination (Ahmad et al., 2018). In order to address this problem, while various solutions have been suggested,[1] educating the population through information campaigns still remains one of the most important public policy tools (Weiss and Tschirhart, 1994). Given the gravity of the problem, Bangladesh was one of the first countries to inform its exposed population about water quality and the various harmful effects of consuming arsenic on human health. In this paper, we seek to estimate the effect of the information campaign on marriage market, focusing primarily on two outcomes – the age at first marriage (for males and females) and marriage payments (bride price[2] and dowry). We also extend our analysis to assess the spillover effect of information campaign on early child bearing for females.

Our study is motivated by the recognition by researchers and commentators that while the health effects of arsenicosis, that is arsenic poisoning which leads to development of skin lesions (see Appendix Figure A1, panel A), various types of cancers, higher mortality and fertility have been extensively studied, there is relatively sparser literature on the socio-demographic (and mental) effects of such poisoning (Brinkel et al., 2009). If such effects are indeed important, then information campaigns increasing awareness may have important demographic consequences, some unintended. For example, while an information campaign telling communities that they are at risk of arsenic exposure may help agents take precautions to prevent exposure, it may also change social perceptions towards the sub-population which has already been exposed, irrespective of whether they show any symptoms of poisoning. Since arsenic exposure increases health risks, it increases the chance of not finding a match in the market where information about arsenic contamination (of tubewells in the neighborhood) has been made public, and the changed perceptions may then cause changes in the marriage market equilibrium, some of which may be socially undesirable. Age at first marriage and marriage payments (like bride price and dowry) are such outcomes and

[1] For example, developing alternative water sources and methods for arsenic testing and removal, see Ravenscroft et al. (2009)

[2] Specifically, when we assess bride price, we look at *mehr*, a monetary payment from the husband to the wife. According to Islamic law, Muslim marriage contracts require specifying a mehr (Bianquis 1996, Carroll (1986)).

they are the focus of our study.

Characteristics of prospective partners may not be fully observable in marriage market and individuals tend to hide adverse information related to health and financial well-being (Becker, 1973; Gary et al., 1981). Information asymmetry is this market has consequences on marriage timing, specifically the study Angelucci and Bennett (2021) finds that removing this information asymmetry aides decision making in marriage market and leads to accelerated marriages. Another study models marriage market behavior (Buchmann et al., 2021) and documents early marriage as an equilibrium outcome in presence of imperfectly observed attributes of brides.[3] Even policy changes related to health outcomes can induce a change in marriage market behavior as shown by a paper by Gershoni and Low (2021a) where they find that a new policy to provide free in vitro fertilization (IVF) to Israeli women which expanded female's reproduction horizon affected the age at which they get married. In case of Bangladesh, the information campaign on arsenic in water provided constant visual cues by painting tubewells in red (unsafe) and green (safe) colors and public forums increased the awareness related to adverse health outcomes like developing skin lesions (see Appendix Figure A1, panel B), various forms of cancers etc. Thus, affected communities at the risk of developing arsenic poisoning symptoms in future and may try to avoid this discovery by marrying early.

Empirical evidence at macro level shows that exogenous variations in adult mortality lead to higher level of risky behavior, higher fertility and lower investment in physical capital (Lorentzen et al., 2008). The extant micro-economic evidence on age at marriage focuses primarily on women and argues that an increase in age at marriage affects educational attainment, fertility decisions (Currie and Moretti, 2003; Breierova and Duflo, 2004; Field and Ambrus, 2008), labor market outcomes (Loughran et al., 2004) and well-being of offspring (Chari et al., 2017). Hence, a reduction in age at marriage can adversely affect all the aforementioned socially and individually desirable outcomes. However, despite the importance of age at marriage in relation to individual well-being and social benefits, little research is devoted to understand how shocks such as the one we examine influences individuals' decisions to marry early or delay it.

[3]Bangladesh is characterized by child marriage as a cultural norm, where most marriages are arranged marriages. It has the highest rate of child marriage for girls marrying before they turn 15. A 2014 report by UNICEF documents that close to 40 and 74 percent of women in the age group 20-49 were married by the time they were 15 and 18 years old respectively (UNICEF, 2014). Delaying marriage is perceived as a negative signal about unobserved bride quality in this set up. Buchmann et al. (2021) provides a detailed description of this phenomenon in Bangladesh.

Further, for those who live in affected regions, greater awareness about them being affected by adverse effects of arsenic, may cause behavioral changes[4]: for example, it is plausible that it would change their risk attitudes, turning them more risk averse. Such changes in risk perception may significantly affect age at marriage, with more risk averse individuals marrying sooner than their more risk-loving counterparts fearing the onset of their arsenic-induced symptoms.[5] Hence one may expect changes in the age at which adults in the marriage market as a consequence of greater awareness due to information campaigns.

Marriage payments like the bride price is a common Islamic practice prevalent in many countries (including Bangladesh). It is the amount which is agreed upon at the time of the marriage, which has to be paid by the groom's family to the bride's family in the event of a divorce. This is considered as a payment owed by groom's family for the use of bride's labor, reproductive capabilities and puts a value on their expectation about the number of children the bride will provide to the groom's family (Anderson, 2007). Dowry, which is the payment from a bride's family to the groom's policy is exchanged at the time of marriage, is also commonly practiced in Bangladesh. Dowry values the groom in the marriage market, it characterizes endogamous marriages where these payments are pegged to the social status of groom's family and also groom's future prospects and earning potential (Anderson, 2007). Both these payments can be large enough to impact household finances, for example dowry payments have been documented to form 62 percent of average annual household income (Esteve-Volart, 2004).[6]

In our analysis of marriage market in Bangladesh, in addition to age at first marriage, we also consider the two marriage market payments - bride price and dowry as outcome variables of interest since perceptions of future health, future physical appearance and longevity, are influenced by information campaign designed to inform the population about adverse effects of arsenic exposure. The potential quality of a match in this market can be inferred based on their place of residence

[4] One possible behavioral change can be out migration from arsenic affected areas which might change the marriage pool in these areas. We address this concern in one of our robustness checks Section 5.5.1.

[5] Spivey (2000) measures risk aversion via a series of hypothetical gamble and finds that risk attitudes significantly affect the timing of marriage.

[6] Marriage market payments can also affect well-being of women. A study from three districts of Bangladesh (Amin et al., 2009) highlights the association between marriage payment and time spent by women on domestic work, self-care and productive work; with dowry payments found to be negatively correlated with time spent on domestic work and positively associated with time spent on self-care. Anderson (2007) also provided a review of these payments and documents their association with extramarital affairs by husbands and domestic violence faced by women.

(the arsenic contamination in the neighborhood), so equilibrium payments which are pegged on quality of prospective brides and grooms may get affected.

The information campaign was implemented from 1999 to 2005[7] and it was designed to create awareness about ill effects of arsenic in drinking water, visually complementing the information by painting tubewells (TWs)[8] into red (dangerous) and green (safe) categories and pursuing users to switch to safe sources of drinking water. The campaign also suggested mitigation strategies such as shifting to a safer well in the neighborhood or well-sharing and finally it informed people about harmful health effects of arsenic exposure via public forums. The information campaign was successful in generating awareness and various studies (Chen et al. (2007); Opar et al. (2007); Bennear et al. (2013); Keskin et al. (2017); Jakariya (2007)) have found evidence on reduction of usage of contaminated wells in response to the campaign.

To evaluate the impact of the information campaign, we use a Difference in Difference (DID) strategy. As mentioned above, the information campaign was implemented all over Bangladesh in 2002.[9] However, since it informed people about arsenic contamination, the campaign was more relevant for those areas which had high level of arsenic contamination. Given this, we define sub-districts with arsenic levels in TWs in excess of a certain level demarcated by the Bangladesh Government as unsafe as the treatment group and those below as the control group. Hence our DID strategy considers the period 1990-2001 as the pre-intervention period and the years 2002-2010 as the post intervention period and compares the difference in the pre-post period outcomes for the treatment group relative to an analogous difference for the control group. To be more precise, our identifying assumption is that conditional on sub-district, marriage cohort fixed effects and district linear trends, our marriage market outcomes do not change differentially in arsenic versus non-arsenic contaminated sub-districts other than for reasons related to information campaign. To assuage concerns on this front, we test whether parallel trends assumption is satisfied, that

[7]World Bank Completion report 2007 mentions that during the initial 2.5 years the program didn't take off but gained steam only later that is in 2002.

[8]Tubewell (TW) is a type of water well in which water is collected from underground aquifer through a tube or pipe. Until the discovery of arsenic in ground water in mid 1990s, it was considered as a safe and affordable source of drinking water and widely promoted by the Government of Bangladesh supported by the UNICEF and World Bank. The widespread adoption of TW was considered as a public health success, and by 1990, the number of TW increased to 2.5 millions (Caldwell et al., 2003) from virtually none in 1970 making it the main source of drinking water for over the 95% of rural population.

[9]Keskin et al. (2017) also use the same cutoff for their analysis due to late actual implementation of the programme. Also see footnote 7.

is the trends in age at marriage (for males and females) and marriage payments (bride price and dowry) are not statistically different between contaminated and uncontaminated areas in the period before information campaign was executed.

Data for age at marriage analysis is sourced from Census Data of Bangladesh for 2011. We use data on all married individuals captured in the census. For data on bride price we use a primary survey dataset from Palli Karma-Sahayak Foundation (PKSF) conducted in December 2010-January 2011 that contains information on bride prices (*mehr*) and other marriage related payments (see Chowdhury et al. (2020) for further details). Additionally this survey contains sub-district identifiers which allow us to conduct the DID analysis.

Using the sample of individuals who got married between 1990 and 2010, we find that both males and females got married earlier and bride price reduced after the information about arsenic in drinking water was made public. In particular, we find that age at marriage for males reduced by 3.3 months (a reduction of 1%) and for females it reduced by 1.8 months (a reduction of 0.67%) in arsenic affected areas in response to information campaign. We also find that bride price reduced substantially while dowry payments were not impacted in arsenic contaminated areas in response to the information campaign. These results survive a battery of robustness checks.

We also find that the information campaign had a greater impact on younger cohorts with greater proportion of individuals from these cohorts getting married earlier. The campaign also had a spillover effect on child bearing, with females exhibiting greater likelihood of early child bearing (for ages between 16 to 20). We provide further support for our results by matching arsenic to non-arsenic sub-districts (using Integrated Public Microdata Series - IPUMS data) based on their demographic and other characteristics and then comparing changes in marriage market outcomes between these two groups.

Our results are consistent with the hypothesis that individuals who live in arsenic areas learn about their likelihood of developing skin lesions and other health problems due to information campaign and tend to get married earlier in order to avoid discovery of symptoms of diseases related to arsenic exposure like skin lesions, cancer etc. (which in an alternative scenario, where they do get discovered would make their chances of finding a mate quite difficult). Similarly in case of bride price, public knowledge about arsenic contamination in an area generates concerns about beauty and fertility of a prospective female match leading to a lower bride price which gets offered. While our results are consistent with these explanations, a more detailed investigation of these mechanisms is outside the scope of this paper due to limitations of data.

Our paper contributes to the literature of how information campaigns about health cause behavior changes in health and other socio-economic and demographic spheres. Impact of information provision, aimed at health, that cause changes in how people behave, in health seeking behavior and other socio-economic dimensions, have been studied in other contexts. Oster et al. (2013) find that in case of Huntington disease which is a hereditary disease with ramifications on life expectancy, individuals who are not tested for the disease are optimistic about their health and make decisions as if they weren't diagnosed with Huntington. However, individuals with confirmed diagnoses (to whom true picture about their health status has been revealed) behave differently. Goldstein et al. (2008) find that HIV-positive mothers who learn their status are more likely to receive medication to prevent transmission to their children. The effect of provision of information on behaviour has also been documented in other studies which assess the impact of reminders about dental health on check-up appointments with dentists (Altmann and Traxler, 2014), reminders which induce gym users to increase physical activity (Calzolari and Nardotto, 2011), information about benefits of using bed-nets to prevent malaria on their usage (Alaii et al., 2003; Habluetzel et al., 1997; Binka et al., 1996) and the impact of dissemination of information about importance of hand washing to reduce infections on frequency of hand washing (Cairncross et al., 2005; Curtis et al., 2001; Luby et al., 2010).

In the case of Bangladesh, the literature of the impact of the information campaign we are focusing on is limited to Keskin et al. (2017) and Buchmann et al. (2019), these papers look at mother's behavioral change in terms of increased breastfeeding duration for infants and unintended consequence of information campaign on child mortality respectively. However none of the studies look at how such information campaigns affect the marriage market. In particular, our paper is the first to examine the causal effect of information about health outcomes related to poor water quality in the neighbourhood on marriage market outcomes. In the process, our paper links information about local disease environment to marriage market outcomes.

Given that we look at the impact of the information campaign on marriage market outcomes, it is important to acknowledge that individuals may already have responded to visible symptoms of arsenic poisoning without knowing the cause. Literature has documented effect of arsenic contamination on longevity for adults, beauty and fertility for females (Hassan et al. (2005); Milton et al. (2005); Rahman et al. (2007); Sohel et al. (2009); Argos et al. (2010)). All of these factors play an important role in the marriage market (Buss (1989)). An information campaign can make these aspects more salient by removing the uncertainty on cause and may therefore still have an effect. However, the pre-existing recognition of some of these effects does imply that the estimated impacts of the information campaign in our paper are likely to be an underestimate.

The paper is organized as follows, the following section provides background on matching in marriage markets, water quality and related policies undertaken in Bangladesh. Section 3 describes various data sources that we use in our analysis. Section 4 describes our empirical strategy and Section 5 presents the corresponding results. Finally, Section 6 provides a conclusion of our study.

2 Background

2.1 Marriage Markets

In marriage market literature since Becker and Lewis (1973), it is widely recognized that brides and grooms have preference for certain attributes; the health outcomes associated with arsenic contamination of drinking water affect multiple such attributes. In his survey, Kalmijn (1998) discusses that marriages exhibit sorting of prospective matches along many attributes including physical traits indicative of health status. Buss (1989) in his study which spanned 37 cultures finds that females value *resource acquisition* in males, while males place high value on *reproductive capacity* in females. Other research (Chiappori et al., 2012) on marriage market has also established that physical attractiveness and BMI (a rough measure of health) is also valued in spousal match process. A study on Bangladesh's marriage market (Buchmann et al., 2021) supports similar findings, with husbands ranking "nature, reputation, character and looks" among the top two desirable characteristics in a bride and 60 percent of the brides reporting earning capacity as the most important characteristic in a husband. Most of these "valued" characteristics are adversely affected by arsenic exposure and thus we explore how individuals looking for a prospective match in marriage market, tend to react to a negative information about health outcomes associated with arsenic exposure.

Suppose in the marriage market the matching is based on sorting which is driven by preferences over prospective match's attributes like beauty, life-expectancy, fertility, health standard and income generating prospects. Let's assume that all of these traits can be subsumed in a single index value over which the sorting for partners takes place. A higher value of the index represents a more desirable partner. Now we know that for an individual belonging to an arsenic affected area, the expected value of this index will take a lower value than the one for an individual who hails from a non-arsenic area. A higher index value is desired more in the market, hence in a stable match the highest ranked woman gets matched to the highest ranked man, the second highest ranked woman gets matched to second highest ranked man and so on. The Gale-Shapley algorithm (Gale and Shapley, 1962) will thus give an equilibrium outcome where high ranked females from non-arsenic areas get matched to high ranked males from non-arsenic areas, and low ranked females from arsenic areas get matched to low ranked males from arsenic areas. We call this arsenic-arsenic matching for the purpose of our discussion.

Our hypothesis is the following: the information campaign made the contamination information public; people now knew their own likelihood of being affected by arsenic poisoning. Also people from other areas (who are looking for a match) could take in the visual information in form of red and green painted tubewells and could ascertain probabilistically the chance of a prospective match being affected by arsenicosis and other negative outcomes associated with arsenic poisoning. The information campaign thus complemented the index value in the marriage market. For an individual from an arsenic area given arsenic-arsenic matching and faced with a possibility of low life-expectancy and higher probability of developing skin lesions, the diminished prospects of finding a good match in marriage market leads her to get married earlier before her symptoms get discovered.

Following a similar argument for bride price, given arsenic-arsenic matching, the groom's family is aware about their matching with a female from arsenic affected area. From a supply angle the marriage pool available for grooms from arsenic areas is now smaller as brides from non-arsenic areas are no longer available for matching which can drive up bride price. At the same time, the social structure is such that stigma attached to a female with skin lesions (and possible low fertility) is way more than the one attached to a male, hence females disproportionately suffer more than males in the marriage market. Thus concerns about prospective bride's beauty and possible low fertility coupled with asymmetrical costs associated with females developing skin lesions may drive down bride prices.

Dowry is also an important aspect of marriages in Bangladesh, the effect of information campaign on dowry can be quite ambiguous (like the case for bride price). Dowry unlike bride price is an amount which is exchanged at the time of marriage when the groom may not have started showing symptoms of arsenicosis. Given arsenic-arsenic matching the brides family know that they get matched to a groom from arsenic area with greater probability of being affected with arsenicosis which ideally drives down the dowry amount. However if we look at things from the supply side then the set of possible matches for a bride, is now also smaller since it now excludes non-arsenic grooms, this drives up the dowry amount. Thus, the effect of information campaign on marriage payments is an open empirical question which we try to answer in our analysis using data from a primary survey.

2.2 Information Campaigns in the literature

Information campaigns have been extensively evaluated in economics and other disciplines (de Walque (2007); Dupas (2011a); Briscoe and Aboud (2012); Gallagher and Updegraff (2011); Huffman (2009)). Information campaigns, especially the ones which have gain framing in their messaging like "exercising regularly can help you lose weight" are found to be more effective when it comes to inducing behaviour change (Gallagher et al. (2011)). Studies have documented how information campaigns nudge people to change behaviors. For example, Kirby et al. (2004) using a randomised control trial found that information about human immunodeficiency virus (HIV) and sexually transmitted disease (STD) had an effect in terms of reducing risky sexual behavior in males who previously indulged in unprotected sex. Duflo et al. (2015) studied the effect of HIV related curriculum in schools in Kenya and found that girls switched to committed relationships and they were significantly more likely to report faithfulness as a way to protect themselves from HIV. However, in contrast to these studies which focused on the impact of information campaigns on their intended consequences, we explore the unintended consequences of information campaigns.

2.3 Effects of Exposure to Arsenic

Exposure to arsenic causes many health problems which have been explored in bio-medical literature[10]. In terms of attributes valued in the marriage market, exposure to arsenic contaminated water can affect "beauty", fertility, mortality and income - all are highly valued in the marriage market. Skin lesions are among the first few symptoms of arsenic poisoning: higher dosage of arsenic and longer exposure to arsenic is positively associated with higher probability of appearance of skin lesions.[11] In addition, adverse pregnancy outcomes like still birth, spontaneous abortion have also been linked to arsenic exposure (Milton et al. (2005); Rahman et al. (2007)). Studies

[10] Such health problems include various types of cancers - lung, skin, kidney, bladder (Smith et al., 1992) as well as adverse effect on mental health (Brinkel et al., 2009; Chowdhury et al., 2016).

[11] In a longitudinal study, Ahsan et al. (2006) have documented such effects.

have also found that risk of all-cause and chronic-disease mortality is higher for people exposed to dangerous level of arsenic (Argos et al. (2010); Sohel et al. (2009)). The health effects observed are irreversible brought about by chronic exposure to arsenic which is a known carcinogen (Dauphiné et al., 2011; Mazumder et al., 2008; Parvez et al., 2013).

The physical manifestation of early symptoms of arsenicosis like skin lesions is more than just a health issue. Given its visibility on the body, it has larger manifestations on the marriage market, as it is linked to the "beauty" of a person. Due to lack of information and low education levels, skin lesions are often confused with leprosy, which is considered a contagious killer by rural people. The early symptoms of arsenicosis which includes formation of black spots and warts thus leads to ostracism and social isolation (Alam et al., 2002; Brinkel et al., 2009). Additionally, beyond the social problem, arsenic exposure has also been found to have implications in the labour market in form of reduced labour supply and income (Carson et al. (2010); Pitt et al. (2012)).

2.4 Arsenic in Water: Bangladesh

During 1960s Bangladesh was struggling with high disease burden due to water borne diseases related to surface water usage.[12] Soon millions of tubewells were dug all across the country. In rural areas the switch to groundwater source was almost universal, and by 1990s almost 95% of households were using tubewells as their primary source of drinking water (Caldwell et al., 2003). By 1998, the infant mortality rate and under-5 mortality rate (per 1,000 live births) reduced to 97.9 and 70.6 respectively.[13]

However, installation of TWs, which had been one of the best public health success stories turned into a one of the major arsenic calamities in human history in 1987 when it was discovered that TW water in Bangladesh is contaminated with naturally-occurring arsenic in ground water (Smedley and Kinniburgh, 2001). Subsequently a nation wide survey conducted by British Geological Survey (BGS) in 1999 found that most of the tubewells being used were of shallow depth and in few areas these tubewells contained dangerous levels of arsenic (shallow tubewells have a greater likelihood of containing arsenic).[14] The BGS and Department of Public Health

[12]Aggregate statistics available from the World Bank's World Development Indicators suggest that in 1961, the infant mortality rate and under-5 mortality rate (per 1,000 live births) in Bangladesh were 257.5 and 171.7 respectively, one of the highest in the world at that time.

[13]The fall in infant and child mortality cannot be attributed to switching to TW water alone. Other public health interventions such as oral rehydration treatments, immunizations etc., were also in place at that period.

[14]While arsenic was first detected in TW water in 1987, no comprehensive study ensued after this discovery until

Engineering of Bangladesh (DPHE) report (2001) estimated that around 35 million people were inadvertently exposed to harmful levels of arsenic by sourcing water from tubewells. Smith et al. (2000) also documents that between 35-77 Million people were exposed to arsenic due to contaminated tubewells usage.

2.5 Intervention: Information Campaign on Arsenic

The Bangladesh government (Department of Public Health Engineering (DPHE)) along with UNICEF and Non-Profit Organisations implemented a water quality information campaign between 1999 and 2005 called the Bangladesh Arsenic Mitigation and Water Supply Programme (BAMWSP). The campaign didn't pick up any steam during the initial 2.5 years (World Bank (2007) - project completion report) with major roll-out happening during later years especially after 2002.[15] The campaign had few distinct features: it tested almost 5 million TWs for arsenic and categorized each TW into safe if it contains arsenic less than 50ug/litre, or unsafe otherwise; it disseminated information about contamination of tubewells by color coding tubewells into red (unsafe) and green (safe) categories; it also suggested mitigation strategies such as shifting to a safer well in the neighbourhood or well-sharing and finally it informed people about harmful health effects of arsenic exposure via public forums.

The constant visual reminders along with negative information about adverse health effects of arsenic exposure did have an impact on the intended population. The information campaign was quite effective in terms of generating awareness with over 80 percent of people reporting that they had heard of arsenic after information campaign and creating awareness about symptoms of arsenicosis (Keskin et al. (2017)), and existing empirical evidence (Chen et al. (2007); Opar et al. (2007); Bennear et al. (2013); Balasubramanya et al. (2014)) suggest that people did switch to safer sources of water after the information campaign.

3 Data

In order to analyse the causal impact of information campaign on marriage market outcomes our analysis combines arsenic contamination information with the demographic data. We describe

late 1990s, that is when British Geological Survey (BGS) conducted a nation wide survey of TWs.

[15](Keskin et al., 2017) looks at the impact of same the intervention on a different outcome also uses 2002 as the cut-off for treatment period.

below our various sources of data:

3.1 Contamination data

British Geological Survey (BGS)

We source data on arsenic contamination from British Geological Survey (BGS) conducted in 1998 and 1999. In this survey, BGS tested a geographically representative sample of 3,534 wells all across the country and also recorded the GPS coordinates of the tubewells along with other details such as the depth of the tubewell and the year in which it was constructed. Bangladesh has 64 districts in total but BGS sampled only 61 of them. Hence our study is restricted to these 61 districts. This survey found that based on the Government of Bangladesh guideline, more than a quarter of total sampled tubewells contained harmful level of arsenic.[16]

We categorize sub-districts into arsenic and non-arsenic affected group using mean arsenic contamination for each sub-district. This is calculated by averaging arsenic contamination level for all tubewells located in a sub-district.[17] To decide the threshold level of contamination that may be deemed dangerous, we use the value of 50ug/litre as recognized by the Bangladesh government. If the mean arsenic figure for a sub-district was above 50ug/litre then we code it as an arsenic affected sub-district and a sub-district with contamination less than 50ug/litre is coded as non-arsenic affected sub-district. Figure 1 shows the geographical variation in arsenic contamination at the sub-district level. The light shaded (green) sub-districts represent non-arsenic affected sub-districts (i.e. arsenic contamination was lower than 50ug/litre) while the dark shaded (red) show arsenic affected sub-districts. As is evident from the figure, contaminated tubewells are more likely to be in the south. However, many of them are located also in the east as well as in the west.

3.2 Demographic data

3.2.1 Census Survey Data - 2011

The individual and household data are obtained from Census Survey Data which was conducted by Bangladesh Bureau of Statistics (BBS) in March 2011. This dataset contains information on

[16]Bangladesh Government recognizes >50ug/litre as the dangerous level of arsenic contamination, however WHO prescribes >10ug/litre as the dangerous cutoff.

[17]On an average this survey tested 8 tubewells in each sub-district.

place of residence (sub-district), duration of residence in the current place, type of construction of house, education of household members and details related to nuptiality which includes our main variable of interest, that is the age at which an individual first got married. While the 2011 census surveyed 167,293 households across all 64 districts of Bangladesh, for the purpose of analysis in this paper, we focus our attention on the rural sample where the tubewell use was almost universal before the implementation of information campaign (Caldwell et al., 2003). We combine the census data with arsenic contamination data (BGS data) to sub-districts to their arsenic contamination status. Our final estimation sample comprises of individuals who got married between 1990 and 2010 (73114 males and 84544 females) from over 400 sub-districts in Bangladesh. 32 percent of the sub-districts were found to have arsenic levels above 50ug/litre . It should also be noted that we don't observe the female's original household, that is the household they were born in. We only observe females in the households they got married into, and for this reason we primarily focus on males and suggest interpreting results from the female sample with caution.[18]

We provide summary statistics for the male and female estimation sample in Table 1 (panels A and B). The average highest class passed by both males and females is 7th.[19] In arsenic areas, a greater proportion of individuals (both males and females) belong to households who own assets (land and house). However, this does not mean that they are necessarily richer as only a small proportion of these households have cemented walls. Most of the individuals in both arsenic and non-arsenic regions have their religion as Islam. The difference in characteristics in individuals imply that we cannot compare outcomes across arsenic and non-arsenic regions. Hence as we describe later, we resort to looking at changes over time.

We describe next one of our outcome variables of interest, age at marriage. When we plot the age at which males and females get married in Figure 2, we observe that males (panel A) in Bangladesh tend to get married earlier than the world average with the mean age at first marriage being 24 years with 60 percent of males being married by this age (70 percent of females were married by the age of 18 years, panel B). In Figure 3, we explore the trends in mean age at marriage during the pre-treatment period in arsenic and non-arsenic areas. The mean age of

[18] In section 2.1, we describe how males from arsenic areas get matched to females from arsenic areas in marriage market, which mitigate some concerns when interpreting results for females

[19] Table 1 doesn't show statistical difference between the two groups (arsenic and non-arsenic), however differences are significant for variables in both male and female sample. We address concerns regarding difference in characteristics which might affect marriage market outcomes in Section 5.5.4.

marriage is higher for both males and females in arsenic affected areas. Panels A and C show the actual age at marriage while Panel B and D plot the demeaned age at marriage to show changes relative the year in which the intervention was introduced.

The information campaign shifted the marriage patterns as shown in Figure 4. The difference in the age at marriage between arsenic and non-arsenic areas is shown via scattered points and fitted lines (panels A and B for males and females respectively). The apparent shift in marriage patterns is observed more explicitly via downward shift in the fitted trend lines for the pre-intervention period versus the trend line for post-intervention period. Our empirical analysis tests the robustness of this result by controlling for changes in other covariates.

3.2.2 Primary Survey

For our bride price analysis we rely on Palli Karma-Sahayak Foundation (PKSF) Survey. This survey contained modules on marriage market outcomes including payments. It was conducted by researchers from University of Sydney in December 2010-January 2011. We combine data from this survey with contamination data (from BGS) to arrive at our final estimation sample for the period of study (1990-2010), with information on 875 marriages from 20 sub-districts. 9 out of these 20 sub-districts were arsenic affected (arsenic contamination greater than 50ug/litre). This dataset contains detailed information about marriage unions which includes year of marriage, the amount of dowry paid, bride price agreed upon[20], age of bride and groom, education of bride groom and income status of bride and groom's family at the time of marriage.

In Table 1, panel C we summarize our data from this survey. Education of both bride and groom is more for couples belonging to the arsenic group (the difference is statistically significant when compared to couples belonging to the non-arsenic group). The age at which brides and grooms get married is not statistically different between arsenic and non-arsenic group. However, the age at marriage is particularly low for females, with mean age at marriage being 16.75 years. We also observe that a small proportion of marriages are those where the groom was chosen by a bride rather than by her family. Lastly the mean bride price amount is close to 53,300 Taka (difference between arsenic and non-arsenic group is not statistically significant). The mean dowry amount is 22,700 Taka. The mean dowry in non-arsenic areas is around 20,000 taka while it is much higher in arsenic areas (dowry amount is 22 percent higher in arsenic affected areas,

[20]The figures for bride price and dowry have been expressed in real terms.

the difference is statistically significant between the two groups). In Table 2 where we provide summary statistics about mean bride price before and after the intervention, we observe that mean bride price increased from 42,611 Taka in pre-treatment period to 66,619 Taka in non-arsenic sub-districts (an increase of 56 percent). However the arsenic affected areas saw an increase in bride price by only 30 percent.[21] The average dowry payments overtime reveal an opposite pattern, while in non-arsenic areas it increased by 16 percent between pre-treatment and post-treatment period on the other hand in arsenic affected areas the corresponding increase was over 40 percent.

4 Estimation Methodology

To estimate the effect of information campaign about arsenic contamination on age at marriage and bride price, we follow a difference-in-difference approach (DID) using the following specification:

$$Y_{ijdt} = \alpha + \theta \mathsf{Arsenic}_j * \mathsf{post2002}_t + \beta X_{ijdt} + \gamma_j + \delta_t + \rho_d t + \varepsilon_{ijdt} \tag{1}$$

where Y_{ijdt} is the marriage market outcome - age at first marriage (for males or females) or log of bride price or dowry for an individual i who resides in sub-district j, belonging to district d and who belongs to marriage cohort t (i.e. who got married in year t). $\mathsf{Arsenic}_j$ is the dummy variable which takes value 1 if the mean arsenic contamination level is greater than 50ug/litre for a sub-district and 0 otherwise, $\mathsf{post2002}_t$ is the dummy variable which takes value 1 for post treatment period (2002-2010) and 0 for pre-treatment period (1990-2001). X_{ijdt} includes controls for individual characteristics which matter in the marriage market. Since they differ for the outcomes being assessed, we describe them in detail below. To control for time-invariant differences between sub-districts and location-invariant differences between marriage cohorts we include sub-district fixed effects, γ_j and marriage cohort fixed effects, δ_t. We also control for district level trends, $\rho_d t$ to account for any underlying trends present at the district level. These fixed effects and trends account for any omitted variables at the sub-district and year level and any linearly time varying factors at the district level. The errors have been clustered at the sub-district level for our analysis.

Our coefficient of interest is θ which captures the effect of information campaign. Essentially we compare difference in outcomes between marriage cohorts from arsenic affected sub-districts

[21] We don't provide detailed year by year figures for this dataset as they are imprecisely estimated due to small sample size for each year.

before and after the information campaign to the difference in outcomes in the same marriage cohorts from non-arsenic sub-districts. The individual level controls (X_{ijdt}) for age at marriage regressions based on the Census data include religion being Islam, ownership of land, ownership of a house, education and an indicator of dwelling quality (that is whether it has cemented walls).

For bride price (or dowry) regressions we rely on PKSF survey data and individual level controls here include education level of bride and groom, age of bride and groom, a dummy for choosing the marital partner by themselves (rather than being chosen by family), a dummy for brides family being richer than groom' family and a dummy for groom's family being richer than bride' family (omitted category being two families belonging to same income class).

Our identifying assumption is that trends in age at marriage (and bride price or dowry) were not differential across arsenic and non-arsenic sub-districts, other than because of the information campaign. The district specific trends also help in establishing validity of our results, as our estimates are identified off deviations from district trends. The possible threats to our identification thus comes from sub-district level trends which might be correlated with arsenic contamination.

For each of our DID specifications we test whether the parallel trend assumption is satisfied by conducting the following estimation exercise:

$$Y_{ijdt} = \alpha + \Sigma_{2001}^{1990} \lambda_t (Arsenic_j * I_t) + \beta X_{ijdt} + \gamma_j + \delta_t + \rho_d t + \varepsilon_{ijdt} \tag{2}$$

where Y_{ijdt} is our outcome of interest: age at first marriage or bride price or dowry and j is the sub-district of residence. I_t is an indicator variable for each of the pre-treatment years. In presence of sub-district and year of marriage fixed effect, the interaction terms between year dummies and arsenic dummy reveal whether control and treatment group followed different trends over time. We look for individual significance of all these interaction terms. If these terms are individually insignificant then that reveals that the parallel trend assumption is satisfied as the two groups followed similar trends in the pre-treatment period.

We estimate specification 2 for all our outcome variables for the pre-treatment period and present our results in Appendix Figure A2 (panels A, B, C and D for age at marriage for males, age at marriage for females, bride price and dowry respectively). We notice that all our models satisfy parallel trend assumption as all the interaction terms are insignificant.[22]

[22]The only exception is parallel trend assumption for Dowry where the coefficient for year 1993 is significant.

5 Results

5.1 Age at Marriage

In Table 3 we present results from specification 1. All columns include sub-district and marriage cohort (year of marriage) fixed effects. Columns 1 and 2 refer to results for the male sample while columns 3 and 4 present results for the female sample. Our main results in columns 2 and 4 control for district level trends. The coefficient of $\mathtt{Arsenic}*\mathtt{Post2002}$ (in Table 3) shows that both males and females from arsenic affected areas are getting married earlier after the implementation of information campaign. For the male sample, the reduction in age at marriage is 0.28 years (around 3.3 months), while for the female sample the magnitude is slightly lower, around 0.15 years (1.8 months).[23] These results translate into a reduction of age at marriage after information campaign by around 1 percent for males and by 0.67 percent for females. The magnitude of our results is similar to the effects found in Gershoni and Low (2021a), that is women pushed their age at marriage by a quarter of year in response to a free IVF policy. Results on other controls reveal that higher level of education[24], having a relatively better dwelling - an indicator of wealth is associated with a higher age of marriage. Also religion of an individual being Islam is associated with getting married earlier. Ownership of assets is also associated with higher age at marriage.

Next, we provide graphical summary of an event study (Figure 5) which provides support for our results. The outcome variable in this analysis was age at first marriage and the plotted coefficients in Figure 5 are for interaction variables for different years (arsenic dummy is interacted with an indicator variable for each year). Other controls included district level time trends, sub-district fixed effects, year of marriage fixed effects and demographic controls. The event analysis shows that for both males and females the information campaign shifted age at first marriage. For males the effect is observed much more clearly in panel A, while for females (in panel B) although there was downward shift in the age at first marriage but the effect was much smaller. This is perhaps due to the fact the mean at first marriage for females was already near the legal level (18

[23] The results on female's age at marriage should be interpreted with some caution as we don't observe them in their original place of residence, however assuming that in equilibrium marriage matches happen between similar areas, i.e. males from arsenic areas get matched to females from arsenic areas and vice versa - a point discussed further in Section 2.1.

[24] Educational attainment can be endogenous as it might be simultaneously determined with marriage timing decisions. Our results remain unchanged even even when we don't include any demographic controls like education in our estimation.

years) and further downward shift from this level could have had legal consequences.

5.2 Proportion of marriages

We now focus on cohorts which might be driving this decrease in age at first marriage. In Figure 6, we provide a graphical summary for the effect that the information campaign had on the proportion of individuals who got married by a certain age (Gershoni and Low (2021a) adopt a similar methodology to identify cohorts which drive the main results). We use information on individuals who were at or above a certain age at the time of intervention to create our main dependent variable - proportion of individuals married by a certain age for each subdistrict and year (subdistrict-year panel data).

We then use a simple difference-in-difference model to evaluate the impact of information campaign on the proportion of individuals getting married by a certain age. Figure 6 plots the coefficient for the interaction term (Arsenic*Post2002)[25]. We observe that for males higher proportion got married earlier for ages 18 to 30, the point estimates tend to be larger for ages 24 and 26. For females the effect is observed for younger ages 14 to 18, which is quite concerning as this points to marriages taking place below the legal age of marriage. These early marriages for females can have important consequences for early child bearing which we describe in the next section.

5.3 Age at First Birth

To explore the effect of information campaign on child bearing for females, we use Demographic Health Surveys for Bangladesh (rounds for 1999, 2004, 2007, 2011). These surveys were conducted by National Institute of Population Research and Training (NIPORT) and followed identical questionnaires overtime. For each year around 10,000 households were sampled from 350 clusters, except for year 2011 when 17,000 households were sampled from 600 clusters. BDHS collected GPS information for all sampled clusters. For our rural sample we focus on the women's questionnaire which contains questions regarding their reproductive history and demographic characteristics. Our final estimation sample contains 1,089 primary sampling units or clusters.

We are able to construct arsenic contamination figures for each individual sampled cluster in BDHS data. Arsenic contamination for a cluster was calculated by averaging contamination

[25]Each coefficient is from a separate regression

level for all tubewells lying in the 5 mile radius around the cluster location. This is a "local" level of contamination with clusters with mean contamination figure greater than 50ug/litre being classified as arsenic affected and those with less than 50ug/litre being classified as non-arsenic affected clusters.

We use a difference-in-difference model to assess the impact of information campaign on early child bearing. The sample for analysis is restricted to rural sample for all first births which took place between 1990 and 2010. The dependent variable for this analysis is a dichotomous variable for giving birth to first child by a certain age (age cut-offs which are chosen for analysis include 14, 16, 18, 20, 22, 24, 26, 28 and 30). Other controls include educational level of the mother, her religion being Islam, age of household head, dummy for household head being a male and a dummy for main source of water being tubewell. We additionally introduce year of birth fixed effects, districts trends, dummy for arsenic contamination status and an interaction variable (arsenic contamination X post-intervention period). The results are presented in Figure 7 (each coefficient represents a separate regression for different age cut-offs) where we plot the coefficient for the interaction term which captures the effect of information campaign on probability of having the first child by a certain age. We observe that the information campaign increased the probability of first child birth for early ages, that is 16 to 20 years for the rural sample (Panel A) while it had no such effect on the urban sample (Panel B). This is expected as urban population had no exposure to the information campaign since the dependence on tubewells was non-existent in urban areas. Thus, the information campaign changed not just marriage market outcomes but also had an impact on early child bearing for the rural population.

5.4 Bride Price and Dowry

Table 4 presents our results for bride price and dowry. Our dependent variable here is log of bride price or logarithm of dowry amount, and thus coefficients of interaction variables can be interpreted in terms of the percentage changes in bride price (or dowry) for arsenic areas in the treatment period. Column 1 presents results with no district level trends and we find a 40 percent decrease in bride price, however this effect is not found to be significant. Column 2 accounts for district level trends and we find that arsenic areas witnessed a significant decrease ($\approx$ 90 percent) in bride price post information campaign.[26] We also observe that bride price is positively associated with education level of the bride while it is negatively associated with her education level. The dowry payments (results presented in columns 3 and 4) were unaffected by the information campaign (we discuss this further in Section 6). Dowry payments are also found to be positively associated with groom's education (Anderson (2007) document a similar association) and age.

5.5 Robustness Checks

5.5.1 Marriage pool before and after information campaign

The results which we observe can potentially arise if the information campaign affected the marriage pool (that is mix of males and females in the marriageable age group potentially due to out migration). We explicitly test for this by looking at the sex ratio at sub-district level before and after the implementation of information campaign. We use IPUMS Census 2001 data and Census Survey 2011 data to create sub-district level mean sex ratio between males and females in age group 15 to 35 years for years 2001 (before intervention) and 2011 (after intervention).[27] Table 5 presents our results for this analysis, we observe (in columns 1 to 3 which correspond to different specifications) that sex ratio did not change due to information campaign. This essentially cements our original hypothesis that the effects we see in marriage market of information campaign are driven by behavioural factors rather than changes in marriage pool.

5.5.2 Shorter analysis window

Our original analysis was based on marriages which took place between 1990 to 2010, we shorten this analysis window to span from 1996 to 2006 to test whether our original results still hold. The objective is to assess the immediate effect of information campaign just around intervention time. In Table 6 (columns 1 and 2), we observe that for the male sample estimate remains almost unchanged, while for the female sample although the estimate still retains the negative sign but the magnitude is smaller and it is no-longer significant.

[26] Bride price (and dowry) results rely on a small sample due to which many estimated coefficients have large standard errors because of which we observe insignificant results.

[27] 410 sub-districts are matched between IPUMS Census 2001 data and Census Survey 2011 data.

5.5.3 Placebo tests

Next, we conduct two placebo tests to establish validity of our results. First we replicate our analysis for urban sample where we don't expect to see any effect of the information campaign as the urban places don't rely on tubewells as a source of water (which were the focus of information campaign). This is similar to findings of Keskin et al. (2017) which finds no change in mother's breastfeeding behavior due to the same information campaign in urban areas. In Table 6 (column 3 and 4), we observe that information campaign had no effect on age at marriage for both males and females which is in line with our expectation.

We also perform another placebo test by randomly shuffling the arsenic contamination status of sub-districts. This basically randomly assigns sub-districts into new treatment and control groups. We then estimate the coefficient of (Arsenic * Post2002) variable by following our original specification (specification 1). The randomization breaks the true relationship between arsenic exposure and outcome variable (age at first marriage), thus giving us an estimate by fluke. We repeat this exercise 1,000 times, each time randomly assigning treatment and control status to sub-districts. This gives rise to a distribution of θ based on 1,000 simulations. In Figure 8, we plot the cumulative probability density for the simulated betas. We observe that for both male and female sample the true estimate (shown by dotted line) is an extreme value in this distribution which is unlikely to arise due to chance.

5.5.4 Addressing difference in characteristics

We complement our findings on age at first marriage from Census data by using additional demographic surveys. The arsenic affected sub-districts can be systematically different from non-arsenic sub-districts, hence we additionally wanted to analyze whether arsenic affected areas which are *similar* to non-arsenic areas exhibit different marriage patterns after information campaign. We conduct this analysis by matching arsenic affected sub-districts with unaffected sub-districts by using sub-district level characteristics before the information campaign was implemented. The data for pre-treatment characteristics (at the sub-district level) is sourced from Integrated Public Microdata Series (IPUMS) Census Data for 2001. The IPUMS Survey is a huge census and for matching purposes we use characteristics which covered over 12 million individuals (2.6 million households) residing in all 64 districts of Bangladesh. This dataset was also compiled by Bangladesh Bureau of Statistics (BBS) and has individual and household information available at sub-district level. We use 19 such variables for our matching exercise.[28] In particular, we use details about employment, education, household characteristics, sex-ratios for the unmarried population and sex ratio for children below one year of age, collapsed at sub-district level for our matching purpose.[29]

Table A1 compares the mean 2001 characteristics of arsenic (treated) and non-arsenic (control) sub-districts. Column 1 and 2 reveal that these two groups are considerably different from each other. To address this concern we follow the matching procedure by using sub-district level characteristics from IPUMS data. Our matching exercise results in 79 arsenic affected sub-districts getting matched to unique 79 non-arsenic sub-districts. Columns 4 and 5 show the mean characteristics of the matched control and treated sub-districts, while, column 6 shows that the matched sub-districts are statistically similar in terms of various demographic and non-demographic characteristics.[30]

We use the sub-sample from 2011 Census data comprising of observations from the matched sub-districts (158 sub-districts) and repeat our main empirical analysis (specification 1). In Table A3 (columns 1 and 2), we observe that for both male and female sub-sample mean age at marriage reduced after information campaign. The magnitude is similar to our original results with age at marriage getting reduced for both males and females by $\approx$ 1 percent.

Another concern can be the characteristics of sub-districts which evolve differently overtime and can potentially have an effect on marriage market outcomes. To assuage any concerns regarding different growth patterns of characteristics, we use pretreatment sub-district level characteristics (same as the ones used in matching analysis, see variable list in Table A1) from 2001 and introduce linear time trends for them in our empirical estimation (This approach is similar to the one followed in Hoynes et al. (2016) and Hjort et al. (2017) which evaluated the long-run impact of the US food stamp program and long-run impact of infant home visit program in Denmark respectively). Adding these trends which capture growth of these characteristics overtime doesn't change our original results. The effect sizes are -0.28 and -0.13 for males and females respectively, and the

[28] IPUMS data available here: https://international.ipums.org/international-action/sample_details/country/bd

[29] We don't use IPUMS data for our main analysis as it doesn't contain information about our main dependent variable i.e. the age at which individuals got married.

[30] The probit regression for generating propensity scores for matching is presented in Appendix Table A2 and Figure A3 in appendix plots the number of treated and control sub-districts matched over p-score. 410 sub-districts from IPUMs dataset are used for analysis. Caliper used for matching is 0.05.

estimates retain their significance as well.[31]

5.5.5 Other contamination measures and additional data on bride price

In our analysis we have categorized sub-districts into arsenic and non-arsenic sub-districts using 50ug/litre as the cut-off for dangerous level of arsenic in drinking water. We now provide additional results where alternate contamination variables are used for analysis. Table A4 (age at marriage results) and Table A5 (bride price results in columns 1 to 4) present results based on four alternate measures of contamination. $\mathsf{MeanArsenic}$ is a continuous measure of arsenic contamination while $\mathsf{Arsenic10}$ is a dummy variable which takes value 1 if mean arsenic contamination in a sub-district is above 10ug/litre which is the WHO safety standard for arsenic in water. We use two other measures of contamination which reflect proportion of wells in a sub-district which are above two threshold values - 50ug/litre and 75ug/litre. In Table A4 in columns 1 to 4 we present results for the male sample while in columns 5 to 8 we present results for the female sample. Table A5 (columns 1 to 4) provides results for bride price. We observe that for both age at marriage and bride price the effect of information campaign based on alternate measures of arsenic contamination is negative. The effect of information campaign using continuous measure of arsenic contamination is significant for both age at marriage (males and females) and bride price. When we use 10ug/litre cut-off for arsenic contamination status of a sub-district then we observe that the point estimate (of Arsenic$_{\mathsf{>10ug/litre}}$ X Post2002) is negative for all outcome variables. The estimate for age at marriage for males is -0.17 which is smaller than our original estimate, while the estimate for females is -0.10 (not significant). The corresponding bride price estimate using 10ug/litre cut-off is negative and smaller in magnitude (in comparison to results based on 50ug/litre cut-off) but not significant.

The results corresponding to two other proportion related contamination measures reveal that as more wells (higher proportion) in a sub-district are arsenic contaminated the corresponding negative effect on behavioral responses in marriage market is stronger. This is perhaps due to stronger visual cues which residents in the arsenic affected sub-districts would have observed with more wells being painted as the ones belonging to the dangerous category (red color).

Our bride price analysis uses only PKSF survey till now. Since the PKSF survey provides a very small sample, so we incorporate additional data on more marriages using Bangladesh Rural

[31] Results available on request.

Urban Linkage (BRUL) Survey. This survey was conducted by International Food Policy Research Institution between December 2004 and January 2005 and it used identical modules on marriage, divorce, bride price and dowry.[32] The combined sample of PKSF and BRULS for marriages between 1990 and 2010 contains 1,699 marriages from 80 sub-districts. In Table A5 column 5 we replicate our original bride price result using this expanded dataset. We find that (log of) bride price reduced by 0.60 in arsenic affected areas after information campaign, which is close to our original estimate of 0.64 reduction in bride price post intervention.

5.6 Heterogeneity

Information campaigns can have differential impact based on various demographic characteristics. We explore how individuals with different educational background responded in marriage market to the information campaign focused on health. The results for this analysis with outcome variable as age at first marriage are presented in Table 7 (columns 1 to 4). Slicing the sample based on literacy status reveals interesting patterns. We find that for both males and females it is only the literate group (who can read or read and write both) which exhibited a behavioral change in the marriage market after the implementation of information campaign while the not-literate group did not show any change in marriage market behavior. This finding is similar in spirit to other studies like de Walque (2007) which finds that educated women reacted strongly to HIV/AIDS information campaigns. Thus, the hypothesis that education mediates reaction to knowledge enhancing campaigns is supported by our findings.

The distribution of arsenic contamination is not uniform across all regions in Bangladesh. While there are areas with no arsenic contamination, there are few sub-districts which had very high mean level contamination that is arsenic level greater than 100ug/litre. We expect that the intensity of information campaign could have been higher for these sub-districts as the arsenic contamination problem was particularly high in these sub-districts. Alternatively, the higher level of exposure to arsenic also implies more likelihood of appearance of arsenic-related symptoms such as skin lesions and arsenicosis (Ahsan et al., 2006), and consequently more awareness of the problem. Hence the behavior change expected in these sub-districts could also be different.

We analyze the dose response to information campaign by assessing whether the effect of information campaign was more pronounced based on different contamination levels. We do this

[32]See Ambrus et al. (2010) for the survey details.

by comparing individuals from sub-districts with mean arsenic contamination less than 10ug/litre (WHO safe limit for arsenic levels) to individuals belonging to three bins of arsenic contamination - between 10-50ug/litre, between 50-100ug/litre and above 100ug/litre. The results are presented in Table 7 (columns 5 and 6 for males and females respectively). While the information campaign did not alter age at marriage for both males and females from sub-districts with arsenic contamination level between 10-50ug/litre (in comparison to the base category with contamination level less than 10ug/litre), it had a greater impact in terms of greater decrease in age at first marriage as the contamination levels increased.

6 Conclusion

The behavioral change induced by an information campaign has mainly been explored in the health domain (for example: increase in breastfeeding time and switch to safer sources of water for concerns related to health), we have gone a step further and shown that the information campaign had a spill-over effect in marriage market as well. Males and females (and their respective households) in marriage market learned about their likelihood of being affected by arsenicosis symptoms in the future and reacted to this information by reducing their age at marriage. In a country where already child marriage is a common practice, we find evidence of a further decrease in age at first marriage especially for females which is quite concerning. A related unintended effect of information campaign was also observed in the form of greater likelihood of early child bearing. The bride price also suffered a dampening effect due to information campaign possibly due to the information garnered about their adverse fertility and beauty outcomes in the future. The campaign owes its success in terms of generating awareness to its unique design. Constant visual reminders, multiple strategies to avoid contaminated water and public forums for information disbursal seem to have worked in Bangladesh. We find evidence that campaigns with such information, which informs people about adverse outcomes, may also lead to undesirable social outcomes, and we demonstrate such consequences in the marriage market and child bearing domain.

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Tables and Figures

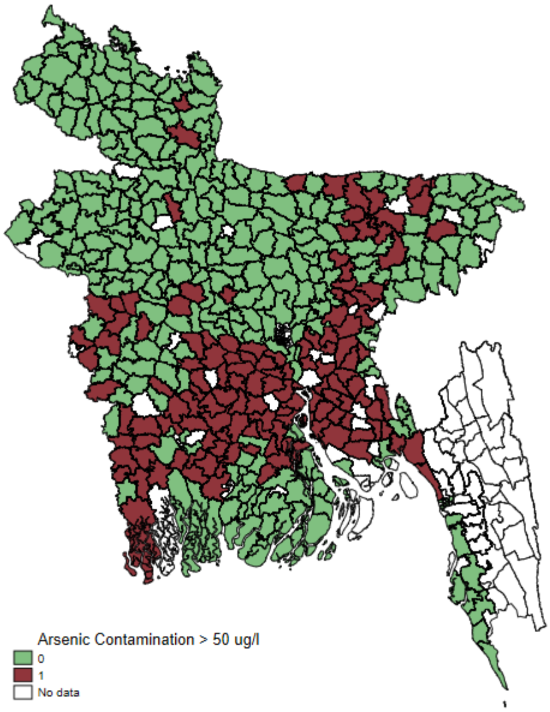
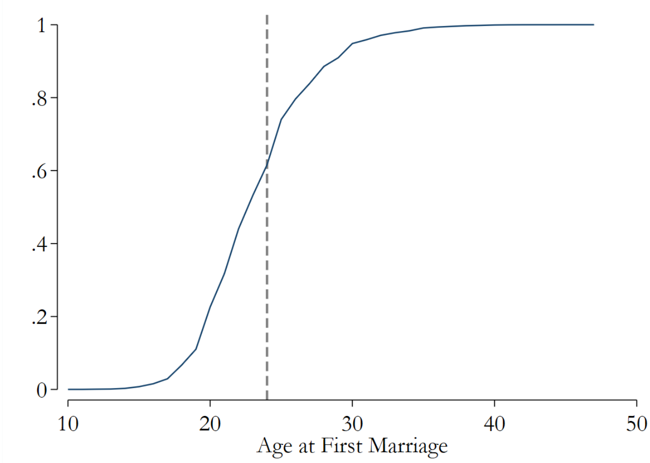
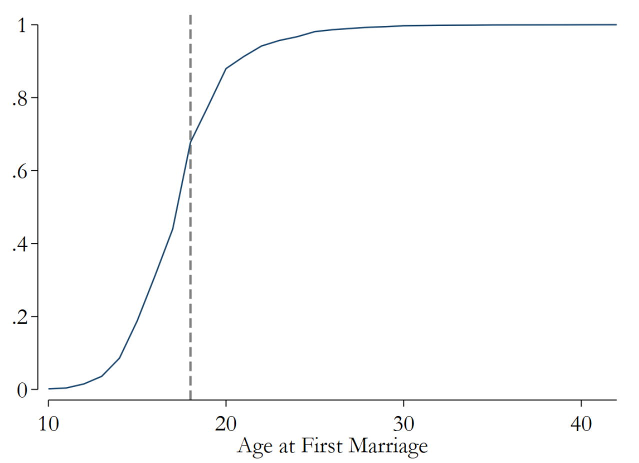


Figure 1: Arsenic Contamination Map for Bangladesh.

Source: British Geological Survey 1999.



(A) Males



(B) Females

Figure 2: Cumulative Density Function for Age at First Marriage

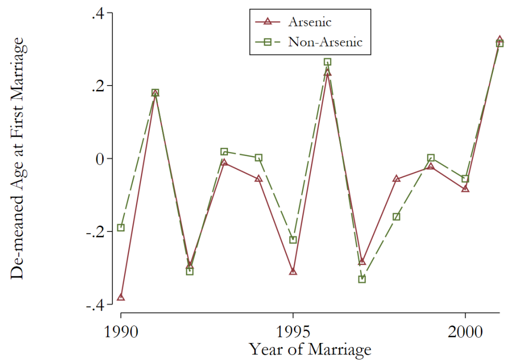
Notes: Figures correspond to data for all marriages which took place between 1990 and 2010. The mean age at first marriage for males in our sample is 24 years while for females it is 18 years.

Source: Census 2011, Bangladesh Bureau of Statistics. Sample restricted to rural areas.

(A) AFM for Males

(B) Demeaned AFM for Males

(C) AFM for Females

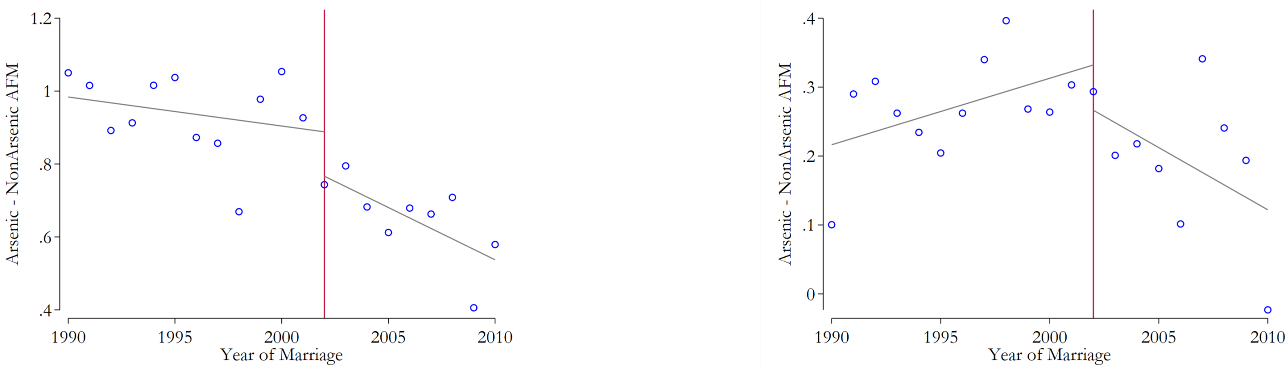


(D) Demeaned AFM for Females

Figure 3: Age at First Marriage (AFM) during the Pre-treatment period for Males and Females in Arsenic and Non-arsenic Areas.

Notes: Panels A & C - Average age at first marriage for arsenic vs non-arsenic areas by year of marriage, shown for males and females separately. Panels B & D - Demeaned average age at first marriage for arsenic vs non-arsenic areas by year of marriage, shown for males and females separately. Demeaned values calculated by subtracting average age at first marriage for year 2002.

Source: Census 2011, Bangladesh Bureau of Statistics. Sample restricted to rural areas.



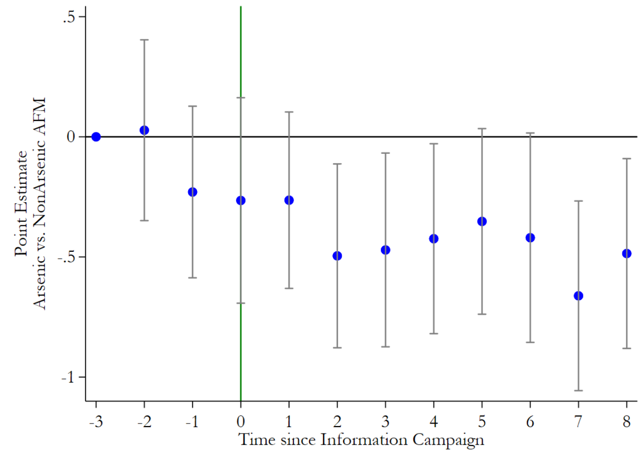
(A) Absolute AFM difference for Males

(B) Absolute AFM difference for Females

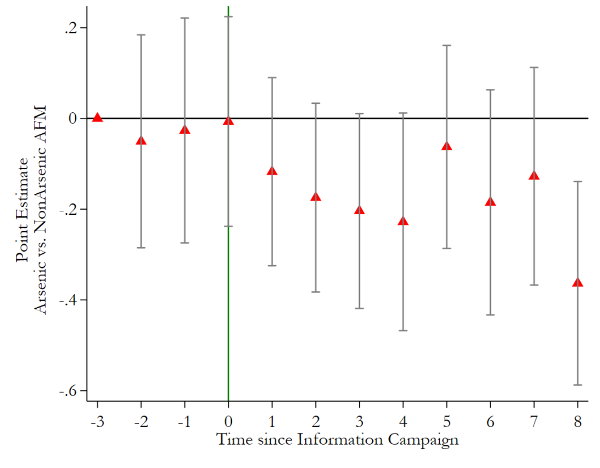
Figure 4: Arsenic vs Non-Arsenic Age at First Marriage (AFM) for Males and Females (Sample period 1990 to 2010)

Notes: Scattered points represent the difference in absolute levels of mean age at first marriage between arsenic and non-arsenic areas. Fitted lines correspond to the pre-treatment period (1990-2001) and post-treatment period (2002 to 2010).

Source: Census 2011, Bangladesh Bureau of Statistics. Sample restricted to rural areas.



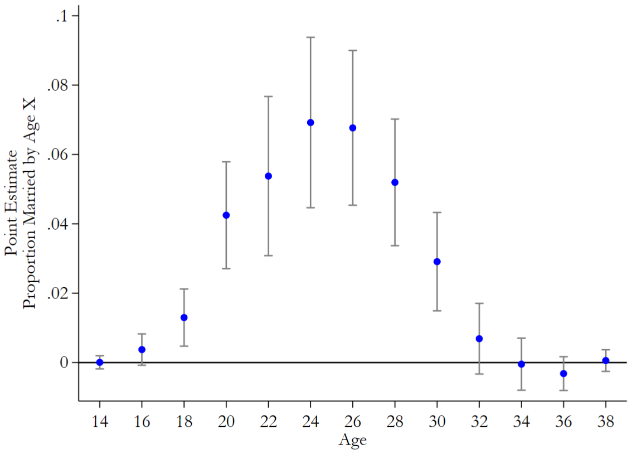
(A) Males



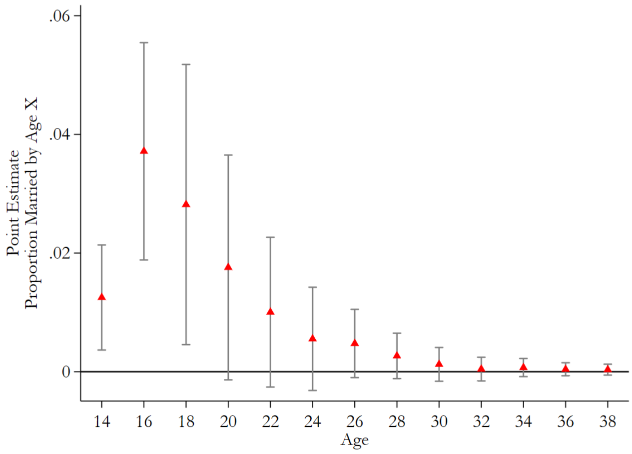
(B) Females

Figure 5: Event Study Analyses

Notes: The figure presents dynamic lag event study analysis for the impact of the information campaign on age at first marriage for arsenic relative to non-arsenic regions. Point estimates and confidence intervals (90% CI) are for the coefficients on yearly dummy variables interacted with an indicator for arsenic contamination (treatment group). Time is year of marriage, with 2002 as time "zero." The regression equation includes year-group interactions for the entire sample period (1990-2010), as well as a district level linear time trends, sub-district fixed effects, year of marriage fixed effects and demographic controls (same as the ones mentioned in notes of Table 3) with clustering at sub-district level. Sample weights have been used in analysis. All regressions restricted to individuals in rural areas.



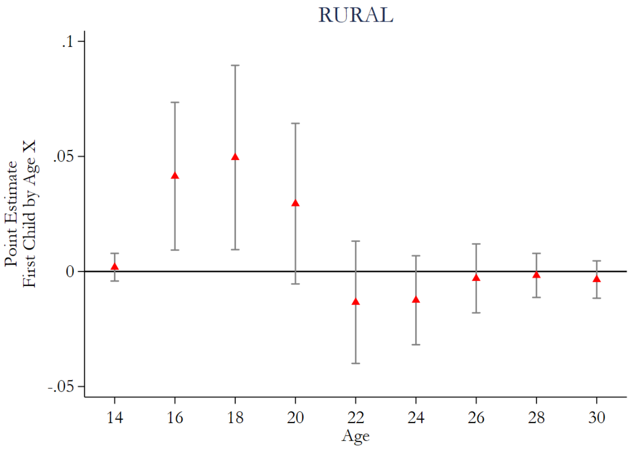
(A) Males



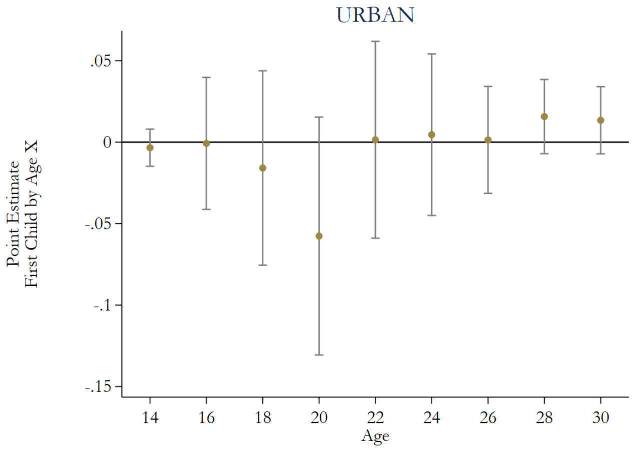
(B) Females

Figure 6: Effect of Information Campaign on Proportion Married by a Given Age

Notes: Each coefficient represents results from individual regressions for the interaction variable (arsenic contamination dummy X post-treatment dummy) from a subdistrict-year level dataset. The dependent variable in these regressions is the proportion of individuals married by a certain age and the controls include an interaction variable, arsenic contamination dummy, year of marriage fixed effects and district level trends. The error bars are 95% confidence intervals with robust standard errors. Estimation sample in each regression is limited to rural areas for all marriages which took place between 1990 and 2010.



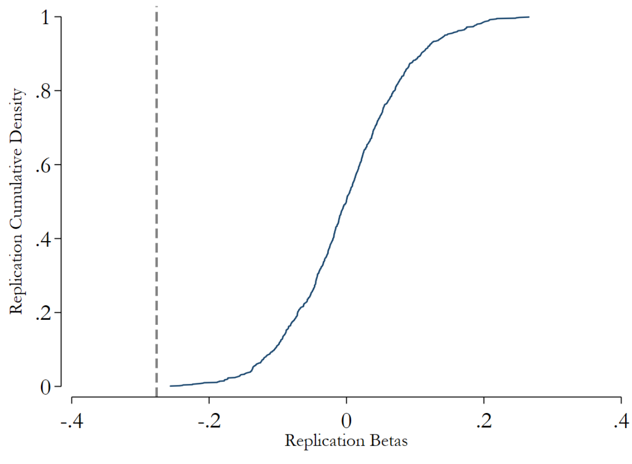
(A)



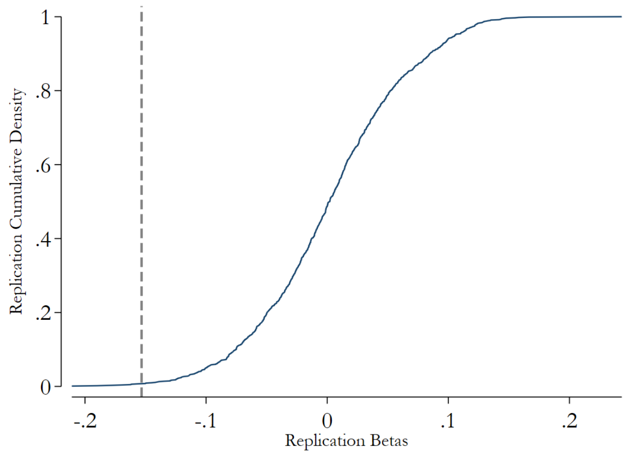
(B)

Figure 7: Effect of Information Campaign on having First Child by a Given Age

Notes: Each coefficient represents results from individual regressions for the interaction variable (arsenic contamination dummy X post-treatment dummy). The dependent variable in these regressions is dummy variable for giving birth by a certain age and other controls apart from the interaction variable include demographic controls (educational level of the mother, her religion being Islam, age of household head, dummy for household head being a male and a dummy for main source of water being tubewell), district level time trends, arsenic contamination dummy and year of child's birth fixed effects. The error bars are 95% confidence intervals, clustering at PSU level. Sample weights have been used in analysis. Estimation sample in each regression is limited to all first births which took place between 1990 and 2010.



(A) Males



(B) Females

Figure 8: Placebo Test using Randomized Inference

Notes: Monte Carlo empirical CDF for coefficient Arsenic Dummy * Post 2002 (from Eq. (1)). The CDF plots estimates based on randomized inference obtained after conducting 1000 simulations which randomly assign exposure to arsenic, 1 (arsenic levels higher than 50 ug/l = 1) or 0 (arsenic levels lower than 50 ug/l = 0) to observations. Our results are extreme values in these set of "coefficients" indicating that they were unlikely to arise due to chance.

Table 1: Summary Table

PANEL A. CENSUS DATA MALES

variablename	*All*		*Non-Arsenic*		*Arsenic*	
	Mean	SE	Mean	SE	Mean	SE
Education (highest class passed)	7.34	0.014	7.38	0.017	7.25	0.023
Religion is Islam (%)	0.89	0.001	0.90	0.001	0.87	0.002
Owns Land (%)	0.92	0.001	0.91	0.001	0.94	0.001
Owns House (%)	0.89	0.001	0.88	0.001	0.91	0.002
House has Cemeneted Walls (%)	0.16	0.001	0.16	0.002	0.16	0.002
Age at First Marriage (years)	23.65	0.015	23.38	0.018	24.19	0.027
Observations	73114		48889		24225	

PANEL B. CENSUS DATA FEMALES

	All		*Non-Arsenic*		*Arsenic*	
	Mean	SE	Mean	SE	Mean	SE
Education (highest class passed)	6.85	0.011	6.81	0.013	6.93	0.017
Religion is Islam (%)	0.89	0.001	0.90	0.001	0.88	0.002
Owns Land (%)	0.92	0.001	0.91	0.001	0.95	0.001
Owns House (%)	0.89	0.001	0.88	0.001	0.91	0.002
House has Cemeneted Walls (%)	0.17	0.001	0.17	0.002	0.16	0.002
Age at First Marriage (years)	17.87	0.010	17.79	0.012	18.03	0.017
Observations	84544		55640		28904	

PANEL C. PKSF DATA

	All		*Non-Arsenic*		*Arsenic*	
	Mean	SE	Mean	SE	Mean	SE
Education bride (in years)	5.31	0.13	4.98	0.19	5.56	0.17
Education groom (in years)	5	0.14	4.74	0.21	5.19	0.18
Bride's age at the time of marriage	16.75	0.1	16.88	0.16	16.64	0.12
Groom's age at the time of marriage	23.59	0.15	23.59	0.22	23.6	0.2
Partner chosen by bride	0.08	0.01	0.08	0.01	0.08	0.01
Brides family richer	0.32	0.02	0.33	0.02	0.32	0.02
Groom's family richer	0.25	0.01	0.21	0.02	0.28	0.02
Mehr (in Taka)	53366	2230	53980	3236	52900	3060
Dowry (in Taka)	22709	1034	20168	1291	24642	1528
Observations	875		378		497	

Table 2: Mean Bride Price and Dowry (in local currency - Taka): PKSF Data

	Bride Price		**Dowry**		**Observations**
	Pre-2002	*Post-2002*	*Pre-2002*	*Post-2002*	
Arsenic	45952 (4013)	59600 (4569)	20268 (1581)	28862 (2388)	497
Non-Arsenic	42611 (4226)	66619 (4801)	18774 (1756)	21718 (1902)	378

Notes: US Dollar - Bangladesh Taka exchange rate in year 2002 was 1 USD = 58 Taka. In the pre-intervention period the mean bride price was $792 in Arsenic areas while it was $735 in Non-Arsenic areas. For the same period the mean dowry was $350 in Arsenic areas while it was $323 in Non-Arsenic areas.

Table 3: Effect of Information Campaign on Age at First Marriage (AFM)

	Males		**Females**	
	(1)	(2)	(3)	(4)
Arsenic X Post2002	-0.22**	-0.28***	-0.097	-0.15**
	(0.091)	(0.098)	(0.061)	(0.069)
Education	0.096***	0.096***	0.050***	0.050***
	(0.0063)	(0.0063)	(0.0060)	(0.0060)
Religion is Islam	-0.91***	-0.91***	-0.55***	-0.55***
	(0.095)	(0.095)	(0.063)	(0.063)
Owns Land	0.41***	0.42***	0.25***	0.26***
	(0.10)	(0.10)	(0.067)	(0.067)
Owns House	0.18**	0.18**	0.16**	0.16**
	(0.079)	(0.079)	(0.066)	(0.066)
House has Cemented Walls	0.85***	0.85***	0.32***	0.31***
	(0.062)	(0.062)	(0.037)	(0.037)
Observations	73114	73114	84544	84544
Control Group Mean AFM (in years)	23.38		17.79	
Subdistrict Fixed Effects	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓
District Trends		✓		✓

Note: Standard errors in parentheses are clustered by sub-district. Sample weights used in analysis. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Table 4: Effect of Information Campaign on Bride Price & Dowry

	Bride Price		**Dowry**	
	(1)	(2)	(3)	(4)
Arsenic X Post2002	-0.34	-0.64*	-0.09	0.08
	(0.45)	(0.37)	(0.19)	(0.22)
Education Bride (in years)	0.06*	0.07**	0.03	0.03
	(0.03)	(0.03)	(0.02)	(0.02)
Education Groom (in years)	0.05*	0.04	0.05***	0.05***
	(0.02)	(0.02)	(0.02)	(0.02)
Age of Bride	-0.06	-0.07*	-0.01	-0.00
	(0.04)	(0.04)	(0.01)	(0.01)
Age of Groom	0.01	0.01	0.02**	0.02**
	(0.03)	(0.03)	(0.01)	(0.01)
Partner Chosen by Bride	0.16	0.11	-0.43	-0.39
	(0.31)	(0.31)	(0.26)	(0.26)
Bride's Family Richer	0.12	0.14	-0.05	-0.04
	(0.16)	(0.16)	(0.09)	(0.09)
Groom's Family Richer	0.24	0.27	0.16	0.16
	(0.17)	(0.16)	(0.10)	(0.10)
Observations	875	875	875	875
Control Group Mean Bride Price (in Taka)	53980		20168	
Subdistrict Fixed Effects	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓
District Trends		✓		✓

Note: Dependent variables are log variables. Standard errors in parentheses are clustered by sub-district. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Table 5: Effect of Information Campaign on Marriage Pool (as captured by Adult Sex Ratios)

	(1)	(2)	(3)
Arsenic X Post	-0.008	-0.008	0.008
	(0.013)	(0.013)	(0.018)
Post	0.12***	0.12***	
	(0.007)	(0.007)	
Arsenic		-0.008	-0.016
		(0.011)	(0.013)
Observations	820	820	820
Subdistrict	✓		
District		✓	
District*Year			✓

Note: Analysis uses a subdistrict-year panel for two census years 2001 (IPUMS data) and 2011 (Census). Post dummy takes value 1 for observations for year 2011 and 0 otherwise. Adult Sex Ratio is calculated by using individuals aged between 15 and 35 years. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Table 6: Alternate Analysis Window and Placebo Analysis using Urban Sample

	Shorter Analysis Window		**Urban Sample**	
	Males	*Females*	*Males*	*Females*
	(1)	(2)	(3)	(4)
Arsenic X Post2002	-0.28**	-0.083	-0.13	-0.045
	(0.12)	(0.092)	(0.33)	(0.20)
Education	0.095***	0.058***	0.22***	0.22***
	(0.0086)	(0.0076)	(0.015)	(0.015)
Religion is Islam	-1.00***	-0.59***	-1.16***	-0.69***
	(0.11)	(0.071)	(0.17)	(0.16)
Owns Land	0.49***	0.28***	0.64***	0.21**
	(0.13)	(0.072)	(0.17)	(0.10)
Owns House	0.19*	0.19***	0.027	0.17*
	(0.098)	(0.069)	(0.15)	(0.094)
House has Cemented Walls	0.91***	0.35***	0.96***	0.60***
	(0.084)	(0.052)	(0.12)	(0.081)
Observations	40887	47161	14382	16174
Control Group Mean AFM (in years)	23.38	17.79	24.89	18.47
Subdistrict Fixed Effects	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓
District Trends	✓	✓	✓	✓

Note: Standard errors in parentheses are clustered by sub-district. Sample weights have been used in the analysis. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Table 7: Heterogeneity

	Education				Contamination Level	
	Males		*Females*		*Males*	*Females*
	(1)	(2)	(3)	(4)	(5)	(6)
	Not Literate	*Literate*	*Not Literate*	*Literate*		
Arsenic X Post2002	-0.21	-0.34***	-0.15	-0.21***		
	(0.15)	(0.12)	(0.11)	(0.071)		
Arsenic below 10ug/litre X Post2002					Base Category	
Arsenic between 10-50ug/litre X Post2002					-0.079	-0.058
					(0.095)	(0.077)
Arsenic between 50-100ug/litre X Post2002					-0.21*	-0.11
					(0.12)	(0.087)
Arsenic above 100 ug/litre X Post2002					-0.49***	-0.30***
					(0.15)	(0.10)
Observations	31956	41158	32231	52313	73114	84544
Subdistrict Fixed Effects	✓	✓	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓	✓	✓
District Trends	✓	✓	✓	✓	✓	✓

Note: Standard errors in parentheses are clustered by sub-district. Sample weights have ben used in the analysis. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in Table 3.

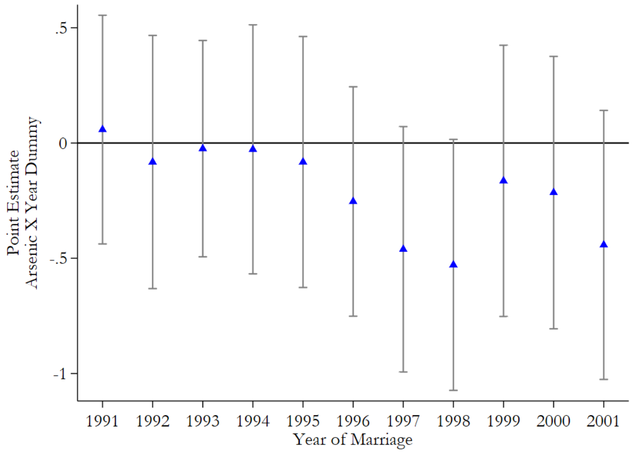
Appendix

(A) Skin lesions due to Arsenicosis

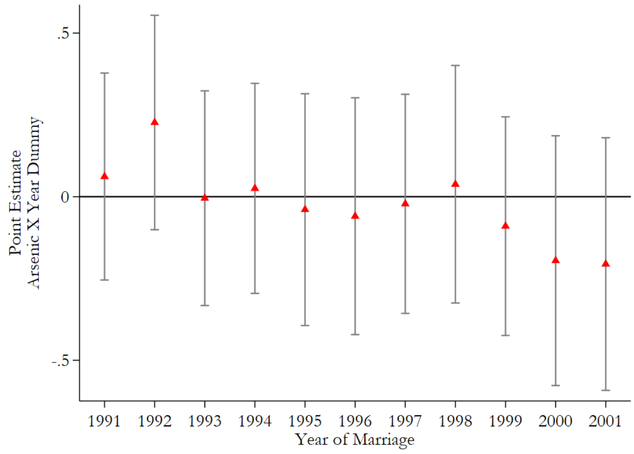
(B) BAMWSP campaign

Figure A1: Arsenicosis and Information Campaign.

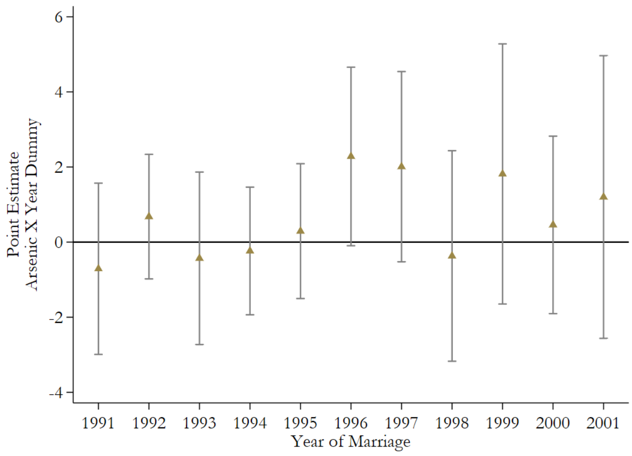
Notes: Panel A shows skin lesions due to arsenicosis. Panel B shows Bangladesh Arsenic Mitigation and Water Supply Programme (BAMWSP) implementation with arsenic affected (unsafe) tubewells painted as red and non-arsenic (safe) tubwells painted in green color.



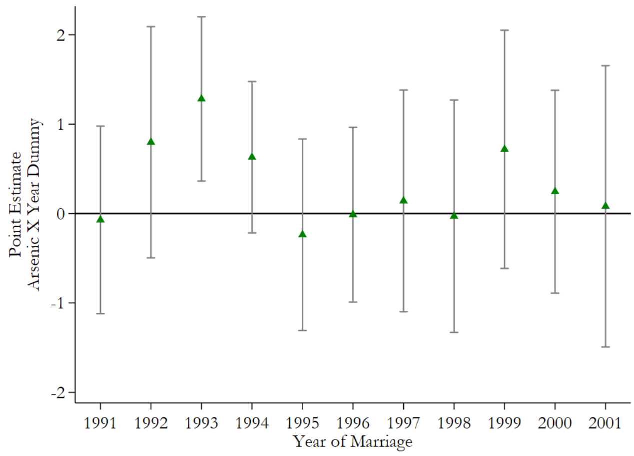
(A) AFM for Males



(B) AFM for Females



(C) Bride Price



(D) Dowry

Figure A2: Testing for Parallel Trend Assumption.

Notes: Each coefficient represents the interaction variable (arsenic contamination dummy X year dummy) for each year during the pre-treatment period. The dependent variable in these regressions are: (A) age at first marriage for males, (B) age at first marriage for females, (C) logarithm of bride price and (D) logarithm of dowry. Other controls apart from the interaction variable include demographic controls (see full list of controls mentioned in Table 3 for panels A & B and Table 4 for panels C & D), subdistrict fixed effects, year of marriage fixed effects and district level time trends. The error bars are 95% confidence intervals, clustering at subdistrict level, sample weights have been used for analysis. All analyses restricted to individuals in rural areas.

Matching Analysis

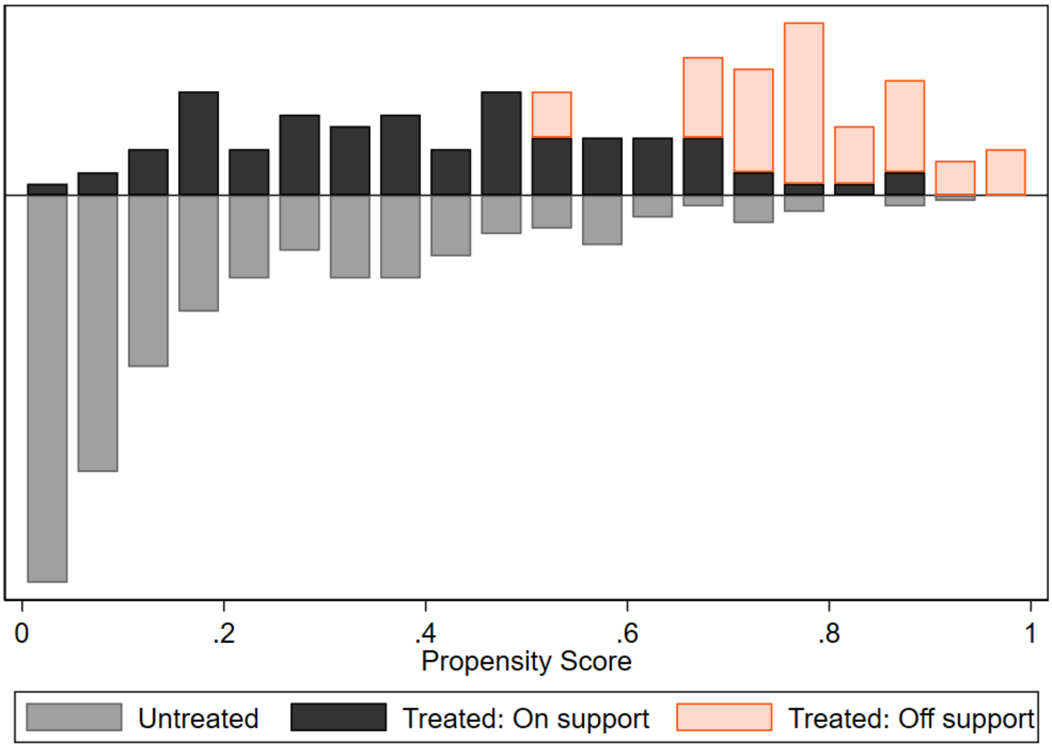


Figure A3: Density of sub-districts over propensity score. The matching is done using psmatch2 command in stata, with caliper value 0.05 and unique matching strategy with no replacement

Table A1: Sub-district characteristics, full sample and matched sample of sub-districts; means and t-stat for differences

SUBDISTRICT LEVEL MEANS	1 Control	2 Treated	3 t-stat ((1) vs (2))	4 Matched Control	5 Matched Treated	6 t-stat ((4) vs (5))
employment category						
employed in agriculture (%)	0.56	0.63	-5.13	0.58	0.58	-0.01
employed in formal sector (%)	0.16	0.14	2.99	0.16	0.16	0.17
employed in business (%)	0.13	0.11	5.93	0.13	0.12	0.28
employed in others (%)	0.15	0.12	4.22	0.14	0.14	-0.30
education details						
literacy level (%)	0.44	0.40	4.02	0.43	0.43	-0.07
number of years of education	3.30	2.96	4.29	3.19	3.20	-0.08
completed primary education (%)	0.91	0.91	-1.41	0.91	0.91	-0.12
employment status details						
employed (%)	0.42	0.43	-4.50	0.43	0.43	0.84
unemployed (%)	0.02	0.02	3.18	0.02	0.02	-0.65
inactive (%)	0.15	0.14	3.15	0.15	0.15	0.39
involved in housework (%)	0.40	0.40	0.24	0.40	0.41	-1.42
household characteristics						
number of children	1.67	1.61	2.98	1.63	1.63	0.06
number of families	1.45	1.39	5.21	1.44	1.45	-0.36
electricity connection (%)	0.24	0.18	4.55	0.22	0.22	-0.10
ownership of house (%)	0.95	0.94	2.44	0.95	0.95	-0.71
religion is muslim (%)	0.87	0.89	-2.39	0.87	0.89	-1.18
other demographic characteristics						
ratio of males to females for adults	0.49	0.50	-5.44	0.50	0.49	1.65
ratio of males in children with age <1 year	0.52	0.52	-0.84	0.52	0.52	1.12
Number of Sub-districts	277	133		79	79	

*Source - IPUMS data for 2001

Table A2: Probit Estimation for Propensity Score Matching

Sub-district level means	**Arsenic Contamination = 1 or 0**
employment category	
employed in agriculture	0.11
	(0.44)
employed in formal sector	0.11
	(0.64)
employed in business	2.05**
	(0.88)
employed in others	-
education details	
literate	-1.88**
	(0.80)
number of years of education	0.39***
	(0.14)
completed primary education	6.55***
	(1.57)
employment status details	
employed	1.40
	(1.45)
unemployed	-2.83
	(5.85)
inactive	0.16
	(0.86)
involved in housework	-
household characteristics	
number of children	0.23**
	(0.11)
number of families	-0.080
	(0.27)
have electricity connection	0.77***
	(0.19)
ownership of house	2.12***
	(0.64)
religion is Islam	-0.93***
	(0.23)
No toilet facility	-0.59***
	(0.16)
other demographic characteristics	
ratio of males to females in adults >15 years	-7.58***
	(1.81)
ratio of males in children with age <1 year	-0.92
	(0.94)
Psuedo R-square	0.3089
Observations (number of subdistricts)	410

Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Table A3: Matched Sample Analysis for Age at First Marriage

	Males (1)	*Females* (2)
Arsenic X Post2002	-0.26*	-0.20**
	(0.15)	(0.096)
Education	0.096***	0.056***
	(0.011)	(0.0097)
Religion is Islam	-1.21***	-0.59***
	(0.16)	(0.10)
Owns Land	0.17	0.30***
	(0.16)	(0.10)
Owns House	0.26**	0.14
	(0.13)	(0.11)
House has Cemented Walls	0.74***	0.31***
	(0.090)	(0.050)
Observations	28189	33053
Control Group Mean AFM (in years)	23.58	17.92
No. of Subdistricts used in analysis	158	158
Subdistrict Fixed Effects	✓	✓
Year of Marriage Fixed Effects	✓	✓
District Trends	✓	✓

Note: Standard errors in parentheses are clustered by subdistrict. Sample weights have been used in analysis. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the table.

Other Robustness Checks

Table A4: Age at First Marriage - Other Contamination Measures

	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean Arsenic X Post2002	-0.002***				-0.001**			
	(0.001)				(0.000)			
$\text{Arsenic}_{>10\text{ug/litre}}$ X Post2002		-0.171*				-0.108		
		(0.089)				(0.069)		
$\text{Proportion Affected}_{>50\text{ug/litre}}$ X Post2002			-0.005***				-0.002	
			(0.002)				(0.001)	
$\text{Proportion Affected}_{>75\text{ug/litre}}$ X Post2002				-0.006***				-0.004***
				(0.002)				(0.001)
Observations	73114	73114	73114	73114	84544	84544	84544	84544
Subdistrict Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓
District Trends	✓	✓	✓	✓	✓	✓	✓	✓

Note: Standard errors in parentheses are clustered by sub-district. Sample weights have been used in analysis. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the Table 3.

Table A5: Bride Price - Other Contamination Measures

	PKSF Data				PKSF+BRULS Data
	(1)	(2)	(3)	(4)	(5)
Mean Arsenic X Post2002	-0.01**				
	(0.00)				
$\text{Arsenic}_{>10\text{ug/litre}}$ X Post2002		-0.10			
		(0.27)			
$\text{Proportion Affected}_{>50\text{ug/litre}}$ X Post2002			-0.01		
			(0.01)		
$\text{Proportion Affected}_{>75\text{ug/litre}}$ X Post2002				-0.02**	
				(0.01)	
Arsenic X Post2002					-0.60*
					(0.31)
Observations	875	875	875	875	1699
Subdistrict Fixed Effects	✓	✓	✓	✓	✓
Year of Marriage Fixed Effects	✓	✓	✓	✓	✓
District Trends	✓	✓	✓	✓	✓

Note: Dependent variables are log variables. Standard errors in parentheses are clustered by sub-district. Notation for p-values *** is $p < 0.01$, ** is $p < 0.05$ & * is $p < 0.1$. Regression includes a constant term and other controls as mentioned in the Table 4.