The effect of the 2010 Haiti Earthquake on women's reproductive health: A difference-in-difference analysis

Julia Andrea Behrman and Abigail Weitzman

New York University
Department of Sociology
295 Lafayette Ave, 4th floor
New York, NY 10012
Jab965@nyu.edu
+001 610.389.4207

Acknowledgements: We are grateful to Jere Behrman, Monica Caudillo, Amber Peterman, Erica Soler, Delia Baldassari and Jennifer Jennings for helpful comments on this manuscript. Background support for this study was provided by the grant *Team 1000+ Saving Brains: Economic Impact of Poverty-Related Risk Factors for Cognitive Development and Human Capital* "0072-03" provided to the Grantee, The Trustees of the University of Pennsylvania by Grand Challenges Canada. Additional support was provided by the National Science Foundation (ID: 2011117755), the William and Flora Hewlett Foundation, and the International Institute for Education (ID: 2012-7263).

Abstract:

This paper explores the effect of the 2010 Haiti earthquake on women's reproductive health using geocoded data from the 2005 and 2012 Haiti Demographic Health Surveys and a difference-in-difference analytical strategy. Results indicated that living in the region most devastated by the earthquake decreased modern contraception use and increased unwanted pregnancy and self-reported sexually transmitted infections. An analysis of impact pathways suggested that the earthquake reduced women's access to contraception and ability to negotiate sex and condom use in partnerships. A secondary analysis of how effects varied by schooling (a proxy for socioeconomic status) found the effects of the earthquake on contraceptive use, contraceptive access and unwanted pregnancy were significantly smaller for better educated women. Our findings highlight how disruptions to health care services following a natural disaster can exacerbate health vulnerabilities along gender and socioeconomic lines.

Key words: Reproductive Health, Unmet Need for Family Planning, Contraception, Haiti Earthquake, Natural Disasters, Difference-in-Difference

I. Introduction

The 2010 Haiti earthquake was one of the most catastrophic national disasters of the start of the twenty-first century. The epicenter of the earthquake was 25 miles southwest of the capital—Port-au-Prince—the largest urban area and most densely populated part of the country. The death toll was enormous with estimates ranging from 50,000 to 230,00 fatalities (Kolbe et al. 2010; Doocy, Cherwick and Kirsch 2013). An estimated 97,000 homes were destroyed and 188,000 homes were damaged (WHO 2010). The earthquake also had a devastating effect on healthcare infrastructure in Port-au-Prince and surrounding areas. The Ministry of Health was destroyed, the national mid-wife school and nursing college both collapsed and half of all public sector health facilities were destroyed or damaged to the point of being unusable (Roberts 2010). Many medical providers and health administrators were killed including approximately 14 percent of Ministry of Health employees (ibid). The full impacts of the Haiti earthquake on the health of the people in Port-au-Prince and the surrounding area are only beginning to be understood.

It is well established that effects of natural disasters on the health and wellbeing of populations are not equally distributed because pre-disaster inequalities are often exacerbated in disasters (Kleinenberg 1999; Cutter, Boruff and Shirley 2003; Squires and Hartman 2006; Neumayer and Plumpert 2007; Farmer 2011). This paper draws attention to one way in which the Haiti earthquake specifically affected the health of women by exploring the effect of the earthquake on women's reproductive health. Scholars of public health have advocated for more attention to the reproductive needs of women following natural disaster (Martine and Guzman 2002; Nour 2011; Ellington et al. 2013). Changes in reproductive healthcare following a natural disaster can lead to increases in unwanted pregnancy, sexually transmitted infections (STIs), pregnancy complications and maternal mortality. Nonetheless

there has been limited scholarship on the effects of the Haiti earthquake, and more broadly of natural disasters, on women's reproductive health.

Our study uses geocoded data from the 2005 and 2012 Haiti Demographic Health Surveys to implement a Difference-in-Difference analytical strategy that compares changes in contraceptive use, pregnancy, and STIs in the pre- and post-earthquake period in the Ouest—the most severely affected administrative department (state)—with those in the Nord—a less severely affected administrative department with a relatively comparable socio-demographic composition. The DID research design improves upon pre-post Ordinary Least Squares estimation strategies by better accounting for the confounding influences of time trends. We use the same DID strategy to explore pathways through which the earthquake could have affected reproductive health including contraception access, partnership norms related to sex and contraceptive use and fertility preferences. In a secondary analysis we consider how effects vary by schooling, a proxy for socioeconomic status, to highlight how the effects of the earthquake on reproductive health may also have socioeconomic dimensions.

2. The effects of natural disasters on women's reproductive health

Natural disasters that lead to changes in contraceptive use and increases in unwanted pregnancy and sexually transmitted infections have serious implications for women's health and well-being. High unmet need for family planning is associated with a lack of lack of control over reproductive choices, which is often used as a proxy for women's empowerment (Casterline and Sinding 2000). Unmet need for family planning also makes women more vulnerable to unwanted pregnancy (ibid), which may be an obstacle for households with resources diminished by disaster. Death in childbirth is already common in

poor countries and women's risk of pregnancy related complication and maternal mortality will be heightened if health infrastructure is damaged by disaster (Nour 2011). Lack of reliable access to condoms puts both women and men at higher risk of sexually transmitted infections—with evidence suggesting that women are biologically and socially more vulnerable to STIs (Padian, Shiboski and Jewell 1991).

There are a number of reasons why women's reproductive health may be affected by a disaster. First, access to reproductive healthcare—including modern contraception —may be diminished (Martine and Guzman 2002; Nour 2011; Ellington et al. 2013). This could be due to the destruction of healthcare services and materials or to increased difficulty in accessing services because of destroyed infrastructure or financial resources (ibid). Diminished contraceptive access may force women to change from more effective to less effective means of contraception or to stop using contraceptive altogether. Second, natural disasters often lead to changes in institutional medical priorities away from reproductive health and towards emergency relief (Martine and Guzman 2002; Claeys 2010). Third, natural disasters frequently correspond with increases in sexual violence against women from partners and other perpetrators and increases in sexual trafficking—situations where women have little control over reproduction and contraceptive use (Martine and Guzman 2002; Nour 2011). Finally, high-mortality natural-disasters may induce preferences to have children sooner because women want to 'replace' deceased family members or compensate for family and community loss (Finlay 2009; Nobles, Frankenberg and Thomas 2015).

A small but growing number of studies document how women's reproductive health is affected by disaster. Small samples of previously contracepting women reported increased difficulty accessing contraception following the Indian Ocean Tsunami in Indonesia (Hapsari et al. 2009) and Hurricanes Ike and Katrina in the Gulf Coast of the United States

(Kissinger, Schmidt and Sanders 2007; Hapsari et al. 2009; Leyster-Whalen et al. 2011). Increases in genital tract infections, pelvic disorders and menstruation disorders were reported in a small sample of women after the Wenchen earthquake in China (Liu et al. 2010). Fertility increases have also been documented following the Indian Ocean Tsunami in Indonesia, and high mortality earthquakes in Turkey, India and Pakistan (Finlay 2009; Nobles, Frankenberg and Thomas 2015).

3. Reproductive healthcare in Haiti before and after the earthquake

Prior to the earthquake, Haiti had the worst malnutrition and maternal mortality in the Western hemisphere and the highest HIV rate outside of sub-Saharan Africa (Claeys 2010; World Bank 2012). The public health infrastructure had been damaged by chronic underinvestment and political instability (Farmer 2011). Ancillary health services were provided by a large number of international NGOs, although critics argued that the proliferation of NGOs led to further deterioration of the public health system and fragmentation of health services (bid). Nonetheless, concerted efforts by healthcare providers led to improvements in women's reproductive healthcare and between 1994 and 2012 the percent of sexually active women using modern forms of contraception increased from 12 percent to 26 percent (DHS 2012).

The 2010 earthquake had a devastating effect on healthcare infrastructure in Port-au-Prince and surrounding areas. Medical facilities that were not destroyed faced considerable operational challenges including a lack of equipment, staff and salaries. An enormous outpouring of humanitarian aid provided important medical assistance, although relief efforts were often poorly coordinated (Farmer 2011). While emergency care was the priority for most health providers, there was also a need for reproductive health services. It is

estimated that 63,000 women in Port-au-Prince were pregnant at the time of the earthquake (Claeys 2010). A study of 2,391 women residing in displacement camps found that almost 12 percent of women were pregnant and two-thirds of pregnancies were unwanted five months following the earthquake (UNFPA 2011). Increases in sexual assault and violence against women were also reported in displacement camps (Farmer 2011). A number of organizations including PROFAMIL, the Haitian Institute for Health and Community Action (INHSAC), and the UNFPA provided contraception and obstetric care in mobile clinics throughout Port-au-Prince in the post-earthquake periods (Claeys 2010; UNFPA 2011). Nonetheless, the full effect of the earthquake on women's reproductive health remains unclear.

4. Empirical Strategy

Data

Data for this analysis came from the 2005 and 2012 Demographic Health Survey (DHS) in Haiti. The DHS is a population-based survey of women aged 15 to 49 collected by ICF International in collaboration with host country governments that includes information about fertility history, fertility preferences, contraceptive use, contraceptive access, prenatal care and child mortality. The 2012 DHS also included a detailed module on the 2010 earthquake, including questions on displacement, destruction, mortality and morbidity.

Sample & Treatment Assignment

Haiti is divided into ten administrative departments, with the epicenter of the earthquake occurring in the Ouest department (Figure 1). We used the *Mercalli* Intensity Scale to quantify geographic variation in earthquake-related destruction. The *Mercalli* Intensity Scale is an internationally recognized scale that quantifies the effect of earthquake

destruction independent of seismic magnitude. The *Mercalli* Intensity Scale is the preferred measure of social science researchers because it captures the effect of earthquakes on people, buildings and the environment (Scathorn 2003). Measures focused on earthquake magnitude, such as the Richter Scale, are misleading because an average magnitude earthquake may cause sizeable destruction in a poor country with weak infrastructure and minimal damage in a wealthier country with sound infrastructure.

We combined geocoded DHS data with United States Geological Survey (USGS) generated *Mercalli* Intensity Scale scores for Haiti to quantify how destruction varied across the ten departments. Average department-level Mercalli scores for Haiti varied considerably, ranging from 4.61 (moderate) in the Nord to 7.95 (violent) in the Ouest. For this analysis, we assigned treatment status to sexually active women living in the Ouest (n=6,256)—the most severely affected department and the epicenter of the earthquake—and control status to sexually active women living in the Nord (n=1,948)— a less severely affected department with a relatively similar socio-demographic composition. Women who had never had sexual intercourse were excluded from the analysis (n=1,720). We discuss in further detail why we believe the Nord is the best available counterfactual for the Ouest in the section on 'assumptions of the model.'

Difference-in-Difference

Our analysis exploited department-level variation in the intensity of the earthquake to assess the effects of the earthquake on reproductive health outcomes using a Difference-in-Difference (DID) analytical strategy. We estimated the DID by running an OLS regression of reproductive health outcomes on a time period indicator (p), treatment indicator (t) and an interaction of treatment and time period (DID) (equation 1). Covariate controls were included for respondent background characteristics including age (<19 years;

20-29 years; 30-34 years; and >35 years), religion (Catholic; Protestant; other; none), parity at earthquake (0 children, 1 child, 2-3 children, >=4 children), completion of primary school and urban residence. We did not include controls that could be considered post-treatment, for example wealth in 2012, because the earthquake may have affected these variables. The one exception is urban residence, which we included because the earthquake disproportionately affected urban areas. As a sensitivity analyses we re-ran all models without the urban variable; results were the same (available upon request). In line with convention, we used linear models for all DID analyses (Puhani 2008).

$$(1) E(y) = \beta_0 + \beta_1 P + \beta_2 T + \beta_3 P * T + \cdots \beta_k X_k + \varepsilon_i$$

We estimated the average treatment effect (ATE) by subtracting the hypothetical change in outcomes over time for the treated if they had not received treatment from the observed change in outcomes over time for the treated (equation 2). Put simply, we used changes over time in reproductive health in the Nord as a counterfactual for the changes over time that would have happened in the Ouest in the absence of the earthquake.

$$(2) E[d^1 - d^0]$$

As a secondary analysis we explored how effects varied by educational status (a proxy for SES) by implementing a Difference-in-Difference-in-Difference (DIDID) strategy. The DIDID compared changes in our outcomes over three differences (i) *time period (p)* (ii) *treatment (t)*; and (iii) *schooling (s)* (equation 3). We focused on the primary-no primary comparison because women who never completed primary school likely represent the poorest population. In 2005, before the earthquake, there was a positive correlation (0.5) between completing primary school and household wealth.

$$(3)\ E(y) = \beta_0 + \beta_1 P + \beta_2 T + \beta_3 S + \beta_4 (P * T) + \beta_5 (P * S) + \beta_6 (T * S) + \beta_7 (P * T * S) + \cdots \beta_k X_k + \mathcal{E}_i$$

The DID provided an improvement over other empirical strategies—including pre-post comparisons of affected areas or cross-sectional comparisons of affected and unaffected areas—if reproductive health was affected by unobserved trends between departments or over time periods independently of the earthquake. If this is the case then OLS estimates will misstate the estimate by partially proxying for unobserved trends. For example, there could have been upwards trends in contraceptive use in the Ouest independently of the earthquake, in which case OLS estimates would misstate the effect of the earthquake because they would be partially proxying for these trends. Thus, it would be impossible to know whether the earthquake—or independent trends—led to observed changes in contraceptive use and other reproductive outcomes. Researchers have used DID strategies to look at the effects of natural disaster on health outcomes including birth weight (Torche 2011), sex ratios at birth (Torche and Kleinhas 2012) and total fertility (Finlay 2009).

Assumptions of the model

Our analysis provided causal estimates conditional on certain assumptions. The first assumption is that unobserved characteristics had the same distribution across time points and treatment groups—in other words that the treatment groups were comparable. The large urban population concentrated in Port-au-Prince made it is difficult to find an appropriate counterfactual for the Ouest, particularly since much of the rest of the country is rural. Nonetheless, the Nord made an attractive counterfactual because it includes Cap Haitian, the second largest urban center in Haiti after Port-au-Prince. In 2005, prior to the earthquake, 59 percent of the population in the Ouest was urban and 43 percent of the

population in the Nord was urban (Appendix 1). In comparison, only 23 percent of the rest of Haiti was urban (Appendix 1). Descriptive statistics of key household characteristics indicated that the Ouest and the Nord were relatively similar—particularly compared to the rest of Haiti (Appendix 1).

The DID also assumed that the mean change in outcomes that women in the Nord experienced over time reflected the same change that women in the Ouest would have experienced had they not been exposed to the earthquake. Graphically it is possible to see that between 2000 and 2005 the predicted probability of using contraception increased at relatively parallel rates in the two departments (Figure 2). Likewise, the predicted probability of reporting unmet need for family planning and current pregnancy decreased at relatively parallel rates in the two departments (Figure 2). All of this suggested the plausibility of the parallel trends assumption. Nonetheless, as a sensitivity analysis we assessed the robustness of results to alternative treatment specifications (Appendix 2).

Another concern is whether earthquake induced mortality would alter the population composition of the two departments and bias our estimates. Estimates of the earthquake death toll ranged from 50,000 to 230,000 (Kolbe et al. 2010; Doocy, Cherwick and Kirsch 2013). A cholera epidemic following the earthquake led to high mortality throughout the country including the Nord and the Ouest (Farmer 2011). While mortality was likely distributed among the population, we would expect mortality to have been concentrated among poorer populations due to pre-existing social, economic and health vulnerabilities. This implies that our effects may be downwardly biased because the poorest women who would have been the most at risk for earthquake related mortality likely also would have faced the largest obstacles accessing reproductive healthcare.

A final issue is the potential for bias from earthquake-induced migration out of the Ouest. The mass destruction of the earthquake in the Ouest led to enormous displacement including an estimated 1.5 million people who moved into internally displaced person (IDP) camps in Port-au-Prince and surrounding areas (Bengtsson et al. 2011; Lu, Bengtsson and Holme 2012; Sherwood et al. 2014). Evidence indicated that earthquake induced migration was predictable and highly localized (ibid). Analysis of cellular network data following the earthquake found that the majority of people (over 70 percent) who moved after earthquake stayed within 50 kilometers of the center of Port-au-Prince (Lu, Bengtsson and Holme 2012). International migration was minimal following the earthquake since wealthier countries in the Western Hemisphere maintained closed border policies and the neighboring Dominican Republic also tried to limit migration.

Earthquake induced migration could have introduced upward bias into the analysis if wealthier populations had resources that made them more likely to leave the Ouest than poorer populations. Alternatively, migration could have induced downward bias into the analysis if wealthier populations were less affected by the earthquake and therefore more likely to stay in the Ouest than poorer populations. Nonetheless, concerns about migration-related bias are somewhat mitigated by the fact that most migration occurred over relatively short distances within the Ouest and our analysis was conducted at the department level (Lu, Bengtsson and Holme 2012). Furthermore, a pre-post descriptive comparison of observable household characteristics in the Ouest indicated that basic characteristics—including age of household head, education of household head, number of household members and urban residence—remained fairly stable before and after the earthquake (Appendix 1). If earthquake induced migration led to a major change in population composition we would expect these characteristics to have changed. As a crude assessment of how our estimates

might be biased by migration, we limited the sample to respondents currently living in the same home as prior to the earthquake (n=5,754) (Appendix 3). This sample should be unbiased by long-term displacement, though potentially biased in other dimensions. Results were substantively unchanged, further alleviating concerns about migration-related bias.

Outcomes: contraceptive use, pregnancy and STIs

In our first set of analyses we considered the effects of the earthquake on key indicators of reproductive health including contraceptive use, pregnancy, and STIs. Contraceptive use was measured by (i) a dichotomous indicator of current use of any modern contraceptive methods including oral contraceptive pills; implants; injectables; intrauterine devices; male condoms; female condoms; male sterilization; female sterilization; lactational amenorrhea and emergency contraception (WHO 2015); (ii) a dichotomous indicator for current use of condoms as the main method of contraception. Condoms were the most widely used contraceptive prior to the earthquake (Table 1) and have the benefit of protecting against STIs; (iii) a dichotomous indicator of current use of injectables as the main method of contraception. Injectables were the second most commonly used form of contraception prior to the earthquake (Table 1) and are viewed by medical practitioners as more reliable and less prone to human error than condoms (WHO 2015).

We assessed the effect of the earthquake on current pregnancy with (iv) a dichotomous indicator of whether the respondent is currently pregnant; and (v) a dichotomous indicator of whether the respondent is currently pregnant with a pregnancy that is unwanted at this time. We assessed the effect of the earthquake on STIs using (vi) a dichotomous indicator of whether the respondent had an STI in the last 12 months (self-reported). Because self-reports of STIs rely on the respondent's own knowledge of having

an STI, which could be a source of measurement error , we also considered the effects of the earthquake on symptoms of STIs including (vii) a dichotomous indicator of having genital sores in the last 12 months; and (viii) a dichotomous indicator of having genital discharge in the last 12 months.

Outcomes: access to contraception and reproductive health services

To explore the effect of the earthquake on access to contraception and reproductive health services we looked at (i) a dichotomous indicator of current unmet need for family planning which was constructed using the most recent DHS specification (Bradley et al. 2012). A woman had unmet need for family planning if she did not want to get pregnant at the time but was not actively using contraception. We also looked at (ii) a dichotomous indicator of current ability to access condoms; (iii) a dichotomous indicator of using government clinics as the main source for contraception; (iv) a dichotomous indicator of using NGOS as the main source for contraception; and (v) a dichotomous indicator of talking with a family planning officer in the last twelve months.

Outcomes: partnership norms and fertility preferences

We also explored a number of additional contextual factors that could influence women's use of contraception independent of access to contraception. First, we looked at the effect of the earthquake on partner dynamics related to contraceptive use. This included (i) a dichotomous indicator for whether the respondent could ask her partner to use a condom (partnered women only); (ii) a dichotomous indicator of whether the respondent thinks a woman is justified in asking her partner to use a condom if he is known to have an

STI; (iii) a dichotomous indicator of whether the respondent can refuse sex (partnered women only).

Next, we looked at indicators of fertility preferences to gauge if preferences changed in a high mortality context. This included (iv) a dichotomous indicator of desire for no more children; and (v) a dichotomous indicator of desire for more children in a year or less (asked only to women who desire more children).

5. Results

The effect of the earthquake on contraceptive use, pregnancy and STIs

Between 2000 and 2005 modern contraceptive use increased at parallel rates in Ouest and Nord (Figure 2). Between 2005 and 2012 the percent of sexually active women using a modern method rose from 22 percent to 24 percent in the Ouest and even more dramatically from 20 percent to 32 percent in the Nord (Table 1). Using the Nord as a counterfactual for what would have happened in the Ouest in the absence of the earthquake, the DID analysis indicated that living in the Ouest led to a 9 percentage point reduction in the probability of using a modern method of contraception ($p<0.001$) (Table 2, Column 1).

Prior to the earthquake the two most common types of modern contraception in Haiti were condoms and injections (Table 1). Between 2005 and 2012, condom use declined from 10 percent to 9 percent in the Ouest and increased from 5 percent to 6 percent in the Nord. Meanwhile, injections rose from 7 percent to 11 percent in the Ouest and from 8 percent to 19 percent in the Nord (Table 1). The DID analysis indicated no significant effect of living in the Ouest on condom use (Table 2, Column 2). However, living in the Ouest decreased a woman's probability of using injections by 7 percentage points as compared to living in the Nord ($p<0.001$) (Table 2, Column 3).

Between 2005 and 2012 the percent of sexually active women in the Ouest who reported a current pregnancy rose from 5 percent to 7 percent and the percent of women who reported a current unwanted pregnancy rose from 3 percent to 4 percent (Table 1). Over the same period in the Nord the percent of women who reported a current pregnancy declined from 8 percent to 6 percent and the percent of women who reported a current unwanted pregnancy declined from 7 percent to 3 percent (Table1). The DID analysis indicated living in the Ouest led to a 4 percentage point increase in the probability of being currently pregnant ($p<0.01$) and a 4 percentage point increase in the probability of being currently pregnant with an unwanted pregnancy as compared to the Nord ($p<0.001$) (Table 2, Columns 4-5).

The percent of women who reported having an STI in the last 12 months increased from 9 percent to 12 percent in the Ouest and decreased from 14 percent to 10 percent in the Nord between 2005 and 2012 (Table 1). The DID analysis indicated that living in the Ouest led to a 7 percentage point increase in the probability of reporting an STI in the last 12 months as compared to the Nord ($p<0.001$) (Table 2, Column 6). Furthermore, living in the Ouest led to a 3 percentage point increase in the probability of reporting a genital sore in the last 12 months ($p<0.001$) and a 7 percentage point increase in the probability of reporting genital discharge in the last 12 months ($p<0.001$) (Table 2, Columns 7-8).

The effect of the earthquake on access to contraception and reproductive health services

Prior to the earthquake unmet need for family planning was decreasing at relatively parallel rates in the two departments (Figure 2). Between 2005 and 2012 the percent of sexually active women reporting unmet need for contraception rose from 28 percent to 29 percent in the Ouest and declined from 34 percent to 27 percent in the Nord (Table 1). Living in the Ouest led to a 8 percentage point increase in the probability of reporting unmet

need for contraception as compared to living in the Nord ($p<0.001$) (Table 3, Column 1). Between 2005 and 2012 the percent of sexually active women reporting access to condoms rose from 84 percent to 86 percent in the Ouest and from 72 percent to 89 percent in the Nord (Table 1). Living in the Ouest led to an 12 percentage point decrease in the probability of reporting access to condoms as compared to living in the Nord ($p<0.001$) (Table 3, Column 2).

Next, we looked at sources for contraception and information about contraception. The percent of women who reported their main source of contraception was a government provider rose from 3 percent to 6 percent in the Ouest and from 6 percent to 17 percent in the Nord between 2005 and 2012 (Table 1). Over the same period the percent of women who reported their main source of contraception was an NGO provider rose from 1 percent to 2 percent in the Ouest and from 2 percent to 4 percent in the Nord (Table 1). Meanwhile, the percent of women who reported meeting with a family planning counselor in the last 12 months stayed constant at 6 percent in the Ouest and increased from 4 percent to 8 percent in the Nord (Table 1). Our models indicated living in the Ouest led to a 7 percentage point reduction in the probability of getting contraception from a government clinic ($p<0.001$) (Table 3, Column 3). However we found no significant effect of living in the Ouest on getting contraceptives from an NGO or speaking to a family planning counselor in the last 12 months (Table 3, Columns 4-5). In part this may be explained by the proliferation of NGOs in the period following the earthquake.

The effect of the earthquake on partner dynamics and fertility preferences

The next impact pathway we considered is the effect of the earthquake on partner dynamics related to sexual intercourse and contraceptive use. The percent of women who

reported being able to ask their partner to use a condom rose from 81 percent to 87 percent in the Ouest and from 69 percent to 85 percent in the Nord between 2005 and 2012 (Table 1). Over the same period the percent of women who reported that women are justified in asking their partner to use a condom if he has an STI declined from 96 percent to 93 percent in the Ouest and increased from 93 percent to 94 percent in the Nord (Table 1). Likewise, the percent of partnered women who reported that they could refuse sex declined from 88 percent to 84 percent in the Ouest and increased from 81 percent to 86 percent in the Nord (Table 1). Our DID models indicated living in the Ouest led to a 10 percentage point reduction in the probability of a woman could ask a partner to use a condom ($p<0.001$); a 3 percentage point reduction in the probability of a woman reporting that a wife is justified in asking a partner to use a condom if he has an STI ($p<0.05$); and a 7 percentage point reduction in the probability that a woman could refuse sex with a parnter ($p<0.01$) (Table 4, Column 1-3).

Next, we explored the effect of the earthquake on fertility preferences. Between 2005 and 2012 the percent of sexually active women who reported that they desired no more children rose from 39 percent to 42 percent in the Ouest and declined from 45 percent to 43 percent in the Nord (Table 1). The DID models indicated that living in the Ouest led to a 4 percentage point increase in the probability of reporting desire for no more children as compared to the Nord ($p<0.05$) (Table 4, Column 4). However, living in the Ouest led to a 7 percentage point increase in the probability of reporting desired timing for the next child to be in a year or less among women who desired more children ($p<0.05$) (Table 4, Column 5).

Analysis of how key outcomes varied by schooling

As a final analysis we conducted a difference-in-difference-in-difference analysis to explore how effects varied between women who completed primary school and those who did not (a proxy for socioeconomic status). The predicted value of contraceptive use was significantly higher for women who completed primary school than for women who did not, which means that the earthquake had a smaller effect on contraceptive use for women who completed primary school than for women who did not (Table 5, Column 1). The same is true for injection use and access to condoms (Table 5, Columns 3 & 8). The predicted values of unwanted pregnancy and unmet need for family planning were significantly lower for women who completed primary school than for women who did not, indicating that the earthquake had a smaller effect on unmet need for family planning and unwanted pregnancy for women who completed primary school than for those who did not (Table 5, Columns 5 & 7). There were no significant differences by schooling on partnership norms or fertility preferences outcomes (results available upon request).

Sensitivity Analysis

Our DID analysis of the effect of the earthquake on women's reproductive health rests on the assumption that the Nord provided an adequate counterfactual for the Ouest. To assess the robustness of results we conducted analyses with alternative specifications of treatment assignment. First, we conducted a country level analysis where treatment was a continuous measure of average departmental *Mercalli* score (see Appendix 4). Results were substantially the same; higher earthquake intensity led to significantly lower levels of modern contraceptive use and significantly higher levels of unmet need for family planning and current pregnancy (Appendix 2). We preferred the dichotomous specification because it made less rigid assumptions about the linearity of the relationship between earthquake

intensity and reproductive health outcomes. As an additional sensitivity analysis we used the Mercalli scores observed among 2012 survey clusters to calculate department averages and then created a three-category variable defined as "moderate" for an average score <5; "severe" for an average score between 5 and 7; and "devastating" for an average score >7. Our "difference-in-difference" was a comparison of changes in the most devastatingly and severely affected areas with changes in the least affected ones. Results from this second sensitivity analysis were also substantively the same as those of our main analysis and are available upon request from the authors. The robustness of our results to alternative treatment specifications reinforced the validity of our findings that living in the most severely affected area had a negative effect on women's reproductive health.

6. Conclusion

This study draws attention to the importance of considering women's reproductive health needs in post-disaster contexts with a case study of the 2010 Haiti earthquake. Descriptive evidence suggested that some dimensions of reproductive health improved over time in spite of the earthquake. For example, use of modern methods of contraception increased over time even in the Ouest, the department most devastated by the earthquake. This could reflect upward trends in modern contraceptive use prior to the earthquake or it could be due to the large presence of NGOs in the post-earthquake period. Nonetheless, unmet need for family planning and unwanted current pregnancy also increased over time in the Ouest. This is particularly striking since unmet need and unwanted pregnancy decreased over time in the Nord, a department with a relatively similar socio-demographic composition that was considerably less affected by the earthquake.

We assessed the effect of the earthquake on women's reproductive health using a difference-in-difference strategy that compared changes in reproductive health in the pre- and post-earthquake period in the Ouest with those in the Nord. The DID research design improved upon pre-post Ordinary Least Squares estimation strategies by better accounting for the confounding influences of time trends. Findings indicated that living in the Ouest negatively affected modern contraception use and positively affected current unwanted pregnancy and self reported STIs in the last 12 months. Analyses of impact pathways suggested that increases in unwanted pregnancy and STIs were at least partially driven by reduced access to contraception and family planning services. Living in the Ouest significantly reduced condom access and significantly increased unmet need for family planning. We also found evidence that the earthquake had a negative effect on partnership dynamics related to women's ability to refuse sex and use condoms. It was less clear whether the earthquake affected fertility preferences in a way that would be consistent with observed pregnancy increases. On one hand, living in the Ouest increased women's desire to stop childbearing. However, among women who still desired more children living in the Ouest reduced desired timing for next child.

Our analysis revealed that the effects of the 2010 earthquake had important socioeconomic dimensions. The effects of the earthquake on modern contraceptive use and unwanted pregnancy were significantly smaller for women who had completed primary school compared to women who had not. Likewise the effects of the earthquake on access to contraception—including unmet need for family planning and access to condoms—were also significantly smaller for women who completed primary school compared to women who had not. However, we found no significant differences by schooling for any of the partnership norms or fertility preferences outcomes. This indicated that the mechanisms

through which the earthquake affected reproductive health varied by SES, with less educated (and presumably low income) women being particularly affected by diminished access to contraception.

Our findings have implications for researchers and policymakers. Our study shows that contraceptives still need to be integrated into both immediate and long-term disaster relief strategies. This includes contraceptives that are easy to disseminate and provide important protection of STIs—such as condoms—and less accessible, but more reliable, forms of contraceptives—such as injectables and other long-acting reversible contraceptives. Targeting women of low socioeconomic status should be a high priority in post-disaster contexts given the special challenges they face. Further research on women's reproductive health in post-disaster contexts is also needed as part of a broader project of understanding gender-based health disparities in post-disaster contexts.

Works cited

Bengtsson, L., Lu, X., Thorson, A., Garfield, R., & von Schreeb, J. (2011). 'Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti.' *PLoS medicine,* vol. 8, no. 8, pp.1-9.

Bradley, S.E.K., Croft, T., Fishel, J.D., & Westoff, C. (2012). 'Revising Unmet Need for Family Planning.' Demographic Health Survey Analytical Study 25: Caverton: Maryland.

Casterline, J. B., & Sinding, S. W. (2000). Unmet Need for Family Planning in Developing Countries and Implications for Population Policy. *Population and Development Review*, *26*(4), 691–723. doi:10.1111/j.1728-4457.2000.00691.x

Claeys, V. (2010). Beyond despair – Sexual and reproductive health care in Haiti after the earthquake. *The European Journal of Contraception and Reproductive Health Care*, *15*(5), 301–304. doi:10.3109/13625187.2010.515082

Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social vulnerability to environmental hazards*. *Social Science Quarterly*, *84*(2), 242–261.

Demographic Health Survey. (2012). Haiti: Enquête Mortalité, Morbidité et Utilisation des Services. Calverton Maryland: Macro International.

Doocy, S., Cherewick, M., & Kirsch, T. (2013). Mortality following the Haitian earthquake of 2010: a stratified cluster survey. *Population Health Metrics*, *11*(5).2-9.

Ellington, S.R. (2013). 'Contraceptive Availability During an Emergency Response in the United States.' *Journal of Women's Health,* vol. 22, no. 3, pp. 189-193.

Farmer, P. (2011). *Haiti after the earthquake*. Public Affairs: New York.

Finlay, J. (2009). 'Fertility Response to Natural Disasters: The Case od Three High Mortality Earthquakes.' Working Paper. Cambridge, MA: Harvard School of Public Health.

Hapsari, E.D. Widyawati, Nisman W.A., Lusmilasari L., Siswishanto R., & Matsuo H. (2009). 'Change in contraceptive methods following the Yogyakarta earthquake and its association with the prevalence of unplanned pregnancy.' *Contraception,* vol. 79, no. 4, pp. 316-322.

Kissinger, P. (2007). 'The effect of the hurricane Katrina disaster on sexual behavior and access to reproductive care for young women in New Orleans.' *Sexually Transmitted Diseases,* vol. 34, no.11, pp. 883-886.

Klinenberg, E. (1999). Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave. *Theory and Society*, *28*(2), 239–295.

Kolbe, A. R., Hutson, R. A., Shannon, H., Trzcinski, E., Miles, B., Levitz, N., et al. (2010). Mortality, crime and access to basic needs before and after the Haiti earthquake: a random survey of Port-au-Prince households. *Medicine, Conflict and Survival*, *26*(4), 281–297.

Leyser-Whalen, O. 2011. 'Natural and Social Disasters: Racial Inequality in Access to Contraceptives After Hurricane Ike.' *Journal of Women's Health*, vol. 20, no. 12, pp. 1861-1866.

Liu, S., Han, J., Xiao, D., Ma, C., & Chen, B. (2010). International Journal of Gynecology and Obstetrics. *International Journal of Gynecology and Obstetrics*, *108*(2), 161–164. doi:10.1016/j.ijgo.2009.08.030

Lu, X., Bengtsson, L., & Holme, P. (2012). 'Predictability of population displacement after the 2010 Haiti earthquake.' *Proceedings of the National Academy of Sciences*, vol. 29, pp. 11576–11581.

Martine, G., & Guzman, J. M. (2002). Population, poverty, and vulnerability: Mitigating the effects of natural disasters. *Environmental Change and Security Policy Report*, *8*, 45–68.

Neumayer, E., & Plümper, T. (2007). The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002. *Annals of the Association of American Geographers*, *97*(3), 551–566.

Nobles, J., Frankenberg, E., & Thomas, D. (2015). The Effects of Mortality on Fertility: Population Dynamics After a Natural Disaster. *Demography*, *52*(1), 15–38.

Nour, N. N. (2011). Maternal health considerations during disaster relief. *Reviews in Obstetrics and Gynecology*, *4*(1), 22–27. doi:10.3909/riog0149

Padian N.S., Shiboski, S.C., & N.P. Jewell. (1991). Female-to-male transmission of human immunodeficiency virus. *Journal of the American Medical Association,* 266, 1664–1667.

Puhani, P.A. (2008). 'The Treatment Effect, the Cross Difference, and the Interaction Term in Nonlinear "Difference-in-Differences" Models.' IZA Working Papers.

Roberts, R. (2010) Responding in a crisis: the role of national and international health workers--lessons from Haiti. Merlin: London.

Scawthorn, C. (2003). 'Earthquakes: seismogenesis, measurement, and distribution'. in *Earthquake Engineering Handbook*, edited by W. Chen & C. Scawthorn. Boca Raton, FL: CRC Press.

Sherwood, A., Bradley, M., Rossi, L., Gitau, R., & Mellicker, B. (2014). 'Supporting Durable Solutions to Urban, Post-Disaster Displacement: Challenges and Opportunities in Haiti.' Research Report. Washington, D.C.: Brookings Institute.

Squires, G. & Hartman, C. (eds). *There's no such thing as a natural disaster: race, class and Hurricane Katrina*. New York: Routledge.

Torche, F. 2011. 'The Effect of Maternal Stress on Birth Outcomes: Exploiting a Natural Experiment.' *Demography*, vol. 48, no. 4, pp. 1473-1491.

Torche, F. & Kleinhaus, K. (2012). 'Prenatal stress, gestational age and secondary sex ratio: the sex-specific effects of exposure to a natural disaster in early pregnancy.' *Human Reproduction,* vol. 27, no. 2, pp. 558-567.

United Nations Fund for Population Action (UNFPA) (2011). 'One year after earthquake Haiti's recovery proceeds slowly.' Research Note. Available online: http://www.unfpa.org/news/one-year-after-earthquake-haiti%E2%80%99s-recovery-proceeds-slowly

World Health Organization (2010). Haiti Health Earthquake Q&A. Available online: http://www.who.int/mediacentre/factsheets/fs351/en/

World Bank. (2012). 'World Bank Development Indicators: Haiti' Available online: http://data.worldbank.org/country/haiti

Table 1. Descriptive statistics (weighted) for Ouest and Nord departments.

	Ouest		Nord	
	2005	2012	2005	2012
Reproductive health outcomes	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Modern contraception (0-1)	0.22 (0.42)	0.24 (0.43)	0.2 (0.4)	0.32 (0.47)
Condoms (0-1)	0.1 (0.29)	0.09 (0.28)	0.05 (0.21)	0.06 (0.24)
Injections (0-1)	0.07 (0.26)	0.11 (0.31)	0.08 (0.27)	0.19 (0.4)
Current pregnancy (0-1)	0.05 (0.22)	0.07 (0.25)	0.08 (0.28)	0.06 (0.24)
Current unwanted pregnancy (0-1)	0.03 (0.16)	0.04 (0.2)	0.07 (0.25)	0.03 (0.18)
STI last 12 mo. (0-1)[a]	0.09 (0.29)	0.12 (0.32)	0.14 (0.35)	0.1 (0.3)
Genital sore last 12 mo. (0-1)[b]	0.04 (0.19)	0.03 (0.17)	0.08 (0.27)	0.04 (0.19)
Genital discharge last 12 mo. (0-1)[c]	0.18 (0.39)	0.24 (0.43)	0.26 (0.44)	0.23 (0.42)
Impact pathway: access to contraception & reproductive health services				
Unmet need for contraception (0-1)	0.28 (0.45)	0.29 (0.46)	0.34 (0.47)	0.27 (0.44)
Access to condoms (0-1)	0.84 (0.36)	0.86 (0.35)	0.72 (0.45)	0.89 (0.31)
Govt. source contraception (0-1)	0.03 (0.17)	0.06 (0.23)	0.06 (0.24)	0.17 (0.38)
NGO source contraception (0-1)	0.01 (0.1)	0.02 (0.15)	0.02 (0.15)	0.04 (0.2)
Family planning counselor (0-1)	0.06 (0.23)	0.06 (0.25)	0.04 (0.2)	0.08 (0.27)
Impact pathways: partner dynamics and fertility preferences				
Condom with partner (0-1)[d]	0.81 (0.4)	0.87 (0.34)	0.69 (0.46)	0.85 (0.36)
Condom with partner if STI (0-1)	0.96 (0.2)	0.93 (0.26)	0.93 (0.26)	0.94 (0.25)
Respondent can refuse sex (0-1)[e]	0.88 (0.32)	0.84 (0.37)	0.81 (0.39)	0.86 (0.35)
No more children (0-1)[f]	0.39 (0.48)	0.42 (0.49)	0.45 (0.5)	0.43 (0.5)
Prefer pregnancy <1 yr (0-1)[g]	0.28 (0.45)	0.26 (0.44)	0.29 (0.45)	0.19 (0.4)
Background characteristics	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Catholic (0-1)	0.51 (0.5)	0.39 (0.49)	0.44 (0.5)	0.48 (0.5)
Protestant (0-1)	0.42 (0.49)	0.53 (0.5)	0.51 (0.5)	0.46 (0.5)
Other religion (0-1)	0.07 (0.26)	0.08 (0.27)	0.04 (0.2)	0.05 (0.22)
<19 years (0-1)	0.14 (0.35)	0.11 (0.31)	0.14 (0.34)	0.13 (0.33)
20-29 years (0-1)	0.43 (0.49)	0.42 (0.49)	0.38 (0.48)	0.38 (0.49)
30-34 years (0-1)	0.14 (0.35)	0.16 (0.36)	0.14 (0.34)	0.15 (0.36)
>35 years (0-1)	0.3 (0.46)	0.31 (0.46)	0.35 (0.48)	0.34 (0.47)
0 children at earthquake (0-1)	0.42 (0.49)	0.43 (0.49)	0.36 (0.48)	0.38 (0.49)
1 child at earthquake (0-1)	0.19 (0.39)	0.23 (0.42)	0.17 (0.37)	0.22 (0.41)
2-3 children at earthquake (0-1)	0.23 (0.42)	0.22 (0.41)	0.22 (0.41)	0.24 (0.43)
>4 children at earthquake (0-1)	0.16 (0.37)	0.12 (0.33)	0.25 (0.43)	0.16 (0.37)
Completed primary school (0-1)	0.56 (0.5)	0.62 (0.48)	0.36 (0.48)	0.52 (0.5)
Urban residence (0-1)	0.64 (0.48)	0.69 (0.46)	0.51 (0.5)	0.49 (0.5)
Residing in camp (0-1)	0 (0)	0.09 (0.29)	0 (0)	0 (0)
Sample size	2293	3963	834	1114

a) missing information on 17 respondents; b) missing information on 14 respondents; c) missing information on 11 respondents; d) missing information on 192 respondents; e) only asked to women currently in partnerships (n=5,498); f) excludes infecund women (n=192) and missing information (n=15); g) only asked to women who desire more children (n=4,242) excluding women who provide non-numeric responses (n=253).

Table 2. DID estimates of the effect of the earthquake on contraceptive use, pregnancy and sexually transmitted infections.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Modern method	Condom	Injectables	Pregnancy	Unwanted pregnancy	STI last 12 mo.	Sore last 12 mo.	Discharge last 12 mo.
Ouest	0.01	0.02	-0.00	-0.02*	-0.02**	-0.06***	-0.04***	-0.07***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Year2012	0.12***	0.01	0.11***	-0.02	-0.03**	-0.04**	-0.04***	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Ouest*Year2012	-0.09***	-0.02	-0.07***	0.04**	0.04***	0.07***	0.03***	0.07***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Constant	0.17***	-0.01	0.07***	0.06***	0.05***	0.12***	0.08***	0.22***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Observations	8,204	8,204	8,204	8,204	8,204	8,187	8,192	8,195

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

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Table 3. DID estimates of the effect of the earthquake on women's access to contraceptives and reproductive health services.

VARIABLES	(1) Unmet need	(2) Condom access	(3) Govt. contraception	(4) NGO contraception	(5) Counselor (12 mo)
Ouest	-0.03	0.08***	-0.03**	-0.01	0.03**
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Year2012	-0.06**	0.13***	0.10***	0.02***	0.03*
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Ouest*Year2012	0.08***	-0.12***	-0.07***	-0.01	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Constant	0.39***	0.68***	0.09***	0.03***	0.07***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	8,204	8,204	8,204	8,204	8,204

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

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Table 4. DID estimates of the effect of the earthquake on partnership norms and fertility preferences.

VARIABLES	(1) Partner condom	(2) Partner condom if STI	(3) Refuse sex	(4) Desire no more children	(5) Prefer children <1 yr.
Ouest	0.07***	0.02	0.05**	0.01	-0.01
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Year2012	0.16***	0.00	0.04	0.03	-0.09***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Ouest*Year2012	-0.10***	-0.03*	-0.07**	0.04*	0.07*
	(0.02)	(0.01)	(0.02)	(0.02)	(0.03)
Constant	0.57***	0.89***	0.80***	0.93***	0.68***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.05)
Observations	5,393	8,095	5,498	7,997	4,242

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

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Table 5. DIDID estimates of how main effects varied by schooling.

VARIABLES	(1) Modern method	(2) Condom	(3) Injectables	(4) Pregnancy	(5) Unwanted pregnancy	(6) STI last 12 mo.	(7) Unmet need	(8) Condom access
Ouest	0.01	0.01	0.01	-0.03*	-0.04***	-0.06**	-0.04	0.11***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Year2012	0.19***	0.02	0.16***	-0.03*	-0.04**	-0.03	-0.09***	0.18***
	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
Primary	0.11***	0.06**	0.05*	-0.06**	-0.05***	0.03	-0.06	0.24***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.03)
Ouest*Year2012	-0.14***	-0.01	-0.11***	0.05**	0.06***	0.07**	0.14***	-0.14***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.03)
Ouest*Primary	-0.02	0.02	-0.05*	0.02	0.03*	-0.01	0.03	-0.10***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)	(0.03)
Primary*Year2012	-0.14***	-0.01	-0.11***	0.03	0.03	-0.02	0.07	-0.13***
	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.04)	(0.03)
Primary*Year2012*Ouest	0.11*	-0.02	0.10**	-0.03	-0.04*	0.01	-0.11*	0.09*
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.05)	(0.04)
Constant	0.15***	-0.01	0.05***	0.07***	0.06***	0.12***	0.39***	0.64***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Observations	8,204	8,204	8,204	8,204	8,204	8,187	8,204	8,204

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

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Appendix 1. Descriptive statistics (weighted) of household characteristics

	Ouest		Nord		Rest of Haiti	
	2005	2012	2005	2012	2005	2012
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Urban (0-1)	0.59 (0.49)	0.61 (0.49)	0.43 (0.5)	0.43 (0.5)	0.23 (0.42)	0.28 (0.45)
Age of household head (years)	43.8 (15.04)	44.11 (14.79)	48.49 (15.43)	49.03 (15.89)	48.71 (16.1)	47.6 (16.5)
Education of household head (years)	3.73 (1.84)	3.69 (1.74)	3.53 (1.71)	3.56 (1.71)	3.29 (1.76)	3.43 (1.74)
Number of household members	4.45 (2.41)	4.39 (2.37)	5.15 (2.74)	5.17 (2.76)	4.75 (2.58)	4.43 (2.51)
Electricity in household (0-1)	0.64 (0.48)	0.63 (0.48)	0.24 (0.43)	0.37 (0.48)	0.14 (0.35)	0.22 (0.41)
Flush toilet (0-1)	0.15 (0.36)	0.22 (0.41)	0.07 (0.25)	0.08 (0.28)	0.03 (0.16)	0.03 (0.18)
Time to get water (minutes)	16.91 (27.42)	21.63 (30.95)	16.53 (19.37)	23.46 (24.79)	25.27 (33.01)	30.62 (35.64)
Mobile phone in household (0-1)	0.35 (0.48)	0.85 (0.36)	0.13 (0.34)	0.82 (0.39)	0.05 (0.23)	0.72 (0.45)
	2276	2882	862	1080	6860	9219

Appendix 2. DID estimates of the effect of the earthquake on key outcomes using a continuous measure of earthquake intensity as an alternative treatment specification

VARIABLES	(1) Modern method	(2) Condom	(3) Injectables	(4) Pregnancy	(5) Unwanted pregnancy	(6) STI last 12 mo.	(7) Unmet need	(8) Condom access
Intensity	-0.01*	0.00*	-0.01*	-0.01***	-0.01***	-0.01*	0.00	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year2012	0.12***	0.01	0.13***	-0.07***	-0.05***	-0.00	-0.08**	0.25***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)
Intensity*Year2012	-0.01*	-0.00	-0.01**	0.01***	0.01***	0.00	0.01**	-0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	0.23***	-0.01	0.12***	0.11***	0.08***	0.09***	0.36***	0.64***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Observations	20,115	20,115	20,115	20,115	20,115	20,073	20,115	20,115

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

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Appendix 3. DID estimates of the effect of the earthquake on key outcomes limiting to respondents living in the same residence as before the earthquake.

VARIABLES	(1) Modern method	(2) Condom	(3) Injectables	(4) Pregnancy	(5) Unwanted pregnancy	(6) STI last 12 mo.	(7) Unmet need	(8) Condom access
Ouest	0.01	0.02+	-0.00	-0.02+	-0.02**	-0.06***	-0.03	0.08***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Year2012	0.13***	0.01	0.12***	-0.02+	-0.03**	-0.03*	-0.08***	0.14***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Ouest*Year2012	-0.10***	-0.00	-0.09***	0.02+	0.04***	0.05**	0.10***	-0.13***
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
Constant	0.17***	-0.01	0.08***	0.07***	0.06***	0.12***	0.39***	0.68***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Observations	5,754	5,754	5,754	5,754	5,754	5,741	5,754	5,754

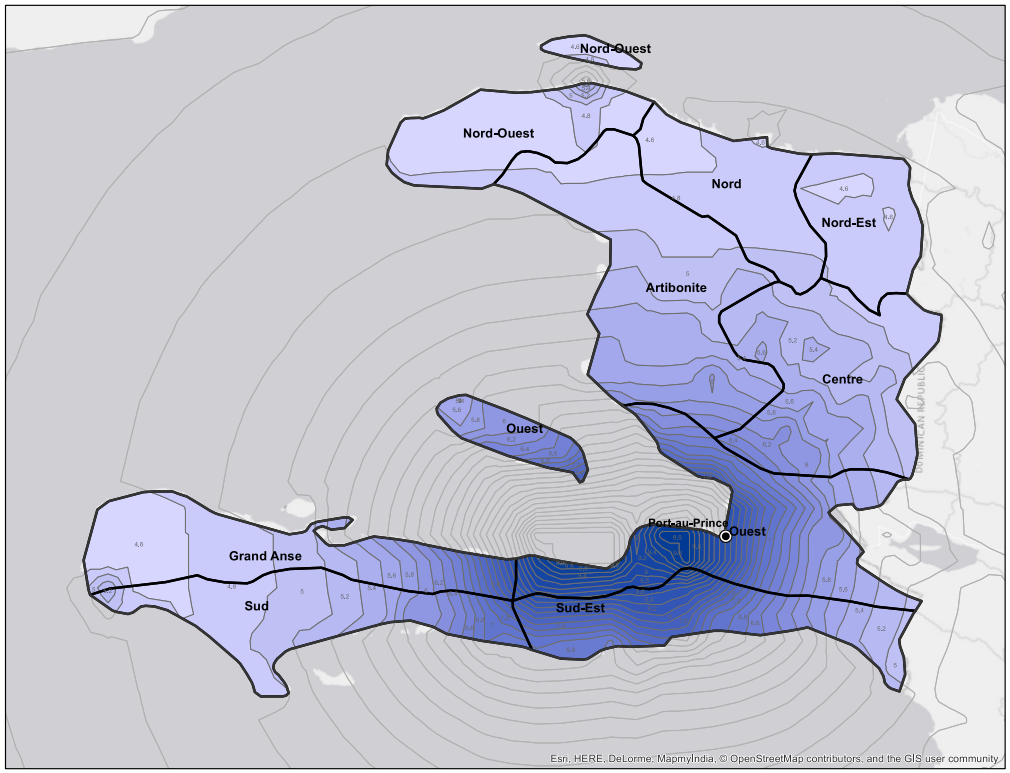
*** p<0.001, ** p<0.01, * p<0.05, +p<0.1

All models control for respondent age, religion, education, parity at earthquake and urban residence.

Appendix 4. Average Modified Mercalli score for the 2010 Haiti earthquake by Department calculated using 2012 DHS (unweighted)

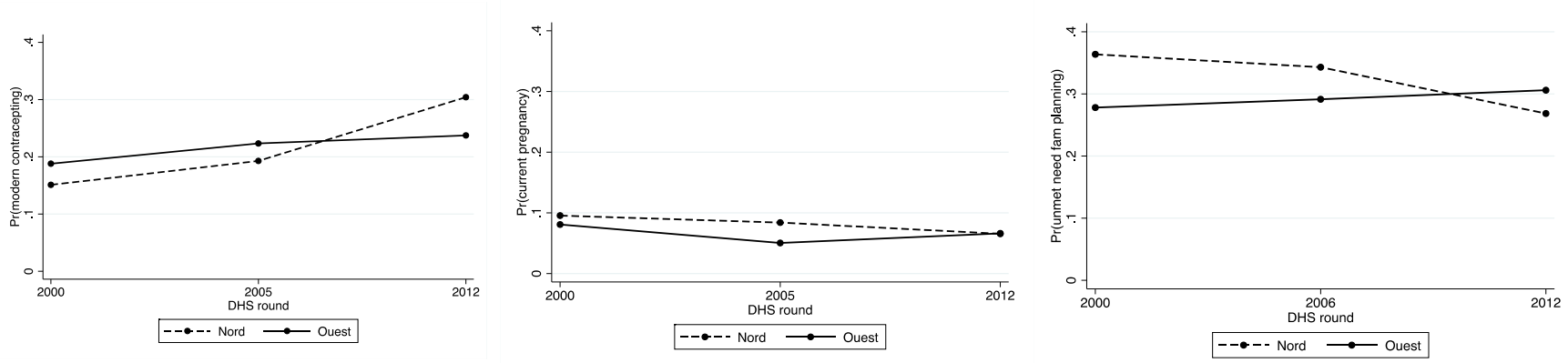
Department	Average Mercalli score
Nord	4.61
Grand'anse	4.71
Nord-est	4.78
Nord-ouest	4.86
Artibonite	5.17
Sud	5.20
Centre	5.34
Nippes	5.68
Sud-est	6.50
Ouest	7.95

Figure 1: Intensity of the Earthquake in Haiti



Sources: United States Geological Survey (USGS) and Demographic Health Survey (DHS).

Figure 2. Marginal Effects of the Predicted Probability of (i) current modern contraceptive use; (ii) unmet need for family planning; (iii) current pregnancy.



Source: Haiti DHS (2002, 2005, 2012).