

## Contraceptive Supply, Use, and Unintended Pregnancy in the Aftermath of Disaster

Jenna Nobles  
University of Wisconsin, Madison

Elizabeth Frankenberg  
Duke University

Duncan Thomas  
Duke University

An important theoretical link between humanitarian crises and population change operates through the disruption of contraceptive supply (Hill 2004). In the aftermath of disasters, facilities and medication may be damaged, providers may be injured or killed, and resupply may be constrained by destruction of transportation or distribution infrastructure (Nour 2011; Hapsari et al. 2009). Reductions in contraceptive availability that translate into reductions in contraceptive *use*—and/or a shift to less effective methods—increase the risk of both unintended pregnancy and sexually transmitted infection. Moreover, disruptions in contraceptive supply in the wake of such crises are often paired with increased *demand* for services (Cordero 1993; Ellington et al. 2013). The conditions associated with the aftermath of disaster may raise population risk of unintended fertility and STIs through an increased likelihood of sexual assault and reductions in fertility demand—for example, via a desire to delay fertility during displacement or until asset losses can be recovered (UNFPA 2012).

Despite the clear implications for population welfare, very little research has successfully documented the effects of disaster on contraceptive services or attendant changes in use. A recent CDC review (Ellington et al. 2013) identifies three studies, each drawing on non-representative samples of less than 1000 respondents. The studies demonstrated a reduction in contraceptive use following Hurricane Katrina, Hurricane Ike, and the 2006 Yogyakarta earthquake, respectively (Kissinger et al. 2011; Leyser-Whalen et al. 2011; Hapsari et al. 2009). A fourth study (Westoff et al. 2013) documented declines in oral contraceptive use the longer women lived in Belizean camps following Hurricane Mitch. In the wake of large-scale events, NGOs and donor organizations are tasked with characterizing changes to contraceptive supply at the local level. Rarely are population data available to attribute supply shifts to the contextual changes wrought by disaster. Longitudinal study of the attendant changes in contraceptive use and subsequent fertility is made difficult by the challenge of long-term data collection following these kinds of events (Guha-Sapir and Bellow 2009). As a result, the population science community has limited evidence about whether environmental shocks to contraceptive supply generate enduring change in the patterns of uptake or method mix—and whether these changes, in turn, influence population fertility.

In this study we use multilevel, longitudinal, population-representative data in regions of Indonesia affected by the 2004 Indian Ocean tsunami. The novel data capture ecological and infrastructure destruction through satellite imagery, community interviews, and interviewer assessments. Contraceptive supply and health services are measured directly via repeated health facility inventories and interviews. A pre-disaster population-representative sample of community residents is tracked and interviewed annually from 2004 (before the disaster) through 2010. In combination, the data provide a unique opportunity to describe the trajectories of contraceptive supply and uptake in a population exposed to—and recovering from—a large scale natural disaster.

We ask three questions:

1. To what extent did the disaster affect contraceptive supply and services?

We use current status and retrospective data collected from service providers and generate a comparison of temporal trends in service provision that vary by the degree and nature of tsunami destruction at the community level.

2. How did the disaster affect patterns of contraceptive use? Can these patterns be attributed to disaster-driven changes in supply?

We focus on two patterns: a) changes in the distribution of methods and b) variation in use across population subgroups. The latter includes attention to respondents in the most vulnerable situations immediately after the disaster—specifically those displaced from homes and communities. Using longitudinal data makes it possible to examine whether short-term changes were enduring—or whether patterns of use returned to pre-disaster levels.

3. How did the changes in supply affect the patterning of fertility after the disaster?

We assess shifts in the fertility rate in the fourth quarter of 2005 and during 2006 that are plausibly attributable to shifts in contraceptive availability. We use data on fertility intentions to test for a spatial alignment of contraceptive access and unintended fertility in the years following the disaster.

## INDONESIA AND THE 2004 INDIAN OCEAN TSUNAMI

The Indonesian population experienced dramatic social and economic change over the past four decades. Sustained economic growth between the mid-60s and the present period was accompanied by marked declines in fertility, increases in education, and expansions in health care. In 1965 life expectancy was 43 years for men and 45 for women; by 2011 it had extended to 68 and 71 years for men and women, respectively (WHO 2013). Over this period, the total fertility rate fell from 6 to 2.4 (Gubhaju 2008). The timing of these declines varied regionally (e.g., Hull and Hatmadji 1988) though most provinces had achieved near-replacement fertility by the time of the 2004 disaster (BPS, 2010).

Our study will focus in particular on the populations of the Aceh and North Sumatra provinces, which had TFR values at 2.4 and 2.8, respectively, in 2000 (BPS 2012). Nearly half of married women in both provinces reported using contraception at the time of the 2007 DHS survey. In Aceh, 70% of those actively contracepting used injections; 20% used the pill. By contrast, 30% of North Sumatran residents using contraceptives employed injections, 20% used the pill and 20% used various forms of traditional or folk forms of contraception. The vast majority of contraceptive injections are acquired at private practices in Indonesia, making them less accessible to those with fewer resources (CBS 2008).

In December 2004, an earthquake measuring 9.3 on the Richter scale struck off of the coast of Sumatra. The quake displaced over one trillion gallons of water, which moved toward the

Indonesian coast at over 500 miles an hour in a series of tidal waves. The devastation was enormous. Estimates suggest that 160,000 people were killed, and as many as 500,000 survivors were displaced (Rofi et al. 2006). 700 clinics and hospitals were damaged or destroyed (UNFPA 2005). The disaster was experienced with considerable local variation. The distance and direction the waves traveled was a complicated function of slope, water depth, and coastal topography (Ramakrishnan 2005). As a result, spatially adjacent communities differed markedly in levels of destruction (McAdoo et al. 2007; Umitsu et al. 2008).

The disaster had clear deleterious effects on reproductive health. Carballo et al. (2005) estimated that 133,000 fecund women were displaced by the tsunami – an estimated 11,000 were pregnant at the time of displacement – and the change in living conditions caused significant physical stress. An estimated 1600 Indonesian midwives were killed during the tsunami. Family planning agencies raised alarm about contraceptive supply. In March 2005, an official from the Indonesian BKKBN (National Coordination Board for Family Planning) estimated that Banda Aceh had acquired less than a fifth of needed contraceptive units (Carballo et al. 2005). Women in temporary camps expressed a strong desire to prevent pregnancies. By Fall 2005, the UNFPA had supported re-establishment of basic reproductive health care in ten districts in Aceh and North Sumatra. An eight-month supply of contraceptive units for the Aceh population was acquired by December 2005 (UNFPA 2006). Recovery work was complicated by repeated seismic aftershocks that persisted through 2005.

## DATA & METHODS

The data for this study come from 6 rounds of the Study for Tsunami Aftermath and Recovery (STAR). The STAR design builds on a national household socioeconomic survey collected annually in Indonesia, SUSENAS. The 2004 SUSENAS was collected in March and April of 2004, before the tsunami. STAR sought recontact with over 40,000 individuals in 400 communities in the Aceh and North Sumatran provinces of Indonesia. Mortality and migration status were determined for 99% of original respondents. More than 8% died during the disaster. Surviving individuals were tracked and reinterviewed 5 times, roughly a year apart, between 2005 and 2010. We refer to the pre-tsunami data as STARA and the follow-up data as STARB-STARF.

The original STARA survey collected sociodemographic information at the individual and household level. In the post-tsunami survey rounds, content was expanded significantly. Community-level data were collected from village leaders and administrative records. In addition, public and private health clinics were surveyed. Facilities and service providers were identified by respondents in STAR communities and surveyed. Data were collected about the availability and price of services, medication, and treatment, as well as the provision of contraception, and tenure and characteristics of staff. In STARB, facility staff were asked to describe changes to service provision relative to the pre-tsunami period.

These data were augmented with MODIS satellite images collected on December 17<sup>th</sup> (before the tsunami) and December 29<sup>th</sup> (after the tsunami). The STAR team merged the data and estimated the degree of vegetation loss created by the tsunami's waves (Gillespie et al. 2009). Data were

linked to the STAR villages using longitude and latitude coordinates. Along with ground reports of water inundation and infrastructure damage, the satellite data make it possible to stratify the survey communities by degree of tsunami destruction.

The sizeable variation in exposure to the tsunami at the community level is central to our analytical strategy. Communities with no tsunami damage provide a valuable temporal comparison (i.e., a period control) against which temporal change observed in communities with light or heavy damage can be compared. We use several measures from the STAR data on physical destruction and mortality to corroborate the satellite-based stratification. Table 1 presents community-level information gathered from village leader reports of destruction to roads, bridges, and water, records of deaths, and aggregated individual information about exposure to the disaster. We conclude that the stratification captures meaningful variation in the degree of tsunami-generated physical destruction to communities.

Table 1. Corroboration of Satellite Imagery using Experiences of STAR Respondents

	Degree of Tsunami Damage (based on satellite imagery)		
	None	Light	Heavy
<i>From Aggregated Individual Interviews:</i>			
Avg % of respondents who felt the earthquake	98	99	99
Avg % who saw friends or family struggling in the water	1	5	36
Avg % of respondents killed in the tsunami	0	1	18
Avg % of children (0-4) killed in the tsunami	0	1	21
<i>From Village Leader Interviews:</i>			
	<i>Percent of Communities</i>		
Debris a problem for community, STAR B	1	17	84
Damage to roads, STAR B	4	32	85
Water supply contaminated, STAR B	1	17	84
Availability of health services declined due to tsunami	2	14	78
Number of communities in STAR	237	235	94
Total number of respondents, STAR A	19,392	18,805	6,651

*Source:* Study of Tsunami Aftermath and Recovery

Our study is primarily concerned with contraceptive access and use following the disaster. Adult women aged 15-49 were asked to report contraceptive use and method in each survey round. Complete fertility histories were collected in STAR C and updated through STAR F. In STAR B, fertility *intentions* were collected, making it possible to generate estimates of contraceptive use relative to inferred demand. Full migration histories were also collected; along with information about respondents' location at the time of interview, these data facilitate identification of displacement in the months after the disaster.

Our analysis proceeds in three stages. We begin by characterizing contraceptive service provision at the community level. Health posts and clinics are linked to communities using data from respondents identifying facility use (some residents travel outside of the community for health services). We measure the gap in contraceptive supply generated by the tsunami by

comparing pre- vs. post-tsunami changes to service provision in communities with moderate and high levels of tsunami destruction—as indicated by satellite data and measures of damage to the local transportation infrastructure (roads, bridges)—relative to the changes occurring at facilities in locations with no reported community destruction. The STAR data allows us to adjust these comparisons for a number of community-level attributes that predict vulnerability to the disaster (for example, proximity to the coastline).

We then analyze patterns of contraceptive *use* by the degree of destruction. We specify a set of regressions that link variation in the probability of transitioning off and transitioning on to various forms of contraceptive practice to disaster exposure, net of sociodemographic controls measured *before* the disaster that may have predicted vulnerability to the disaster (e.g., having a wealthier family in the provincial capital). Arraying patterns of contraceptive use by degree of tsunami exposure suggests the disaster may have impacted contraceptive uptake. We observe a substantial drop in use among women in the hardest-hit areas. By contrast, we observe no such change in areas with no tsunami damage. Preliminary regression results (not shown) suggest that, indeed, women in the hardest hit areas were more likely to transition off *and* less likely to transition on to contraceptives between the two survey rounds, relative to women in communities with no tsunami damage. Further analysis will a) distinguish shifts in method-mix, b) use the data from STAR C, D, E, and F, to assess whether and when contraceptive use returned to pre-disaster levels, c) assess whether the transition probabilities differ by the degree of change to the contraceptive service environment.

Table 2. Contraceptive Use, Ever-Married Women Age 15-49, Aceh and North Sumatran provinces, Indonesia

	Tsunami damage indicated by satellite imagery		
	None	Light	Heavy
STAR A (2004, pre-tsunami)	28%	26%	30%
STAR B (2005-6, post-tsunami)	29%	25%	20%

Source: Study of Tsunami Aftermath and Recovery

Finally, we consider whether patterns of contraceptive supply and use are associated with fertility patterns in the post-tsunami period. We specify a set of discrete-time event history regressions in which the probability of a birth in each month is a function of traits measured before the tsunami (including age, education, expenditures, and parity), a set of community level traits that retrospectively describe the pre-tsunami infrastructure and health service environment, and finally, measures of change in contraceptive supply. Because the tsunami could have affected fertility through a number of mechanisms beyond changes to the supply environment, we adjust for both individual-level and community-level measures of disaster exposure. The introductions of interactions between intended fertility measured in STAR-B and damage to

contraceptive supply allow us to test whether women who experienced reduced access to contraception in the aftermath of the disaster disproportionately exceeded their desired fertility, relative to women in communities with sustained access.

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