



## The impact of natural disasters on child health and investments in rural India

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### ARTICLE INFO

#### Article history:

Available online 7 November 2012

#### Keywords:

India  
Natural disasters  
Child health  
Immunization  
Stunting  
Underweight

### ABSTRACT

There is growing concern that climate change will lead to more frequent natural disasters that may adversely affect short- and long-term health outcomes in developing countries. Prior research has primarily focused on the impact of single, large disaster events but very little is known about how small and moderate disasters, which are more typical, affect population health. In this paper, we present one of the first investigations of the impact of small and moderate disasters on childhood morbidity, physical growth, and immunizations by combining household data on over 80,000 children from three waves of the Indian National Family and Health Survey with an international database of natural disasters (EM-DAT). We find that exposure to a natural disaster in the past month increases the likelihood of acute illnesses such as diarrhea, fever, and acute respiratory illness in children under 5 year by 9–18%. Exposure to a disaster in the past year reduces height-for-age and weight-for-age z-scores by 0.12–0.15 units, increases the likelihood of stunting and underweight by 7%, and reduces the likelihood of having full age-appropriate immunization coverage by nearly 18%. We also find that disasters' effects vary significantly by gender, age, and socioeconomic characteristics. Most notably, the adverse effects on growth outcomes are much smaller among boys, infants, and families with more socioeconomic resources.

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### Introduction

Natural disasters are a common occurrence in developing countries, and there is growing concern that they may become more frequent due to climate change (Van Aalst, 2006). Disasters result in significant economic damage and can cause large-scale death. In 2009, 335 natural disasters were reported worldwide, killing over 10,000 people and causing damages over 41 billion USD (Vos, Rodriguez, Below, & Guha-Sapir, 2010).

In addition to their immediate effects on health and mortality, disasters can have indirect, long-term, population health effects through various mechanisms, including income shocks to households and restricted access to health care. In particular, exposure to disasters during critical growth phases, such as childhood, could permanently alter health trajectories by interrupting important health investments. For example, disasters may prevent children from receiving timely immunizations or may induce households to divert resources away from children. Indeed, a large body of literature indicates that childhood socioeconomic (SES) conditions and

health exhibit long-term influences on individuals' health and mortality (e.g., Case & Paxson, 2010; Galobardes, Lynch, & Smith, 2004; Haas, 2008; Victora et al., 2008). Exposure to severe environmental conditions, including epidemics, tropical diseases, and famines, during gestation and early years of life has been shown to significantly contribute to poor long-run outcomes (Almond, 2006; Bleakley, 2009; Chen & Zhou, 2007).

Prior research examining the effects of natural disasters on children's health generally focuses on singular large disaster events. For example, studies show that the drought in Zimbabwe slowed the growth of children under two (Hoddinott & Kinsey, 2001), forest fires in Southeast Asia increased child mortality (Frankenberg, McKee, & Thomas, 2004; Jayachandran, 2009; Sastry, 2002), and Hurricane Mitch in Nicaragua impaired children's health and nutrition and increased their labor force participation (Baez & Santos, 2007).

While understanding the effects of large disaster events is important, nations are more frequently affected by smaller-scale disasters, sometimes repeatedly. In fact, large disasters typically attract greater international aid and resources to the affected regions (Stroemberg, 2007), potentially mitigating some adverse effects. In contrast, smaller disasters often do not receive as wide attention and may lead to significant detrimental effects on child

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health and access to health care, even if immediate effects on mortality may be small. Consequently, impacts of large-scale disaster events may not be generalizable to the majority of disasters, particularly for developing countries. Only one recent study has examined the impact of several different natural disasters on child health using data from Guatemala. Pörtner (2010) estimates the impact of frost, hurricanes, storms, heavy rains, and floods on child height-for-age, weight-for-height, and the occurrence of fever, diarrhea, or Acute Respiratory Infections (ARIs) within two weeks of the interview. The study found that most disasters had negative and often large effects on children's long-term health: each disaster occurrence reduced children's height-for-age z-scores by 0.1–0.2 units.

In this paper, we examine the effects of exposure to disaster events, including small-to-moderate scale natural disasters on children's health and critical health investments using data from rural households in India. The focus on India is useful for several reasons. First, with nearly 1.2 billion people, India ranks among the lowest in terms of key child health indicators, including malnutrition and under-five mortality. The UN estimates that 2.1 million Indian children die before reaching the age of five every year, mostly from preventable illnesses such as diarrhea, typhoid, malaria, measles, and pneumonia (United Nations, 2008). Second, the country is annually struck by several natural disasters of varying intensity and types. From 1992 to 2006, the period of time spanning our data, there were 228 natural disasters reported in India that led to over 96,000 fatalities and affected several million people. This includes some very large disasters, such as the 2004 Indian Ocean earthquake and tsunami (over 16,000 killed), the 1999 Orissa cyclone (nearly 10,000 killed), and floods in Gujarat and Maharashtra in 2005 (affecting over 20 M people). However, a majority of these disasters did not result in large fatalities, and there has been no systematic examination of whether exposure to these disasters affected morbidity, nutrition, and health investments in childhood.

We use data on over 80,000 children from three waves of India's National Family and Health Surveys (NFHS; 1992–93, 1998–99, 2005–06) linked to EM-DAT, an international database of natural disaster occurrences containing information on all disasters affecting India during and around the period covered by the NFHS. This effort represents the first time that the EM-DAT data have been linked to micro-level household survey data, enabling a comprehensive assessment of the impact of natural disasters and not just single disaster events.

### Conceptual framework

Natural disasters can affect children's health in three main ways. The first is a direct effect on family (either child and/or parent/caregiver) morbidity and mortality (e.g., a child drowns in a flood or contracts illness from contamination of food or water, death or illness of parent or caregiver).

The second effect is through the disaster's impact on the supply of health care. By destroying, damaging, or straining health infrastructure, natural disasters might affect access to health care. Increased search or travel costs following health infrastructure destruction increases the marginal cost of health investments. For example, damage to hospitals or health clinics may result in reduced pre- and postnatal care, fewer births attended by a health professional and incomplete immunization. In addition, disasters may also compromise other water and sewage infrastructure that can have an impact on child health and increase exposure to vector-borne diseases.

The third effect is through the disaster's impact on the demand for health inputs, either through lost income or increased

expenditures needed to cope with damage. In agricultural societies like much of rural India, disasters such as droughts and floods may lead to significant income shocks from damage to crops and livestock. Economic theory predicts that income shocks would reduce the demand for health inputs. The need to relocate or reconstruct housing, replenish food reserves, or replace lost livestock may crowd out critical early childhood health investments (e.g., nutrition and immunization). Disasters may also reduce the marginal returns to health investments. For example, the benefits of immunizing children may be less in the event of a famine if the risk of dying from hunger is high.

The impacts of natural disasters are also likely to vary by child and household characteristics. Differential investments across boys and girls is a well-documented fact in developing countries (for a review, see Miller, 1997), particularly in India (e.g. Behrman, 1988; Rosenzweig & Schultz, 1982). One main hypothesis for gender discrimination is that boys have larger returns to human capital investments relative to girls. In this situation, one might expect that the crowding out of health inputs due to a disaster may be larger for girls than boys, resulting in attenuated effects of disasters among boys relative to girls. The differential impact of disasters by a child's age is less clear. While infant nutrition and health may be protected because of exclusive breastfeeding (e.g. from water contamination), they may be more vulnerable to diseases and other environmental hazards due to less-developed immune systems. Similarly, differential impacts by SC/ST status are also not clear *a priori*. On the one hand, SC/ST households may have fewer resources (e.g. access to credit markets) to smooth consumption, leading to greater adverse effects of disasters. On the other hand, the effects on SC/ST households might be smaller if health outcomes are already much worse than the general population, and shocks from a natural disaster is only one among a large set of health shocks to the child. Mother's education has been shown to be critical for determining a variety of child health outcomes across developing countries (Desai & Alva, 1998), and these effects may be more pronounced after a natural disaster when critical decisions regarding disease management and prevention and nutrition must be made. Finally, wide regional disparities in economic and human development exist in India with Southern states (Kerala, Karnataka, Andhra Pradesh, and Tamil Nadu) having more favorable SES and child health indicators than Northern states (Mishra, Roy, & Retherford, 2004; Rani et al., 2008). As a result, children in Southern states may be expected to fare better than their Northern counterparts in the aftermath of a disaster.

### Data

#### *Emergency Events Database*

The World Health Organization (WHO) Collaborating Center for Research on the Epidemiology of Disasters maintains the Emergency Events Database (EM-DAT) of natural disasters that have occurred since 1900. The EM-DAT includes an event as a disaster if at least 10 persons were killed, 100 persons were affected (i.e. requiring immediate assistance during a period of emergency), or the affected state either declared a state of emergency or called for international assistance. For each disaster, EM-DAT provides information on where the disaster occurred, the type of disaster (i.e. droughts, earthquakes, epidemics, extreme temperatures, floods, mass movements, storms, and wildfires), the beginning and ending dates, and the damage incurred (i.e. people killed, injured, and rendered homeless, and estimated damages). Geographic specificity of the disaster includes identifiers such as name of a city, village, province, state, or district depending on the relevance. These data have been used extensively in disasters and public

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