The effects of climate variability on psychological well-being in India

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ARTICLE INFO

ABSTRACT

Climate variability has been shown to have adverse effects on morbidity and mortality. Less is known about its effects on psychological well-being, especially in developing countries with agriculture-based economies. In this paper, we test whether extreme temperature and precipitation in India have an effect on self-reported depression symptoms, cognitive and sleep difficulties, and ability to cope with and control life. We use time and geographic variation in weather and show that hot weather in the previous year worsens psychological well-being among rural, but not urban, Indian adults. We examine potential mechanisms and show that the effect is largely driven by hot temperatures during the agricultural season and could be partly attributed to a reduction in agricultural production. We further provide suggestive evidence that the effects of weather shocks could be mitigated with poverty reduction programs such as India's National Rural Employment Guarantee Scheme. Poor mental health has been associated with low productivity and high healthcare expenditures and is a serious concern in India and many developing countries. The adverse impacts of climate change on rural, agriculture-based economies such as India are likely to increase over time. Given that nearly half of the global population lives in rural areas and is vulnerable to climate variability, understanding the effects of climate on psychological well-being and identifying potential resolutions is critical for insuring vulnerable populations and breaking the poverty cycle.

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1. Introduction

Climate change is leading to higher temperatures around the globe and increasingly erratic weather patterns. The Intergovernmental panel on climate change (IPCC) estimates that the global temperature will increase by more than 1.5 °C by the end of the 21st century relative to 1850–1950 temperatures (IPCC, 2014). Extreme heat has adverse effects on morbidity and mortality, increasing vector-borne diseases and cardiovascular problems (Dell, Jones, & Olken, 2012). It also increases aggression (Anderson, Anderson, Deneve, Flanagan, & Door, 2000) and raises violent suicide rates (Lin, Chen, Xirasagar, & Lee, 2008; Maes, Demeyer, Thompson, Peeters, & Cosyns, 1994). In addition, erratic climate patterns influence individuals' beliefs about future weather fluctuations, increasing anxiety and distress in anticipation of future threats (Fritze, Blashki, Burke, & Wiseman, 2008). Climate variability can also worsen psychological well-being by affecting agricultural production and livelihoods, creating economic and social insecurity (Berry, Bowen, & Kjellstrom, 2010).

While the potential impacts of climate variability on psychological well-being have been identified, there is little rigorous

empirical evidence for these effects (APA, 2009; Berry et al., 2010). Much of the existing literature tends to focus on acute traumatic events such as typhoons or hurricanes, and uses qualitative approaches to assess extreme weather effects. To address this gap, we use survey data from the World Health Survey (WHS) and the Study on global AGEing and adult health (SAGE) to examine the effects of weather fluctuations on the psychological well-being of Indian adults. We take advantage of time and geographic variation and use a generalized difference-in-differences model to test whether higher frequencies of extreme temperature and precipitation (in terms of deviations from the long-run average) are associated with higher rates of depression symptoms, cognitive and sleep difficulties, and self-reported inability to cope with life and control the important things in life.

The effects of climate extremes are not uniform. Developing countries with agriculture-based economies, large poor populations, and weak institutions may be less able to manage the stresses associated with climate variability than their wealthy, industrialized counterparts (Dell et al., 2012; Mudaliar & Rishi, 2012). In 2005, 55% of total employment in India was in agriculture, and close to 19% of Indian GDP was from agriculture.[1] Burgess, Deschenes, Donaldson, and Greenstone (2014) using

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[1] World Development Indicators, http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

historical data from 1957 to 2000, show that hot and dry weather in India decreases agricultural output and wages. Mahajan (2017) extends this analysis to demonstrate differential wage impacts by gender. Similarly, Guiteras (2007) predicts that the projected change in climate between 2010 and 2039 will reduce major crop yields in India by 4.5–9 percent, imposing substantial economic costs on farmers.

These weather shocks are likely to harm psychological well-being. Carroll, Frijters, and Shields (2009) find that drought conditions during Australian growing seasons significantly reduce life satisfaction among rural populations. Chemin, Laat, and Haushofer (2013) show that negative income shocks, resulting from low rainfall in the preceding year, increase cortisol levels and self-reported stress of Kenyan farmers. Similarly, Carleton (2017) demonstrates that higher temperatures during the agricultural growing season significantly increase annual suicide rates of Indian farmers, and provides supporting evidence that climate effects operate through economic channels.

The effects of climate variability on psychological well-being have important economic and social implications. Psychological distress and depression have been associated with low labor force participation and high healthcare utilization, and may pose a substantial burden on households creating cycles of poverty (Lund et al., 2011). Similarly, agency, the feeling of being able to control the important things in life, has been shown to affect individual education and labor market outcomes (Almlund, Angela Lee, James, & Kautz, 2011; Krishnan & Krutikova, 2013). Finally, stress affects both cognitive capacity and executive control, compromising individuals' economic decision making (Haushofer & Fehr, 2014; Schilbach, Schofield, & Mullainathan, 2016).

Poor mental health, and its economic consequences, are a serious concern in India. One study found that the lifetime prevalence of common mental disorders in Goa was 46% (Patel, Araya, De Lima, Ludermir, & Todd, 1999). Another study of ultra-poor households in Andhra Pradesh found that 35% of households felt anxious or depressed in the previous year (Ravi & Engler, 2015). While there may be a biological basis for depressive symptoms, changes in the environment also matter (Quidt & Haushofer, 2016). Given India's vulnerability to climate change, and the potential burden of mental distress on economic and health outcomes, it is important to understand the effects of climate variability on the psychological well-being of its population.

This paper shows that the number of months with warmer than usual temperatures (higher than one standard deviation above the long-term average) in the previous calendar year have a significant negative effect on psychological well-being, increasing cognitive and sleep difficulties, as well as feelings of being unable to cope with or control the important things in life. The effects of extreme precipitation are weaker and less consistently significant; the effects of temperature are strong and robust to controlling for extreme precipitation. Examining heterogeneity by area of residence, we find that temperature fluctuations primarily affect rural populations, and have no effect on urban residents. Splitting annual temperature and precipitation measures into six-month indicators, roughly corresponding to the agricultural and non-agricultural seasons, we find that the effects of hot temperatures on rural populations are explained by temperatures during the agricultural season in the latter half of the year. We then show that high agricultural-season temperatures are associated with lower agricultural output and diminished physical health, suggesting two potential mechanisms through which climate may affect psychological well-being: income shocks, which create economic uncertainty, and consumption shocks, which affect physical health and impact mental health indirectly. We further explore the potential role of poverty alleviation programs in moderating the effects of income shocks on psychological well-being by examining the effect of India's National Rural Employment Guarantee Scheme (NREGS) – a workfare program – and find that such programs could mitigate some of the distress caused by climate-induced economic hardship.

The paper proceeds as follows. Next, we describe the data and sample used for analysis. Then, in Section 3, we present the identification strategy and empirical specification. Section 4 presents the results of the main analysis, while Section 5 discusses potential mechanisms. We test whether India's workfare program is successful in insuring against climate variability in Section 6. Section 7 concludes.

2. Data

2.1. Household-survey data

This paper uses data from the World Health Survey (WHS) and the Study on global AGEing and adult health (SAGE). The WHS took place in 2003 in six Indian states (Assam, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal), selected to be nationally representative. A cohort of WHS respondents over 50 years of age was interviewed again during the 2007 SAGE survey. While the WHS interviewed one adult from each household, the SAGE survey included additional older respondents from the same households to account for future attrition due to mortality. A sample of 4600 younger adults (18–49) from participating WHS survey households was also included in 2007; this sample specifically targeted women because of a nested study, which aimed to examine women's reproductive health. In some cases, non-WHS households from the same primary sampling units (psus) were included in the 2007 SAGE sample and several new psus were added (Arokiasamy, Sulabha, Sekher, & Lhungdim, 2013). Psus in rural areas are villages, while psus in urban areas are city wards. In this study, we restrict the sample to psus that are available in both years (371 of them). The final sample includes working-age adults (between the ages of 18 and 60) and contains 8468 individuals from the 2003 WHS and 7759 individuals from the 2007 SAGE survey.

While the SAGE survey is more detailed and comprehensive, both the WHS and SAGE surveys contain information on various individual and household characteristics for individuals older than 18 including age, marital status, household consumption and assets, and anthropometrics. In addition, the surveys include questionnaires on various physical and mental health outcomes. We use several different measures of psychological well-being. First, we study the presence of key depression symptoms. In both surveys, respondents are asked if they felt sad, lost interest or lacked energy for more than two weeks in the last 12 months. We use an indicator for having all three key depression symptoms as our measure of mental distress. Further, we examine agency, the feeling of being able to control the important things in life, and stress. Our measures of stress are based on self-reported cognitive and sleep difficulties and the feeling of being unable to cope with all the things that they have to do.

Table 1 presents descriptive statistics on the demographic characteristics and psychological well-being outcomes for individuals by survey wave.

Individuals in 2007 are significantly less likely to have all three of the key depression symptoms (7% vs. 11%, p-value < 0.001) and cognitive difficulties (11% vs 16%, p-value < 0.001), yet they are more likely to report sleep difficulties (10% vs. 9.5%, p-value = 0.045), and not being able to control the important things in life (18% vs. 13%, p-value < 0.001) or cope with everything they need to do (20% vs. 18%, p-value = 0.001). Differences in mental health outcomes over time could be due to changes in the composition of the sample because of the different survey methodology used