FETAL ORIGINS OF MENTAL HEALTH: EVIDENCE FROM AFRICA

ACHYUTA ADHVARYU, JAMES FENSKE, NAMRATA KALA AND ANANT NYSHADHAM

ABSTRACT. Mental health disorders are a substantial portion of the global disease burden, yet their determinants are understudied, particularly in developing countries. We find that temperature shocks in utero increase depressive symptoms in adulthood in Africa. A ten percent increase in heat exposure increases our depression indices .05 to .07 standard deviations. We find no evidence that the effects of these shocks are smaller for more recent birth cohorts, nor do shocks predict greater treatment of depressive symptoms. Temperature fluctuations, increasingly frequent due to climate change, worsen the mental health disease burden and health care systems in Africa do not mitigate these impacts.

Keywords: Fetal origins, mental health, climate change, global warming, Africa
JEL Classification Codes: I15, O12

1. INTRODUCTION

Mental health disorders comprise 13 percent of the global disease burden (Collins et al., 2011). This cost is highest in poor countries: mental disorders account for 10 million disability-adjusted life years (DALYs) in developed countries, and 55 million DALYs in developing countries (Mathers, Fat and Boerma, 2008). Depressive disorders are the second leading cause of years lived under disability worldwide, and are major contributors to the burden apportioned to ischemic heart disease and suicide (Ferrari et al., 2013). They also form the largest source of disease burden among women (Mathers, Fat and Boerma, 2008).

The picture is equally stark for the *treatment* of mental disorders. The percentage of mentally ill individuals who have not received treatment in the last twelve months for serious mental illnesses, known as the mental health treatment gap, is estimated to be between 35.5 percent and 50.3 percent in developed countries and between 76.3 percent and 85.4 percent in developing countries (Demyttenaere et al., 2004). While effective treatments in general exist, the majority of those affected do not receive them; this fraction is less than 10 percent in some countries (WHO, 2012). In addition, Kessler et al. (2007) find that about half of all lifetime disorders begin by the mid-teenage years, and three quarters by the mid-20s. In sum, developing

---

Date: May 6, 2017.
Adhvaryu: University of Michigan, Ann Arbor, MI-48109, USA & NBER, adhvaryu@umich.edu. Fenske: University of Oxford, Oxford, OX1 3UQ, United Kingdom, jamesfenske@gmail.com. Kala: Harvard University, Cambridge, MA 02138, USA & Jameel Poverty Action Lab, kala@fas.harvard.edu. Nyshadham: Boston College, nyshadha@bc.edu. Acknowledgements: The authors are grateful to Dr. Srinivasa Murthy for his help with data sources and Karry Lu for research assistance.

country populations are particularly vulnerable to mental health disorders during the most productive years of their life, and are least likely to receive treatment.

We test whether environmental shocks experienced in the year before an individual's birth increase self-reported symptoms of mental illness using a large sample covering 19 African countries. Our approach merges data on more than 50,000 Africans with geospatial data on historical temperatures. Our fixed-effects method identifies the effect of *in utero* temperature exposure on adult mental health by netting out location-specific mean temperatures and comparing individuals to others from the same birth cohort. This regression specification is similar to the specifications used by other studies in the literature studying the impact of temperature on economic outcomes, such as Dell, Jones and Olken (2014), Dell, Jones and Olken (2012), Deschenes and Greenstone (2007), Deschenes and Greenstone (2011), and Hsiang (2010). Because the idiosyncratic temperature shocks that remain, net of location and birth cohort means, are plausibly exogenous, our estimates can be interpreted as causal impacts of *in utero* temperature exposure. Further, we show that our results are not driven by potentially omitted confounders that might trend with temperature; that our results are not sensitive to alternative measures of temperature or mental health; and that they are not sensitive to the inclusion of additional controls.

Our main estimates consider indices of mental health that aggregate several measures together. Considering these individual components separately, we show that several symptoms of psychological distress respond to temperature. Self-reported depression in the past thirty days is worsened by *in utero* exposure, and we find evidence that mild, moderate and severe depression all respond to temperature. Similarly, we find that depressive episodes within the past year increase when an individual has been exposed to greater temperatures *in utero*. These include episodes of reduced appetite and energy. We test whether these increases in depressive symptoms are matched with increases in diagnosis, treatment, or medication for depression. There is no evidence of this in our data. Further, we find no evidence that the link between *in utero* temperature and adult depressive symptoms is diminishing in more recent birth cohorts, suggesting that access to mitigating medical care is not improving.

We perform several additional exercises to confirm the robustness of our results. We use data on ethnicity to exclude possible migrants from the sample, showing this does not change our results. Our baseline statistical inference allows for serial correlation at level of geographic points on which our temperature data are recorded. Our results remain robust to allowing for arbitrary serial correlation at even more aggregate levels that are approximately equivalent to districts and provinces. Our baseline specifications allow for country-specific time trends. A more demanding specification that allows for separate time trends for each

geographic point at which temperature is reported does little to the results. As cohort size does not respond to temperature, it is unlikely that our results are driven by selective fertility or mortality.

The probable mechanisms of impact fall into two categories: direct and indirect (Berry, Kathryn and Kjellstrom, 2010). Direct effects cover the impact of temperature on fetal development. Heat stress affects fetal and placental growth, which is strongly associated with adult health outcomes (Hansen, 2009). In the extreme, hyperthermic conditions cause severe intra-uterine growth restriction and fetal demise (Regnault et al., 2002). Further, increased prenatal stress exposure is linked to schizophrenia, major affective disorder, and depressive outcomes in offspring (Brown et al., 2000; O'Connor et al., 2005; St Clair et al., 2005; Watson et al., 1999). Possible mechanisms include the impact of prenatal stress on altering the functioning of the hypothalamo-pituitary-adrenal (HPA) axis (Weinstock, 2008), and compromising the protective capacity of the placenta (Schmitt et al., 2014).

Indirect effects operate through the effects of temperature on the mother's disease exposure and economic environment. Increases in temperature may create a more favourable environment for the transmission of malaria, for example (Barreca, 2010). Exposure to malaria *in utero* and early life is known to produce anemia, interrupted nutritional transmission, hamper cognitive development, and raise vulnerability to other illness; as a result, it predicts later life outcomes such as literacy, education and income (Bleakley, 2010; Lucas, 2010). Adult mental health difficulties may be created alongside these health impacts or result from them and their later consequences. Several recent contributions have established that temperature shocks reduce agricultural and industrial output, increase conflict, and harm economic growth, among other effects (Dell, Jones and Olken, 2014, 2012). These effects reduce maternal health and the ability of parents to invest in young children, both of which are crucial determinants of adult health (Almond and Currie, 2011; Conti et al., 2012; Heckman, 2007).

We contribute to a rich body of work, both in medicine and in economics, on the impacts of economic shocks *in utero* and during early life on adult outcomes (Almond and Currie, 2011; Currie and Vogl, 2013). Epidemiological studies have long emphasized the impacts of extreme caloric deprivation via famines during gestation on adult mental health (Brown et al., 1995, 2000; Hoek et al., 1996; Hoek, Brown and Susser, 1998; Huang et al., 2013; Neugebauer, Hoek and Susser, 1999; Pol et al., 2000; Susser and Lin, 1992). The physiological mechanisms for these effects are well researched: stress (via, e.g., heat exposure) generates hypertrophy of the amygdala and neural network deterioration in the hippocampus and prefrontal cortex (Shonkoff et al., 2012). But relatively little is known about how relatively milder shocks *in utero* and early life circumstances impact mental health during adulthood.

We know a few recent exceptions in economics from a varied set of contexts. Adhvaryu, Fenske and Nyshadham (2016) finds that individuals born in cocoa-growing regions in Ghana experience higher levels of psychological distress as adults if they were born in years of lower cocoa prices. Persson and Rossin-Slater (2016) show for Sweden that the death of a maternal relative in early life increases take-up of medications that treat mental illness in later life. Dinkelman (2016) demonstrate the long-run impacts of droughts in early childhood on adult mental and physical disabilities. Similarly, Almond and Mazumder (2011) estimate the impacts on mental disabilities of *in utero* exposure to *Ramadan*-related fasting for an Arab population in Michigan. Our paper extends this small literature by using nationally representative samples covering a large number of respondents from multiple African countries.

Our results also have implications for the future effects of climate change in Africa. Global temperatures are projected to increase by at least 1.5 degree Celsius by 2100, along with an increased probability of heat waves (IPCC, 2013). Several sectors of the economy are projected to be affected, including agriculture (Deschenes and Greenstone, 2007; Kurukulasuriya et al., 2006; Lobell, Schlenker and Costa-Roberts, 2011), industry (Adhvaryu, Kala and Nyshadham, 2016; Hsiang, 2010) and health (Burke, Gong and Jones, 2015). While there is considerable work on how rising temperatures may increase mortality (Danet et al., 1999; Deschenes and Greenstone, 2011) and increase the burdens of certain diseases like malaria (Martens et al., 1995), there is little work on how climate change might impact mental health outcomes. Ours is the first study to our knowledge that estimates whether higher temperatures experienced *in utero* are linked to adult mental health. Given the critical role of mental health in adult wellbeing and economic outcomes, understanding how future climate change may impact mental health is important to inform comprehensive estimates of the benefits of climate change mitigation, as well as climate adaptation policies.

2. SPECIFICATION

We are interested in estimating the impact of *in utero* temperature shocks on adult mental health outcomes as well as treatment-seeking behaviors. Our sample consists of a cross-section of African adults from nineteen countries. Our primary regression specification is given by:

$$Depression_{i,j,t} = \beta \cdot Temperature_{j,t-1} + x'_{i,j,t}\gamma + \delta_i + \eta_t + t_c + \epsilon_{i,j,t} \tag{1}$$

Here, $Depression_{ijt}$ is a measure of depression for person i adjacent to temperature point j, born in year t. We join each respondent to the temperature point closest to his or her geographic coordinates. We discuss

possible migration below. $Temperature_{j,t-1}$ is the temperature at point j in the year before individual i was born. Because individuals report their ages, rather than precise dates of birth, this is the best proxy measure available for *in utero* temperature exposure. We use linear temperature and report the impact of the natural log of temperature in the Appendix. $x_{i,j,t}$ is a vector of controls. In all specifications this includes a constant and rainfall recorded at point j in the year before individual i was born. In additional specifications, $x_{i,j,t}$ also includes dummies for female and urban.[1]

δ_j and η_t are fixed effects for temperature point and year of birth. The inclusion of these fixed effects means that we are identifying the effect of temperature off of deviations of temperature from location-specific long-run historical means and removing any unobserved determinants of mental health that might affect all individuals in a given birth cohort.[2] Put differently, this "difference in differences" specification estimates the causal impacts of idiosyncratic shocks to in utero temperature on adult mental health, and the fact that some regions are simply warmer than others plays no role in our inference.[3]

t_c is a vector of country time trends. We also report specifications with the addition of temperature point trends instead of country-level trends, and in the Appendix, with the additional inclusion of country by 5-year fixed effects. These will ensure that our results are not driven by unobserved variables whose trends may be correlated with country-specific or temperature-point specific patterns of climate change, or other short-term country-specific changes. Similarly, these trends remove the possibility of spurious correlations with unobserved non-stationary time series variables. Standard errors are clustered at the country-level level, and estimated using the wild cluster bootstrap to account for the small number of clusters (Cameron and Miller, 2015). In addition to depressive symptoms, we also analyze the impact of temperature shocks on other symptoms of mental illness, as well as treatment for symptoms, using the same empirical approach. We also ensure that the results are not driven by migrants by removing probable migrants from the sample (see section 4.4.2 for details). Furthermore, we test whether controlling for composite health measures and education impacts our results. Finally, we test the robustness of the results to the inclusion of lags and leads of temperature and rainfall.

[1] We do not find heterogeneous impacts of temperature by either of these variables (gender or urban).

[2] Note that the inclusion of year fixed effects is a non-parametric version of controlling for age that allows each year/age to have a separate effect, and controls for it.

[3] A possible concern is that in-utero temperature affect education which affects age reporting. To ensure that the measurement error in age reporting is not correlated with in-utero temperature, we regress years of education on in-utero temperature shocks and rest of the specification as in Equation 1. We find no evidence that in-utero temperature shocks impact education. Results are available upon request.

3. DATA

We combine two primary sources of data - the first is data on mental health, and the second on temperature and rainfall.

3.1. **Mental Health.**

Data on mental health is taken from the World Health Organization's (WHO) World Health Surveys. These surveys were conducted from 2002-2004 in partnership with 70 countries. The WHO has made data available for 69 of these, including 20 in Africa. The survey questionnaire was designed for use in multiple cultures and locations, and translated into several local languages. Enumerators were instructed to interview respondents in private over the course of roughly 90 minutes. Respondents were sampled from the *de facto* population of each country using a sample frame encompassing all adult members of the general population aged 18 or older. Households were selected using a random, stratified procedure with known probabilities and without replacement.

The WHO data includes comprehensive information on individual physical and mental health outcomes, as well as some economic and demographic information.[4] In addition to questions on health, the data include latitude and longitude coordinates that allow us to match respondents to historical weather data. We include only adults in our sample (aged 18 to 65 years), and those with valid data on location. Our base sample, then, potentially includes 61,885 individuals from 19 countries: Burkina Faso, Chad, Comoros, Republic of Congo. Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Mauritania, Mauritius, Morocco, Namibia, Senegal, South Africa, Swaziland, Zambia, and Zimbabwe.[5] Reported sample sizes differ from this number because not every individual answered every survey question.

The survey includes questions regarding self-reported measures of depression and anxiety as well as their symptoms for two time frames: the last 30 days and the past 12 months. We use 9 of these in our analysis:

- *Depression: 30 days*: On a five point scale, ranging from "none" to "extreme," the respondent's answer to "Overall in the last 30 days, how much of a problem did you have with feeling sad, low or depressed?"
- *Anxiety*: On a five point scale, ranging from "none" to "extreme," the respondent's answer to "Overall in the last 30 days, how much of a problem did you have with worry or anxiety?"

[4]These include BMI, education (including a categorical measure that ranges from 1 to 7), and a self-reported composite health measure that ranges from 1 to 5 (1 being best and 5 being worst) that we use as controls in Tables 8, A8, and A15. These also include gender and dummy variable for urban location, which we add as controls in all specifications.

[5]While data from Tunisia was available, the lack of GIS data meant that we were unable to include it in the sample, and so the sample comprises of 19 countries out of the 20 for which mental health data are available.

- *Feel depressed, past 12 months*: The respondent's yes/no answer to the question "During the last 12 months, have you had a period lasting several days when you felt sad, empty or depressed?"
- *Lost interest: past 12 months*: The respondent's yes/no answer to the question "During the last 12 months, have you had a period lasting several days when you lost interest in most things you usually enjoy such as hobbies, personal relationships or work?"
- *Decreased energy: past 12 months*: The respondent's yes/no answer to the question "During the last 12 months, have you had a period lasting several days when you have been feeling your energy decreased or that you are tired all the time?"
- *Feel depressed, more than two weeks*: Having answered yes to one of the three questions about a period lasting several days and to the question "Was this period [of sadness/loss of interest/low energy] more than 2 weeks?"
- *Feel depressed most of time*: Having answered yes to one of the three questions about a period lasting several days and to the question "Was this period [of sadness/loss of interest/low energy] most of the day, nearly every day?"
- *Lost appetite: past 12 months*: Having answered yes to one of the three questions about a period lasting several days and to the question "During this period, did you lose your appetite?"
- *Slow thinking: past 12 months*: Having answered yes to one of the three questions about a period lasting several days and to the question "During this period, did you notice any slowing down in your thinking?"

The exact survey questions used in this analysis are given below. We exclude two types of mental health measures from our main analysis. First, we do not include reports of diagnoses in our baseline. In very poor countries such as those in our sample, actual diagnoses are rare, and so respondents' answers will better capture access to care than the existence of illness. We consider these as separate outcomes but do not include them in our aggregate indices. Second, a small number of questions were targeted towards schizotypal or psychotic disorders. For example, respondents were asked whether they felt that their thoughts were "being directly interfered or controlled by another person", or that their minds were "being taken over by strange forces." We restrict our analysis to symptoms that resemble anxiety and depression.

The World Health Survey data did not ask mental health questions in high-income countries. The same questions were, however, asked in other low-income countries, and the responses for the African sample are similar to those in these other countries. Consider, for example, the five point Depression index. This averages 1.75 with a standard deviation of 1.02 in our African sample. In India, the comparable figures are

1.81 and 1.05, while in China they are 1.28 and 0.62. In Mauritius and South Africa, two of the richest countries in the African sample, the means of this measure are 1.60 and 1.81, respectively.

In addition to considering these raw measures as outcomes, we construct aggregate indicators of mental health. There are two reasons for this. The first is that these aggregates measure general tendencies for several individual components of mental health to move in the same direction in response to early life health shocks. Second, they improve statistical power by smoothing over measurement error in any individual measure. We use two methods of aggregation: sums and a mean effects analysis that follows other recent papers (Glennerster, Miguel and Rothenberg, 2013; Kling, Liebman and Katz, 2007). In particular, we present results using four summary measures. Each of these differs in how it weights the disaggregate measures and treats missing values. Our results, then, do not depend on the weights we choose or on how we treat missing responses to specific survey questions:

- *Depression: mean effect (m.e.), average (avg.) of nonmissing*. We begin by converting each of the individual measures into a standard normal variable with mean 0 and standard deviation 1. For each respondent, we average over the non-missing measures. We then convert this average into a standard normal variable with mean 0 and standard deviation 1.
- *Depression: m.e., no missing*. We again begin by converting each of the individual measures into a standard normal variable with mean 0 and standard deviation 1. For each individual, we sum over the non-missing measures. We keep only individuals with no missing values, i.e. those who provided valid answers to all nine survey questions. We then convert this sum into a standard normal variable with mean 0 and standard deviation 1.
- *Depression: avg. of nonmissing*. We average over the non-missing individual measures. We then convert this average into a standard normal variable with mean 0 and standard deviation 1.
- *Depression: avg., no missing*. We average over the individual measures. We keep only individuals who gave valid answers to all nine survey questions, and so have no missing values. We then convert this average into a standard normal variable with mean 0 and standard deviation 1.

3.2. **Temperature.** The weather data we use comes from the well-known Matsuura *et al.* (2009) series hosted by the University of Delaware. These provide monthly temperature and rainfall at the $0.5^\circ \times 0.5^\circ$ degree resolution for the period 1900-2010. This series is constructed by combining station-level data from several sources, including the Global Historical Climatology Network (GHCN) and the Global Surface

Summary of Day (GSOD), with interpolation techniques to account for missing data, and spatial cross-validation to check the accuracy of the interpolation.[6] These data have been used in several other studies (e.g. Dell, Jones and Olken (2012)) and are chosen because of their geographic scope and long time scale. We are not aware of any alternative daily series that would overlap with more than a small fraction of the in-utero periods of the individuals in our sample, the youngest of whom were born in 1986. We merge each individual to the mean annual temperature and rainfall outcome at the nearest geographic point in the year before the individual was born. Respondents in the WHO data are thereby joined to weather data from 1,164 grid points.[7]

We estimate the impact of temperature shocks in the calendar year before the individual's year of birth. Since the survey contains information on age in years, not precise birth dates, the primary right hand right side variable may be measured with error. However, measurement error will bias our estimates downward, and so the impacts we find are lower bounds on actual impacts.

3.3. **Other controls.** Rainfall is also taken from Matsuura and Wilmott (2009), and is constructed in the same manner as temperature. The controls for female and urban are contained in the World Health Surveys. We present summary statistics in table 1.

4. RESULTS

4.1. **Main results.** In Table 2, we report our main results. In column (1) we present estimates of equation (1) that include only *in utero* rainfall, grid point fixed effects, and year of birth fixed effects. Column (2) adds individual controls – gender and urban residence. Column (3) removes these controls, adding country-specific linear time trends. Column (4) includes both country-specific trends and controls together. Column (5) replaces these individual controls and country-specific trends with linear time trends for each grid point in the data. Finally, column (6) re-introduces individual controls to the specification with grid-point time trends.

Both the country and grid-point trends account for the possibility that our results may be driven by differences in the trend rate of change in mental health outcomes across countries, or across locations, that might be correlated by chance with differential trends in climate.

[6]For more details, please refer to `http://climate.geog.udel.edu/~climate/html_pages/Global2011/README.GlobalTsT2011.html`.

[7]The average distance of the WHS points to the nearest temperature grid point is 19.36, the 25th percentile is 13.36, and the 75th percentile is 25.57.

We cluster standard errors at the country-level to account for possible serial correlation in the error term, and estimate the p-values using a wild-cluster bootstrap to account for the small number of clusters (19 clusters, one for each country).

Table 2 shows that the particular method used to aggregate the individual components of mental health into a single index does not influence the results. The estimates of the impact of temperature shocks in Table 2 indicate that exposure to a year that is one degree warmer than the local historical average increases our measure of depression in adulthood by roughly .03 standard deviations, a number that is consistent across several specifications. This magnitude is similar to the effects of early life treatments in the published literature, such as the standardized impacts of birth weight on high school graduation (Black, Devereux and Salvanes, 2007), *in utero* exposure to the 1918 flu pandemic on high school graduation (Almond, 2006), or early life malaria exposure on adult consumption (Cutler et al., 2010).

Table 2 shows that results are consistent in magnitude and statistical significance irrespective of how we handle respondents who failed to answer individual questions about their own mental health. As expected, the results are not dependent on using the mean effect transformations of these indices as opposed to the raw average or sum, though the mean effects provide more easily interpretable coefficients.

4.2. **Components of mental health.** We next study which specific indicators of mental health drive the response of our aggregate measures to *in utero* temperature exposure. This serves two purposes. First, we demonstrate that our aggregate results are not driven by a single indicator of mental health. Second, because the effects of *in utero* temperature present across a range of symptoms, the mechanisms underlying these results are unlikely to be narrow in scope.

Table 3 presents estimates of impacts on the measure of general depression. The first outcome variable, "Depression: 30 days," measures self-reported general depression in the 30 days prior to survey on a scale from 1 (none) to 5 (extreme). The order of columns here is the same as in Table 2: trends and controls are added moving from left to right. The result from the first panel implies that for each additional degree Celsius of exposure during the *in utero* period, this index rises for adults by roughly .03 points.

The remaining outcomes in Table 3 explore how much *in utero* temperature impacts the incidence of mild, moderate, severe, or extreme depression. The results suggest that the impacts are most apparent along the margins of mild and moderate depression. The probability of at-least moderate depression, for example, rises by 1.3 percentage points in response to a 1 degree increase in temperature in the second panel of the table. The remainder of the impacts are seen on severe depression, while there is no evidence of an impact on the incidence of extreme depression.

Table 4 presents results from regressions of measures of specific symptoms of depression on the same temperature measure from Tables 2 and 3. Note that all of the symptom measures studied in Table 4 are measured over the 12 months prior to survey as opposed to the 30-day window measured in Table 3. We follow the same ordering of columns as in these previous tables. The results indicate that these measures of longer-term depression also show impacts of *in utero* temperature exposure. In particular, we find significant increases in the incidence of feeling sad, empty or depressed for 2 weeks or more (Feel depressed, more than two weeks); feeling sad, empty or depressed for several days in the past 12 months (Feel depressed, past 12 months); and having felt sad, empty or depressed most of the day, every day during this episode (Feel depressed most of time). We also find strong evidence of an impact on loss of appetite (Lost appetite: past 12 months) but limited evidence of impacts on energy (Decreased energy: past 12 months), interest in things the respondent normally enjoys (Lost interest: past 12 months), and speed of thinking (Slow thinking: past 12 months).

4.3. **Adaptation.** The individuals in our sample are from cohorts born between 1937 and 1986. To forecast the effects of future temperature shocks and of climate change on mental health in poor countries, it is important to test whether individuals are adapting to these effects by seeking (and gaining access to) medical care.

In Table 5, we explore impacts on diagnosis and treatment of depression.[8] Despite robust, consistent evidence of strong impacts on the incidence of mild-to-severe depression and long-lasting symptoms of depression, Table 5 shows no evidence of impacts on receiving a formal diagnosis of depression in the past year; having taken medication for the treatment of depression in the past two weeks, and; ever having received treatment. We interpret the small point estimates and tight standard errors as precisely estimated zero impacts. These results hold irrespective of the inclusion of controls, fixed effects, and country-specific trends. These results indicate that temperature shocks *in utero* increase the mental health disease burden, since the increased depression outcomes are not matched with increased treatment. This is expected, given the "grossly inadequate" manpower and infrastructure for mental health in Africa (Jacob et al., 2007). Given the importance of mental health for economic outcomes as well as the large mental health gap discussed in the introduction, these results imply that a higher frequency of temperature shocks might affect important socio-economic outcomes through a greater mental health disease burden.

[8]While this measure - whether someone has ever been diagnosed or treated for mental health- is not a precise measure of health-seeking, it allows us to assess how in-utero temperature shocks impact the mental health treatment gap (the percentage of mentally ill individuals who do not receive treatment), which is more relevant for assessing the policy implications of these shocks.

We report supporting evidence in the appendix. In tables A16 through A19, we add country-level variables from the World Development Indicators to our main specification and interact them with the measure of treatment. That is, we assess whether potentially policy-actionable outcomes at the country level can mitigate the effects of *in utero* temperature. The measures we consider are the availability of community health workers, the availability of hospital beds, health expenditure per capita, and the fraction of health expenditure that is public. Our sample is slightly reduced due to data availability, and significantly reduced when we use data on community health workers. Across our four main measures of mental health, we find little to no evidence of significant interactions of these country-level variables with temperature before birth. Their role in facilitating adaptation, then, has been limited or nil.

4.4. **Robustness.**

4.4.1. *Heterogeneous Effects by Age.* In Table 9, we divide our sample by age. We consider results for cohorts aged 18-31, 32-48, and 49-65 in successive panels. As is clear from the panel, results are both much larger and more statistically significant for the youngest respondents in our sample. Three plausible explanations for this pattern are as follows: First, the youngest individuals in our sample are those for whom age estimates and historic weather data are both more accurate. Estimates of temperature effects may suffer from greater attenuation bias in the older cohorts. Second, it is possible that individuals are capable of exhibiting a slow resilience, eventally recovering from past shocks to fetal health. Third, as individuals live longer, the additional shocks and events orthogonal to past events may lead to greater convergence across individuals receiving different exposures to in-utero temperature.

4.4.2. *Migration.* To address possible out-migration, we use ethnicity to proxy for location of birth. The data record an individual's current place of residence. To remove individuals whose *in utero* temperatures may have been mis-coded due to migration, we discard any individuals living in locations defined by temperature grid points that are home to less than 10 percent of that ethnic group's population in the survey. Results given in table 6 are nearly identical to our baseline results.

4.4.3. *Lags and leads.* In table 7, we validate our use of *in utero* temperature as the primary treatment of interest by showing that it better predicts adult measures of depression than temperatures in other years immediately before and after birth and that it is robust to the inclusion of these other measures. In particular, we include temperature two years before birth, at birth, and in the two years after birth as additional controls. Across dependent variables, our estimates of the effect of *in utero* temperature rise relative to the baseline. Other lags and leads of temperature generally enter insignificantly, and with smaller coefficient estimates.

4.4.4. *Additional robustness.* We report several additional robustness exercises in the appendix. We use tables A9 through A15 to replicate the results presented in tables 2 through 8, except that we now include fixed effects for country $\times$ quinquennium of birth.

To show that our results are not driven by selective fertility and mortality, we make the sizes of the cohorts that appear in our sample a dependent variable in Table A1. Were temperature to produce selective patterns of fertility and mortality, we would expect this to appear in the size of the surviving cohort. The number of individuals in each temperature point $\times$ year of birth cell does not, however, respond significantly to lagged temperature.

To further test for the role of infant mortality and selective fertility, use appended data from the Demographic and Health Surveys (DHS) for about 400,000 individuals. [9] In Table A21 in the appendix, we compare the cohorts available in the WHS and in the DHS births recodes. There is some overlap, though a few differences are apparent. First, we do not have births recodes data that can be merged with GIS coordinates for the Republic of Congo, Mauritius, Swaziland, Chad, or South Africa. Second, the adults in our WHS data, surveyed in 2003, are generally born earlier than the children considered in the more recently-administered births recodes. In Table A22, in the appendix, we compare some of our basic controls between the WHS and DHS samples. The WHS sample is slightly more female than the DHS sample. Again, the adults in our sample are older and born earlier than the children covered by the more recent DHS births recodes. The DHS sample is more rural than the WHS sample, since fertility is generally higher in rural areas. Rainfall and temperature values in the year before birth are similar across the two samples.

To test for whether infant mortality is impacted by in-utero weather shocks, we regress a binary variable that takes the value 1 if the child was reported to have died as an infant, and 0 otherwise, on in-utero temperature and rainfall and the fixed effects in all of the three specifications we consider (grid point and year fixed effects, grid point and year fixed effects with country-level trends, and grid point and year fixed effects with grid-point-level trends). Results are presented in Table A23, and do not indicate that infant mortality is impacted by in-utero temperature shocks conditional on the fixed effects.

To test for selective fertility, we regress several key mother's and households' characteristics, as well as infant characteristics that are likely to be pre-determined and might be correlated with in-utero temperature, on in-utero temperature and rainfall and the fixed effects in all of the three specifications we consider (grid point and year fixed effects, grid point and year fixed effects with country-level trends, and grid point and year fixed effects with grid-point-level trends). We look at the following variables for the child: gender of

[9] We include the most recently available DHS data from all countries from the mental health sample that allowed us to merge the data with the temperature data.

the child, birth order and whether the child was part of multiple births to ensure that selective fertility on these dimensions would not be driving the selection in our results. Similarly, we test the following household and mother characteristics: whether the mother is in a polygonous household, wealth index (constructed by DHS which includes information on the households ownership of a number of consumer items, dwelling characteristics, water and sanitation access.[10]), mother's literacy and age, whether the person grew up in a rural household. Results are presented in Table A20. None of these variables are strongly or statistically significantly linked to in-utero temperature (or rainfall), indicating the main results are not driven by a certain population selecting into fertility during high-temperature years, or by the characteristics of the cohort like gender ratios or birth order.

To explore possible nonlinearities in the effect of in-utero temperature on mental health, we use tables A2 through A8 to replicate the results presented in tables 2 through 8, except that we use the natural log of temperature in the year of birth as our principal right hand side variable. Results remain similar to their linear temperature counterparts. The addition of squared temperature shock in addition to linear temperature shocks also results in marginal effects of temperature that are very similar to the main specifications in Table 2. Both these indicate that the impacts of temperature in this case are linear, which is further supported by the fact that when we plot the mental health residuals after netting out grid point and year fixed effects as well as country-trends, against in-utero temperature shock residuals also after netting out the same covariates, the relationship, shown in Figure 1, looks quite linear.

Furthermore, we test for whether other factors are impacted in-utero temperature, which may act as possible mechanisms or mediating factors. We consider physical health (a measure of overall self-reported physical health ranging from 1 to 5), years of education, and an indicator variable that takes the value 1 if the respondent reported having worked in the last 12 months, and 0 otherwise. We find no effects of in-utero temperature shocks on these variables, indicating that the effects of in-utero temperature likely operate via a direct effect of stress on mental health, a finding similar to studies in the medical literature discussed in Section 1 (results available upon request).

Finally, while we do not have information on the month of birth of respondents, we can construct the weighted annual temperature in-utero using the probability that a child was born in a certain month from the nearest point in the DHS data (which does have information on month of birth), and using these probabilities as weights for each month. While there is some seasonality in births, doing so results in weighted in-utero temperature that is highly correlated with unweighted temperature (over 0.99). Using both weighted

[10]For a more detailed description, see: `http://www.dhsprogram.com/topics/wealth-index/Index.cfm#sthash.e3HNAVEI.dpuf`.

temperature and precipitation results thus results in nearly identical results as unweighted temperature and precipitation. Furthermore, when we use the same specification as in Table 7 and add lags and leads and contemporaneous temperature (and precipitation) using weighted temperature and precipitation, only in-utero temperature is statistically significant (as in Table 7), and the impacts are nearly identical as results obtained from unweighted temperature and precipitation (results available on request). These results help corroborate our main results, as well as confirm the importance of in-utero temperature as the appropriate right hand-side variable.

4.5. **Mediation by other adult outcomes.** In table 8, we evaluate whether the link between *in utero* temperature and later life mental health can be accounted for by other later life outcomes, i.e. the degree to which these serve as mediators or candidate mechanisms through which the effect of temperature operates. We select three measures from the WHS data because they are available for a large fraction of the sample: "health," a qualitative assessment of self-rated health in which 1 is best and 5 is worst; "education," a categorical ordering of the respondent's level of education between 1 and 7, and the respondent's body mass index (BMI). Education and health both correlate with mental health as one would expect; better health (lower values of the index) and higher education both predict lower levels of our depression measures. However, the inclusion of these additional measures does little to reduce the estimate of the direct effect of temperature on mental health. Coefficients are only slightly less than those in table 2. The role of these other outcomes as possible mediators is small.

5. CONCLUSION

We have shown that *in utero* temperature shocks have adverse effects on adult mental health across multiple summary measures and specific symptoms in a large set of nationally representative samples covering 19 African countries. In particular, we find no evidence of adaptation. There is no significant evidence from our data that greater *in utero* temperature exposure increases the chance that an individual is diagnosed with depression or receives treatment for it. Similarly, we find no evidence that the effect of temperature shocks has become less severe in more recent years. If the observed trend of unresponsiveness of health care systems continues, the effects of warmer temperatures in the future on African mental health are likely to go unmitigated. In addition to contributing to the literature on the long-run impacts of *in utero* shocks, our study has added to the growing literature on the projected impacts of climate change.

Our findings have considerable implications for countries seeking to reduce the current mental health treatment gap, as well as adapt to future climate change. Many cost-effective mental health interventions

exist in developing countries, but are not implemented (Kohn et al., 2004; Patel et al., 2007). Warmer temperatures and a large treatment gap may exacerbate the incidence of depression, and consequently impact economic outcomes and wellbeing (Haines et al., 2006; McMichael, Woodruff and Hales, 2006). Reducing the mental health treatment gap through better provision of mental health facilities (Saxena et al., 2007) and policy initiatives to reduce stigma for people seeking treatment (Saraceno et al., 2007) may thus have considerable adaptation co-benefits.

REFERENCES

Adhvaryu, A, J Fenske, and A Nyshadham. 2016. "Early life circumstance and adult mental health." University of Oxford, Department of Economics Discussion Paper.

Adhvaryu, A, N Kala, and A Nyshadham. 2016. "The light and the heat: Productivity co-benefits of energy-saving technology." Paper presented at the IZA workshop: Labor Market Effects of Environmental Policies.

Almond, D, and J Currie. 2011. "Killing me softly: The fetal origins hypothesis." *Journal of Economic Perspectives*, 25(3): 153–172.

Almond, Douglas. 2006. "Is the 1918 Influenza pandemic over? Long-term effects of in utero Influenza exposure in the post-1940 US population." *Journal of Political Economy*, 114(4): 672–712.

Almond, Douglas, and Bhashkar A Mazumder. 2011. "Health capital and the prenatal environment: the effect of Ramadan observance during pregnancy." *American Economic Journal: Applied Economics*, 3(4): 56–85.

Barreca, Alan I. 2010. "The long-term economic impact of in utero and postnatal exposure to malaria." *Journal of Human Resources*, 45(4): 865–892.

Berry, H, B Kathryn, and T Kjellstrom. 2010. "Climate change and mental health: A causal pathways framework." *International Journal of Public Health*, 55(2): 123–132.

Black, Sandra E, Paul J Devereux, and Kjell G Salvanes. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *The Quarterly Journal of Economics*, 122(1): 409–439.

Bleakley, Hoyt. 2010. "Malaria eradication in the Americas: A retrospective analysis of childhood exposure." *American Economic Journal: Applied Economics*, 2(2): 1–45.

Brown, Alan S, Ezra S Susser, Shang P Lin, Richard Neugebauer, and Jack M Gorman. 1995. "Increased risk of affective disorders in males after second trimester prenatal exposure to the Dutch hunger winter of 1944-45." *The British Journal of Psychiatry*, 166(5): 601–606.

Brown, Alan S, Jim van Os, Corine Driessens, Hans W Hoek, and Ezra S Susser. 2000. "Further evidence of relation between prenatal famine and major affective disorder." *American Journal of Psychiatry*, 157(2): 190–195.

Burke, Marshall, Erick Gong, and Kelly Jones. 2015. "Income shocks and HIV in Africa." *The Economic Journal*, 125(585): 1157–1189.

Cameron, A Colin, and Douglas L Miller. 2015. "A practitioners guide to cluster-robust inference." *Journal of Human Resources*, 50(2): 317–372.

Collins, Pamela Y., Vikram Patel, Sarah S. Joestl, Dana March, Thomas R. Insel, and Abdallah S. Daar. 2011. "Grand challenges in global mental health." *Nature*, 475(7354): 27–30.

Conti, G, C Hansman, J J Heckman, M F X Novak, A Ruggiero, and S J Suomi. 2012. "Primate evidence on the late health effects of early-life adversity." *Proceedings of the National Academy of Sciences of the United States of America*, 109(23): 8866–8871.

Currie, Janet, and Tom Vogl. 2013. "Early-Life Health and Adult Circumstance in Developing Countries." *Annu. Rev. Econ*, 5: 1–36.

Cutler, David, Winnie Fung, Michael Kremer, Monica Singhal, and Tom Vogl. 2010. "Early-life malaria exposure and adult outcomes: Evidence from malaria eradication in India." *American Economic Journal: Applied Economics*, 2(2): 72–94.

Danet, S, et al. 1999. "Unhealthy Effects of Atmospheric Temperature and Pressure on the Occurrence of Myocardial Infarction and Coronary Deaths. A 10-Year Survey: The Lille-World Health Organization MONICA Project (Monitoring Trends and Determinants in Cardiovascular Disease)." *Circulation*, 100(1): e1–e7.

Dell, M, B Jones, and B Olken. 2014. "What do we learn from the weather? The new climate-economy literature." *Journal of Economic Literature*, 52(3): 740–798.

Dell, Melissa, B Jones, and B Olken. 2012. "Temperature shocks and economic growth: Evidence from the last half century." *American Economic Journal: Macroeconomics*, 4(3): 66–95.

Demyttenaere, K, et al. 2004. "Prevalence, severity, and unmet need for treatment of mental disorders in the World Health Organization World Mental Health Surveys." *Journal of the American Medical Association*, 291(21): 2581–2590.

Deschenes, O, and M Greenstone. 2007. "The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather." *American Economic Review*, 97(1): 354–385.

Deschenes, O, and M Greenstone. 2011. "Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US." *American Economic Journal: Applied Economics*, 3(4): 152–185.

Dinkelman, Taryn. 2016. "Long run health repercussions of drought shocks: Evidence from South African homelands." *The Economic Journal*.

Ferrari, Alize J., Fiona J. Charlson, Rosana E. Norman, Scott B. Patten, Greg Freedman, Christopher J. L. Murray, Theo Vos, and Harvey A. Whiteford. 2013. "Burden of Depressive Disorders by Country, Sex, Age and Year: Findings from the Global Burden of Disease Study 2010." *PLoS Medicine*, 10(11): e1001547.

Glennerster, R, E Miguel, and A D Rothenberg. 2013. "Collective action in diverse Sierra Leone communities." *Economic Journal*, 123(568): 285–316.

Haines, S, R S Kovats, S Campbell-Lendrum, and C Corvalan. 2006. "Climate change and human health: Impacts, vulnerability and public health." *Public Health*, 120(7): 585–596.

Hansen, P. 2009. "Effects of heat stress on mammalian reproduction." *Philosophical Transactions of the Royal Society London B Biological Sciences*, 364(1534): 3341–3350.

Heckman, J J. 2007. "The economics, technology, and neuroscience of human capability formation." *Proceedings of the National Academy of Sciences of the United States of America*, 104(33): 13250–13255.

Hoek, Hans W, Ezra Susser, Karen A Buck, LH Lumey, et al. 1996. "Schizoid personality disorder after prenatal exposure to famine." *The American journal of psychiatry*, 153(12): 1637.

Hoek, HW, AS Brown, and E Susser. 1998. "The Dutch famine and schizophrenia spectrum disorders." *Social psychiatry and psychiatric epidemiology*, 33(8): 373–379.

Hsiang, S M. 2010. "Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America." *Proceedings of the National Academy of Sciences of the United States of America*, 107(35): 15367–15372.

Huang, Cheng, Michael R Phillips, Yali Zhang, Jingxuan Zhang, Qichang Shi, Zhiqiang Song, Zhijie Ding, Shutao Pang, and Reynaldo Martorell. 2013. "Malnutrition in early life and adult mental health: evidence from a natural experiment." *Social Science & Medicine*, 97: 259–266.

IPCC. 2013. "Working Group I contribution to the IPCC 5th Assessment Report "Climate Change 2013: The Physical Science Basis". Final Draft Underlying Scientific-Technical Assessmen." Cambridge University Press.

Jacob, KS, P Sharan, I Mirza, M Garrido-Cumbrera, Soraya Seedat, Jair Jesus Mari, V Sreenivas, and Shekhar Saxena. 2007. "Mental health systems in countries: Where are we now?" *The Lancet*,

370(9592): 1061–1077.

Kessler, R C, et al. 2007. "Age of onset of mental disorders: A review of recent literature." *Current Opinion Psychiatry*, 20(4): 359–364.

Kling, J R, J B Liebman, and L F Katz. 2007. "Experimental analysis of neigborhood effects." *Econometrica*, 75(1): 83–119.

Kohn, R, S Saxena, I Levav, and B Saraceno. 2004. "The treatment gap in mental health care." *Bulletin of the World Health Organization*, 82(11): 858–866.

Kurukulasuriya, P, et al. 2006. "Will African agriculture survive climate change?" *The World Bank Economic Review*, 20(3): 367–388.

Lobell, D B, W Schlenker, and J Costa-Roberts. 2011. "Climate trends and global crop production since 1980." *Science*, 333(6042): 616–620.

Lucas, Adrienne M. 2010. "Malaria eradication and educational attainment: Evidence from Paraguay and Sri Lanka." *American Economic Journal. Applied Economics*, 2(2): 46.

Martens, W, L W Niessen, J Rotmans, T H Jetten, and A J McMichael. 1995. "Potential impact of global climate change on malaria risk." *Environmental Health Perspectives*, 103(5): 458–464.

Mathers, C, D M Fat, and J Boerma. 2008. "The global burden of disease: 2004 update." World Health Organization.

Matsuura, K, and C J Wilmott. 2009. "Terrestrial precipitation: 1900–2008 gridded monthly time series." Center for Climatic Research Department of Geography Center for Climatic Research, University of Delaware.

McMichael, A, R Woodruff, and S Hales. 2006. "Climate change and human health: Present and future risks." *Lancet*, 367(9513): 859–869.

Neugebauer, Richard, Hans Wijbrand Hoek, and Ezra Susser. 1999. "Prenatal exposure to wartime famine and development of antisocial personality disorder in early adulthood." *JAMA: the journal of the American Medical Association*, 282(5): 455–462.

O'Connor, Thomas G, Yoav Ben-Shlomo, Jon Heron, Jean Golding, Diana Adams, and Vivette Glover. 2005. "Prenatal anxiety predicts individual differences in cortisol in pre-adolescent children." *Biological Psychiatry*, 58(3): 211–217.

Patel, V, et al. 2007. "Treatment and prevention of mental disorders in low-income and middle-income countries." *Lancet*, 370(9591): 991–1005.

Persson, Petra, and Maya Rossin-Slater. 2016. "Family Ruptures, Stress, and the Mental Health of the

Next Generation." *Forthcoming, American Economic Review*.

Pol, Hilleke E Hulshoff, Hans W Hoek, Ezra Susser, Alan S Brown, Alexandra Dingemans, Hugo G Schnack, Neeltje EM van Haren, Lino Moreira Pereira Ramos, Christine C Gispen-de Wied, and René S Kahn. 2000. "Prenatal exposure to famine and brain morphology in schizophrenia." *American Journal of Psychiatry*, 157(7): 1170–1172.

Regnault, T, H Galan, T Parker, and R Anthony. 2002. "Placental Development in Normal and Compromised Pregnancies - A Review." *Place*, 23: S110–S129.

Saraceno, B, et al. 2007. "Barriers to improvement of mental health services in low-income and middle-income countries." *Lancet*, 370(9593): 1164–1174.

Saxena, S, G Thornicroft, M Knapp, and H Whiteford. 2007. "Resources for mental health: Scarcity, inequity, and inefficiency." *Lancet*, 370(9590): 878–889.

Schmitt, Andrea, Berend Malchow, Alkomiet Hasan, and Peter Falkai. 2014. "The impact of environmental factors in severe psychiatric disorders." *Frontiers in Neuroscience*, 8: 19.

Shonkoff, Jack P, Andrew S Garner, Benjamin S Siegel, Mary I Dobbins, Marian F Earls, Laura McGuinn, John Pascoe, David L Wood, et al. 2012. "The lifelong effects of early childhood adversity and toxic stress." *Pediatrics*, 129(1): e232–e246.

St Clair, David, Mingqing Xu, Peng Wang, Yaqin Yu, Yourong Fang, Feng Zhang, Xiaoying Zheng, Niufan Gu, Guoyin Feng, Pak Sham, et al. 2005. "Rates of adult schizophrenia following prenatal exposure to the Chinese famine of 1959-1961." *Journal of the American Medical Association*, 294(5): 557–562.

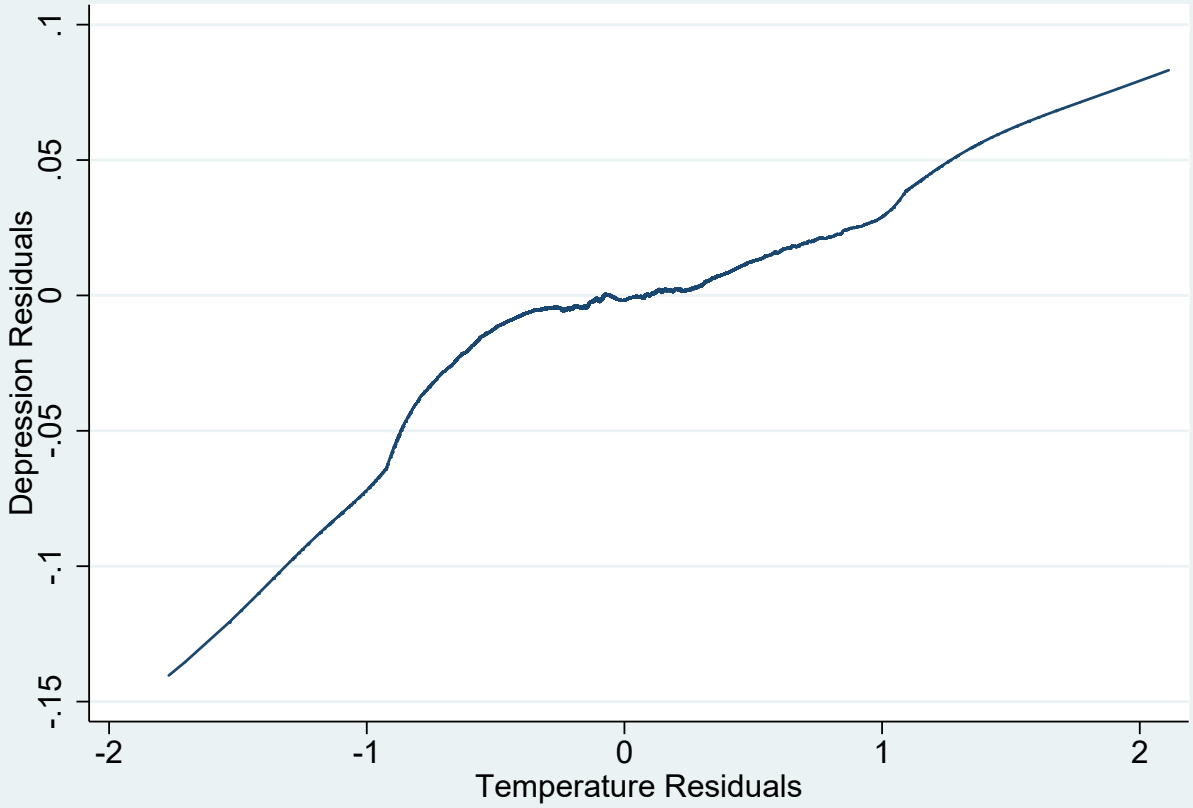
Susser, Ezra S, and Shang P Lin. 1992. "Schizophrenia after prenatal exposure to the Dutch Hunger Winter of 1944-1945." *Archives of general psychiatry*, 49(12): 983–988.

Watson, Jennifer B, Sarnoff A Mednick, Matti Huttunen, and Xueyi Wang. 1999. "Prenatal teratogens and the development of adult mental illness." *Development and Psychopathology*, 11(03): 457–466.

Weinstock, Marta. 2008. "The long-term behavioural consequences of prenatal stress." *Neuroscience & Biobehavioral Reviews*, 32(6): 1073–1086.

WHO. 2012. "World Health Organization Fact sheet No. 369."

FIGURE 1. Depression Mean Effect (No missing values) Residual against In-Utero Temperature Shock Residuals



Note: Residuals constructed by netting out grid point and year fixed effects, as well as country trends.

TABLE 1. Summary statistics

	Mean	s.d.	Min	Max	N
Depression: avg., no missing	0.0	1.00	-0.76	3.65	51,647
Depression: avg. of nonmissing	0.0	1.00	-1.29	10.1	60,188
Depression: m.e., no missing	0.0	1.00	-0.67	3.33	51,647
Depression: m.e., avg. of nonmissing	0.0	1.00	-0.99	4.21	60,188
Depression: 30 days	1.75	1.02	1	5	59,930
Depression: 30 days mild	0.44	0.50	0	1	59,930
Depression: 30 days moderate	0.21	0.41	0	1	59,930
Depression: 30 days severe	0.084	0.28	0	1	59,930
Depression: 30 days extreme	0.014	0.12	0	1	59,930
Anxiety	1.75	1.02	1	5	56,600
Depression: diagnosed past 12 months	0.040	0.20	0	1	58,630
Depression: ever treated	0.022	0.15	0	1	51,467
Depression: medicated past 2 weeks	0.017	0.13	0	1	51,044
Feel depressed, past 12 months	0.25	0.43	0	1	59,050
Lost interest: past 12 months	0.20	0.40	0	1	58,970
Decreased energy: past 12 months	0.24	0.42	0	1	58,788
Feel depressed, more than two weeks	0.12	0.32	0	1	56,100
Feel depressed most of time	0.17	0.37	0	1	56,022
Lost appetite: past 12 months	0.19	0.39	0	1	56,036
Slow thinking: past 12 months	0.15	0.35	0	1	56,006
Temperature L1	23.0	4.33	5.36	31.3	61,885
Log Temperature L1	3.12	0.20	1.68	3.44	61,885
Female	0.54	0.50	0	1	61,826
Urban	0.37	0.48	0	1	61,589
Year of Birth	1,968	12.6	1,937	1,986	61,885

Notes: Source: Authors' Calculations.

TABLE 2. Impact of In Utero Temperature on Aggregate Depression Measures

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.03068*	.03237*	.02594**	.02709**	.03063***	.03219***
	(.07)	(.06)	(.01)	(.01)	(.002)	(.004)
Rainfall	0.0003	.00037	.00028	.000290	.00035	.00036
	(.42)	(.37)	(.46)	(.44)	(.33)	(.32)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing					
Temperature	.03212***	.03394***	.03137***	.03225***	.03352***	.03478***
	(.01)	(.01)	(.002)	(.004)	(.004)	(.004)
Rainfall	.00030	.00032	.00031	.00029	.00034	.00032
	(0.29)	(0.28)	(.25)	(.28)	(.21)	(.24)
N	60,188	59,857	60,189	59,858	60,190	59,859
	Depression: m.e., no missing					
Temperature	.03121*	0.03237*	.02334**	.02393**	.02613***	.02727***
	(.06)	(.06)	(.01)	(.01)	(.008)	(.008)
Rainfall	0.00025	0.00029	.00018	.00019	.00024	.00025
	(.49)	(.44)	(.62)	(.60)	(.52)	(.50)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: me. of non- missing					
Temperature	0.03172**	0.03321**	.02936**	.02993**	.03159***	.03254***
	(.02)	(.02)	(.01)	(.01)	(.004)	(.002)
Rainfall	0.00029	0.00031	.00027	.00026	.00028	.00027
	(.39)	(.36)	(.42)	(.44)	(.41)	(.43)
N	60,188	59,857	60,189	59,858	60,190	59,859
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 3. Impact of In Utero Temperature on Separate Depression Measures: General Depression

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: 30 days					
Temperature	.0278*	.0302*	.0306**	.0322**	.0338***	.0353***
	(.05)	(.05)	(.02)	(.01)	(.008)	(.008)
Rainfall	.0003	.0003	.0004	.0004	.0005	.0004
	(.30)	(.29)	(.15)	(.16)	(.11)	(.11)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days mild					
Temperature	.0135**	.0145**	.0132**	.0138**	.0157***	.0162***
	(.02)	(.02)	(.02)	(.02)	(.008)	(.008)
Rainfall	.0003*	.0003*	.0002*	.0002*	.0003*	.0003*
	(.06)	(.06)	(.08)	(.09)	(.06)	(.06)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days moderate					
Temperature	.0097*	.0108*	.0103**	.011**	.0114**	.0121***
	(.08)	(.05)	(.04)	(.03)	(.01)	(.008)
Rainfall	.00004	.00004	.00008	.00008	.0001	.0001
	(.76)	(.74)	(.54)	(.57)	(.44)	(.45)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days severe					
Temperature	.005	.0054	.0063**	.0066**	.0064**	.0066**
	(.17)	(.15)	(.01)	(.01)	(.02)	(.01)
Rainfall	0.00001	.00001	.00008	.00007	.0001	.0001
	(.99)	(.95)	(.38)	(.38)	(.24)	(.24)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days extreme					
Temperature	-.0005	-.0005	.0008	.0008	.0003	.0003
	(.77)	(.78)	(.56)	(.55)	(.78)	(.77)
Rainfall	-.00003	-.00003	-3.82E-06	-4.066e-06	-2.807e-06	-2.989e-06
	(.29)	(.30)	(.91)	(.91)	(.93)	(.92)
N	59,930	59,605	59,930	59,605	59,930	59,605
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 4. Impact of In Utero Temperature on Separate Depression Measures: Symptoms

	(1)	(2)	(3)	(4)	(5)	(6)
	Feel depressed: past 12 months					
Temperature	.011**	.0115**	.0112***	.0115***	.011**	.0115**
	(.02)	(.01)	(0.00)	(0.00)	(.02)	(.01)
Rainfall	-.00005	-.00004	-.00007	-.00007	-.00004	-.00004
	(.65)	(.60)	(.51)	(.52)	(.65)	(.69)
N	59,050	58,738	59,050	58,738	59,050	58,738
	Lost interest: past 12 months					
Temperature	.0053	.0055	.007*	.007	.0053	.0055
	(.30)	(.30)	(.09)	(.11)	(.30)	(.30)
Rainfall	-.00005	-.00004	-.00005	-.00005	-.00005	-.00004
	(.69)	(.71)	(.65)	(.63)	(.69)	(.71)
N	58,970	58,651	58,970	58,651	58,970	58,651
	Decreased energy: past 12 months					
Temperature	.0091	.0096	.0053*	.0054*	.0091	.0095
	(.15)	(.14)	(.06)	(.05)	(.15)	(.14)
Rainfall	.0001	.0001	.00009	.00009	.0001	.0002
	(.23)	(.19)	(.41)	(.39)	(.23)	(.19)
N	58,788	58,471	58,788	58,471	58,788	58,471
	Feel depressed, more than two weeks					
Temperature	.014**	.014**	.011**	.0108**	.014**	.014**
	(.03)	(.04)	(.02)	(.03)	(.03)	(.04)
Rainfall	.0002*	.0002**	.0002*	.0002*	.00002*	.00002**
	(.05)	(.04)	(.08)	(.08)	(.05)	(.04)
N	56,100	55,796	56,100	55,796	56,100	55,796
	Feel depressed most of time					
Temperature	.0102*	.001*	.0083**	.0078*	.0102*	.01*
	(.07)	(.09)	(.04)	(.06)	(.07)	(.09)
Rainfall	6.154e-07	9.625e-06	-.00004	-.00004	6.154e-07	9.625e-06
	(.97)	(.89)	(.66)	(.67)	(.97)	(.89)
N	56,022	55,721	56,022	55,721	56,022	55,721
	Lost appetite: past 12 months					
Temperature	.0089	.0096*	.0071**	.0076**	.0089	.0096*
	(.10)	(.09)	(.04)	(.04)	(.10)	(.09)
Rainfall	.0001	.0001	.0001	.0001	.0001	.0001
	(.14)	(.10)	(.40)	(.35)	(.14)	(.10)
N	56,036	55,734	56,036	55,734	56,036	55,734
	Slow thinking: past 12 months					
Temperature	.0037	.0037	.0029	.0027	.0036	.0037
	(.46)	(.47)	(.43)	(.47)	(.46)	(.47)
Rainfall	.00005	.00006	.0001	.0001	.0001	.0001
	(.70)	(.68)	(.66)	(.67)	(.70)	(.68)
N	56,006	55,704	56,006	55,704	56,006	55,704
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 5. Impact of In Utero Temperature on Separate Depression Measures: Treatment

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: diagnosed past 12 months					
Temperature	-0.0034	-0.0034	-.002	-.0021	-.0021	-.0022
	(.25)	(.24)	(.28)	(.25)	(.26)	(.24)
Rainfall	-.0001*	-.0001*	-.0001	-.0001	-.00005	-.00005
	(.09)	(.09)	(.43)	(.43)	(.44)	(.44)
N	58,630	58,326	58,630	58,326	58,630	58,326
	Depression: ever treated					
Temperature	.0007	.0004	.0014	.001	.0001	-.0003
	(.62)	(.80)	(.23)	(.35)	(.88)	(.80)
Rainfall	-.0001	-.0001	-.00002	-.00003	-.00002	-.00003
	(.43)	(.42)	(.82)	(.78)	(.83)	(.79)
N	51,467	51,190	51,467	51,190	51,467	51,190
	Depression: medicated past 2 weeks					
Temperature	-.0003	-.0008	.0003	-.0004	.00004	-.001
	(.87)	(.59)	(.80)	(.78)	(.95)	(.69)
Rainfall	-.0001**	-.0001**	-.0001**	-.0001**	-.0001**	-.0001**
	(.03)	(.03)	(.04)	(.03)	(.04)	(.03)
N	51,044	50,771	51,044	50,771	51,044	50,771
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 6. Impact of In Utero Temperature on Aggregate Depression Measures: Removing Probable Migrants

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.037*	.039*	.0486***	.0509***	.0335**	.0353***
	(0.07)	(.06)	(0.00)	(0.00)	(.01)	(.006)
Rainfall	.0003	.0003	.0004	.0004	.0004	.0004
	(.39)	(.33)	(.33)	(.33)	(.27)	(.25)
N	42,519	42,385	42,519	42,385	42,519	42,385
	Depression: avg. of non- missing					
Temperature	.0359**	.0382**	.0445***	.0472***	.035***	.037***
	(.02)	(.01)	(0.00)	(0.00)	(.002)	(.002)
Rainfall	.0003	.0003	.0003	.0003	.0003	.0003
	(.39)	(.35)	(.37)	(.41)	(.26)	(.28)
N	49,980	49,831	49,980	49,831	49,980	49,831
	Depression: m.e., no missing					
Temperature	.0373*	.0391*	.0444***	.0465***	.0286**	0303**
	(.08)	(.07)	(0.00)	(0.00)	(.02)	(.01)
Rainfall	.0003	.0004	.0003	.0003	.0003	.0004
	(.37)	(.33)	(.49)	(.48)	(.35)	(.34)
N	42,519	42,385	42,519	42,385	42,519	42,385
	Depression: me. of non- missing					
Temperature	.0367**	.0387**	.047***	.0491***	.0345***	.036***
	(.03)	(.03)	(0.00)	(0.00)	(.006)	(.004)
Rainfall	.0004	.0004	.0003	.0003	.0004	.0004
	(.26)	(.24)	(.32)	(.36)	(.26)	(.26)
N	49,980	49,831	49,980	49,831	49,980	49,831
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 7. Impact of In Utero Temperature on Aggregate Depression Measures: Lags and Leads

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature 2 Year Lead	.0119	.0116	.0091	.0084	.0133	.0119
	(.62)	(.63)	(.68)	(.69)	(.53)	(.60)
Temperature 1 Year Lead	-.0191	-.0216	-.0096	-.012	-.0094	-.0115
	(.16)	(.12)	(.43)	(.34)	(.41)	(.35)
Contemporaneous Temperature	-.0167	-.0185	-.0239*	.026*	-.0235*	-.0262*
	(.30)	(.27)	(.09)	(.08)	(.09)	(.08)
Temperature 1 Year Lag (In-utero)	.0476***	.0489***	.0433***	.0444***	.0457***	.0475***
	(.008)	(.006)	(.004)	(.004)	(.002)	(0.00)
Temperature 2 Year Lag	-.0063	-.0015	-.0058	-.001	-.0043	.0002
	(.67)	(.90)	(.57)	(.93)	(.68)	(1.00)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing					
Temperature 2 Year Lead	.0099	.0094	.0105	.0092	.0125	.0107
	(.61)	(.63)	(.59)	(.61)	(.53)	(.58)
Temperature 1 Year Lead	-.0286*	-.03*	-.023	-.0246*	-.0228	-.0242*
	(.07)	(.05)	(.12)	(.09)	(.12)	(.09)
Contemporaneous Temperature	.0015	-.0003	-.0033	-.0055	-.0002	-.0026
	(.92)	(.97)	(.75)	(.62)	(.96)	(.79)
Temperature 1 Year Lag (In-utero)	.0431***	.045***	.0425***	.0439***	.0424***	.0442***
	(.004)	(.004)	(.002)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	-.0076	-.0047	-.0074	-.0048	-.0078	-.0053
	(.60)	(.74)	(.54)	(.67)	(.52)	(.65)
N	60,188	59,857	60,188	59,857	60,188	59,857
	Depression: m.e., no missing					
Temperature 2 Year Lead	.0125	.0126	.0077	.0074	.0109	.01
	(.64)	(.64)	(.70)	(.72)	(.61)	(.65)
Temperature 1 Year Lead	-.0201	-.022	-.0109	-.0129	-.0116	-.0134
	(.18)	(.14)	(.39)	(.33)	(.37)	(.31)
Contemporaneous Temperature	-.014	-.0165	-.0225	-.0254*	-.0237	-.0271*
	(.42)	(.38)	(.11)	(.09)	(.10)	(.09)
Temperature 1 Year Lag (In-utero)	.0446***	.0455***	.0392***	.0399***	.0413***	.0427***
	(.008)	(.008)	(.006)	(.002)	(0.00)	(.002)
Temperature 2 Year Lag	-.0003	.0043	-.0014	.0031	-.001	.0033
	(.97)	(.77)	(.89)	(.76)	(.87)	(.79)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: me. of non- missing					
Temperature 2 Year Lead	.0123	.012	.012	.011	.0144	.0129
	(.58)	(.60)	(.54)	(.57)	(.43)	(.49)
Temperature 1 Year Lead	-.0313*	-.0329*	-.0247	-.0266	-.0245	-.0263
	(.09)	(.06)	(.16)	(.13)	(.18)	(.15)
Contemporaneous Temperature	.0015	-.0006	-.0046	-.0072	-.0047	-.0074
	(.95)	(.95)	(.74)	(.63)	(.70)	(.59)
Temperature 1 Year Lag (In-utero)	.0405***	.0422***	.0393***	.0406***	.0405***	.0422***
	(.002)	(.002)	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	.00003	.003	-.0002	.0024	-.0002	.0023
	(.94)	(.77)	(.98)	(.78)	(.97)	(.81)
N	60,188	59,857	60,188	59,857	60,188	59,857
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y
Controls for Rainfall (2 year lag, 1 year lag, contemporaneous rainfall, 1 year lead and 2 year lead)	Y	Y	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 8. Impact of In Utero Temperature on Aggregate Depression Measures: Controlling for Health and Education

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.0285*	.0305*	.029**	.0308***	.0332***	.03528***
	(.06)	(.06)	(.01)	(.008)	(0.00)	(0.00)
Rainfall	.0003	.0003	.0003	.0002	.0004	.0004
	(.44)	(.43)	(.46)	(.49)	(.33)	(.33)
Health	.3055***	.2988***	.304***	.2972***	.3033***	.2967***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0231***	-.01434	-.0229***	-.014	-.0227***	-.0139
	(.008)	(.11)	(.008)	(.10)	(.008)	(.10)
BMI	.0002	.0001	.0003	.0002	.0003	.0002
	(.67)	(.75)	(.58)	(.67)	(.56)	(.66)
N	37,813	37,649	37,813	37,649	37,813	37,649
	Depression: avg. of non- missing					
Temperature	.0275*	.0293*	.0307**	.0319***	.0332***	.0346***
	(.09)	(.07)	(.02)	(.006)	(.002)	(0.00)
Rainfall	.0004	.0004	.0003	.0003	.0004	.0004
	(.23)	(.24)	(.23)	(.26)	(.18)	(.21)
Health	.2808***	.2747***	.2795***	.2734***	.2801***	.2741***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0195**	-.0131*	-.0203**	-.0139*	-.0198**	-.0134*
	(.01)	(.09)	(.01)	(.07)	(.01)	(.08)
BMI	.0004	.0003	.0004	.0003	.0004	.0003
	(.34)	(.41)	(.32)	(.39)	(.31)	(.36)
N	42,847	42,651	42,847	42,651	42,847	42,651
	Depression: m.e., no missing					
Temperature	.0299*	.0314*	.0281**	.02945**	.0312***	.0329***
	(.07)	(.07)	(.01)	(.01)	(0.00)	(0.00)
Rainfall	.0002	.0002	.0001	.0001	.0002	.0002
	(.61)	(.59)	(.70)	(.72)	(.54)	(.54)
Health	.2678***	.2615***	.2666***	.2603***	.2659***	.2597***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0225**	-.014	-.0223***	-.0137	-.022**	-.0134
	(.01)	(.11)	(.006)	(.11)	(.01)	(.10)
BMI	.0002	.0001	.0003	.0002	.0002	.0002
	(.69)	(.79)	(.61)	(.68)	(.61)	(.69)
N	37,813	37,649	37,813	37,649	37,813	37,649
	Depression: me. of non- missing					
Temperature	.02532	.0267	.028**	.0288**	.0309***	.0319***
	(.11)	(.10)	(.01)	(.01)	(0.00)	(0.00)
Rainfall	.0002	.0002	.0002	.0002	.0003	.0002
	(.51)	(.52)	(.56)	(.59)	(.47)	(.49)
Health	.2664***	.2603***	.2654***	.2592***	.2659***	.2597***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0228***	-.0149*	-.0235***	-.0155*	-.0228***	-.0149*
	(.006)	(.07)	(.004)	(.06)	(.006)	(.07)
BMI	.0002	.0001	.0003	.0002	.0003	.0002
	(.63)	(.78)	(.56)	(.67)	(.50)	(.60)
N	42,847	42,651	42,847	42,651	42,847	42,651
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE 9. Impact of In Utero Temperature on Aggregate Depression Measures: Heterogeneous Effects by Age

	(1)	(2)	(3)	(4)	(5)	(6)
	Age (18-31)					
	Depression: avg, no missing					
Temperature	.0601***	.0608***	.0518***	.0521***	.0615***	.0618***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
N	26005	25883	26005	25883	26005	25883
	Depression: avg. of non- missing					
Temperature	.0467***	.0465***	.0401***	.0396***	.0477***	.0474***
	(.00)	(.00)	(.002)	(.002)	(.00)	(.00)
N	29778	29630	29778	29630	29778	29630
	Depression: m.e., no missing					
Temperature	.0581***	.0591***	.0491***	.0496***	.0585***	.0593***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
N	26005	25883	26005	25883	26005	25883
	Depression: me. of non- missing					
Temperature	.0549***	.0561***	.0492***	.05***	.0531***	.0546***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
N	29778	29630	29778	29630	29778	29630
	Age (32-48)					
	Depression: avg, no missing					
Temperature	.0059	.005	.0071	.0062	.0151	.0144
	(.73)	(.77)	(.69)	(.74)	(.46)	(.51)
N	17170	17076	17170	17076	17170	17076
	Depression: avg. of non- missing					
Temperature	.0186	.0198	.0201	.0209	.0142	.0159
	(.34)	(.36)	(.39)	(.40)	(.48)	(.48)
N	20416	20302	20416	20302	20416	20302
	Depression: m.e., no missing					
Temperature	.0116	.0097	.0122	.0102	.0192	.0174
	(.52)	(.62)	(.51)	(.62)	(.34)	(.40)
N	17170	17076	17170	17076	17170	17076
	Depression: me. of non- missing					
Temperature	.0+D37118	.0114	.0124	.0115	.0112	.0108
	(.49)	(.52)	(.52)	(.58)	(.47)	(.54)
N	20416	20302	20416	20302	20416	20302
	Age (49-65)					
	Depression: avg, no missing					
Temperature	.0055	.0186	.0313	.0417	.0047	.0142
	(.84)	(.60)	(.35)	(.18)	(.86)	(.67)
N	8472	8410	8472	8410	8472	8410
	Depression: avg. of non- missing					
Temperature	.0232	.0333	.0432	.0495*	.0393	.0426
	(.35)	(.21)	(.18)	(.09)	(.20)	(.13)
N	9994	9925	9994	9925	9994	9925
	Depression: m.e., no missing					
Temperature	-.0295	-.0178	-.002	.007	-.0196	-.0115
	(.42)	(.62)	(.96)	(.83)	(.58)	(.73)
N	8472	8410	8472	8410	8472	8410
	Depression: me. of non- missing					
Temperature	.007	.0161	.0316	.0373	.0210	.0253
	(.82)	(.63)	(.35)	(.24)	(.58)	(.48)
N	9994	9925	9994	9925	9994	9925
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. All regressions include rainfall in the year before birth. Additional controls where included are female and urban.

Appendix: Not for publication

TABLE A1. Robustness: Cohort size

	(1)	(2)	(3)
	Cohort Size		
Temperature	0.0606	-.0917	-.0949
	(.71)	(.29)	(.14)
Rainfall	-.0014	-.0030	-.0029
	(.51)	(.11)	(.15)
N	24,082	24,082	24,082
Grid Point FE	Y	Y	Y
Year of Birth FE	Y	Y	Y
Country Trends	N	Y	N
Grid Point Trends	N	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap.

APPENDIX A. APPENDIX TABLES

TABLE A2. Impact of In Utero Log(Temperature) on Aggregate Depression Measures

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.61803*	.6589*	.54557**	.57271**	.63576***	.66957***
	(.09)	(.08)	(.01)	(.01)	(.004)	(.002)
Rainfall	-.01053	-.0074	0.00103	.00187	.01117	.01191
	-0.74	(.80)	(.97)	(.94)	(.65)	(.62)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing					
Temperature	.63207**	.66904**	.68922***	.70404***	.72452***	.74531***
	(.04)	(.03)	(.004)	(.004)	(.008)	(.008)
Rainfall	-.01373	-.01296	.00173	-.00026	.00862	.0067
	(.83)	(.86)	(.90)	(1.00)	(.69)	(.73)
N	60,188	59,857	60,189	59,858	60,190	59,859
	Depression: m.e., no missing					
Temperature	.6795*	.70944*	.53723**	.55291**	.58651***	.61201***
	(.07)	(.06)	(.01)	(.01)	(.006)	(.006)
Rainfall	-0.00569	-0.00303	.00220	.00253	.01035	.01089
	(.83)	(.90)	(.92)	(.91)	(.62)	(.61)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: me. of non- missing					
Temperature	0.67599**	.70776**	.68762***	.69797***	.72121***	.73738***
	(.03)	(.02)	(.008)	(.008)	(.004)	(.004)
Rainfall	-0.00216	-0.00159	.00927	.00744	.01504	.01333
	(.97)	(.98)	(.67)	(.71)	(.50)	(.54)
N	60,188	59,857	60,189	59,858	60,190	59,859
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A3. Impact of In Utero Log(Temperature) on Separate Depression Measures: General Depression

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: 30 days					
Temperature	.523	.581	.6183*	.6493**	.6657**	.6926**
	(.13)	(.10)	(.06)	(.04)	(.01)	(.01)
Rainfall	-.0159	-.0145	.003	.0021	.0121	.0105
	(.66)	(.68)	(.89)	(.93)	(.59)	(.64)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days mild					
Temperature	.2483*	.2704*	.265*	.2774*	.3103**	.3209**
	(.07)	(.05)	(.09)	(.07)	(.03)	(.02)
Rainfall	.0045	.0052	.0084	.0081	.0102	.0095
	(.78)	(.75)	(.48)	(.50)	(.36)	(.39)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days moderate					
Temperature	.1813	.2017*	.195*	.2089*	.2119**	.2239**
	(.14)	(.09)	(.08)	(.06)	(.02)	(.01)
Rainfall	-.0102	-.0097	-.0052	-.0054	-.0015	-.002
	(.41)	(.44)	(.56)	(.54)	(.87)	(.83)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days severe					
Temperature	.0943	.1017	.1246**	.1284**	.1198**	.1236**
	(.38)	(.34)	(.03)	(.03)	(.04)	(.03)
Rainfall	-.0081	-.008	-.0002	-.0005	.003	.0026
	(.20)	(.21)	(.91)	(.85)	(.45)	(.52)
N	59,930	59,605	59,930	59,605	59,930	59,605
	Depression: 30 days extreme					
Temperature	.006	.007	.0342	.035	.0237	.0242
	(.91)	(.90)	(.20)	(.19)	(.28)	(.27)
Rainfall	-.0021*	-.002*	6.542e-06	-.00002	.0004	.0004
	(.09)	(.09)	(.99)	(.99)	(.84)	(.85)
N	59,930	59,605	59,930	59,605	59,930	59,605
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A4. Impact of In Utero Log(Temperature) on Separate Depression Measures: Symptoms

	(1)	(2)	(3)	(4)	(5)	(6)
	Feel Depressed: past 12 months					
Temperature	.2412**	.2504**	.2705***	.274***	.2412**	.2504**
	(.01)	(.01)	(0.00)	(0.00)	(.01)	(.01)
Rainfall	-.0087	-.0087	-.0063	-.0069	-.0087	-.0087
	(.29)	(.30)	(.32)	(.29)	(.29)	(.30)
N	59,050	58,738	59,050	58,738	59,050	58,738
	Lost interest: past 12 months					
Temperature	.1392	.1443	.1901**	.19**	.1392	.1443
	(.15)	(.14)	(.02)	(.02)	(.15)	(.14)
Rainfall	-.0016	-.0018	.0004	-.0004	-.0016	-.0012
	(.80)	(.79)	(.95)	(.96)	(.80)	(.79)
N	58,970	58,651	58,970	58,651	58,970	58,651
	Decreased energy: past 12 months					
Temperature	.1963	.2069	.1402**	.1439**	.1963	.2069
	(.17)	(.16)	(.01)	(.01)	(.17)	(.16)
Rainfall	.0082	.0087	.0105*	.0104*	.0082	.0087
	(.35)	(.35)	(.06)	(.07)	(.35)	(.35)
N	58,788	58,471	58,788	58,471	58,788	58,471
	Feel depressed, more than two weeks					
Temperature	.3333**	.3333**	.2827***	.2779**	.3333**	.3333**
	(.02)	(.02)	(.006)	(.01)	(.02)	(.02)
Rainfall	.0107	.0103	.0134**	.0124*	.0107	.0103
	(.30)	(.32)	(.02)	(.05)	(.30)	(.32)
N	56,100	55,796	56,100	55,796	56,100	55,796
	Feel depressed most of time					
Temperature	.233*	.2321*	.2113**	.2039**	.233*	.2321*
	(.05)	(.06)	(.02)	(.02)	(.05)	(.06)
Rainfall	.0005	.0008	.0012	.0006	.0005	.0008
	(.90)	(.86)	(.83)	(.91)	(.90)	(.86)
N	56,022	55,721	56,022	55,721	56,022	55,721
	Lost appetite: past 12 months					
Temperature	.1833	.1975	.1637**	.1724**	.1833	.1975
	(.12)	(.10)	(.01)	(.01)	(.12)	(.10)
Rainfall	.0032	.004	.0029	.003	.0032	.0040
	(.71)	(.67)	(.67)	(.67)	(.71)	(.67)
N	56,036	55,734	56,036	55,734	56,036	55,734
	Slow thinking: past 12 months					
Temperature	.0582	.0612	.0584	.0562	.0582	.0612
	(.60)	(.58)	(.38)	(.40)	(.60)	(.58)
Rainfall	-.0038	-.0033	-.0001	-.0004	-.0038	-.0033
	(.66)	(.70)	(.99)	(.97)	(.66)	(.70)
N	56,006	55,704	56,006	55,704	56,006	55,704
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A5. Impact of In Utero Log(Temperature) on Separate Depression Measures: Treatment

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: diagnosed past 12 months					
Temperature	-.0767	-.0767	-.0402	-.0418	-.0377	-.0394
	(.21)	(.21)	(.28)	(.25)	(.32)	(.28)
Rainfall	-.0061*	-.0061*	-.002	-.0021	-.0018	-.002
	(.06)	(.06)	(.54)	(.53)	(.60)	(.58)
N	58,630	58,326	58,630	58,326	58,630	58,326
	Depression: ever treated					
Temperature	.0189	.0131	.0349	.0272	.0095	.0015
	(.56)	(.67)	(.19)	(.27)	(.66)	(.92)
Rainfall	-.0025	-.0027	-.0007	-.0011	-.0012	-.0018
	(.25)	(.21)	(.78)	(.62)	(.57)	(.40)
N	51,467	51,190	51,467	51,190	51,467	51,190
	Depression: medicated past 2 weeks					
Temperature	-.0131	-.023	.0013	-.0107	-.0059	-.0174
	(.69)	(.49)	(.94)	(.70)	(.87)	(.57)
Rainfall	-.0029*	-.0032*	-.0019	-.0024	-.0026	-.0031*
	(.07)	(.06)	(.20)	(.12)	(.12)	(.05)
N	51,044	50,771	51,044	50,771	51,044	50,771
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A6. Impact of In Utero Log(Temperature) on Aggregate Depression Measures: Removing Probable Migrants

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.7474	.7919*	1.0961***	1.1496***	.7139**	.747**
	(.10)	(.09)	(0.00)	(0.00)	(.02)	(.02)
Rainfall	-.0002	.0022	.0292	.0289	.0269	.0263
	(.99)	(.93)	(.21)	(.22)	(.32)	(.31)
N	42,519	42,385	42,519	42,385	42,519	42,385
	Depression: avg. of non- missing					
Temperature	.686*	.7299**	1.001***	1.0506***	.7578**	.7839**
	(.05)	(.04)	(0.00)	(0.00)	(.01)	(.01)
Rainfall	-.0152	-.0145	.0131	.0115	.0155	.0132
	(.73)	(.75)	(.57)	(.63)	(.49)	(.56)
N	49,980	49,831	49,980	49,831	49,980	49,831
	Depression: m.e., no missing					
Temperature	.8005	.8401*	1.0073***	1.0575***	.6515**	.6826**
	(.10)	(.09)	(0.00)	(0.00)	(.03)	(.03)
Rainfall	.0059	.0079	.0255	.0251	.0271	.0263
	(.85)	(.80)	(.23)	(.25)	(.29)	(.29)
N	42,519	42,385	42,519	42,385	42,519	42,385
	Depression: me. of non- missing					
Temperature	.7555**	.7939**	1.0798***	1.1185***	.7823**	.8012**
	(.04)	(.03)	(0.00)	(0.00)	(.01)	(.01)
Rainfall	.0061	.0062	.0296	.027	.029	.027
	(.81)	(.81)	(.22)	(.25)	(.26)	(.29)
N	49,980	49,831	49,980	49,831	49,980	49,831
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A7. Impact of In Utero Log(Temperature) on Aggregate Depression Measures: Lags and Leads

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature 2 Year Lead	.3673	.3572	.3367	.319	.4079	.3736
	(.48)	(.50)	(.42)	(.47)	(.35)	(.40)
Temperature 1 Year Lead	-.5041	-.5445*	-.3503	-.3923	-.3587	-.3949
	(.11)	(.08)	(.17)	(.12)	(.16)	(.12)
Contemporaneous Temperature	-.4156	-.437	-.5266*	-.5551*	-.5079*	-.5477*
	(.17)	(.16)	(.06)	(.06)	(.09)	(.07)
Temperature 1 Year Lag (In-utero)	1.0605***	1.0768***	.9702***	.9805***	1.0016***	1.0259***
	(.002)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	-.2074	-.107	-.1988	-.1009	-.1472	-.0563
	(.56)	(.76)	(.42)	(.65)	(.56)	(.84)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing					
Temperature 2 Year Lead	.1718	.1652	.2433	.2199	.2618	.2252
	(.68)	(.69)	(.50)	(.54)	(.44)	(.53)
Temperature 1 Year Lead	-.6714*	-.6973*	-.5812*	-.6127*	-.5669*	-.5937*
	(.06)	(.05)	(.08)	(.06)	(.09)	(.05)
Contemporaneous Temperature	-.0145	-.0325	-.0754	-.1005	-.0235	-.0529
	(.91)	(.86)	(.74)	(.65)	(.89)	(.80)
Temperature 1 Year Lag (In-utero)	.9108***	.9362***	.9313***	.9453***	.9231***	.9444***
	(.002)	(.002)	(.002)	(.002)	(0.00)	(0.00)
Temperature 2 Year Lag	-.1485	-.0895	-.1341	-.0826	-.135	-.0887
	(.65)	(.78)	(.57)	(.72)	(.58)	(.68)
N	60,188	59,857	60,188	59,857	60,188	59,857
	Depression: m.e., no missing					
Temperature 2 Year Lead	.4008	.3971	.3371	.3238	.4052	.3787
	(.45)	(.46)	(.43)	(.46)	(.38)	(.43)
Temperature 1 Year Lead	-.4971	-.5319	-.3495	-.3867	-.3827	-.4138
	(.13)	(.12)	(.20)	(.16)	(.18)	(.15)
Contemporaneous Temperature	-.3325	-.3661	-.4701*	-.5111*	-.4819	-.5334*
	(.31)	(.29)	(.09)	(.08)	(.11)	(.09)
Temperature 1 Year Lag (In-utero)	.9886***	.9998***	.8765***	.8819***	.907***	.9277
	(.002)	(.002)	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	-.0393	.0555	-.0628	.0291	-.0358	.051
	(.91)	(.88)	(.79)	(.89)	(.89)	(.84)
N	51,647	51,369	51,647	51,369	51,647	51,369
	Depression: me. of non- missing					
Temperature 2 Year Lead	.234	.2302	.2817	.2628	.3366	.305
	(.63)	(.64)	(.47)	(.52)	(.38)	(.44)
Temperature 1 Year Lead	-.7594*	-.7904*	.6599*	-.6971*	-.6579	-.6917*
	(.06)	(.05)	(.08)	(.07)	(.10)	(.07)
Contemporaneous Temperature	.0596	.0365	-.0289	-.0595	-.0313	-.0656
	(.89)	(.93)	(.90)	(.80)	(.90)	(.81)
Temperature 1 Year Lag (In-utero)	.8711***	.8937***	.8707***	.8829***	.8859***	.9058***
	(.004)	(.004)	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	.0058	.0675	.0103	.064	.0136	.0613
	(.97)	(.79)	(.95)	(.76)	(.97)	(.76)
N	60,188	59,857	60,188	59,857	60,188	59,857
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y
Controls for Rainfall (2 year lag, 1 year lag, contemporaneous rainfall, 1 year lead and 2 year lead)	Y	Y	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A8. Impact of In Utero Log(Temperature) on Aggregate Depression Measures: Controlling for Health and Education

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression: avg, no missing					
Temperature	.5917	.6372	.6484**	.6888***	.7509***	.7966
	(.14)	(.11)	(.01)	(.008)	(0.00)	(0.00)
Rainfall	-.0018	.0001	.0069	.0074	.022	.0223
	(.98)	(.96)	(.73)	(.72)	(.39)	(.38)
Health	.3054***	.2987***	.3039***	.2972***	.3033***	.2966***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.023***	-.0142	-.0228***	-.0139	-.0226***	-.0138
	(.008)	(.12)	(.008)	(.11)	(.008)	(.10)
BMI	0.0002	.0001	.0003	.0002	.0003	.0002
	(.66)	(.74)	(.58)	(.68)	(.57)	(.66)
N	37,813	37,649	37,813	37,649	37,813	37,649
	Depression: avg. of non- missing					
Temperature	.5677	.6038	.7171**	.7403**	.7874***	.8122***
	(.15)	(.14)	(.02)	(.01)	(.002)	(0.00)
Rainfall	.0012	.0021	.013	.0124	.023	.0222
	(.94)	(.90)	(.53)	(.53)	(.31)	(.31)
Health	.2807***	.2746***	.2794***	.2733***	.2801***	.2741***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0194**	-.013*	-.0203**	-.0139*	-.0197**	-.0133*
	(.01)	(.09)	(.01)	(.07)	(.01)	(.09)
BMI	.0004	.0003	.0004	.0003	.0004	.0003
	(.35)	(.41)	(.33)	(.39)	(.31)	(.36)
N	42,847	42,651	42,847	42,651	42,847	42,651
	Depression: m.e., no missing					
Temperature	.6567*	.6934*	.6642**	.6944**	.7363***	.7748***
	(.09)	(.08)	(.01)	(.01)	(0.00)	(0.00)
Rainfall	.0011	.0026	.0063	.0063	.0198	.0199
	(.93)	(.88)	(.72)	(.72)	(.40)	(.39)
Health	.2677***	.2615***	.2666***	.2603***	.2659***	.2597***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0224**	-.0139	-.0223***	-.0136	-.022**	-.0134
	(.01)	(.11)	(.006)	(.11)	(.01)	(.10)
BMI	.0002	.0001	.0003	.0002	.0002	.0002
	(.69)	(.79)	(.61)	(.68)	(.62)	(.69)
N	37,813	37,649	37,813	37,649	37,813	37,649
	Depression: me. of non- missing					
Temperature	.5465	.5769	.6767***	.6931***	.7394***	.7598***
	(.14)	(.13)	(.008)	(.008)	(0.00)	(0.00)
Rainfall	.003	.0039	.0111	.0104	.0214	.0207
	(.84)	(.82)	(.61)	(.63)	(.36)	(.38)
Health	.2664***	.2602***	.2654***	.2592***	.2659***	.2597***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0227***	-.0149*	-.0234***	-.0155*	-.0227***	-.0148*
	(.006)	(.07)	(.004)	(.06)	(.006)	(.07)
BMI	.0002	.0001	.0003	.0002	.0003	.0002
	(.63)	(.79)	(.56)	(.67)	(.50)	(.61)
N	42,847	42,651	42,847	42,651	42,847	42,651
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A9. Impact of In Utero Temperature on Aggregate Depression Measures (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: avg, no missing			
	Linear	Linear	Log	Log
Temperature	.03658***	.03855***	.84834***	.89826***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.00027	.00028	.01316	.01348
	(.48)	(.48)	(.56)	(.57)
N	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing			
Temperature	.03732***	.03914***	.86827***	.90519***
	(.004)	(.004)	(.004)	(.004)
Rainfall	.00025	.00024	.00507	.00361
	(.39)	(.44)	(.83)	(.89)
N	60,190	59,859	60,190	59,859
	Depression: m.e., no missing			
Temperature	.03336***	.03482***	.79262***	.83184***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.00015	.00016	.01041	.01039
	(.70)	(.68)	(.62)	(.63)
N	51,647	51,369	51,647	51,369
	Depression: me. of non- missing			
Temperature	.03766***	.03906***	.90916***	.9383***
	(.002)	(.002)	(.002)	(.002)
Rainfall	.00022	.00021	.01628	.01435
	(.54)	(.57)	(.48)	(.53)
N	60,190	59,859	60,190	59,859
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A10. Impact of In Utero Temperature on Separate Depression Measures: General Depression (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: 30 days			
	Linear	Linear	Log	Log
Temperature	.0332**	.0351**	.787**	.827**
	(.04)	(.04)	(.04)	(.03)
Rainfall	.0005	.0004	.0203	.019
	(.17)	(.18)	(.40)	(.44)
N	59,930	59,605	59,930	59,605
	Depression: 30 days mild			
Temperature	.0142*	.015*	.356*	.375*
	(.05)	(.05)	(.05)	(.05)
Rainfall	.0002*	.0002	.0148	.014
	(.09)	(.11)	(.22)	(.24)
N	59,930	59,605	59,930	59,605
	Depression: 30 days moderate			
Temperature	.012*	.0125*	.2553*	.2659**
	(.06)	(.05)	(.06)	(.04)
Rainfall	.0001	.0001	.0013	.0008
	(.36)	(.38)	(.92)	(.97)
N	59,930	59,605	59,930	59,605
	Depression: 30 days severe			
Temperature	.0063	.0069*	.1311	.141*
	(.10)	(.06)	(.12)	(.09)
Rainfall	.0001	.0001	.0029	.0027
	(.42)	(.42)	(.53)	(.56)
N	59,930	59,605	59,930	59,605
	Depression: 30 days extreme			
Temperature	.0007	.0007	.0446	.0452
	(.52)	(.57)	(.16)	(.16)
Rainfall	-7.613e-06	-7.793e-06	.0015	.0015
	(.81)	(.79)	(.52)	(.52)
N	59,930	59,605	59,930	59,605
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A11. Impact of In Utero Temperature on Separate Depression Measures: Symptoms (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Feel depressed: past 12 months			
	Linear	Linear	Log	Log
Temperature	.0151***	.0158***	.3544***	.368***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	-.0001	-.0001	-.0067	-.0071
	(.38)	(.37)	(.38)	(.35)
N	59,050	58,738	59,050	58,738
	Lost interest: past 12 months			
Temperature	.0121***	.0122***	.2961***	.3003***
	(.008)	(.008)	(.006)	(.006)
Rainfall	-.0001	-.0001	.0004	.0004
	(.63)	(.61)	(.99)	(.93)
N	58,970	58,651	58,970	58,651
	Decreased energy: past 12 months			
Temperature	.0029	.0033	.0762	.085
	(.54)	(.49)	(.39)	(.35)
Rainfall	.00004	.00004	.0075	.0073
	(.71)	(.70)	(.22)	(.25)
N	58,788	58,471	58,788	58,471
	Feel depressed, more than two weeks			
Temperature	.0156***	.0155***	.3973***	.3956***
	(.002)	(.004)	(0.00)	(.002)
Rainfall	.0002*	.0002*	.0179***	.0167
	(.05)	(.06)	(.002)	(.002)
N	56,100	55,796	56,100	55,796
	Feel depressed most of time			
Temperature	.0091*	.0088*	.2467***	.244**
	(.05)	(.06)	(.008)	(.01)
Rainfall	-.00002	-.00002	.0059	.0053
	(.83)	(.83)	(.39)	(.43)
N	56,022	55,721	56,022	55,721
	Lost appetite: past 12 months			
Temperature	.0102**	.0115**	.2348***	.2525***
	(.02)	(.01)	(.006)	(.006)
Rainfall	.0001	.0001	.0027	.0029
	(.74)	(.68)	(.72)	(.72)
N	56,036	55,734	56,036	55,734
	Slow thinking: past 12 months			
Temperature	.0079*	.008*	.0181**	.1857**
	(.08)	(.08)	(.03)	(.03)
Rainfall	.00003	.00003	.0019	.0018
	(.82)	(.83)	(.83)	(.83)
N	56,006	55,704	56,006	55,704
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A12. Impact of In Utero Temperature on Separate Depression Measures: Treatment (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: diagnosed past 12 months			
	Linear	Linear	Log	Log
Temperature	-.0004	-.0004	.0023	.0016
	(.93)	(.91)	(.98)	(.98)
Rainfall	-.00006	-.00006	-.0023	-.0026
	(.33)	(.32)	(.47)	(.43)
N	58,630	58,326	58,630	58,326
	Depression: ever treated			
Temperature	.0005	.0002	.0292	.0244
	(.77)	(.88)	(.37)	(.45)
Rainfall	-.00002	-.00003	-.0002	-.0006
	(.86)	(.82)	(.91)	(.74)
N	51,467	51,190	51,467	51,190
	Depression: medicated past 2 weeks			
Temperature	.00004	-.0006	-.0064	-.0169
	(.95)	(.83)	(.92)	(.73)
Rainfall	-.00006*	-.00006*	-.0015	-.0018
	(.07)	(.06)	(.40)	(.26)
N	51,044	50,771	51,044	50,771
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A13. Impact of In Utero Temperature on Aggregate Depression Measures: Removing Probable Migrants (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: avg, no missing			
	Linear	Linear	Log	Log
Temperature	.0486***	.0509***	1.0961***	1.1496***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0004	.0004	.0293	.0289
	(.33)	(.33)	(.21)	(.22)
N	42,519	42,385	42,519	42,385
	Depression: avg. of non- missing			
Temperature	.0445***	.0472***	1.001***	1.0506***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0003	.0003	.0131	.0115
	(.37)	(.41)	(.57)	(.63)
N	49,980	49,831	49,980	49,831
	Depression: m.e., no missing			
Temperature	.0444***	.0465***	1.0073***	1.0575***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0003	.0003	.0255	.0251
	(.49)	(.48)	(.23)	(.25)
N	42,519	42,385	42,519	42,385
	Depression: me. of non- missing			
Temperature	.047***	.0491***	1.08***	1.1185***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0003	.0003	.0296	.027
	(.32)	(.36)	(.22)	(.56)
N	49,980	49,831	49,980	49,831
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A14. Impact of In Utero Temperature on Aggregate Depression Measures: Lags and Leads (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: avg, no missing			
	Linear	Linear	Log	Log
Temperature 2 Year Lead	.01	.0081	.3782	.3359
	(.66)	(.73)	(.40)	(.48)
Temperature 1 Year Lead	-.01	-.012	-.3903	-.4127
	(.42)	(.34)	(.15)	(.13)
Contemporaneous Temperature	-.022	-.024	-.4932	-.5134
	(.20)	(.18)	(.19)	(.17)
Temperature 1 Year Lag (In-utero)	.0474***	.0492***	1.12***	1.1513***
	(.002)	(.002)	(0.00)	(0.00)
Temperature 2 Year Lag	-.0051	-.0007	-.0831	.0107
	(.66)	(.93)	(.71)	(.95)
N	51,647	51,369	51,647	51,369
	Depression: avg. of non- missing			
Temperature 2 Year Lead	.0046	.0018	.11	.0537
	(.80)	(.90)	(.76)	(.89)
Temperature 1 Year Lead	-.0304*	-.0319**	-.7284**	-.7449**
	(.05)	(.04)	(.03)	(.01)
Contemporaneous Temperature	-.0022	-.0045	-.0452	-.072
	(.84)	(.70)	(.85)	(.77)
Temperature 1 Year Lag (In-utero)	.0447***	.0467***	1.032***	1.0642***
	(0.00)	(.002)	(.002)	(0.00)
Temperature 2 Year Lag	-.0093	-.0066	-.1006	-.0458
	(.47)	(.59)	(.70)	(.86)
N	60,188	59,857	60,188	59,857
	Depression: m.e., no missing			
Temperature 2 Year Lead	.0071	.0058	.3633	.3313
	(.77)	(.81)	(.47)	(.50)
Temperature 1 Year Lead	-.0123	-.0139	-.4227	-.4399
	(.34)	(.29)	(.15)	(.15)
Contemporaneous Temperature	-.0206	-.0234	-.4265	-.4604
	(.28)	(.24)	(.28)	(.26)
Temperature 1 Year Lag (In-utero)	.0436***	.0451***	1.0149***	1.0398***
	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	-.0015	.0026	.0267	.1157
	(.85)	(.84)	(.96)	(.66)
N	51,647	51,369	51,647	51,369
	Depression: me. of non- missing			
Temperature 2 Year Lead	.0083	.0057	.2456	.1934
	(.69)	(.79)	(.57)	(.65)
Temperature 1 Year Lead	-.0295	-.0312*	-.7761*	-.7944**
	(.12)	(.08)	(.06)	(.04)
Contemporaneous Temperature	-.0024	-.0049	.0119	-.0197
	(.84)	(.75)	(.98)	(.94)
Temperature 1 Year Lag (In-utero)	.0437***	.0455***	1.02***	1.0462***
	(0.00)	(0.00)	(0.00)	(0.00)
Temperature 2 Year Lag	.0001	.0025	.0903	.1442
	(1.00)	(.78)	(.64)	(.48)
N	60,188	59,857	60,188	59,857
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	N	N
Grid Point Trends	Y	Y	Y	Y
Country by 5 Year FE	Y	Y	Y	Y
Controls for Rainfall (2 year lag, 1 year lag, contemporaneous rainfall, 1 year lead and 2 year lead)	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A15. Impact of In Utero Temperature on Aggregate Depression Measures: Controlling for Health and Education (Including Country by 5-Year Fixed Effects)

	(1)	(2)	(3)	(4)
	Depression: avg, no missing			
	Linear	Linear	Log	Log
Temperature	.0365***	.0385***	.9116***	.9557***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0003	.0003	.0221	.022
	(.43)	(.44)	(.38)	(.39)
Health	.3011***	.2945***	.3011***	.2945***
	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0227***	-.014	-.0227***	-.014
	(.008)	(.11)	(.008)	(.11)
BMI	.0003	.0002	.0003	.0002
	(.57)	(.64)	(.58)	(.64)
N	37,813	37,649	37,813	37,649
	Depression: avg. of non- missing			
Temperature	.0382***	.0403***	.947***	.987***
	(.004)	(.002)	(.004)	(.002)
Rainfall	.0003	.0003	.017	.0165
	(.34)	(.37)	(.49)	(.50)
Health	.2783***	.2723***	.2783***	.2723***
	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0202**	-.0139*	-.0202***	-.0139*
	(.01)	(.08)	(.01)	(.08)
BMI	.0005	.0004	.0005	.0004
	(.30)	(.34)	(.30)	(.34)
N	42,847	42,651	42,847	42,651
	Depression: m.e., no missing			
Temperature	.0383***	.0399***	.9493***	.9865***
	(0.00)	(0.00)	(0.00)	(0.00)
Rainfall	.0001	.0001	.0193	.0188
	(.72)	(.72)	(.38)	(.40)
Health	.2641***	.2579***	.2641***	.2579***
	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0223***	-.0137	-.0223***	-.0137
	(.006)	(.10)	(.006)	(.10)
BMI	.0003	.0002	.0003	.0002
	(.57)	(.68)	(.58)	(.68)
N	37,813	37,649	37,813	37,649
	Depression: me. of non- missing			
Temperature	.0388***	.0402***	.9656***	.9933***
	(.004)	(0.00)	(0.00)	(0.00)
Rainfall	.0002	.0002	.021	.0199
	(.58)	(.60)	(.35)	(.38)
Health	.2641***	.258***	.2641***	.258***
	(0.00)	(0.00)	(0.00)	(0.00)
Education	-.0231***	-.0153*	-.0231***	-.0153*
	(.004)	(.06)	(.004)	(.06)
BMI	.0003	.0002	.0003	.0002
	(.50)	(.58)	(.50)	(.59)
N	42,847	42,651	42,847	42,651
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y
Controls	N	Y	N	Y
Country Trends	N	N	Y	Y
Grid Point Trends	N	N	N	N
Country by 5 Year FE	Y	Y	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A16. Role of Country-Level Health Spending and Infrastructure on Reducing the Impact of In Utero Temperature on Aggregate Depression (Depression measure: Average, No Missing Data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Depression: avg, no missing							
Temperature	.0236**	.0241**	0.0198*	.0199	.022***	.0227***	.0165**	0.0178**
	(.03)	(.03)	(.09)	(.11)	(.004)	-0.006	(.03)	(.04)
Community health workers (per 1,000 people) X Temperature	.0104	.0112						
	(.67)	(.67)						
Community health workers (per 1,000 people)	-.1653	-.1744						
	(.71)	(.71)						
Hospital beds (per 1,000 people) X Temperature			0.0058	.006				
			(.80)	(.79)				
Hospital beds (per 1,000 people)			-.1487	-.1593				
			(.80)	(.79)				
Health expenditure per capita, PPP (constant 2011 international $) X Temperature					-.0012	-.0011		
					(.78)	(.79)		
Health expenditure per capita, PPP (constant 2011 international $)					.0417	.0419		
					(.64)	(.63)		
Health expenditure, public (% of total health expenditure) X Temperature							-.0026	-.003
							(.56)	(.49)
Health expenditure, public (% of total health expenditure)							-.004	.0121
							(1.00)	(.89)
N	15,050	15,025	37,796	37,602	36,421	36,227	36,421	36227
Rainfall Controls	Y	Y	Y	Y	Y	Y	Y	Y
Grid Point FE	Y	Y	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A17. Role of Country-Level Health Spending and Infrastructure on Reducing the Impact of In Utero Temperature on Aggregate Depression (Depression measure : Average of Non-Missing)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Depression: avg. of non- missing							
Temperature	.0276**	.0276**	.027*	.0265*	.0292***	.0298***	.0254***	.0264***
	(.03)	(.03)	(.06)	(.05)	(.004)	(0.004)	(.006)	(.006)
Community health workers (per 1,000 people) X Temperature	.0102	.0105						
	(.57)	(.55)						
Community health workers (per 1,000 people)	-.1954	-.1932						
	(.66)	(.66)						
Hospital beds (per 1,000 people) X Temperature			.0034	.004				
			(.87)	(.84)				
Hospital beds (per 1,000 people)			-.1048	-.1256				
			(.85)	(.82)				
Health expenditure per capita, PPP (constant 2011 international $) X Temperature					-.0011	-.0012		
					(.76)	(.75)		
Health expenditure per capita, PPP (constant 2011 international $)					.0438	.0479		
					(.66)	(.63)		
Health expenditure, public (% of total health expenditure) X Temperature							-.001	-.0014
							(.67)	(.58)
Health expenditure, public (% of total health expenditure)							-.0131	-.0025
							(.89)	(.99)
N	16,474	16,447	43,695	43,457	42,296	42,058	42,296	42,058
Rainfall Controls	Y	Y	Y	Y	Y	Y	Y	Y
Grid Point FE	Y	Y	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A18. Role of Country-Level Health Spending and Infrastructure on Reducing the Impact of In Utero Temperature on Aggregate Depression (Depression measure: Mean Effect, No Missing Data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Depression: m.e., no missing							
Temperature	.0274**	.0283**	.0208*	.0208*	.0235***	.0238**	.0172**	.0181**
	(.01)	(.03)	(.06)	(.07)	(.004)	(.01)	(.04)	(.04)
Community health workers (per 1,000 people) X Temperature	.0118	.0126						
	(.67)	(.67)						
Community health workers (per 1,000 people)	-.1964	-.2042						
	(.73)	(.69)						
Hospital beds (per 1,000 people) X Temperature			.0071	.0072				
			(.68)	(.66)				
Hospital beds (per 1,000 people)			-.1013	-.1906				
			(.67)	(.63)				
Health expenditure per capita, PPP (constant 2011 international $) X Temperature					-.0012	-.0011		
					(.76)	(.78)		
Health expenditure per capita, PPP (constant 2011 international $)					.0436	.0429		
					(.63)	(.63)		
Health expenditure, public (% of total health expenditure) X Temperature							-.0016	-.002
							(.68)	(.61)
Health expenditure, public (% of total health expenditure)							-.0256	-.0144
							(.86)	(.94)
N	15,050	15,025	37,796	37,602	36,421	36,227	36,421	36,227
Rainfall Controls	Y	Y	Y	Y	Y	Y	Y	Y
Grid Point FE	Y	Y	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A19. Role of Country-Level Health Spending and Infrastructure on Reducing the Impact of In Utero Temperature on Aggregate Depression (Depression measure: Mean Effect, Average of Non-Missing Data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Depression: me. of non- missing							
Temperature	.0342**	.0337**	.0267**	.0265**	.0294***	.0299***	.0241**	.0251**
	(.03)	(.03)	(.03)	(.03)	(.002)	(.002)	(.01)	(.01)
Community health workers (per 1,000 people) X Temperature	.0111	.0116						
	(.61)	(.61)						
Community health workers (per 1,000 people)	-.1955	-.1993						
	(.73)	(.73)						
Hospital beds (per 1,000 people) X Temperature			.0053	.0055				
			(.85)	(.84)				
Hospital beds (per 1,000 people)			-.1405	-.1519				
			(.83)	(.82)				
Health expenditure per capita, PPP (constant 2011 international $) X Temperature					-.0009	-.0009		
					(.79)	(.78)		
Health expenditure per capita, PPP (constant 2011 international $)					.0364	.0392		
					(.65)	(.63)		
Health expenditure, public (% of total health expenditure) X Temperature							-.0011	-.0015
							(.73)	(.63)
Health expenditure, public (% of total health expenditure)							-.0237	-.0122
							(.85)	(.94)
N	16,474	16,447	43,695	43,457	42,296	42,058	42,296	42,058
Rainfall Controls	Y	Y	Y	Y	Y	Y	Y	Y
Grid Point FE	Y	Y	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap. Additional controls where included are female and urban.

TABLE A20. Role of Country-Level Health Spending and Infrastructure on Reducing the Impact of In Utero Temperature on Aggregate Depression (Depression measure: Mean Effect, Average of Non-Missing Data)

	(1)	(2)	(3)	(4)	(5)	(6)
	1(Polygynous Household)			*Wealth Index*		
Temperature	-0.0025	-0.0004	-0.0011	0.0036	0.0022	0.0051
	(.72)	(.87)	(.75)	(.49)	(.69)	(.37)
Rainfall	-0.0002	-0.00001	-0.00002	0.0001	-0.00005	-0.00008
	(.22)	(.80)	(.74)	(.76)	(.78)	(.67)
N	357,678	357,678	357,678	414,207	414,207	414,207
	1(Mother is Literate)			*Mother's age*		
Temperature	.0077	0.00008	0.0017	-0.0805	0.0562	0.062*
	(.30)	(.92)	(.16)	(.44)	(.29)	(.09)
Rainfall	-0.0002	0.000002	0.000007	-0.0009	-0.0009	-0.0008
	(.14)	(.97)	(.95)	(.74)	(.22)	(.24)
N	411,115	411,115	411,115	414,207	414,207	414,207
	1(Rural)			*1(Baby is Female)*		
Temperature	-0.0013	-0.0003	0.0001	-0.0022	-0.0025	-0.0037
	(.67)	(.96)	(.95)	(.47)	(.33)	(.14)
Rainfall	-0.00003	-0.000009	0.000007	0.000004	0.00002	0.00002
	(.50)	(.88)	(.83)	(.97)	(.80)	(.84)
N	414,207	414,207	414,207	414,207	414,207	414,207
	Birth Order			*1(Multiple Birth)*		
Temperature	-0.0579	-0.0074	0.005	0.0014	0.0005	0.0012
	(.14)	(.82)	(.77)	(.13)	(.49)	(.20)
Rainfall	0.0002	0.000007	0.0001	-0.000002	-0.00003	-0.00002
	(.61)	(1.00)	(.75)	(.93)	(.34)	(.45)
N	414,207	414,207	414,207	414,207	414,207	414,207
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Country Trends	N	Y	N	N	Y	N
Grid Point Trends	N	N	Y	N	N	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap.

TABLE A21. Countries and Years of Data Available in the DHS and the WHS)

Country	WHS Data				DHS Data			
	Min	Mean	Max	N	Min	Mean	Max	N
Burkina Faso	1937	1968.943	1985	4532	1973	1999.68	2011	56423
Côte d'Ivoire	1938	1969.313	1985	2992	1975	2000.982	2012	28033
Congo, Rep.	1938	1968.53	1985	2016				
Comoros	1938	1965.232	1985	1270	1975	2001.778	2012	11497
Ethiopia	1938	1968.467	1985	4584	1965	1992.171	2003	45540
Ghana	1938	1965.601	1985	3262	1971	1996.971	2008	11821
Kenya	1939	1969.215	1986	3839	1971	1997.543	2009	22534
Morocco	1938	1965.422	1985	3200	1966	1990.359	2004	32494
Mali	1938	1965.923	1985	3320	1975	2002.97	2013	33736
Mauritania	1938	1966.715	1985	3241	1977	2000.821	2013	67
Mauritius	1938	1964.462	1985	2114				
Malawi	1938	1970.326	1985	4791	1973	1999.51	2010	72301
Namibia	1938	1968.569	1985	3872	1978	2002.329	2013	18090
Senegal	1938	1967.112	1985	2696	1972	2000.218	2011	42510
Swaziland	1938	1967.731	1985	2675				
Chad	1938	1968.736	1985	4230				
South Africa	1937	1966.703	1985	1984				
Zambia	1938	1969.258	1985	3492	1976	2002.805	2014	49207
Zimbabwe	1938	1968.523	1985	3775	1975	1999.678	2011	19279

TABLE A22. Mean Weather and Sample Respondent Characteristics: Comparision of the DHS and the WHS)

	Mean	s.d.	Min	Max	N
			WHS Data		
Female	0.54	0.50	0	1	61,826
Year of Birth	1,968	12.6	1,937	1,986	61,885
Rain L1	79.1	44.2	0.050	333	61,885
Temperature L1	23.0	4.33	5.36	31.3	61,885
Log Rain L1	4.16	0.76	-3.00	5.81	61,885
Log Temperature L1	3.12	0.20	1.68	3.44	61,885
Rural	0.63	0.48	0	1	61,589
			DHS Data		
Female	0.49	0.50	0	1	443,532
Year of birth	1,999	8.41	1,965	2,014	443,532
Rain L1	77.1	37.0	0	282	415,317
Temperature L1	23.7	4.22	4.09	31.6	415,317
Ln Rain L1	4.21	0.59	-3.40	5.64	415,289
Ln Temperature L1	3.15	0.20	1.41	3.45	415,317
Rural	0.74	0.44	0	1	443,532

TABLE A23. Impact of In Utero Temperature on Infant Mortality (DHS Data)

	(1)	(2)	(3)	(4)	(5)	(6)
	1(Child Died as an Infant)					
Temperature	-.0035	-.0037	-.0010	-.0013	-.002	-.0023
	(.25)	(.22)	(.36)	(.25)	(.17)	(.12)
Rainfall		-.00005		-.00006*		-.00006**
		(.42)		(.07)		(.03)
N	414,207	414,207	414,207	414,207	414,207	414,207
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Country Trends	N	N	Y	Y	N	N
Grid Point Trends	N	N	N	N	Y	Y

Notes: ***Significant at the 1 percent level, **Significant at the 5 percent level, *Significant at the 10 percent level. P-values in parentheses. Standard errors are clustered at the country level unless otherwise indicated, and estimated using wild cluster bootstrap.

APPENDIX B. SURVEY INSTRUMENTS

- *Variable*: Depression: 30 days.

  Question Number: $q2090$.

  Pre-question: Now I would like to review different functions of your body. When answering these questions, I would like you to think about the last 30 days, taking both good and bad days into account. When I ask about difficulty, I would like you to consider how much difficulty you have had, on an average, in the past 30 days, while doing the activity in the way that you usually do it. By difficulty I mean requiring increased effort, discomfort or pain, slowness or changes in the way you do the activity. Please answer this question taking into account any assistance you have available.

  Literal question: Overall in the last 30 days, how much of a problem did you have with feeling sad, low or depressed?

  Valid answers: 1, None; 2, Mild; 3, Moderate; 4, Severe; 5, Extreme.

- *Variable*: Worry or anxiety in last 30 days.

  Question Number: $q2091$.

  Pre-question: Now I would like to review different functions of your body. When answering these questions, I would like you to think about the last 30 days, taking both good and bad days into account. When I ask about difficulty, I would like you to consider how much difficulty you have had, on an average, in the past 30 days, while doing the activity in the way that you usually do it. By difficulty I mean requiring increased effort, discomfort or pain, slowness or changes in the way you do the activity. Please answer this question taking into account any assistance you have available.

  Literal question: Overall in the last 30 days, how much of a problem did you have with worry or anxiety?

  Valid answers: 1, None; 2, Mild; 3, Moderate; 4, Severe; 5, Extreme.

- *Variable*: Feel depressed, past 12 months.

  Question Number: $q6028$

  Pre-question: For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is

also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

Literal question: During the last 12 months, have you had a period lasting several days when you felt sad, empty or depressed?

Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Lost interest: past 12 months.

  Question Number: $q6029$.

  Pre-question: For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

  Literal question: During the last 12 months, have you had a period lasting several days when you lost interest in most things you usually enjoy such as hobbies, personal relationships or work?

  Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Decreased energy: past 12 months.

  Question Number: $q6030$

  Pre-question: During the last 12 months, have you experienced any of the following... For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

Literal question: During the last 12 months, have you had a period lasting several days when you have been feeling your energy decreased or that you are tired all the time?

Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Feel depressed, more than two weeks.

  Question Number: $q6031$.

  Pre-question: During the last 12 months, have you experienced any of the following... For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

  Literal question: Was this period [of sadness/loss of interest/low energy] more than 2 weeks?

  Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Feel depressed most of time.

  Question Number: $q6032$.

  Pre-question: During the last 12 months, have you experienced any of the following... For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

  Literal question: Was this period [of sadness/loss of interest/low energy] most of the day, nearly every day?

  Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Lost appetite: past 12 months.

  Question Number: $q6033$.

  Pre-question: During the last 12 months, have you experienced any of the following... For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

  Literal question: During this period, did you lose your appetite?

  Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.

- *Variable*: Slow thinking: past 12 months.

  Question Number: $q6034$.

  Pre-question: During the last 12 months, have you experienced any of the following... For this set of questions, the interviewer must read out a series of symptoms and determine if the respondent had any of those symptoms in the last 12 months. The point of asking symptom-related questions is to screen those individuals who might have a specific health condition or disease. Because there could be a number of symptoms that characterise a given health condition, and because some symptoms may be common to different conditions, it is important that the interviewer probe for each symptom to see whether the respondent may have an active disease. It is also important that the time period for the symptoms (in the last 12 months) be clearly understood by the respondent and not confused with other time frames used in this section (such as "ever" and "the last 2 weeks").

  Literal question: During this period, did you notice any slowing down in your thinking?

  Valid answers: 1, Yes; 5, No. We have recoded 5 as 0.