FETAL ORIGINS OF MENTAL HEALTH: EVIDENCE FROM AFRICA

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ABSTRACT. Mental health disorders are a substantial portion of the global disease burden, and the treatment gap is higher in developing countries. We find that temperature shocks in utero increase depressive symptoms in adulthood using data on 19 African countries. A ten percent increase in heat exposure increases the depression indices by .05 to .07 standard deviations. These shocks do not significantly predict greater treatment of depressive symptoms. Temperature shocks worsen the mental health disease burden, and health care systems for the individuals in our sample do not appear to measurably mitigate these impacts.

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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

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(Demyttenaere et al., 2004). The majority of those affected do not receive effective treatment; 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 country populations are particularly vulnerable to mental health disorders during the most productive years of 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 individuals 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. We do not find strong 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, and so it does not appear that access to mitigating medical care is improving.

We perform several additional exercises to confirm the robustness of our results. We use data on ethnicity to exclude probable migrants from the sample, showing this does not change our results. Our baseline statistical inference allows for serial correlation at the level of countries. Our results remain robust to allowing for arbitrary serial correlation at even more aggregate levels that are approximately equivalent to districts and provinces. A more demanding specification that allows for separate time trends for each geographic point at which temperature is reported does little to the results. We do not find strong evidence that cohort size responds to temperature, and so the quantitative importance of selective fertility or mortality in explaining our results is likely to be small.

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. In animal studies, 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, interrupt 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 hamper economic growth, among other effects (Dell, Jones and Olken, 2014, 2012). These outcomes 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). However, relatively little is known about how relatively milder shocks *in utero* and early life circumstances impact mental health during adulthood. Adhvaryu, Fenske and Nyshadham (2018) find 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 (2018) 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 (2017) demonstrates 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.

To the extent that effects of temporary weather variation can be used to forecast later impacts of changes in climate, 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 informing 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 adults from nineteen African countries. Our primary regression specification is given by:

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

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 from 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] Thus, 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. 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, 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 show that the results are unlikely to be driven by migrants by removing probable migrants from the sample (see section 4.5.1 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.

3. Data

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

3.1. **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.[4] 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.[5] 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.[6] 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?"

[4]The WHO has made data available for 69 of these, including 20 in Africa.

[5]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 6, 9, and 13. These also include gender and dummy variable for urban location, which we add as controls in all specifications.

[6]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.

- *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?"
- *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 in Appendix B. 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 may be endogenous to other individual characteristics and general access to health-care. Thus, 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 $0.5° \times 0.5°$ 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.[7] 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 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.[8]

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

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

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 side variable may be measured with error. However, classical measurement error would bias our estimates downward, and so the impacts we find are likely lower bounds on actual impacts. Across individuals in the sample, the standard deviation of temperature exposure is 4.33. Considering instead the difference between an individual's temperature exposure and the point-specific mean, this difference has a standard deviation of 0.43. Note that the finest temporal resolution of the raw data is monthly, which prevents us from using degree days or other measures of temperature exposure that use daily variations.

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. Coefficients on rainfall are not reported here for space, but are reported in Table A1 in the Appendix.

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.

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). It is also roughly in line with other studies on the impacts of temperature on health, including Catalano, Bruckner and Smith (2008); Danet et al. (1999); Dell, Jones and Olken (2014) and Barreca et al. (2016).

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. **Adaptation.** The individuals in our sample are from cohorts born between 1937 and 1986. Next, we test whether individuals are adapting to these effects by seeking (and gaining access to) medical care.[9]

In Table 3, we explore impacts on diagnosis and treatment of depression.[10] Despite robust, consistent evidence of significant impacts on the incidence of mild-to-severe depression and long-lasting symptoms of depression, Table 3 does not show clear evidence of on treatment outcomes such as receiving a formal diagnosis of depression in the past year; having taken medication for the treatment of depression in the past two weeks, or; ever having received treatment. The 95%

[9]Readers familiar with the medical literature may prefer the term “mitigation” to “adaptation,” since we examine ex-post responses.

[10]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.

confidence intervals suggest that we can rule out effects of an additional one degree of temperature of 0.212 percentage points for diagnosis in the past year, 0.365 percentage points for ever being treated, and 0.351 percentage points for medication in the past two weeks. That is, we can rule out even relatively small treatment effects.

These results are robust to 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. 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.

We report supporting evidence in the appendix. In table A2, 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 evidence of significant interactions of these country-level variables with temperature before birth. We do not find strong evidence, then, that they have played a quantitatively important role in facilitating adaptation.

4.3. **Heterogeneity and mediation.**

4.3.1. *Heterogeneous Effects by Age.* In Tables 4 and 5, we divide our sample by age, estimating results separately for individuals with above-median and below-median ages. Results are both 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, eventually 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.

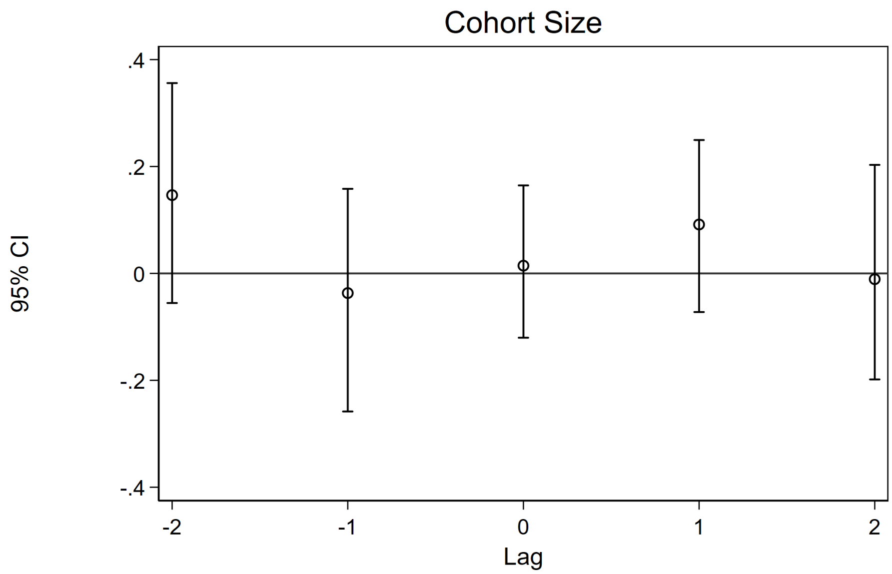
4.4. **Mediation by other adult outcomes.** In table 6, we evaluate whether the link between *in utero* temperature and later life mental health can be accounted for by other later life outcomes; i.e., the degree to which these serve as mediators or candidate mechanisms through which the effect of temperature 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. Accordingly, the role of these other outcomes as possible mediators appears small.

4.5. **Robustness.**

4.5.1. *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 7 are nearly identical to our baseline results.

4.5.2. *Selective fertility and mortality.* Other studies in the literature link temperatures to outcomes indicative of possible selective fertility or mortality, such as sex ratios (Catalano, Bruckner and Smith, 2008). To assess how likely it is that our results are driven by selective fertility and mortality, we make the sizes of the cohorts that appear in our sample a dependent variable in Table 8. 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 by year of birth cell does not, however, respond significantly to lagged temperature. In the same table, we show that results are similar if we use the log of the cohort size as an outcome. To give an idea of the largest effect sizes we can reject here, the widest confidence interval in the logarithmic specification has a minimum of -0.0781. This would correspond to a 7.5 percentage point reduction in cohort size ($e^{-0.0781} - 1$) in response to a one degree temperature increase. Further, we use Figure 1 to show that additional lags and leads of temperature also fail to predict cohort size.

FIGURE 1. Cohort Size: Leads and Lags



This figure reports coefficients and 95% confidence intervals from a regression of cohort size on year fixed effects, point fixed effects, and forward lags/leads of temperature. Confidence intervals computed using a wild cluster bootstrap accounting for clustering by country.

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.[11] In Table A3 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 A4, in the

[11]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.

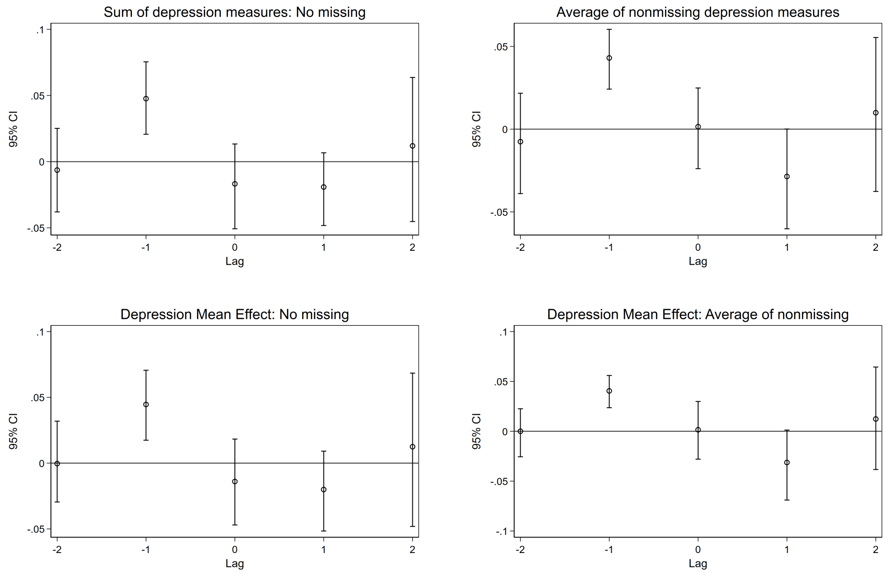
appendix, we compare some of our basic controls between the WHS and DHS samples. The WHS sample is slightly more female than the DHS sample. Again, the adults in our sample are older and born earlier than the children covered by the more recent DHS births recodes. The DHS sample is more rural than the 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 affected 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, 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 9, and do not seem to indicate that infant mortality is affected by in-utero temperature shocks conditional on the fixed effects. The widest 95% confidence interval reported corresponds to a reduction in the probability of death of 1.12 percentage points in response to a one degree temperature increase.

To test for selective fertility, we regress several key maternal and household 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 the same three specifications. We look at the following variables for the child: gender of 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 polygynous household, wealth index (constructed by DHS which includes information on the household's ownership of a number of consumer items, dwelling characteristics, water and sanitation access),[12] mother's literacy and age, and whether the person grew up in a rural household. Results are presented in Table 9. None of these variables are strongly or statistically significantly linked to in-utero temperature (or rainfall), and so we do not find strong evidence that our results are 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. The 95% confidence intervals are generally small compared to the outcome means.

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

FIGURE 2. Main results: Leads and Lags



These figures report coefficients and 95% confidence intervals from a regression of an aggregate depression index on year fixed effects, point fixed effects, and forward lags/leads of temperature. Confidence intervals computed using a wild cluster bootstrap accounting for clustering by country.

4.5.3. *Lags and leads.* In figure 2, 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. The estimates in the figure correspond to column (1) of Table 2, but results are similar if additional controls, country trends, or point-specific trends are included.

4.6. **Additional robustness.** We report several additional robustness exercises in the appendix.

4.6.1. *Components of mental health.* We study which specific indicators of mental health drive the response of our aggregate measures to *in utero* temperature exposure. In doing so we demonstrate that our aggregate results are not driven by a single indicator of mental health.

Table A5 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 A5 explore how much *in utero* temperature impacts the incidence of mild, moderate, severe, or extreme depression. The results suggest that the largest impacts in terms of percentage point increases are apparent for 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 A6 presents results from regressions of measures of specific symptoms of depression on the same temperature measure from Tables 2 and A5. Note that all of the symptom measures studied in Table A6 are measured over the 12 months prior to survey as opposed to the 30-day window measured in Table A5. 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).

4.6.2. *Omitted variables.* While our baseline approach removes omitted heterogeneity at the level of grid points and birth cohorts, and while we have reported specifications that rule out a role for omitted trends at the country and grid point levels, it is still possible that unobserved time-varying variables that correlate with intra-location temperature changes confound our results. We report several approaches in the appendix that attempt to address these.

First, we note that our results are *not* significant with country-by-year fixed effects. These are reported in Table A7. This is consistent with fixed effects exacerbating attenuation bias due to measurement error in the right-hand-side variable, since the gridded temperature reconstructions in the University of Delaware series will only capture actual temperature inexactly.

Our results do, however, remain significant with alternative approaches that are more demanding than our baseline specification. In Table A8, we replace our year of birth fixed effects with region-by-year of birth fixed effects. By "region," we follow the standard UN classification of Western, Southern, Northern, Eastern and Central Africa. The coefficient on temperature remains significant at the 10% level for four of our main outcomes, and the coefficient magnitudes are similar to our baseline. In Table A9, we report country-by-quinquennium (5-year-period) of birth fixed effects. The coefficient on temperature remains significant at the 10% level for all of our main outcomes, and the magnitude is similar to the baseline. In Table A10, we report results with quadratic point-specific trends. The coefficient on temperature remains significant at the 5% level for all of our main outcomes, and the magnitude is similar to the baseline.

In the event that temperature is correlated with country-specific macroeconomic fluctuations, we use Table A11 to show that our results are robust to controlling for log GDP per capita in the year before a respondent's birth. Although we prefer to restrict our set of baseline observable controls to outcomes that are unlikely to respond to early-life circumstance, we use Table A12 to show robustness to including additional control variables: dummies for status as household head, for marital status, for level of education, and for ethnicity. For each of these, we preserve sample size by treating "missing" as a category. Results largely remain robust to the inclusion of these additional controls.

Lastly we acknowledge that the impacts we estimate may be lower bounds on impacts given that reporting of mental health disorders is likely stigmatized (Bharadwaj, Pai and Suziedelyte, 2017).

4.6.3. *Nonlinearities.* We take several approaches to explore possible nonlinearities in the effect of in-utero temperature on mental health. First, we use table A13 to replicate the results presented in table 2, except that we use the natural log of temperature in the year before birth as our principal right hand side variable. Results remain similar to their linear temperature counterparts.

In Table A14, we add squared terms of rainfall and temperature to our baseline specification. Both the linear and quadratic terms are usually insignificant, albeit with a few exceptions. The point estimates universally suggest a positive effect of temperature over the range of values observed in the sample, given that the inflection point at which the effect of temperature becomes negative is larger than the maximum temperature recorded for our sample of individuals.

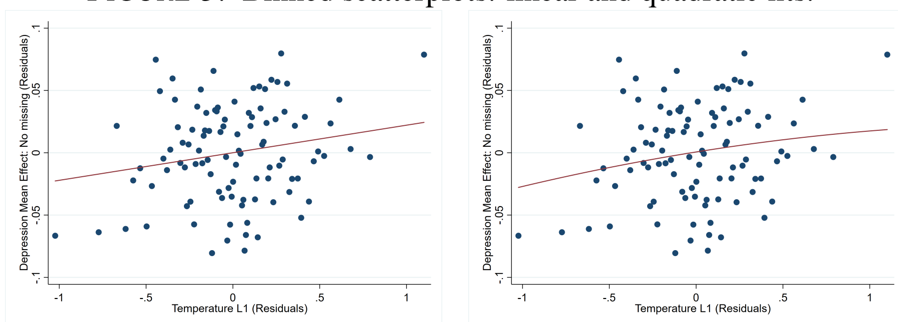
In Table A15, we replace our baseline measure of temperature with a set of four dummies. These capture deviations of temperature from the point-specific mean of one standard deviation or more, or two standard deviations or more, in either positive or negative directions. The coefficients are generally insignificant. However, they do have a pattern suggestive of our baseline specification: coefficients are generally largest and positive for a temperature two standard deviations above the point-specific mean, and negative for a temperature two standard deviations below the point-specific mean.

Relatedly, in Table A16, we re-compute our temperature variable in terms of standard deviations from the point-specific mean. We further include the square of this standardized deviation as an additional control. The linear terms resemble our baseline in that greater temperatures predict worse mental health outcomes. These are, however, only significant for two of our four main outcome measures. The quadratic terms are generally insignificant, and indeed often have a positive sign, suggesting the effect is not concave.

Further, estimating our main results in sub-samples defined by quartiles of mean temperature across grid points, we lack statistical power to distinguish effects. These are now reported in tables 17 through 20 in the appendix. Across samples, the estimates are generally positive, excepting in the 4th (warmest) quartile. But, as we lose sample size by more than two thirds in each case, these estimates are generally insignificant. The exception is in the 3rd (second-warmest) quartile, and this only in some specifications.

As another alternative, we have replaced the average temperature in the year before an individual's birth with the temperature of the hottest month during that year. We call this "maximum temperature" and report the results in Table A21. While the coefficients are positive, they are not statistically significant.

FIGURE 3. Binned scatterplots: linear and quadratic fits.



These figures report binned scatterplots of depression index residuals against lagged temperature residuals. Both are residuals net of grid point and year fixed effects. 100 bins are shown. The line in the left figure is the best linear fit of the data, and the line in the right figure is the best quadratic fit of the data.

In sum, these exploratory results generally indicate that the impacts of monthly average temperature in this case are linear or logarithmic. They largely appear to be monotonic. This is further supported by the fact that, when we plot the mental health residuals after netting out grid point and year fixed effects against in-utero temperature shock residuals also after netting out the same fixed effects, the relationship, shown in Figure 3, looks linear. In particular, we show binned scatterplots with 100 bins, and both linear and quadratic fits of the data. The quadratic fit hints at a slight concavity, but the results in Table A14 suggest that this is not statistically significant.

4.7. **Other checks.** Furthermore, we test for whether other factors are affected by 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 clear evidence of 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. These results are reported in Table A22.

The WHS data contain four questions that ask about symptoms similar to those of schizotypal or psychotic disorders:

- Whether the respondent felt something strange or unexplainable in the last 12 months.
- Whether the respondent felt people were too interested in them in the last 12 months.
- Whether the respondent felt others were controlling his or her thoughts in the last 12 months.
- Whether the respondent experienced hallucinations in the last 12 months.

We aggregate these into a mean effects index and show in Table A23 that in utero temperature does not appear to affect these symptoms. Note that the coefficient magnitudes here are smaller than in Table 2.

We present results using six measures of generalized health seeking and health expenditures in Table A24. For each, we have regressed the outcome on temperature in the year before birth, rainfall in the year before birth, temperature point fixed effects, and year of birth fixed effects. In Appendix Table A24, we report the coefficient estimates and p-values for these outcomes, as well as the mean of each outcome variable. The effect of in-utero temperature on the amount spent on healthcare by the household in the last 4 weeks is statistically significant at the 10% level, negative and a large effect relative to mean health expenditure. However, other health-seeking behaviors do not show a consistent pattern across variables - for instance, expenditure on medication and drugs, as well as expenditure on overnight hospital stays, are positive and not statistically significant. We therefore conclude that the weight of the evidence suggests that temperature exposure in utero does not seem to affect health seeking behaviors in adulthood in a systematic way.

In Table A25, we report results using an inverse-distance weighting to match individuals to temperature data. We take all grid points within 500 km of a respondent's location, and assign each point a weight of $1/D$, where D is the distance in km to the point. We then normalize these weights so that they sum to 1 for each respondent. We use these weights to assign an individual a weighted average of the temperatures at points within 500 km of his location. Results computed using this alternative method are similar to our baseline.

In Table A26, we report ordered logit results for the two ordinal outcomes used in our main aggregate indices: Depression in last 30 days and Worry/Anxiety in last 30 days. The positive and significant coefficient estimates continue to suggest adverse effects of in utero temperature exposure.

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 temperature and precipitation 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.

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 do not find clear 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, it does not appear that the effects of temperature shocks have 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. Subject to the caveat that the relationship between short-run weather effects and long-run climate effects is potentially unclear, our results are also relevant to adaptation 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.

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Table 1: Summary Statistics

	Mean	s.d.	Min	Max	N
Sum of depression measures: No missing	1.2e-08	1.00	-0.76	3.65	51,647
Average of nonmissing depression measures	-8.2e-09	1.00	-1.29	10.1	60,188
Depression Mean Effect: No missing	3.5e-09	1.00	-0.67	3.33	51,647
Depression Mean Effect: Average of nonmissing	-1.3e-10	1.00	-0.99	4.21	60,188
Depression in last 30 days	1.75	1.02	1	5	59,930
Depression in last 30 days at least mild	0.44	0.50	0	1	59,930
Depression in last 30 days at least moderate	0.21	0.41	0	1	59,930
Depression in last 30 days at least severe	0.084	0.28	0	1	59,930
Depression in last 30 days at least extreme	0.014	0.12	0	1	59,930
Worry or anxiety in last 30 days	1.75	1.02	1	5	56,600
Worry or anxiety in last 30 days at least mild	0.44	0.50	0	1	56,600
Worry or anxiety in last 30 days at least moderate	0.22	0.41	0	1	56,600
Worry or anxiety in last 30 days at least severe	0.085	0.28	0	1	56,600
Worry or anxiety in last 30 days at least extreme	0.016	0.12	0	1	56,600
Diagnosed with depression in last 12 months	0.040	0.20	0	1	58,630
Ever treated for depression	0.022	0.15	0	1	51,467
Medicated for depression in last 2 weeks	0.017	0.13	0	1	51,044
Feel sad empty or depressed for several days in last 12 months	0.25	0.43	0	1	59,050
Lost interest for several days in last 12 months	0.20	0.40	0	1	58,970
Decreased energy for several days in last 12 months	0.24	0.42	0	1	58,788
Feel sad empty or depressed for 2 weeks or more in last 12 months	0.12	0.32	0	1	56,100
Feel sad empty or depressed most of the day every day in last 12 months	0.17	0.37	0	1	56,022
Lose appetite in last 12 months	0.19	0.39	0	1	56,036
Slowing in thinking in last 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

Table 2: Main Results

	Sum of depression measures: No missing					
Temperature L1	0.0307	0.0324	0.0259	0.0271	0.0306	0.0322
p	{0.0711}	{0.0661}	{0.0160}	{0.0110}	{0.00100}	{0.00200}
CI	[-0.00345,0.0594]	[-0.00233,0.0641]	[0.00861,0.0432]	[0.00882,0.0439]	[0.0136,0.0477]	[0.0149,0.0502]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Average of nonmissing depression measures					
Temperature L1	0.0321	0.0339	0.0314	0.0323	0.0335	0.0348
p	{0.0170}	{0.0150}	{0}	{0.00100}	{0.00200}	{0.00100}
CI	[0.00771,0.0541]	[0.00985,0.0554]	[0.0146,0.0465]	[0.0165,0.0465]	[0.0170,0.0498]	[0.0178,0.0502]
N	60,167	59,835	60,167	59,835	60,167	59,835
	Depression Mean Effect: No missing					
Temperature L1	0.0312	0.0324	0.0233	0.0239	0.0261	0.0273
p	{0.0731}	{0.0781}	{0.0130}	{0.0220}	{0.0110}	{0.00601}
CI	[-0.00166,0.0612]	[-0.00357,0.0664]	[0.00619,0.0389]	[0.00579,0.0414]	[0.00772,0.0464]	[0.00899,0.0460]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0317	0.0332	0.0294	0.0299	0.0316	0.0325
p	{0.0270}	{0.0260}	{0.00300}	{0.00400}	{0.00500}	{0.00100}
CI	[0.00341,0.0581]	[0.00554,0.0629]	[0.0146,0.0433]	[0.0135,0.0449]	[0.0145,0.0474]	[0.0157,0.0484]
N	60,167	59,835	60,167	59,835	60,167	59,835
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 3: Treatment

	Diagnosed with depression in last 12 months					
Temperature L1	-0.0034	-0.0034	-0.002	-0.0021	-0.0021	-0.0022
p	{0.227}	{0.212}	{0.281}	{0.239}	{0.273}	{0.272}
CI	[-0.00901,0.00197]	[-0.00915,0.00181]	[-0.00554,0.00204]	[-0.00576,0.00159]	[-0.00593,0.00212]	[-0.00592,0.00187]
N	58,608	58,303	58,608	58,303	58,608	58,303
	Ever treated for depression					
Temperature L1	0.0007	0.0004	0.0014	0.001	0.0001	-0.0003
p	{0.580}	{0.769}	{0.207}	{0.333}	{0.946}	{0.764}
CI	[-0.00194,0.00365]	[-0.00237,0.00291]	[-0.00103,0.00384]	[-0.00110,0.00314]	[-0.00251,0.00260]	[-0.00277,0.00198]
N	51,426	51,148	51,426	51,148	51,426	51,148
	Medicated for depression in last 2 weeks					
Temperature L1	-0.0003	-0.0008	0.0003	-0.0004	0	-0.0006
p	{0.864}	{0.568}	{0.843}	{0.775}	{0.982}	{0.707}
CI	[-0.00348,0.00309]	[-0.00401,0.00250]	[-0.00277,0.00325]	[-0.00308,0.00246]	[-0.00329,0.00351]	[-0.00362,0.00263]
N	50,998	50,724	50,998	50,724	50,998	50,724
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 4: Above Median Age

	Sum of depression measures: No missing					
Temperature L1	0.0195	0.0215	0.0105	0.0116	0.0103	0.0134
p	{0.433}	{0.357}	{0.443}	{0.400}	{0.443}	{0.333}
CI	[-0.0281,0.0632]	[-0.0287,0.0654]	[-0.0192,0.0407]	[-0.0171,0.0394]	[-0.0166,0.0372]	[-0.0155,0.0388]
N	25,685	25,528	25,685	25,528	25,685	25,528
	Average of nonmissing depression measures					
Temperature L1	0.0272	0.0303	0.0255	0.0269	0.026	0.0288
p	{0.143}	{0.120}	{0.0831}	{0.0591}	{0.0931}	{0.0681}
CI	[-0.0139,0.0593]	[-0.0108,0.0635]	[-0.00491,0.0526]	[-0.00123,0.0534]	[-0.00541,0.0533]	[-0.00358,0.0554]
N	30,452	30,268	30,452	30,268	30,452	30,268
	Depression Mean Effect: No missing					
Temperature L1	0.0192	0.0202	0.007	0.0069	0.0047	0.0067
p	{0.437}	{0.413}	{0.562}	{0.603}	{0.690}	{0.604}
CI	[-0.0263,0.0652]	[-0.0311,0.0619]	[-0.0199,0.0336]	[-0.0210,0.0342]	[-0.0205,0.0293]	[-0.0181,0.0345]
N	25,685	25,528	25,685	25,528	25,685	25,528
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0232	0.0245	0.0194	0.019	0.0187	0.0198
p	{0.203}	{0.206}	{0.106}	{0.131}	{0.150}	{0.104}
CI	[-0.0139,0.0560]	[-0.0172,0.0602]	[-0.00549,0.0427]	[-0.00752,0.0429]	[-0.00756,0.0440]	[-0.00570,0.0445]
N	30,452	30,268	30,452	30,268	30,452	30,268
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 5: Below Median Age

	Sum of depression measures: No missing					
Temperature L1	0.0445	0.046	0.0448	0.0461	0.0562	0.0564
p	{0.0100}	{0.00901}	{0.00100}	{0}	{0}	{0.00100}
CI	[0.0143,0.0706]	[0.0144,0.0746]	[0.0299,0.0611]	[0.0283,0.0635]	[0.0352,0.0772]	[0.0344,0.0789]
N	25,942	25,820	25,942	25,820	25,942	25,820
	Average of nonmissing depression measures					
Temperature L1	0.0383	0.0386	0.0384	0.0382	0.0426	0.0419
p	{0.00400}	{0.00601}	{0}	{0}	{0}	{0}
CI	[0.0153,0.0617]	[0.0139,0.0617]	[0.0227,0.0541]	[0.0246,0.0522]	[0.0276,0.0587]	[0.0276,0.0573]
N	29,715	29,567	29,715	29,567	29,715	29,567
	Depression Mean Effect: No missing					
Temperature L1	0.046	0.0476	0.0434	0.0448	0.0531	0.0536
p	{0.00500}	{0.00901}	{0}	{0}	{0}	{0.00100}
CI	[0.0150,0.0758]	[0.0171,0.0771]	[0.0269,0.0575]	[0.0278,0.0618]	[0.0311,0.0738]	[0.0312,0.0758]
N	25,942	25,820	25,942	25,820	25,942	25,820
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0425	0.0443	0.0418	0.0431	0.0479	0.0487
p	{0.00601}	{0.00701}	{0}	{0}	{0.00100}	{0.00100}
CI	[0.0152,0.0707]	[0.0168,0.0736]	[0.0249,0.0586]	[0.0277,0.0587]	[0.0256,0.0682]	[0.0296,0.0694]
N	29,715	29,567	29,715	29,567	29,715	29,567
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 6: Controlling for Health and Education

	Sum of depression measures: No missing					
Temperature L1	0.0282552	0.0302327	0.0287921	0.0306469	0.0330639	0.0351751
	{.0860861018}	{.068068102}	{.0110109998}	{.007007}	{0}	{0}
Health	0.305340886	0.298680812	0.30385831	0.297155798	0.303106993	0.296520114
	{0}	{0}	{0}	{0}	{0}	{0}
Education	-0.023364199	-0.0145911	-0.023123	-0.0142444	-0.022914801	-0.0142065
	{.0050050002}	{.089089103}	{.0050050002}	{.0940940976}	{.007007}	{.0880881026}
BMI	0.0002026	0.0001361	0.0002666	0.0001978	0.0002663	0.0002003
	{.592592597}	{.6996996999}	{.502502501}	{.6196196079}	{.4914914966}	{.5785785913}
N	37768	37603	37768	37603	37768	37603
	Average of nonmissing depression measures					
Temperature L1	0.027539	0.0292859	0.0306064	0.0318828	0.032983001	0.034343101
	{.0690691024}	{.0580581017}	{.0080080004}	{.003003}	{.0010010001}	{0}
Health	0.280813098	0.274739206	0.2795178	0.273436695	0.280132294	0.274073601
	{0}	{0}	{0}	{0}	{0}	{0}
Education	-0.019774601	-0.0133393	-0.020570099	-0.0141642	-0.0200681	-0.0136405
	{.0060060001}	{.0770770982}	{.0060060001}	{.0610610992}	{.0110109998}	{.0590590984}
BMI	0.0003819	0.0003052	0.0004252	0.0003468	0.0004261	0.0003492
	{.3013013005}	{.3473472893}	{.2732732892}	{.307307303}	{.2882882953}	{.3063063025}
N	42798	42601	42798	42601	42798	42601
	Depression Mean Effect: No missing					
Temperature L1	0.029661899	0.0311809	0.0279769	0.029298799	0.031059699	0.032783199
	{.0660661012}	{.0580581017}	{.0060060001}	{.003003}	{0}	{0}
Health	0.267695487	0.261525691	0.266492605	0.260271788	0.265781194	0.259634286
	{0}	{0}	{0}	{0}	{0}	{0}
Education	-0.0227532	-0.0142417	-0.022616699	-0.0139652	-0.022291999	-0.0137599
	{.0060060001}	{.0940940976}	{.0080080004}	{.0930930972}	{.0060060001}	{.0800800994}
BMI	0.0001869	0.0001205	0.0002637	0.0001947	0.0002464	0.0001795
	{.6786786914}	{.7867867947}	{.5465465188}	{.6256256104}	{.5525525808}	{.6576576829}
N	37768	37603	37768	37603	37768	37603
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.025235901	0.026570899	0.0278755	0.028699201	0.0306076	0.031631
	{.1101100966}	{.0960960984}	{.0050050002}	{.0010010001}	{0}	{0}
Health	0.266477495	0.260378093	0.265464604	0.259335399	0.265846014	0.25974831
	{0}	{0}	{0}	{0}	{0}	{0}
Education	-0.023034001	-0.0152161	-0.023724301	-0.0158081	-0.023060501	-0.0151936
	{.003003}	{.0410410017}	{.003003}	{.0410410017}	{.0040040002}	{.0400400013}
BMI	0.0002042	0.000123	0.0002644	0.0001812	0.0002817	0.0001997
	{.5835835934}	{.7237237096}	{.4854854941}	{.5955955982}	{.4864864945}	{.5655655861}
N	42798	42601	42798	42601	42798	42601
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 7: Removing Probable Migrants

	Sum of depression measures: No missing					
Temperature L1	0.036	0.038	0.03	0.0314	0.0322	0.0341
p	{0.0651}	{0.0591}	{0.0160}	{0.0150}	{0.00400}	{0.00300}
CI	[-0.00337,0.0649]	[-0.00228,0.0694]	[0.00943,0.0505]	[0.00870,0.0526]	[0.0120,0.0532]	[0.0129,0.0561]
N	42,499	42,364	42,499	42,364	42,499	42,364
	Average of nonmissing depression measures					
Temperature L1	0.036	0.0385	0.0355	0.037	0.035	0.0371
p	{0.0200}	{0.00500}	{0}	{0.00100}	{0.00200}	{0}
CI	[0.00786,0.0618]	[0.0113,0.0627]	[0.0195,0.0509]	[0.0210,0.0513]	[0.0185,0.0510]	[0.0190,0.0542]
N	49,959	49,809	49,959	49,809	49,959	49,809
	Depression Mean Effect: No missing					
Temperature L1	0.0363	0.0381	0.027	0.0282	0.0273	0.0292
p	{0.0601}	{0.0611}	{0.0240}	{0.0240}	{0.0180}	{0.0130}
CI	[-0.00246,0.0673]	[-0.00535,0.0712]	[0.00665,0.0466]	[0.00602,0.0502]	[0.00618,0.0505]	[0.00826,0.0516]
N	42,499	42,364	42,499	42,364	42,499	42,364
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0366	0.0387	0.0342	0.0353	0.0343	0.036
p	{0.0290}	{0.0240}	{0.00500}	{0.00500}	{0.00801}	{0.00601}
CI	[0.00394,0.0665]	[0.00635,0.0687]	[0.0165,0.0503]	[0.0152,0.0524]	[0.0144,0.0537]	[0.0164,0.0554]
N	49,959	49,809	49,959	49,809	49,959	49,809
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table 8: Cohort Size

	(1)	(2)	(3)
	Cohort Size		
Temperature L1	0.0606	-0.0936	-0.0949
p	{0.718}	{0.307}	{0.129}
CI	[-0.284,0.385]	[-0.297,0.0762]	[-0.245,0.0239]
N	24,062	24,062	24,062
	ln Cohort Size		
Temperature L1	-0.0019	-0.027	-0.0226
p	{0.963}	{0.148}	{0.153}
CI	[-0.0788,0.0668]	[-0.0718,0.0109]	[-0.0618,0.0100]
N	24,062	24,062	24,062
Grid Point FE	Y	Y	Y
Year of Birth FE	Y	Y	Y
Controls	N	N	N
Country Trends	N	Y	N
Grid Point Trends	N	N	Y

P-values in braces, 95% confidence intervals in brackets. All regressions control for rainfall. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. Controls are female and urban.

Table 9: DHS Outcomes

	Polygynous			Wealth index		
Temperature L1	-0.0025	-0.0004	-0.0011	0.0039	0.0027	0.0054
p	{0.738}	{0.873}	{0.726}	{0.417}	{0.559}	{0.349}
CI	[-0.0156,0.0150]	[-0.00547,0.00654]	[-0.00615,0.00423]	[-0.00855,0.0151]	[-0.00934,0.0138]	[-0.00781,0.0165]
N	358,591	358,591	358,591	415,316	415,316	415,316
	Literate			Mother Age		
Temperature L1	0.0077	0.0001	0.0018	-0.08	0.0563	0.0623
p	{0.267}	{0.952}	{0.159}	{0.424}	{0.340}	{0.0911}
CI	[-0.00695,0.0158]	[-0.00321,0.00374]	[-0.000908,0.00385]	[-0.222,0.147]	[-0.0562,0.183]	[-0.00755,0.151]
N	412,151	412,151	412,151	415,316	415,316	415,316
	Rural			Female		
	-0.0015	-0.0005	-0.0001	-0.0019	-0.0022	-0.0034
p	{0.581}	{0.871}	{0.971}	{0.553}	{0.370}	{0.167}
CI	[-0.00614,0.00555]	[-0.00550,0.00574]	[-0.00579,0.00629]	[-0.00922,0.00402]	[-0.00828,0.00250]	[-0.00934,0.00152]
N	415,316	415,316	415,316	415,316	415,316	415,316
	Birth order			Multiple		
Temperature L1	-0.0572	-0.007	0.0058	0.0015	0.0006	0.0013
p	{0.146}	{0.802}	{0.780}	{0.118}	{0.513}	{0.142}
CI	[-0.110,0.0199]	[-0.0487,0.0448]	[-0.0317,0.0574]	[-0.000466,0.00431]	[-0.00102,0.00286]	[-0.000672,0.00298]
N	415,316	415,316	415,316	415,316	415,316	415,316
	Died as infant					
Temperature L1	-0.0037	-0.0013	-0.0023			
p	{0.222}	{0.205}	{0.122}			
CI	[-0.0111,0.00154]	[-0.00408,0.00101]	[-0.00536,0.000833]			
N	415,316	415,316	415,316			
Grid Point FE	Y	Y	Y	Y	Y	Y
Year of Birth FE	Y	Y	Y	Y	Y	Y
Controls	N	N	N	N	N	N
Country Trends	N	Y	N	N	Y	N
Grid Point Trends	N	N	Y	N	N	Y

P-values in braces, 95% confidence intervals in brackets. All regressions control for rainfall. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. Controls are female and urban.

Appendix: Not for publication

Appendix A. Appendix Tables

Table A1: Main Results with Rainfall Coefficient Reported

	Sum of depression measures: No missing					
Temperature L1	0.03068	0.03237	0.02593	0.02709	0.03063	0.03218
p	{.0710}	{.0860}	{.0100}	{.0150}	{.0050}	{.0030}
Rainfall L1	0.0003	0.00034	0.00027	0.00029	0.00035	0.00036
p	{.4284}	{.3543}	{.4284}	{.3963}	{.3413}	{.2922}
N	51627	51348	51627	51348	51627	51348
	Average of nonmissing depression measures					
Temperature L1	0.03212	0.03394	0.03136	0.03225	0.03352	0.03477
p	{.0170}	{.0110}	{.0020}	{.0010}	{.0010}	{.0030}
Rainfall L1	0.0003	0.00032	0.0003	0.00029	0.00034	0.00032
p	{.2832}	{.2532}	{.1891}	{.2532}	{.1971}	{.2112}
N	60167	59835	60167	59835	60167	59835
	Depression Mean Effect: No missing					
Temperature L1	0.03121	0.03236	0.02334	0.02392	0.02613	0.02725
p	{.0740}	{.0730}	{.0130}	{.0190}	{.0040}	{.0110}
Rainfall L1	0.00025	0.00028	0.00018	0.00019	0.00023	0.00024
p	{.5015}	{.4214}	{.6036}	{.5725}	{.4934}	{.4754}
N	51627	51348	51627	51348	51627	51348
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.03171	0.0332	0.02936	0.02993	0.03158	0.03252
p	{.0240}	{.0390}	{.0030}	{.0030}	{.0030}	{.0080}
Rainfall L1	0.00029	0.00031	0.00026	0.00025	0.00028	0.00027
p	{.3583}	{.3183}	{.3603}	{.4034}	{.3463}	{.3913}
N	60167	59835	60167	59835	60167	59835
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A2: Role of Country-Level Health Spending and Infrastructure

	Sum of depression measures: No missing		Depression Mean Effect: No missing	
Temperature L1	.02714 {.0937}	.02756 {.1562}	.03281 {.0312}	.03351 {.0312}
Community Health Workers	-.1465 {.7187}	-.1561 {.7187}	-.1753 {.7187}	-.1839 {.6875}
Interaction	.00958 {.6562}	.01042 {.6562}	.01088 {.6562}	.01169 {.6562}
N	15040	15015	15040	15015
Temperature L1	.02218 {.0430}	.02205 {.0540}	.02473 {.0290}	.02437 {.0420}
Hospital Beds	-.1407 {.7947}	-.1532 {.6926}	-.1655 {.6086}	-.1769 {.5845}
Interaction	.00540 {.7357}	.00570 {.7287}	.00638 {.6086}	.00663 {.5675}
N	37779	37584	37779	37584
Temperature L1	.02341 {.0090}	.02384 {.0260}	.02616 {.0230}	.02629 {.0180}
Health Expenditure	.04506 {.5505}	.04534 {.5465}	.04720 {.4884}	.04671 {.5195}
Interaction	-.0013 {.7517}	-.0012 {.7317}	-.0013 {.7057}	-.0012 {.7327}
N	36402	36207	36402	36207
Temperature L1	.01829 {.0590}	.01926 {.0770}	.02027 {.0410}	.02091 {.0680}
Public Health Expenditure	.00040 {.9959}	.01258 {.8908}	-.0261 {.8008}	-.0152 {.8808}
Interaction	-.0025 {.5035}	-.0029 {.4274}	-.0015 {.6746}	-.0019 {.6246}
N	36402	36207	36402	36207
	Average of nonmissing depression measures		Depression Mean Effect: Average of nonmissing	
Temperature L1	.03344 {.0312}	.03348 {.0312}	.04036 {.0312}	.03999 {.0312}
Community Health Workers	-.1885 {.5937}	-.1867 {.5937}	-.1879 {.7187}	-.1921 {.6562}
Interaction	.00986 {.5312}	.01013 {.5625}	.01070 {.5937}	.01127 {.5625}
N	16464	16437	16464	16437
Temperature L1	.02824 {.0130}	.02770 {.0130}	.02884 {.0150}	.02855 {.0120}
Hospital Beds	-.1007 {.8058}	-.1224 {.7597}	-.1282 {.7827}	-.1406 {.7877}
Interaction	.00319 {.8268}	.00388 {.8068}	.00472 {.7987}	.00498 {.7917}
N	43677	43438	43677	43438
Temperature L1	.02979 {.0010}	.03033 {.0020}	.03079 {.0010}	.03126 {.0060}
Health Expenditure	.04459 {.5485}	.04895 {.4904}	.03721 {.5625}	.04030 {.5145}
Interaction	-.0011 {.7167}	-.0012 {.6776}	-.0009 {.7937}	-.0009 {.7747}
N	42276	42037	42276	42037
Temperature L1	.02620 {.0090}	.02713 {.0040}	.02583 {.0130}	.02682 {.0130}
Public Health Expenditure	-.0110 {.8648}	-.0010 {.9919}	-.0221 {.7977}	-.0109 {.8908}
Interaction	-.0011 {.6746}	-.0014 {.6026}	-.0011 {.6656}	-.0015 {.6086}
N	42276	42037	42276	42037
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	N	N	N	N

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A3. 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	1999.683	2010	56178
Côte d'Ivoire	1938	1969.313	1985	2992	1975	2000.973	2012	28211
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	1996.969	2008	11888
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	2002.966	2013	33803
Mauritania	1938	1966.715	1985	3241				
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 A4. Mean Weather and Sample Respondent Characteristics: Comparision of the DHS and the WHS

	(1) Mean	(2) s.d.	(3) Min	(4) Max	(5) 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
Log Rain L1	4.21	0.59	-3.40	5.64	415,289
Log Temperature L1	3.15	0.20	1.41	3.45	415,317
Rural	0.74	0.44	0	1	443,532

Table A5: Levels

	(1)	(2)	(3)	(4)	(5)	(6)
	Depression in last 30 days					
Temperature L1	0.0278	0.0302	0.0306	0.0322	0.0338	0.0353
p	{0.0430}	{0.0300}	{0.0240}	{0.0150}	{0.00601}	{0}
CI	[0.000411,0.0511]	[0.00344,0.0535]	[0.00559,0.0534]	[0.00794,0.0530]	[0.0126,0.0524]	[0.0164,0.0541]
N	59,911	59,585	59,911	59,585	59,911	59,585
	Depression in last 30 days at least mild					
Temperature L1	0.0136	0.0145	0.0132	0.0138	0.0157	0.0162
p	{0.0140}	{0.0190}	{0.0290}	{0.0310}	{0.00801}	{0.00701}
CI	[0.00354,0.0224]	[0.00335,0.0242]	[0.00196,0.0229]	[0.00245,0.0236]	[0.00566,0.0239]	[0.00600,0.0247]
N	59,911	59,585	59,911	59,585	59,911	59,585
	Depression in last 30 days at least moderate					
Temperature L1	0.0097	0.0108	0.0103	0.011	0.0114	0.0121
p	{0.0621}	{0.0511}	{0.0360}	{0.0330}	{0.0100}	{0.00701}
CI	[-0.000606,0.0191]	[-0.000150,0.0202]	[0.000892,0.0189]	[0.00135,0.0197]	[0.00358,0.0192]	[0.00385,0.0198]
N	59,911	59,585	59,911	59,585	59,911	59,585
	Depression in last 30 days at least severe					
Temperature L1	0.005	0.0054	0.0063	0.0066	0.0064	0.0066
p	{0.150}	{0.144}	{0.0170}	{0.0140}	{0.0250}	{0.0190}
CI	[-0.00234,0.0120]	[-0.00179,0.0126]	[0.00113,0.0114]	[0.00162,0.0115]	[0.00110,0.0123]	[0.00103,0.0124]
N	59,911	59,585	59,911	59,585	59,911	59,585
	Depression in last 30 days at least extreme					
Temperature L1	-0.0005	-0.0005	0.0008	0.0008	0.0003	0.0003
p	{0.781}	{0.784}	{0.520}	{0.531}	{0.761}	{0.740}
CI	[-0.00478,0.00293]	[-0.00512,0.00291]	[-0.00191,0.00339]	[-0.00183,0.00342]	[-0.00170,0.00225]	[-0.00167,0.00250]
N	59,911	59,585	59,911	59,585	59,911	59,585
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A6: Symptoms

	Feel sad empty or depressed for several days in last 12 months					
Temperature L1	0.011	0.0114	0.0112	0.0114	0.0128	0.0132
p	{0.0260}	{0.0200}	{0.00100}	{0}	{0}	{0.00100}
CI	[0.00195,0.0198]	[0.00259,0.0199]	[0.00564,0.0167]	[0.00609,0.0165]	[0.00624,0.0188]	[0.00671,0.0198]
N	59,028	58,715	59,028	58,715	59,028	58,715
	Lost interest for several days in last 12 months					
Temperature L1	0.0053	0.0055	0.007	0.007	0.0067	0.0068
p	{0.324}	{0.306}	{0.0470}	{0.0771}	{0.0951}	{0.100}
CI	[-0.00550,0.0152]	[-0.00588,0.0156]	[0.000144,0.0148]	[-0.00113,0.0150]	[-0.00160,0.0152]	[-0.00166,0.0151]
N	58,949	58,629	58,949	58,629	58,949	58,629
	Decreased energy for several days in last 12 months					
Temperature L1	0.0091	0.0096	0.0053	0.0055	0.0045	0.0048
p	{0.175}	{0.126}	{0.0701}	{0.0591}	{0.221}	{0.165}
CI	[-0.00383,0.0218]	[-0.00261,0.0223]	[-0.000669,0.0116]	[-0.000287,0.0112]	[-0.00225,0.0119]	[-0.00195,0.0119]
N	58,767	58,449	58,767	58,449	58,767	58,449
	Feel sad empty or depressed for 2 weeks or more in last 12 months					
Temperature L1	0.014	0.014	0.011	0.0108	0.01	0.01
p	{0.0210}	{0.0300}	{0.0170}	{0.0330}	{0.0270}	{0.0260}
CI	[0.00180,0.0261]	[0.00122,0.0264]	[0.00157,0.0211]	[0.000690,0.0209]	[0.00133,0.0188]	[0.00120,0.0191]
N	56,076	55,771	56,076	55,771	56,076	55,771
	Feel sad empty or depressed most of the day every day in last 12 months					
Temperature L1	0.0102	0.01	0.0083	0.0078	0.0081	0.0078
p	{0.0501}	{0.0891}	{0.0460}	{0.0671}	{0.0541}	{0.0591}
CI	[-9.85e-06,0.0198]	[-0.00156,0.0200]	[6.99e-05,0.0161]	[-0.000439,0.0155]	[-0.000245,0.0168]	[-0.000443,0.0169]
N	55,999	55,697	55,999	55,697	55,999	55,697
	Lose appetite in last 12 months					
Temperature L1	0.0089	0.0096	0.0072	0.0076	0.0077	0.0083
p	{0.0911}	{0.0891}	{0.0260}	{0.0430}	{0.0460}	{0.0390}
CI	[-0.00181,0.0191]	[-0.00215,0.0206]	[0.00125,0.0132]	[0.000364,0.0142]	[0.000157,0.0148]	[0.000347,0.0161]
N	56,013	55,710	56,013	55,710	56,013	55,710
	Slowing in thinking in last 12 months					
Temperature L1	0.0036	0.0037	0.0029	0.0027	0.005	0.0049
p	{0.516}	{0.538}	{0.416}	{0.483}	{0.242}	{0.236}
CI	[-0.00810,0.0158]	[-0.00920,0.0149]	[-0.00514,0.0112]	[-0.00526,0.0113]	[-0.00338,0.0133]	[-0.00345,0.0133]
N	55,983	55,680	55,983	55,680	55,983	55,680
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A7: Results with Country-Year Fixed Effects

	Sum of depression measures: No missing	Average of nonmissing depression measures	Depression Mean Effect: No missing	Depression Mean Effect: Average of nonmissing
Temperature L1	-0.0025	0.0036	-0.0008	0.0116
p	{0.887}	{0.834}	{0.954}	{0.514}
CI	[-0.0407,0.0364]	[-0.0320,0.0394]	[-0.0384,0.0345]	[-0.0223,0.0479]
N	51,626	60,167	51,626	60,167
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Country X Year	Country X Year	Country X Year	Country X Year
Controls	N	N	N	N
Country Trends	N	N	N	N
Grid Point Trends	N	N	N	N

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall.

Table A8: Results with Region-Year Fixed Effects

	Sum of depression measures: No missing	Average of nonmissing depression measures	Depression Mean Effect: No missing	Depression Mean Effect: Average of nonmissing
Temperature L1	0.025	0.0341	0.0256	0.0313
p	{0.155}	{0.0200}	{0.180}	{0.0551}
CI	[-0.00998,0.0558]	[0.00589,0.0590]	[-0.0122,0.0600]	[-0.000700,0.0600]
N	51,626	60,167	51,626	60,167
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Region X Year	Region X Year	Region X Year	Region X Year
Controls	N	N	N	N
Country Trends	N	N	N	N
Grid Point Trends	N	N	N	N

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall.

Table A9: Results with Country-Five-Year Fixed Effects

	Sum of depression measures: No missing	Average of nonmissing depression measures	Depression Mean Effect: No missing	Depression Mean Effect: Average of nonmissing
Temperature L1	0.025	0.0272	0.0212	0.0269
p	{0.0621}	{0.0310}	{0.0861}	{0.0240}
CI	[-0.00213,0.0516]	[0.00383,0.0504]	[-0.00532,0.0457]	[0.00444,0.0503]
N	51,626	60,167	51,626	60,167
Grid Point FE	Y	Y	Y	Y
Year of Birth FE	Country X 5-Year	Country X 5-Year	Country X 5-Year	Country X 5-Year
Controls	N	N	N	N
Country Trends	N	N	N	N
Grid Point Trends	N	N	N	N

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall.

Table A10: Results using quadratic temperature point trends

	Sum of depression measures: No missing	
Temperature L1	0.036	0.037
p	{0.00100}	{0.00300}
CI	[0.0154,0.0577]	[0.0156,0.0587]
N	51,627	51,348
	Average of nonmissing depression measures	
Temperature L1	0.039	0.039
p	{0.00400}	{0.00100}
CI	[0.0178,0.0573]	[0.0178,0.0581]
N	60,167	59,835
	Depression Mean Effect: No missing	
Temperature L1	0.033	0.033
p	{0.00500}	{0.00200}
CI	[0.0127,0.0555]	[0.0123,0.0560]
N	51,627	51,348
	Depression Mean Effect: Average of nonmissing	
Temperature L1	0.037	0.037
p	{0.00300}	{0.00200}
CI	[0.0158,0.0550]	[0.0165,0.0544]
N	60,167	59,835
Grid Point FE	Y	Y
Year of Birth FE	Y	Y
Controls	N	Y
Country Trends	N	N
Grid Point Trends	Y	Y
Grid Point Quadratic Trends	Y	Y

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A11: Controlling for ln GDP per capita

	Sum of depression measures: No missing					
Temperature L1	0.0288	0.02919	0.0257	0.02582	0.03094	0.03038
p	{.0130}	{.0240}	{0}	{.0010}	{0}	{.0010}
ln GDP pc	-0.0377	-0.0305	-0.0583	-0.0444	-0.0428	-0.0329
p	{.4664}	{.5805}	{.1441}	{.2682}	{.4834}	{.6056}
N	40580	40389	40580	40389	40580	40389
	Average of nonmissing depression measures					
Temperature L1	0.0346	0.03518	0.03345	0.03337	0.03505	0.03469
p	{.0030}	{.0010}	{0}	{0}	{.0010}	{.0010}
ln GDP pc	-0.0201	-0.0147	-0.0572	-0.0483	-0.0494	-0.0442
p	{.5855}	{.6866}	{.2262}	{.2942}	{.3793}	{.4234}
N	47435	47201	47435	47201	47435	47201
	Depression Mean Effect: No missing					
Temperature L1	0.03148	0.03165	0.02642	0.0263	0.03116	0.03042
p	{.0120}	{.0130}	{.0010}	{.0060}	{.0020}	{.0090}
ln GDP pc	-0.0344	-0.0276	-0.0454	-0.0317	-0.0304	-0.0208
p	{.5615}	{.6166}	{.2742}	{.4824}	{.6046}	{.7037}
N	40580	40389	40580	40389	40580	40389
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.03467	0.03523	0.03165	0.03152	0.03504	0.0344
p	{.0040}	{.0020}	{0}	{0}	{.0010}	{.0050}
ln GDP pc	-0.022	-0.0161	-0.0319	-0.019	-0.0232	-0.0145
p	{.6256}	{.7677}	{.4684}	{.6296}	{.6546}	{.7647}
N	47435	47201	47435	47201	47435	47201
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

P-values in braces. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A12: Results using additional controls

	Sum of depression measures: No missing							
Temperature L1	0.0307	0.0324	0.0288	0.0309	0.0313	0.0327	0.034	0.0355
p	{0.0711}	{0.0661}	{0.127}	{0.0821}	{0.0751}	{0.0601}	{0.0501}	{0.0511}
CI	[-0.00333,0.0594]	[-0.00243,0.0643]	[-0.00778,0.0599]	[-0.00536,0.0640]	[-0.00446,0.0591]	[-0.00149,0.0606]	[-0.000315,0.0635]	[-7.03e-05,0.0668]
N	51,627	51,348	51,627	51,348	51,627	51,348	50,986	50,716
	Average of nonmissing depression measures							
Temperature L1	0.0321	0.034	0.0308	0.0332	0.0323	0.034	0.033	0.035
p	{0.0140}	{0.0160}	{0.0250}	{0.0220}	{0.0180}	{0.0100}	{0.0200}	{0.0170}
CI	[0.00745,0.0548]	[0.00767,0.0569]	[0.00513,0.0539]	[0.00710,0.0561]	[0.00853,0.0550]	[0.0106,0.0571]	[0.00883,0.0552]	[0.00981,0.0578]
N	60,167	59,835	60,167	59,835	60,167	59,835	59,485	59,155
	Depression Mean Effect: No missing							
Temperature L1	0.0312	0.0324	0.0295	0.0311	0.0318	0.0327	0.0353	0.0364
p	{0.0851}	{0.0811}	{0.0901}	{0.100}	{0.0551}	{0.0721}	{0.0601}	{0.0440}
CI	[-0.00506,0.0614]	[-0.00499,0.0632]	[-0.00583,0.0612]	[-0.00651,0.0656]	[-0.000658,0.0609]	[-0.00416,0.0614]	[-0.00243,0.0664]	[0.000934,0.0680]
N	51,627	51,348	51,627	51,348	51,627	51,348	50,986	50,716
	Depression Mean Effect: Average of nonmissing							
Temperature L1	0.0317	0.0332	0.0303	0.0324	0.0319	0.0332	0.0344	0.0361
p	{0.0310}	{0.0300}	{0.0450}	{0.0390}	{0.0200}	{0.0210}	{0.0170}	{0.0270}
CI	[0.00292,0.0580]	[0.00338,0.0603]	[0.000595,0.0569]	[0.00185,0.0608]	[0.00595,0.0560]	[0.00438,0.0589]	[0.00641,0.0623]	[0.00373,0.0650]
N	60,167	59,835	60,167	59,835	60,167	59,835	59,485	59,155
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
Additional Contols	Head		Marital Status		Education		Ethnicity	
Country Trends	N	N	N	N	N	N	N	N
Grid Point Trends	N	N	N	N	N	N	N	N

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A13: Results using log temperature

	Sum of depression measures: No missing					
ln Temperature L1	0.6181	0.6592	0.5456	0.5729	0.6358	0.6696
p	{0.116}	{0.0951}	{0.0130}	{0.00701}	{0.00200}	{0.00100}
CI	[-0.155,1.244]	[-0.103,1.319]	[0.206,0.920]	[0.232,0.928]	[0.265,1.085]	[0.309,1.102]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Average of nonmissing depression measures					
ln Temperature L1	0.6321	0.6691	0.6893	0.7041	0.7245	0.7453
p	{0.0330}	{0.0300}	{0.00500}	{0.00500}	{0.00701}	{0.00701}
CI	[0.0467,1.220]	[0.0691,1.198]	[0.321,1.006]	[0.313,1.002]	[0.306,1.076]	[0.345,1.084]
N	60,167	59,835	60,167	59,835	60,167	59,835
	Depression Mean Effect: No missing					
ln Temperature L1	0.6796	0.7095	0.5373	0.553	0.5865	0.6119
p	{0.0841}	{0.0791}	{0.00801}	{0.00801}	{0.00901}	{0.00200}
CI	[-0.0892,1.321]	[-0.104,1.401]	[0.204,0.867]	[0.216,0.911]	[0.191,1.093]	[0.234,1.059]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Depression Mean Effect: Average of nonmissing					
ln Temperature L1	0.676	0.7078	0.6877	0.698	0.7212	0.7372
p	{0.0360}	{0.0350}	{0.00100}	{0.00100}	{0.00400}	{0.00100}
CI	[0.0689,1.285]	[0.0894,1.339]	[0.376,0.938]	[0.359,0.959]	[0.365,1.063]	[0.380,1.061]
N	60,167	59,835	60,167	59,835	60,167	59,835
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A14: Results using quadratic temperature

	Sum of depression measures: No missing					
Temperature L1	0.07961	0.08444	0.07225	0.0761	0.0511	0.05416
p	{.3143}	{.2932}	{.2172}	{.2312}	{.3433}	{.3843}
Squared	-0.001	-0.0011	-0.001	-0.001	-0.0004	-0.0004
p	{.5215}	{.4844}	{.4214}	{.4444}	{.7337}	{.7097}
Rainfall L1	0.00019	0.00031	0	0.00002	0.00008	0.00012
p	{.8018}	{.6476}	{.9799}	{.9819}	{.9069}	{.8668}
Squared / 1000	0.00047	0.00014	0.00118	0.00109	0.00106	0.00096
p	{.8358}	{.9569}	{.5235}	{.5725}	{.5815}	{.5835}
N	51627	51348	51627	51348	51627	51348
	Average of nonmissing depression measures					
Temperature L1	0.09072	0.09453	0.11653	0.11874	0.10175	0.10379
p	{.1771}	{.1741}	{.0460}	{.0410}	{.0690}	{.0630}
Squared	-0.0012	-0.0013	-0.0018	-0.0019	-0.0015	-0.0015
p	{.2972}	{.3203}	{.0720}	{.0800}	{.1351}	{.1391}
Rainfall L1	0.00051	0.00057	0.00046	0.00041	0.00046	0.00042
p	{.3813}	{.3403}	{.4214}	{.4344}	{.4284}	{.4454}
Squared / 1000	-0.0008	-0.0009	-0.0005	-0.0004	-0.0004	-0.0003
p	{.6966}	{.6416}	{.7567}	{.7837}	{.7657}	{.8348}
N	60167	59835	60167	59835	60167	59835
	Depression Mean Effect: No missing					
Temperature L1	0.10523	0.11071	0.0901	0.09475	0.06603	0.06942
p	{.1991}	{.1781}	{.1301}	{.1191}	{.2482}	{.2392}
Squared	-0.0016	-0.0017	-0.0014	-0.0015	-0.0008	-0.0009
p	{.2852}	{.2892}	{.1991}	{.2262}	{.4294}	{.4634}
Rainfall L1	0.00028	0.00039	2.16	0.00002	0.00004	0.00006
p	{.6496}	{.5435}	{.9989}	{.9759}	{.9449}	{.9199}
Squared / 1000	0	-0.0003	0.00075	0.00073	0.00079	0.00074
p	{.9679}	{.8608}	{.6646}	{.6776}	{.6776}	{.6696}
N	51627	51348	51627	51348	51627	51348
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.10599	0.11118	0.12223	0.12572	0.10215	0.10511
p	{.1201}	{.1071}	{.0320}	{.0240}	{.0480}	{.0560}
Squared	-0.0016	-0.0017	-0.002	-0.0021	-0.0015	-0.0016
p	{.2022}	{.1821}	{.0400}	{.0450}	{.1041}	{.1261}
Rainfall L1	0.00054	0.00059	0.00043	0.00039	0.00038	0.00034
p	{.3443}	{.2712}	{.5125}	{.5145}	{.5595}	{.5725}
Squared / 1000	-0.0009	-0.001	-0.0006	-0.0004	-0.0003	-0.0002
p	{.6696}	{.5855}	{.7357}	{.7857}	{.8518}	{.9019}
N	60167	59835	60167	59835	60167	59835
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

P-values in braces. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A15: Results using standard deviation temperature dummies

	Sum of depression measures: No missing					
+1 S.D.	0.01016	0.01208	0.00674	0.0075	0.00891	0.01015
p	{.7027}	{.6466}	{.7757}	{.7587}	{.7237}	{.6646}
+2 S.D.	0.05194	0.05769	0.01802	0.02227	0.02465	0.02954
p	{.4334}	{.3993}	{.7857}	{.7327}	{.6766}	{.6396}
-1 S.D.	0.01117	0.01159	0.00486	0.00512	0.00008	0.00064
p	{.3243}	{.3363}	{.6856}	{.6726}	{.9949}	{.9559}
-2 S.D.	-0.0559	-0.0519	-0.0529	-0.048	-0.0485	-0.0439
p	{.1291}	{.1841}	{.1541}	{.2322}	{.2002}	{.2792}
N	51627	51348	51627	51348	51627	51348
	Average of nonmissing depression measures					
+1 S.D.	0.01686	0.01803	0.01668	0.01643	0.01757	0.01731
p	{.4224}	{.4034}	{.4684}	{.4504}	{.3803}	{.4324}
+2 S.D.	0.07973	0.08824	0.05819	0.06491	0.06004	0.0667
p	{.2532}	{.2112}	{.3663}	{.2962}	{.3093}	{.2242}
-1 S.D.	0.00315	0.0029	-0.0025	-0.0027	-0.0031	-0.003
p	{.7437}	{.7837}	{.8198}	{.8028}	{.7837}	{.7697}
-2 S.D.	-0.0215	-0.0198	-0.0207	-0.018	-0.0171	-0.0147
p	{.4214}	{.4604}	{.4434}	{.4684}	{.5295}	{.5875}
N	60167	59835	60167	59835	60167	59835
	Depression Mean Effect: No missing					
+1 S.D.	0.01003	0.01231	0.00092	0.00206	0.00432	0.00612
p	{.7257}	{.6416}	{.9699}	{.9329}	{.8558}	{.7847}
+2 S.D.	0.0671	0.07125	0.02544	0.0283	0.02343	0.02694
p	{.2662}	{.2652}	{.6876}	{.6596}	{.7167}	{.6506}
-1 S.D.	0.01043	0.01127	0.00405	0.00475	0.00029	0.00121
p	{.3573}	{.3343}	{.7427}	{.6796}	{.9779}	{.9369}
-2 S.D.	-0.051	-0.0477	-0.0466	-0.0424	-0.044	-0.0401
p	{.1761}	{.2212}	{.2032}	{.2582}	{.2772}	{.3003}
N	51627	51348	51627	51348	51627	51348
	Depression Mean Effect: Average of nonmissing					
+1 S.D.	0.01647	0.01874	0.01228	0.0131	0.01436	0.01531
p	{.4574}	{.3773}	{.5425}	{.5365}	{.5035}	{.4834}
+2 S.D.	0.07494	0.08086	0.04279	0.04707	0.0419	0.04629
p	{.2082}	{.1461}	{.4624}	{.3983}	{.4304}	{.3613}
-1 S.D.	0.00748	0.00752	0.00036	0.00049	-0.0018	-0.0015
p	{.4864}	{.5095}	{.9799}	{.9629}	{.8868}	{.9119}
-2 S.D.	-0.034	-0.0307	-0.0325	-0.0283	-0.0305	-0.0266
p	{.2652}	{.3503}	{.3003}	{.3343}	{.3173}	{.3563}
N	60167	59835	60167	59835	60167	59835
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

P-values in braces. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A16: Results using quadratic standardized temperature deviations

	Sum of depression measures: No missing					
Temperature L1	0.00714	0.00802	0.00497	0.00542	0.00753	0.00813
p	{.3503}	{.3083}	{.3463}	{.3043}	{.1811}	{.1661}
Squared	0.00077	0.00141	-0.0026	-0.0021	-0.0025	-0.0019
p	{.8348}	{.7387}	{.5645}	{.6856}	{.5645}	{.6596}
N	51627	51348	51627	51348	51627	51348
	Average of nonmissing depression measures					
Temperature L1	0.01179	0.01276	0.01182	0.01215	0.01253	0.01297
p	{.0600}	{.0380}	{.0280}	{.0180}	{.0180}	{.0090}
Squared	0.00471	0.00525	0.00261	0.003	0.00303	0.00344
p	{.1391}	{.1051}	{.4574}	{.3973}	{.3633}	{.2892}
N	60167	59835	60167	59835	60167	59835
	Depression Mean Effect: No missing					
Temperature L1	0.00778	0.0084	0.00351	0.00368	0.00529	0.0057
p	{.3173}	{.2902}	{.4934}	{.4964}	{.3623}	{.3173}
Squared	0.00194	0.0026	-0.0024	-0.0019	-0.0026	-0.002
p	{.6376}	{.5265}	{.5755}	{.7257}	{.5475}	{.6846}
N	51627	51348	51627	51348	51627	51348
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.01051	0.01137	0.00919	0.00943	0.01029	0.01066
p	{.1211}	{.1201}	{.0770}	{.0570}	{.0370}	{.0440}
Squared	0.00345	0.00409	0.00011	0.00059	0.00011	0.00061
p	{.2742}	{.2022}	{.9789}	{.8838}	{.9779}	{.8668}
N	60167	59835	60167	59835	60167	59835
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

P-values in braces. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A17: Effects by Quartile of Temperature - Q1 (coolest)

	Sum of depression measures: No missing					
Temperature L1	0.0296	0.0329	0.0336	0.0361	0.0214	0.0242
p	{0.445}	{0.398}	{0.219}	{0.188}	{0.406}	{0.344}
CI	[-0.0939,0.0825]	[-0.0912,0.0886]	[-0.0470,0.0706]	[-0.0423,0.0751]	[-0.0764,0.0709]	[-0.0752,0.0752]
N	10,304	10,304	10,304	10,304	10,304	10,304
	Average of nonmissing depression measures					
Temperature L1	0.039	0.0414	0.06	0.0609	0.0472	0.0486
p	{0.371}	{0.305}	{0.0781}	{0.0742}	{0.102}	{0.0977}
CI	[-0.0627,0.114]	[-0.0570,0.113]	[-0.0155,0.102]	[-0.0118,0.104]	[-0.0407,0.0875]	[-0.0356,0.0899]
N	14,497	14,497	14,497	14,497	14,497	14,497
	Depression Mean Effect: No missing					
Temperature L1	0.0275	0.0305	0.0253	0.0275	0.0123	0.0148
p	{0.477}	{0.453}	{0.313}	{0.266}	{0.586}	{0.555}
CI	[-0.0907,0.0788]	[-0.0837,0.0812]	[-0.0349,0.0611]	[-0.0314,0.0678]	[-0.0639,0.0555]	[-0.0626,0.0629]
N	10,304	10,304	10,304	10,304	10,304	10,304
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0321	0.0343	0.0494	0.0501	0.0391	0.0404
p	{0.422}	{0.309}	{0.0977}	{0.0781}	{0.121}	{0.109}
CI	[-0.0476,0.0949]	[-0.0438,0.0968]	[-0.00960,0.0774]	[-0.00522,0.0778]	[-0.0297,0.0675]	[-0.0237,0.0680]
N	14,497	14,497	14,497	14,497	14,497	14,497
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A18: Effects by Quartile of Temperature - Q2

	Sum of depression measures: No missing					
Temperature L1	0.0514	0.0549	0.0323	0.0353	0.0398	0.0447
p	{0.227}	{0.211}	{0.152}	{0.133}	{0.0156}	{0}
CI	[-0.0502,0.143]	[-0.0427,0.144]	[-0.0120,0.119]	[-0.00807,0.0943]	[0.00512,0.133]	[0.0122,0.111]
N	11,151	11,151	11,151	11,151	11,151	11,151
	Average of nonmissing depression measures					
Temperature L1	0.0377	0.0383	0.0187	0.0186	0.0278	0.0296
p	{0.180}	{0.177}	{0.206}	{0.160}	{0.0440}	{0.0410}
CI	[-0.0202,0.105]	[-0.0203,0.104]	[-0.00882,0.0912]	[-0.00864,0.0708]	[0.00175,0.0869]	[0.00491,0.0692]
N	12,396	12,396	12,396	12,396	12,396	12,396
	Depression Mean Effect: No missing					
Temperature L1	0.0529	0.0561	0.0348	0.0376	0.0345	0.039
p	{0.219}	{0.211}	{0.0859}	{0.0469}	{0.0352}	{0}
CI	[-0.0386,0.143]	[-0.0311,0.144]	[-0.00414,0.0923]	[0.000829,0.0951]	[0.00200,0.106]	[0.00984,0.0976]
N	11,151	11,151	11,151	11,151	11,151	11,151
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0551	0.0566	0.0344	0.0355	0.0332	0.036
p	{0.150}	{0.145}	{0.0561}	{0.0330}	{0.0150}	{0.0150}
CI	[-0.0189,0.125]	[-0.0253,0.128]	[-0.00110,0.0831]	[0.00306,0.0730]	[0.00755,0.0756]	[0.0124,0.0764]
N	12,396	12,396	12,396	12,396	12,396	12,396
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A19: Effects by Quartile of Temperature - Q3

	Sum of depression measures: No missing					
Temperature L1	0.043	0.0446	0.0595	0.0602	0.0614	0.0616
p	{0.138}	{0.117}	{0.00601}	{0.00300}	{0.0190}	{0.0180}
CI	[-0.0135,0.103]	[-0.0120,0.110]	[0.0166,0.111]	[0.0174,0.114]	[0.0106,0.124]	[0.0102,0.122]
N	18,894	18,707	18,894	18,707	18,894	18,707
	Average of nonmissing depression measures					
Temperature L1	0.028	0.0295	0.0382	0.0383	0.0398	0.0391
p	{0.251}	{0.241}	{0.0811}	{0.0771}	{0.0861}	{0.108}
CI	[-0.0238,0.0789]	[-0.0285,0.0859]	[-0.00559,0.0806]	[-0.00547,0.0844]	[-0.00477,0.0936]	[-0.00810,0.0918]
N	20,865	20,641	20,865	20,641	20,865	20,641
	Depression Mean Effect: No missing					
Temperature L1	0.0499	0.0506	0.0611	0.0608	0.0636	0.063
p	{0.112}	{0.104}	{0.0180}	{0.0180}	{0.0350}	{0.0360}
CI	[-0.0160,0.113]	[-0.0143,0.118]	[0.0117,0.116]	[0.0120,0.114]	[0.00396,0.131]	[0.00344,0.138]
N	18,894	18,707	18,894	18,707	18,894	18,707
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0309	0.0323	0.0402	0.0404	0.0437	0.0432
p	{0.229}	{0.210}	{0.0751}	{0.0651}	{0.0621}	{0.0641}
CI	[-0.0204,0.0843]	[-0.0216,0.0859]	[-0.00473,0.0854]	[-0.00266,0.0862]	[-0.00250,0.0938]	[-0.00350,0.0935]
N	20,865	20,641	20,865	20,641	20,865	20,641
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A20: Effects by Quartile of Temperature - Q4 (warmest)

	Sum of depression measures: No missing					
Temperature L1	0.0136	0.0134	-0.0193	-0.0208	-0.0146	-0.0133
p	{0.906}	{0.906}	{0.602}	{0.648}	{0.758}	{0.805}
CI	[-0.130,0.144]	[-0.164,0.153]	[-0.126,0.0693]	[-0.163,0.0812]	[-0.111,0.0857]	[-0.126,0.0979]
N	11,276	11,184	11,276	11,184	11,276	11,184
	Average of nonmissing depression measures					
Temperature L1	0.0382	0.0403	0.0113	0.013	-0.003	0.0002
p	{0.641}	{0.688}	{0.797}	{0.813}	{0.945}	{0.969}
CI	[-0.124,0.149]	[-0.152,0.160]	[-0.114,0.0896]	[-0.139,0.101]	[-0.118,0.0838]	[-0.142,0.0956]
N	12,408	12,300	12,408	12,300	12,408	12,300
	Depression Mean Effect: No missing					
Temperature L1	0.0049	0.0034	-0.0284	-0.0306	-0.0251	-0.0246
p	{0.969}	{0.984}	{0.523}	{0.523}	{0.586}	{0.633}
CI	[-0.127,0.134]	[-0.147,0.145]	[-0.118,0.0678]	[-0.136,0.0829]	[-0.112,0.0826]	[-0.124,0.0984]
N	11,276	11,184	11,276	11,184	11,276	11,184
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0202	0.0196	-0.0094	-0.0105	-0.0103	-0.0096
p	{0.859}	{0.867}	{0.797}	{0.820}	{0.742}	{0.766}
CI	[-0.0836,0.145]	[-0.110,0.147]	[-0.0925,0.0802]	[-0.114,0.0915]	[-0.0848,0.0928]	[-0.0867,0.0983]
N	12,408	12,300	12,408	12,300	12,408	12,300
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A21: Results using maximum temperature

	Sum of depression measures: No missing					
Max Temperature	0.0055	0.0068	0.0048	0.0061	0.0042	0.0058
p	{0.670}	{0.621}	{0.626}	{0.551}	{0.637}	{0.544}
CI	[-0.0241,0.0309]	[-0.0262,0.0356]	[-0.0180,0.0254]	[-0.0170,0.0261]	[-0.0156,0.0228]	[-0.0148,0.0245]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Average of nonmissing depression measures					
Max Temperature	0.0104	0.0114	0.0108	0.0115	0.0093	0.0102
p	{0.342}	{0.326}	{0.306}	{0.303}	{0.394}	{0.337}
CI	[-0.0151,0.0322]	[-0.0183,0.0325]	[-0.0134,0.0297]	[-0.0131,0.0316]	[-0.0155,0.0293]	[-0.0156,0.0309]
N	60,167	59,835	60,167	59,835	60,167	59,835
	Depression Mean Effect: No missing					
Max Temperature	0.0049	0.0059	0.0033	0.0042	0.003	0.0043
p	{0.722}	{0.675}	{0.752}	{0.719}	{0.749}	{0.643}
CI	[-0.0292,0.0319]	[-0.0286,0.0348]	[-0.0201,0.0238]	[-0.0200,0.0255]	[-0.0186,0.0235]	[-0.0182,0.0251]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Depression Mean Effect: Average of nonmissing					
Max Temperature	0.0118	0.0125	0.0122	0.0127	0.0117	0.0125
p	{0.339}	{0.303}	{0.321}	{0.302}	{0.340}	{0.304}
CI	[-0.0186,0.0346]	[-0.0177,0.0349]	[-0.0114,0.0347]	[-0.0141,0.0352]	[-0.0131,0.0323]	[-0.0127,0.0352]
N	60,167	59,835	60,167	59,835	60,167	59,835
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A22: Results for other health outcomes

	Self-rated health					
Temperature L1	0.0022	0.0045	-0.0042	-0.0029	-0.0035	-0.0015
p	{0.834}	{0.721}	{0.717}	{0.781}	{0.707}	{0.906}
CI	[-0.0214,0.0241]	[-0.0212,0.0273]	[-0.0278,0.0194]	[-0.0263,0.0194]	[-0.0268,0.0184]	[-0.0249,0.0205]
N	59,902	59,586	59,902	59,586	59,902	59,586
	Education					
Temperature L1	0.0086	0.0007	0.0192	0.0133	0.0096	0.0026
p	{0.793}	{0.979}	{0.236}	{0.374}	{0.622}	{0.903}
CI	[-0.0570,0.0756]	[-0.0622,0.0672]	[-0.0148,0.0533]	[-0.0170,0.0443]	[-0.0347,0.0534]	[-0.0374,0.0489]
N	61,748	61,405	61,748	61,405	61,748	61,405
	Worked during 12 months					
Temperature L1	-0.0092	-0.0026	-0.0227	-0.0152	-0.0279	-0.02
p	{0.780}	{0.934}	{0.588}	{0.657}	{0.529}	{0.551}
CI	[-0.0813,0.0635]	[-0.0702,0.0634]	[-0.108,0.0528]	[-0.0852,0.0552]	[-0.108,0.0511]	[-0.0847,0.0510]
N	1,830	1,812	1,830	1,812	1,830	1,812
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A23: Schizophrenia-like symptoms

	Sum of schizophrenia-like symptoms					
Temperature L1	-0.0007	-0.0019	0.0023	0.0009	-0.0004	-0.0016
p	{0.935}	{0.836}	{0.762}	{0.903}	{0.958}	{0.856}
CI	[-0.0184,0.0167]	[-0.0195,0.0149]	[-0.0137,0.0183]	[-0.0165,0.0176]	[-0.0175,0.0154]	[-0.0209,0.0164]
N	57,205	56,902	57,205	56,902	57,205	56,902
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A24: Other Health Outcomes

	Outcome	Coefficient {p}	N	Mean of Dependent Variable
1	Amount Spent On Health Care By Hh Last 4 Weeks	-223.6728 {.0580}	50733	328.50
2	Amount Spent On Medication Or Drugs By Hh Last 4 Weeks	363.1499 {.1341}	54073	3594.60
3	Household Spend On Traditional Healers By Hh Last 4 Weeks	44.9822 {.7097}	51323	741.72
4	Amount Spent On Care Required Staying Overnight By Hh Last 4 Weeks	414.4057 {.1991}	51538	2318.13
5	Last 5 Years: Overnight Stay In Hospital	.0063 {.3453}	58581	0.17
6	The Last Time You Needed Health Care, Did You Get Health Care?	.0020 {.5535}	42209	0.93

Coefficient on temperature in year before birth reported. P-values in braces. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall, temperature point fixed effects, and year of birth fixed effects.

Table A25: Results using inverse distance weighting to construct temperature

	Sum of depression measures: No missing					
Temperature L1	0.0425	0.0421	0.0411	0.0405	0.0435	0.0433
p	{0.0480}	{0.0591}	{0.0230}	{0.0190}	{0.0190}	{0.0300}
CI	[0.00110,0.0806]	[-0.00172,0.0824]	[0.00952,0.0728]	[0.00725,0.0734]	[0.0101,0.0757]	[0.00489,0.0805]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Average of nonmissing depression measures					
Temperature L1	0.045	0.0468	0.0484	0.0499	0.0481	0.0496
p	{0.0140}	{0.0100}	{0.00200}	{0.00500}	{0.00200}	{0.00500}
CI	[0.0135,0.0767]	[0.0148,0.0773]	[0.0231,0.0723]	[0.0240,0.0735]	[0.0197,0.0760]	[0.0206,0.0749]
N	60,167	59,835	60,167	59,835	60,167	59,835
	Depression Mean Effect: No missing					
Temperature L1	0.0443	0.0439	0.04	0.0394	0.042	0.0418
p	{0.0170}	{0.0410}	{0.00500}	{0.0150}	{0.0100}	{0.0130}
CI	[0.00847,0.0814]	[0.00238,0.0819]	[0.0138,0.0670]	[0.0107,0.0696]	[0.0129,0.0743]	[0.0108,0.0754]
N	51,627	51,348	51,627	51,348	51,627	51,348
	Depression Mean Effect: Average of nonmissing					
Temperature L1	0.0428	0.044	0.0446	0.0454	0.0458	0.0467
p	{0.0190}	{0.0160}	{0.00300}	{0}	{0.00300}	{0.00901}
CI	[0.0114,0.0712]	[0.0132,0.0755]	[0.0202,0.0689]	[0.0197,0.0690]	[0.0190,0.0748]	[0.0182,0.0756]
N	60,167	59,835	60,167	59,835	60,167	59,835
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

P-values in braces, 95% confidence intervals in brackets. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A26: Ordered Logit

	Depression in last 30 days		Worry/Anxiety in last 30 days	
Temperature L1	0.0512**	0.0550**	0.0352*	0.0418**
se	(0.0225)	(0.0228)	(0.0189)	(0.0195)
N	59,930	59,605	56,600	56,276
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	N	N	N	N

Standard errors clustered by country in parentheses. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A27: Cohort Size with Polynomial Terms

	Cohort Size		
Temperature L1	0.76029	0.31297	0.19439
p	{.0760}	{.0660}	{.2532}
Squared/1000	-0.015	-0.0084	-0.0057
p	{.0580}	{.0180}	{.0770}
Rainfall L1	0.01013	0.00664	0.00796
p	{.2162}	{.4254}	{.3003}
Squared/1000	-0.0561	-0.0468	-0.0527
p	{.1491}	{.2722}	{.2142}
N	24062	24062	24062
	ln Cohort Size		
Temperature L1	0.12274	0.04084	0.03648
p	{.2032}	{.3173}	{.3073}
Squared/1000	-0.0027	-0.0015	-0.0013
p	{.0980}	{.0240}	{.0330}
Rainfall L1	0.00045	-0.0005	-0.0004
p	{.7277}	{.4424}	{.4844}
Squared/1000	-0.0024	0.00088	0.00064
p	{.5445}	{.7337}	{.7717}
N	24062	24062	24062
Grid Point FE	Y	Y	Y
Year of Birth FE	Y	Y	Y
Controls	N	N	N
Country Trends	N	Y	N
Grid Point Trends	N	N	Y

P-values in braces, 95% confidence intervals in brackets. All regressions control for rainfall. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

Table A28: DHS Infant Mortality with Temperature Bins

	Died as infant		
2.5 to 7.5	0.059523799	0.0353522	0.034062002
p	{.0050050002}	{.0940940976}	{.5125125051}
7.5 to 12.5	0.0193305	0.008305	0.0102355
p	{.6306306124}	{.6106106043}	{.507507503}
12.5 to 17.5	0.0015858	-0.0059838	-0.0030745
p	{.8918918967}	{.4164164066}	{.6966966987}
17.5 to 22.5	0.0116985	0.0085926	0.0059104
p	{.0560561009}	{.1191191003}	{.0720721036}
27.5 to 32.5	0.0047616	0.0044849	0.0055455
p	{.3063063025}	{.4344344139}	{.0380380005}
N	415316	415316	415316
Grid Point FE	Y	Y	Y
Year of Birth FE	Y	Y	Y
Controls	N	N	N
Country Trends	N	Y	N
Grid Point Trends	N	N	Y

P-values in braces, 95% confidence intervals in brackets. All regressions control for rainfall. These are estimated using a wild cluster bootstrap accounting for clustering at the country level. All regressions control for rainfall. Controls are female and urban.

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.