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Heat Exposure and Gender Attitudes: Evidence from India

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Abstract: Can rising temperature reinforce masculine attitudes within households? This study examines the impact of prolonged heat exposure on men's normative attitudes using a life-course design in India. Increasing occurrence of heat waves, with temperatures exceeding 40°C across several districts, pose serious physiological as well as psychological risks. Using National Family Health Survey-4 (NFHS-4) combined with district-level weather data, the study finds that heat exposure measured as degree days above 32°C is most strongly associated with men's endorsement of attitude on restricting spousal autonomy. Weaker but positive associations of heat exist with men's attitudes on justifying intimate partner violence (IPV), and asserting unilateral authority over household purchase decisions. Effects are concentrated among men in their middle adulthood years and is amplified when wives are economically dependent on husbands, suggesting women's weaker fallback position shapes household environment during heat stress.

Keywords: climate change, gender, intimate partner violence, household bargaining

JEL: Q54, J16, J12, D13

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AI Disclosure

The use of AI in this paper is limited to using ChatGPT and Claude to debug the code during data cleaning using Stata and Python, formatting LaTex script on Overleaf, summarizing findings of cited studies, and fine-tuning the vocabulary to academic language (in some portions of the thesis). Google Scholar's AI search facility was used to refine search for literature to extract relevant studies for this paper. For any AI help that was taken through these means, outputs were reviewed, verified, and either adopted, modified, or rejected by the author. All empirical decisions, analytical choices, interpretations of results, and final written content reflect the author's own work.

Contents

1 Introduction

The world is inching close to crossing the 1.5°C global warming threshold[1] at an alarming rate. Global temperatures have been on the rise since years but as of 2024 have broken the record, making it the hottest year in climate history. With Asia accounting for almost 45 percent of global heat-related deaths between 2000 and 2019, India records more than a billion people facing extreme heatwaves every year [Prabhu et al., 2025] and remains as the most affected regions in the continent. As of 2026, India harbors 98 of the 100 hottest cities on a global scale. 57% of Indian districts, home to 76% of India's total population, are currently at high or very high heat risk. Consistent warming of Indian states, and recurrence of droughts in recent years have rendered a population ∼70% of which rely on heat-exposed labor vulnerable to growing health and socioeconomic risks. As the compounding effects of climate change intensify, it poses both physiological as well as psychological risks. While the physiological consequences of heat stress are well documented, the psychological burden is comparatively underexplored.

Chronic exposure to extreme temperatures has been linked to heightened irritability, cognitive impairment, sleep disruption, and exacerbation of preexisting mental health conditions. These effects do not occur in a social vacuum; they interact with existing structural inequalities, amplifying vulnerabilities that are already distributed unevenly across lines of gender, class, and geography. Effects of climate change are not only gendered but also vary across vulnerable groups with children, women, and elderly being the most affected. Climate vulnerability is even higher for social classes including Scheduled Caste (SC) and Scheduled Tribe (ST) communities, people with heat-exposed occupations, pre-

[1] The Paris Agreement in 2015 defined 1.5°C as a critical benchmark. It represents an average global surface temperature rise of 1.5°C compared to pre-industrial levels (1850-1900) which upon crossing would mark the most catastrophic impacts of climate change.

carious living conditions, and lack of income safety nets. Among these, incidence of IPV towards women is found to be one of the deleterious impacts of climate change, exacerbating women's vulnerable status due to weather shocks [Epstein et al., 2020]. Unforeseen crises including climatic, economic, political, or pandemic create conditions for patriarchal intensification [Edström et al., 2024]. Since prior studies document the relationship between men's behavior and heat conditions, this study examines attitude as a precursor to behavior and its association with heat. With NFHS-4 survey data confirming India's predominantly male-headed household structure, this paper addresses a critical question: does exposure to extreme heat intensify patriarchal attitudes among married men?

Developing nations are characterized by patriarchal household settings. Women in these households are often over-worked and contribute to unpaid domestic labor. Gendered social positioning in India that places men as household heads gives them a disproportionate share of control and power over household resources [Singh et al., 2022] and introduces an imbalance of power between married couples. Control mechanisms including restrictions on physical mobility, deference customs, and seeking permission at home for outside employment, stifle women's autonomy under the guise of social norms. In extreme cases this can manifest into internalization of gender attitudes for women as evidence suggests increased tolerance of domestic violence among women than men (37% vs 33%) in India [Jayachandran, 2015]. This paper provides complementary evidence that such internalization extends to attitudinal dimensions among women as well.

Masculine gender role stress project traditional masculine norms on men which often leads to rigid coping styles such as aggression, dominance, emotional suppression, and competitiveness [Eisler and Blalock, 1991]. Such rigid masculine norms on power and control affect household dynamics promoting control rather than cooperation in relationships, and may contribute to marital violence, spouse abuse, and sexual coercion. Additionally, parenthood actively reinforces behaviors along with attitudes towards traditional gender roles within family [Katz-Wise et al., 2010]. The male backlash mechanism suggests that economic stress from drought, income loss, or anticipated income loss can cause men, typically the primary earners to assert control through violence [Dulhunty, 2025].

Empirical literature of heat and violence in India has primarily focused on women's reported experience of violence. The record of ever-married women in India experiencing any form of IPV is around 32.8% in NFHS-4 (2015-16) and nearly 29% in NFHS-5 (2019-21). By examining men's normative attitudes, the cognitive precursors to behavioral IPV, this study complements evidence provided by a recent study that temperature shocks substantially increase the incidence of physical IPV in India [Rahman and D'Exelle, 2025]. While they use recent (13-24 month) heat exposure to examine women's reported experience of IPV, this study uses a cumulative life-course heat exposure during a man's lived years to study the relationship between heat and normative attitudes on endorsing authority within marriage.

Unlike prior literature that infers men's behavior from women's reported experience of IPV, this paper captures men's attitudes by using self-reported responses from the men's module in NFHS-4.[2] The empirical specification employs a two-way fixed-effects model with district and birth cohort fixed effects. The life-course design captures cumulative heat exposure across each man's lived years rather than contemporaneous weather shocks. To study the heat-attitude impact, three indices for attitudes are designed on justification of IPV: capturing physical abuse and sexual coercion is deemed acceptable by husbands, spouse autonomy: whether husbands should have a greater say on spouse's freedom of mobility and financial independence, and household purchase decisions: whether husbands should unilaterally take major expenditure decisions. Using data from approximately 10,600 married men in 36–45 age-window from the NFHS-4 (2015–16), linked to ERA5-Land climate records for 639 Indian districts spanning 1960–2016, the study estimates the association between cumulative heat exposure and the three indices of patriarchal

[2] Data governance restrictions prevent direct analysis of individually reported IPV incidence; the focus on attitudinal measures is both a methodological constraint and a substantive contribution that men's normative attitudes constitute the ideological precursors to behavioral IPV.

attitudes.

This paper finds that heat exposure in the 36-45 age-window is positively associated with men's endorsement of patriarchal attitudes across all three attitudinal dimensions. Among married men in mid-life, positive association between heat and attitude is strongest with endorsement of attitudes on restricting spouse's mobility, followed by attitudes on justifying IPV. A weaker but positive heat-attitude association is found in men endorsing attitudes on making unilateral household purchase decisions. The results provide suggestive evidence of women's bargaining channel interpretation. The heat-attitude relationship is amplified when wives are economically dependent on their spouses, suggesting women's weak bargaining position in these households.

The rest of this paper is organized as follows. In Chapter 2 previous literature that discusses climate change vulnerabilities, mechanism of attitudes explaining behavior, male heat-aggression pathways are outlined. Chapter 3 details data sources and presents some descriptive statistics. Chapter 4 presents the empirical specification. Chapter 5 discusses the main results, explores underlying mechanisms, and runs some robustness checks. The paper concludes in Chapter 6.

2 Literature Review

Ambient climate influences how people live and generate a livelihood [Adger et al., 2003]. While the growing sensitivity to climate change can lead to people developing several adaptation techniques, there is a difference in how different vulnerable groups adapt to the existing variations in weather and climate based on structural factors. A growing body of literature documents that vulnerabilities to climate change are systematically gendered [Rao et al., 2019]. Increased familial responsibilities, men out-migration, and depleting natural resources add disproportionate hardships on women while constraining their earning capacities [Eastin, 2018] and mobility. Climate shocks in the form of deviations from long-term mean temperatures and increasing incidence of climatological disasters weaken gender equality, women's economic and social rights. Challenges to unequal social relations, and hierarchies enforce gender differentiated vulnerabilities [Tanjeela, 2023]. Environmental distress compounds female subordination in households through several reinforcing channels: increased controlling behavior by husband, lack of trust [Angula, 2010], women losing assets faster (jewelry, small livestock), constrained exit options from an exploitative marriage [Agarwal, 1997], and gender-differentiated investment in children [Datar et al., 2013].

Patriarchal household structures in developing countries that places men as economic providers as well as household heads, leaves little space for women to claim agency. NFHS-4 survey data reveals approximately 87% of women respondents belong to male-headed households, conforming to India's common patriarchal family structures. Economic factors along with societal structures reinforce subordination of women in households, allowing male dominance in decision-making [Simon and Hasan, 2025]. The prevalence of patrilocal systems in India that requires bride to move into her spouse's family after marriage, patrilineality that favors men in inheritance rights, or norms around restricted physical mobility of women with no similar repercussion on men curtail women's autonomy. Even when these norms have been contested, there have been counteractive outcomes. In the 1980s and 1990s when the law on inheritance was amended to treat both sons and daughters equally, it met with a backlash of increased bargaining power of women leading to female suicides and marital conflict [Anderson and Genicot, 2015]. These backlash dynamics are consistent within intra-household bargaining power models in which an individual's bargaining power depends primarily on their contribution to household income [Rogers, 1990]. The inability to contribute to productive assets, and increased reliance on male income raises the opportunity costs of divorce thus reducing women's agency [Eastin, 2018].

Among the noticeable effects of high temperatures on the human body, includes psychological distress apart from the physiological exhaustion [Rony and Alamgir, 2023]. Hot temperature increases aggression by increasing the feelings of hostility and aggressive thoughts [Anderson, 2001]. Several European and North American scholars in the late 1800s and early 1900s provide evidence of increased violent crime rates in the hottest times of the year, and places with the hottest climates [Anderson, 1989]. Climate literature provides one such evidence of a positive association between weather shock and incidence of IPV. Indian women in drought-prone areas are more likely to experience emotional, sexual, and physical IPV than those living in non-drought prone areas [Dehingia et al., 2024]. Rainfall shocks increase men's marital controlling behavior and alcohol-related aggression through anticipated economic insecurity [Diaz and Saldarriaga, 2023]. The authors also document that loss of economic independence among women weakens their negotiating position in relationship during periods of dry shocks, worsening their bargaining power in households. But in South Asian contexts, economic independence alone is not enough to alleviate bargaining position of women in households without simultaneous norm change. Additionally, threatened provider identity drives male backlash and contributes to men being more violent with heat disruption [Rahman and D'Exelle, 2025].

Intra-household bargaining models predict the role of women's participation in labor, ownership of assets, education, and economic status [Dulhunty, 2025] at improving their fallback position in marriage. An improved bargaining position of women in household can contribute to improved health and educational outcomes in children [Doss, 2013]. A weak fallback position within abusive marriages can lead to them spending more time with abusive partners in close quarters [Diaz and Saldarriaga, 2023]. Leaving women in charge of their own earnings has clear positive outcomes on household power compared to approaches like targeted transfers [Jayachandran and Voena, 2025]. Along with financial autonomy, strengthening women's fallback position particularly through land rights and collective organization has more effective outcomes than raising women's awareness of their interests [Agarwal, 1997]. But in India, structural barriers to accessing land ownership, financial resources, education among others weaken women's position making them more vulnerable to husband's coercive authority.

Attitudes shape a person's behavior through intention, temporal consistency, and social norms ([Bentler and Speckart, 1981];[Kraus, 1995]). Patriarchal beliefs act as strong predictors of violence against women as beliefs justify or reinforce male dominance, and violence can be a way to exert that dominance [Crittenden and Wright, 2013]. The authors provide several mechanisms for this including patriarchal attitude increases acceptance of controlling behavior, normalizes inequality, and use violence when authority seems threatened. A meta analysis confirms that husbands with pro-violence attitudes against wives are more likely to be violent [Sugarman and Frankel, 1996]. The channel can either operate from attitude to behavior where men who believe violence is acceptable are more likely to endorse it in practice or a behavior to attitude mechanism where men justify violence after committing it. In the context of IPV, more than individual acceptance of violent attitudes, perceived social norms play a major role in perpetrating the behavior. Men who believe their community endorses wife-beating are more likely to endorse it in practice suggesting attitudes operate both as individual precursor and socially embedded permissions for violent behaviors [Shakya et al., 2022]. The predictive nature of attitudes on behaviors depends on several factors including attitudinal stability, consistency between feeling and belief, and lived experience. These are most likely to characterize in a man's adulthood when belief and attitudes are more crystallized, and less responsive to norm change.

On the opposite spectrum of having authoritative attitude is having egalitarian or equitable attitudes. This gives each individual an autonomy to decide and act upon things by themselves. Similar to violent or controlling attitude, a very close link exists between egalitarian attitudes and practices. Egalitarian gender attitudes among men is passed on across generations; boys tend to observe gender roles and internalize what seems 'normal' [Levtov et al., 2014]. Therefore, differential discipline patterns embed gender-power associations into children's internalized schemas in a household and reinforce masculinity to dominance and femininity to subordination [Dipela, 2025]. Apart from inter-generation transmission, other factors that facilitate equitable gender attitudes among men are education, being raised in a fairly urbanized set-up [Du et al., 2021], and having a working mother and an income-earning wife [Boehnke, 2011]. The sample of this paper although substantially educated, is predominantly rural, male-headed households with non-working spouses, and represents a context in which patriarchal attitudes are particularly embedded and potentially susceptible to external stressors like heat.

Life-course designs have been widely used in epidemiological studies [Kuh et al., 2003] in the past and are increasingly being used in climate economics research. An aspect of this approach is to link exposures across life-course to outcomes in later life. Studies in climate literature using this design span from examining long-term impacts of drought exposure during early childhood on adult outcomes for women in sub-Saharan Africa [Hyland and Russ, 2019], effect of early-life rainfall shocks on human-capital formation [Shah and Steinberg, 2017], to studying effects of negative weather shocks on child health in Ethiopia [Randell et al., 2020]. Most of these studies concentrate on linkage to child growth and development, later-life opportunities, cognitive skills among others but not attitudes. Existing literature on heat and IPV has documented the behavioral outcomes of climate stress primarily women's reported experience of physical violence using contemporaneous or recent weather shocks. This paper extends the literature in two directions. First, the study of men's normative attitudes rather than behavioral outcomes, examining attitudes as the ideological precursors to IPV. Second, the use of a cumulative life-course heat exposure design rather than contemporaneous shocks, asking if long-run heat exposure during men's adult years is associated with their attitudinal dispositions. Together, these extensions provide the first evidence on how heat is associated with the normative attitudes on male coercive authority within Indian marriages.

3 Data

3.1 Survey Data and Outcome Variables

The National Family and Health Survey (NFHS-4) is used as the primary dataset which is extracted from the Demographic and Health Surveys (DHS) website. Conducted in 2015-16, NFHS is a comprehensive, large-scale multi-round cross-sectional survey in India which provides representative data on health, nutrition, and population indicators. The survey covers 572,000 households across 640 districts of India, interviewing 699,686 women aged 15–49 and 122,051 men aged 15–54 in 2015-16. For the main analysis, the men's module from NFHS-4 is used which outlines the outcome variables of interest regarding men's attitudes about spousal autonomy, IPV, and household decision. The main sample is restricted to married men with cohabiting spouses who are permanent residents[3] of the district. After restricting by these parameters the men's module is merged with women's module based on a spouse identifier to arrive at a matched sample of 40,461 cohabiting couples. The three indices are constructed from binary coded variables from the NFHS men's module and together they capture male authority in households. For a detailed information on the creation of index, refer to Table A.1 to find the survey questions used in the development of the three indices.

3.2 Census 2011 Data

To map the district of residence and its climate, administrative boundaries are taken from the Census of India 2011 district shape files. Since this paper looks into the prolonged heat

[3] The paper designates permanent resident status to men who answered "always" to the survey question on years lived in the place of residence. This along with the status of cohabitation with wife is used to ensure the sample of men are non-migrants.

exposure on individuals who are permanent residents of a district, Census 2011 district boundaries are used as the consistent geographic reference throughout the analysis. The assumption of limited lifetime migration is addressed empirically by restricting the sample to permanent residents of their district, as defined by NFHS question on years of residence.

3.3 Weather Data

The temperature and precipitation data come from ERA5 Land dataset provided by the European Centre for Medium-Range Weather Forecasts (ECMWF). ERA-5 dataset is a land-only reanalysis that offers high resolution of 0.1° (9–11 km grid) with higher spatial resolution over land. Estimates from reanalysis data are known to be consistent estimates of weather in a grid cell especially for areas with low coverage [Saenz-Molina, 2025] and thus have been extensively used in economic literature. Hourly daily maximum temperature[4] and total precipitation[5] for years 1960 until 2016 are used as the primary climate variables. Since men in NFHS-4 (2015-16) aged between 15 - 54 years were born between 1961 and 2001, a climate panel from 1960 to 2016 is constructed to ensure completeness of all exposure windows. Climate variables are extracted for all months from 1960-2016 to calibrate temperature (two meters maximum air temperature) and precipitation data across all states and districts of India to annual measures. Of the 640 districts in India, due to lack of climate data on district Dadra Nagar & Haveli, the final climate panel consists of 639 districts to be merged with NFHS data. For spatial analysis, all climate variables are aggregated to the district-year level, matching Census 2011 district boundaries.

For the grid-to-district mapping, climate variables in ERA5-Land are provided on a regular latitude–longitude grid. To assign grid cells to districts, the following steps were

[4] The daily maximum temperature represents the highest temperature observed across all 24 hourly readings within each calendar day.

[5] Total precipitation variable is extracted at 23:00 UTC for each day, which in ERA5-Land's accumulated-variable convention represents the cumulative precipitation from 00:00 to 23:00 UTC of that day. The daily values are summed within each year to obtain annual total precipitation per grid cell, converting from meters to millimeters (multiplying by 1000).

implemented:

1. The ERA5 grid coordinates for India (latitude 6°–35°N, longitude 67°–98°E) were extracted
2. Grid cell centroids were spatially joined to Census 2011 district polygons
3. Each grid cell was assigned to a district based on spatial intersection
4. District identifiers were constructed using a state–district combination to avoid ambiguities from identical district names across states (e.g., Bilaspur, Hamirpur in multiple states)

This ensured a unique mapping between each grid cell and its corresponding administrative district. A nearest valid land grid cell substitution is implemented on districts with missing values in grid cells and six small, coastal, island districts that got masked by ERA5-Land grid due to land-sea classification. This helped in restoring complete district coverage for the sample. For each day in a year, the daily mean maximum temperature is computed across all grid cells within a district, producing a district-day time series of 365 (or 366) values per district-year. From this district-day series, these annual measures are computed:

1. Mean annual daily maximum temperature
2. Number of heat days above 32°C
3. Degree days above 32°C[6]
4. Annual total precipitation (in mm)

The 32°C threshold[7] is constructed with empirical distribution of mean daily maximum temperature in the climate panel for years 1960-2016, where 32°C corresponds to the 75th percentile of the pooled district-year distribution (Figure A.1). Heat days here refer to the number of days in a year when temperature exceeded 32°C, while degree days capture

[6]This represents the sum of daily exceedance above 32°C, computed as $\sum_{d=1}^{365} \max(0, Tmax_d - 32)$. This captures both the frequency and intensity of heat exposure in degree day units.

[7]Temperature thresholds have been used actively in several agriculture and labor productivity literature in the context of climate change [Schlenker and Roberts, 2009]: [Somanathan et al., 2021]

the intensity of heat by summing the excess temperature on each day it was exceeded beyond the threshold. Degree days is used as the primary heat metric as it captures both frequency and intensity of heat exposure in a single measure [Lobell et al., 2011]. The resulting dataset is a balanced panel of state-district-year climate variables for 1960-2016.

District and state names are harmonized between Census 2011 boundaries and NFHS-4 survey coding. In cases of state reorganization (e.g., Telangana formed in 2014), districts are mapped according to their administrative status during the climate exposure period (1960–2016). A composite state–district, birth year identifier is constructed to ensure consistent merging across datasets. The final climate panel containing state, district, year, mean maximum temperature, heat days (> 32°C), degree days (> 32°C), and annual precipitation is merged with individual-level NFHS-4 men's module with spouse data using district of residence and birth year. Additionally the men are assigned into four different birth cohorts beginning with birth year 1961 and ending with 2001, each cohort spanning a decade in range.

To capture the lifetime effects of climate exposure, individual-level exposure windows are constructed by linking each respondent's birth year and district of residence to the corresponding district-year climate variables. For each respondent, climate variables were averaged across the years corresponding to each exposure window, yielding a single time-averaged exposure measure per window per respondent. Six exposure windows are constructed following developmental and life-course stages: early childhood (ages 0–5), middle childhood (ages 6–12), adolescence (ages 13–18), early adulthood (ages 19–25), adulthood (ages 26–35), and late-adulthood (ages 36-45). The upper bound of birth years eligible for each window is restricted to ensure that no exposure year exceeded 2016, the terminal year of the climate panel. Consequently, the sample size gets reduced for later windows especially for 26–35 and 36-45 windows. For the 36-45 window, only men born between 1961 and 1971 have complete exposure coverage, yielding a sample of approximately 10,600 men. The final exposure dataset is merged back with individual-level NFHS-4 data using a unique respondent identifier, with climate exposure measures entering as time-invariant individual characteristics. Figure 3.1 demonstrates average daily maximum temperature distribution on the analytical sample of spouse autonomy index.

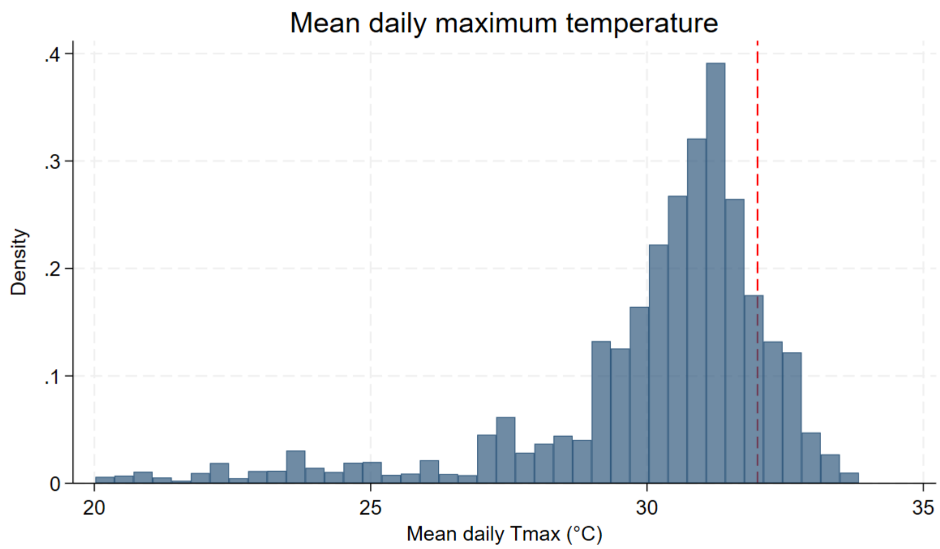

Figure 3.1: Distribution of mean annual daily maximum temperature, analytical sample (ages 36-45 window). *Notes:* The distribution is based on the regression sample on the spouse autonomy index with observations of size N = 10,587 averaged across each man's ages 36-45 exposure window. The red dashed line marks 32°C, the degree-days threshold corresponding to the 75th percentile of the pooled district-year temperature distribution. The histogram is trimmed at 20°C for visual clarity; a small number of observations (291) from high-altitude Himalayan and hill districts that fall below this value are not shown in the figure but are included in all regressions. *Source: Author's rendering of ERA-5 climate data (1960–2016).*

Due to data governance restrictions under research ethic framework consistent with GDPR, this paper does not analyze real incidence of intimate partner violence reported by women, and likewise for incidence of controlling behavior by spouses which are part of the domestic violence module. The analysis therefore focuses on the attitudinal measures from men's module and later compares with spillover analysis using wives' attitudinal responses on acceptance of IPV and financial autonomy drawn from the same household survey.

Descriptive Statistics

Table 3.1 presents summary statistics for the full merged sample of 40,461 cohabiting couples. The sample is predominantly rural (77.4%), with below-median wealth, 40% working in agriculture, and at least educated until secondary level. Household characteristics reveal a predominantly joint-family set-up with an average of nearly six adults in each household, of which 67.3% are headed by the male respondents themselves. Almost three-quarters of wives (76.9%) depend on their husbands economically, reflecting limited labor force participation of women in the sample. Nearly 41% of the women in sample married underage (below 18 years). 45.5% of the married men endorse some form of IPV justification, with similar figure for unilateral household purchase decision (40.7%). The low mean value for spouse autonomy (24.3%) is interpreted to be reflecting the index's two-component structure as well as the specific nature of questions being asked to the respondent. A closer look at the distribution of degree days above 32°C by Indian states, reveals states including Rajasthan, Delhi, Haryana, Punjab, Madhya Pradesh, Uttar Pradesh, Telangana, Gujarat, Maharashtra, and Chhattisgarh recording highest mean annual degree days above the threshold. In contrast, north-eastern states and island territories record near-zero degree days above the threshold, consistent with the cold-left tail in Figure 3.1. Last, climate exposure statistics are shown for the main age-window of analysis, 36-45 window for both degree days above 32°C and total precipitation, which brings the total observations down to 10,611.

Table 3.1: Descriptive Statistics

	Mean	SD	N
Men's demographic characteristics			
Age	37.204	8.540	40,461
Education level (0–3)	1.580	0.923	40,461
Wealth quintile (1–5)	2.885	1.386	40,461
Rural residence	0.774	0.418	40,461
Household head	0.673	0.469	40,461
Scheduled Caste or Tribe	0.362	0.481	40,461
Other Backward Class	0.391	0.488	40,461
Hindu	0.761	0.426	40,461
Muslim	0.139	0.346	40,461
Household characteristics			
Household members	5.881	2.585	40,461
Living children	2.398	1.670	40,461
Land ownership	0.655	0.475	40,461
Agricultural occupation	0.406	0.491	40,461
Alcohol consumption	0.366	0.482	40,461
Wife characteristics			
Wife age	32.777	8.110	40,461
Wife education level (0–3)	1.194	1.020	40,461
Wife economically dependent	0.769	0.422	40,461
Wife has bank account	0.496	0.500	40,461
Wife consumes media (weekly)	0.668	0.471	40,461
Underage marriage (wife <18)	0.411	0.492	40,461
Spousal age gap (years)	4.430	3.385	40,450
Outcome variables			
Spouse autonomy index	0.243	0.429	40,404
IPV justification index	0.455	0.498	40,439
Household purchase index	0.407	0.491	40,461
Climate exposure — ages 36–45 window			
Degree days >32°C (per 100)	4.687	3.127	10,611
Mean annual rainfall (per 100mm)	13.388	7.743	10,611

Notes: Sample is married men with cohabiting spouses with permanent district residence, merged with women's module (N = 40,461 couples). Binary variables are coded 1 = yes, 0 = no. Education level: 0 = no education, 1 = primary, 2 = secondary, 3 = higher. Climate exposure statistics correspond to the ages 36–45 window subsample (N = 10,611), which is the primary analytical sample used in main regressions. Outcome variable means are for the full merged sample. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

4 Empirical Specification

This paper employs a cross-sectional fixed effects model with district and birth cohort fixed effects in this specification:

$$Y_{idc} = \alpha + \beta DD_{idc} + \gamma P_{idc} + \eta Z_{idc} + \mu_d + \lambda_c + \epsilon_{idc}$$

where Y_{idc} is the outcome variable for individual i in district d born in birth cohort c. The three primary outcome variables of interest are namely - attitude on spouse autonomy, justification of IPV, and attitude on household purchases decision. The key primary heat variable of interest here is degree days denoted by DD_{idc} which captures the cumulative temperature effect above 32° scaled to per 100 degree days in the man's heat exposure windows. P_{idc} is the total accumulated precipitation scaled to per 100 mm rainfall in the man's climate-age windows. Total precipitation serves as a control along with other demographic characteristics due to its correlation with temperature [Auffhammer et al., 2013]. Z_{idc} is a set of demographic controls. Demographic factors include man's age, rural status, religion, caste, wealth quintile, and education. μ_d and λ_c represent district and birth cohort fixed effects respectively. μ_d absorbs all time-invariant district characteristics including permanent geographic, infrastructural, and cultural determinants of the outcome variable. λ_c absorbs national-level generational trends in outcomes across birth cohorts. Clustering of standard errors is done at the district level. As a robustness check standard errors are also clustered at state level, along with reporting Conley standard errors. Lastly, ϵ_{idc} captures the idiosyncratic error term. To match the survey design and ensure representativeness, all observations are weighted using the NFHS sample weights. Since the age windows report high correlation ($\rho > 6$), the main specification is run by per age-window. Main results in chapter 5 reveal, heat-attitude relationship survives only in age 36-45. It can be suggestive that this particular age also aligns with the theory that mid-life is a crucial transition period in men's life both in terms of marital and occupational decisions [Levinson, 1977] or a time-period when attitudes crystallize and lived experiences shape ideologies.

The empirical strategy relies on the identification assumption that climate variables are exogenous to individual characteristics, ensuring that the heat exposure in each age-window is as good as randomly assigned for each respondent. To test this, falsification test is run, regressing degree days on a variable that should not be affected by heat. Testing on religion, the results come out as null.

For robustness check the threshold of 32°C in main specification is complemented with a flexible binned specification that traces the temperature response. The threshold specification imposes two functional-form restrictions: (1) a kink at the threshold (zero marginal effect below 32°C, linear marginal effect above), and (2) constant marginal effect per degree-day across the entire above-threshold range. The binned specification relaxes the second restriction by allowing bin-specific coefficients across the temperature distribution. The following regression is run in this specification:

$$Y_{idc} = \alpha + \sum_{k=1}^{K} \beta_k Days_{idc}^{k} + \gamma P_{idc} + \eta Z_{idc} + \mu_d + \lambda_c + \epsilon_{idc}$$

dropping one bin as reference category (here 22-24°C)[8]. Fifteen uniform 2°C bins are constructed. Each β_k is the effect of additional day scaled to hundred in a bin k relative to the reference bin. Same controls and fixed effects are applied in running the regression with only bins replacing the single threshold variable. The specification is run for each of the three outcome variables. The response is displayed as a coefficient plot A.2 where the shape of the response tells if the effect is driven by moderately hot days or extreme hot days.

[8]This is based on the histogram depicting the distribution of temperature in the climate panel A.1. Conventionally a thermally neural range is usually picked as a reference bin.

5 Results

5.1 Main Results

Heat exposure during ages 36-45 is positively associated with men's endorsement of coercive patriarchal attitudes across all three attitudinal dimensions. Since all windows together have high correlation ($\rho > 0.6$), the main specification is run on each age window separately shown in Table 5.1. This paper finds that men in their mid-life or in ages 36-45 is the only window to find the heat-attitude association. All previous windows return null results across all three indices. Results in the age-window 36-45 reveal a 6.06 percentage point increase in endorsing attitudes on restricting spousal autonomy, and a 5.5 percentage point increase in justifying IPV, per 100 units of degree days above 32°C. An approximately 7 percentage point increase is seen in unilateral household purchase decision per 100 units of degree days above 32°C.

To assess the sensitivity of the functional form, the threshold robustness is replaced with a flexible binned temperature-response plot (2°C uniform bins in Figure A.2). Instead of one variable which is degree days above 32°C, multiple variables are built, one per temperature bin to calculate the number of days spent in each bin for each individual aged 36-45 in their district of residence. For spouse autonomy index, the bins are systematically positive starting from below 22°C and continuing through $\sim$ 42°C. The binned response on the index on IPV justification shows positive coefficients in the upper temperature range while for household purchase decision index shows no clear temperature dependence as the coefficients are near zero across the full distribution. The latter shows weaker dependence than the other two outcomes suggesting limited robustness to functional form choice. Joint F-tests are run on two different temperature bands 28-38°C and $\geq$ 32°C to confirm if for

Table 5.1: Heat Exposure and Attitudes by Age Window

	Spouse Autonomy		Justify IPV		Household Decision	
Degree days >32°C (per 100)	(1)	(2)	(3)	(4)	(5)	(6)
Age 0–5	0.0053	0.0030	−0.0072	−0.0044	0.0042	0.0024
	(0.0070)	(0.0071)	(0.0074)	(0.0072)	(0.0085)	(0.0087)
Age 6–12	−0.0033	−0.0049	−0.0013	−0.0050	0.0083	0.0067
	(0.0069)	(0.0070)	(0.0095)	(0.0096)	(0.0101)	(0.0100)
Age 13–18	0.0007	−0.0005	−0.0096	−0.0092	−0.0099	−0.0107
	(0.0067)	(0.0068)	(0.0080)	(0.0082)	(0.0088)	(0.0090)
Age 19–25	0.0092	0.0069	0.0027	−0.0014	0.0193*	0.0176
	(0.0096)	(0.0096)	(0.0104)	(0.0103)	(0.0117)	(0.0117)
Age 26–35	−0.0091	0.0002	0.0108	0.0048	−0.0260	−0.0241
	(0.0146)	(0.0145)	(0.0181)	(0.0178)	(0.0182)	(0.0186)
Age 36–45	0.0329	0.0606**	0.0758**	0.0549*	0.0451	0.0696*
	(0.0265)	(0.0282)	(0.0301)	(0.0308)	(0.0346)	(0.0383)
Controls	No	Yes	No	Yes	No	Yes

Notes: Each cell reports the coefficient on degree days >32°C (per 100) from a separate regression where heat exposure is measured over the indicated age window. Columns (1), (3), (5) are without controls; columns (2), (4), (6) include the full set of demographic and household controls. Observations vary by age window: approximately 40,400 for ages 0–18; 38,300 for 19–25; 25,060 for 26–35; 10,587–10,599 for 36–45. Standard errors clustered at district level in parentheses. Sampling weights applied. Includes both district and birth cohort fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

the outcomes the temperature-dependence pattern is concentrated in moderate or extreme heat range.

The tests reveal different temperature-dependence patterns across the three outcomes. For index on spouse autonomy, the joint test passes in the upper tail range (≥32°C, F = 2.42, p = 0.025) but fails in the 28-38°C (F = 1.55, p = 0.173). The response is concentrated specifically in the extreme heat range and not in the moderate heat band and the 32°C threshold is well aligned for this outcome. The IPV justification index signal is broad, extending below 32°C. The index is significant in the moderate-to-high heat range (28-38°C, F=3.40, p=0.005), with this range showing stronger significance than the upper-tail-only range (≥32°C, F=2.40, p = 0.026). This indicates the heat-induced shifts in attitudes on justifying IPV operate across a broad temperature range than what the threshold of 32°C captures. As an additional check, an alternate threshold of 28°C is used, further explained in robustness section. Last, outcome on household purchase decision index, fails both the joint tests (F=0.91, p=0.473; F=1.20, p=0.303), confirming the absence of clear temperature dependence at any reasonable temperature range.

These differing patterns suggest that heat-attitude relationship operate through partially distinct mechanisms across the outcomes. While attitudes on IPV justification respond to a broad range of moderate-to-high heat exposure, attitudes on spousal autonomy respond specifically to extreme heat conditions. Figure A.2 also reveals the nature of coefficients in IPV index as they seem to bounce, which can be explained by sparse observations in extreme temperature bins (and inflated standard errors). Nevertheless, the six bins above 32°C collectively show a positive association with IPV justification that is statistically distinguishable from zero. This confirms that the threshold-specification result reflects a real above-threshold heat response rather than a spurious correlation.

5.2 Heterogeneity Analysis

The heterogeneity analysis is conducted across nine interaction terms for each of the three outcomes as shown in Table 5.2. The discussion is organized across three theoretically motivated channels: women's bargaining position, asset ownership, and economic vulnerability.

Three proxies are constructed to capture wives' household bargaining position: economic dependence (wife not working or earning no independent income), bank account ownership, and weekly media exposure (television, radio, or newspaper). The most consistent finding across outcomes is the interaction between heat and wife's economic dependence. When wives are economically dependent on their husbands, the heat-attitude relationship is amplified for IPV justification ($\beta = 0.0137^{**}$) and household purchase decisions ($\beta = 0.0131^{**}$), though not for spouse autonomy ($\beta = 0.0066$, insignificant). This pattern is consistent with a bargaining-channel interpretation, heat intensifies patriarchal attitudes most when wives lack the economic independence that could counterbalance male coercive authority within marriage [Dulhunty, 2025].

The remaining two bargaining proxies show less consistent patterns. For IPV justification, bank account ownership and media exposure both show directionally consistent attenuation of the heat-IPV association, though neither reach conventional significance individually. For spouse autonomy and household purchase decision, neither proxy shows significant moderation. It is interpreted that the three bargaining proxies together provide suggestive evidence of a bargaining channel for IPV justification, with wife's economic dependence as the most precisely estimated and theoretically direct measure. The low share of working wives in the sample ($\approx$23%) limits the ability to draw strong inference on the bargaining channel, as the reference group of economically independent wives is small.

Land ownership attenuates the heat-attitude relationship for spouse autonomy ($\beta = -0.0110^{**}$) and IPV justification ($\beta = -0.0100^{*}$), but shows no significant moderation of household purchase decision. The finding on IPV aligns with another study that provides evidence of attenuation effects on IPV incidence due to land ownership [Saha, 2025]. This can suggest that land ownership may provide economic security that can insulate men from heat-induced stress and its attitudinal consequences. But this warrants caution, since the index on spouse autonomy measures attitudes about wife's mobility and financial independence, and not economic anxiety directly, the channel linking land ownership to this specific attitudinal dimension is less clear. Men in bottom two wealth quintile show smaller attitudinal heat effects on spouse autonomy ($\beta = -0.0106^{**}$) and household decision-making ($\beta = -0.0096^{*}$), though not for IPV justification. A possible explanation for this counterintuitive finding can be that poorer households may exhibit higher baseline for patriarchal attitudes, leaving less room for heat to shift attitudes any further. This paper acknowledges this as a speculative interpretation and alternative explanations including differential coping strategies or living conditions cannot be ruled out.

This paper finds no significant moderation through rural residence, agricultural occupation, low education, or alcohol consumption[9] across the three outcomes. IPV justification and household purchase attitudes are amplified by wife's economic dependence, consistent with a bargaining interpretation. Spouse autonomy is attenuated by land ownership and economic vulnerability, consistent with asset-buffer and ceiling-effect interpretations. No outcome shows significant moderation through male behavioral or contextual characteristics. These findings are treated as complementary to the main results.

A closer look at the components of spouse autonomy index in Table A.2 shows that the index is primarily moved by men deciding unilaterally on visits to their wife's family, highlighting mobility restrictions on women in these households. Component analysis on IPV index shown in Table A.3 demonstrates that attitude on IPV justification is primarily driven by men justifying to be violent if not in control of their spouse's mobility followed by if wife does not do her caregiving duties properly, being unfaithful or disrespectful

[9]The inclusion of alcohol consumption in heterogeneity analysis is because alcohol is ruled out as a mediator to heat unlike the evidence in [Nguyen, 2024].

Table 5.2: Heterogeneity analysis on heat exposure and patriarchal attitudes

	(1) Rural	(2) Agriculture	(3) Poor	(4) Low Edu.	(5) Own Land	(6) Alcohol	(7) Bank	(8) Wife Dep.	(9) Media
Panel A: Attitude on Spouse Autonomy									
Degree days >32°C (per 100)	0.0614**	0.0646**	0.0661**	0.0598**	0.0703**	0.0591**	0.0608**	0.0566**	0.0605**
	(0.0281)	(0.0281)	(0.0281)	(0.0283)	(0.0287)	(0.0283)	(0.0282)	(0.0279)	(0.0287)
Heat × Group	−0.0012	−0.0051	−0.0106**	0.0011	−0.0110**	0.0022	0.0015	0.0066	0.0003
	(0.0057)	(0.0049)	(0.0050)	(0.0037)	(0.0055)	(0.0049)	(0.0042)	(0.0048)	(0.0056)
N	10,587	10,587	10,587	10,587	10,587	10,587	10,587	10,587	10,587
R^2 within	0.007	0.009	0.008	0.007	0.008	0.008	0.009	0.008	0.008
Panel B: Attitude on justification of IPV									
Degree days >32°C (per 100)	0.0553*	0.0539*	0.0528*	0.0524*	0.0632**	0.0522*	0.0570*	0.0462	0.0569*
	(0.0305)	(0.0306)	(0.0306)	(0.0307)	(0.0310)	(0.0308)	(0.0309)	(0.0312)	(0.0313)
Heat × Group	−0.0006	0.0026	0.0031	0.0048	−0.0100*	0.0051	−0.0031	0.0137**	−0.0033
	(0.0064)	(0.0057)	(0.0056)	(0.0048)	(0.0059)	(0.0062)	(0.0047)	(0.0058)	(0.0053)
N	10,591	10,591	10,591	10,591	10,591	10,591	10,591	10,591	10,591
R^2 within	0.019	0.019	0.019	0.019	0.021	0.021	0.020	0.020	0.020
Panel C: Attitude on Household Purchases Decision									
Degree days >32°C (per 100)	0.0680*	0.0719*	0.0754*	0.0719*	0.0739*	0.0702*	0.0709*	0.0614	0.0676*
	(0.0387)	(0.0385)	(0.0385)	(0.0384)	(0.0389)	(0.0386)	(0.0382)	(0.0383)	(0.0384)
Heat × Group	0.0022	0.0013	−0.0096*	−0.0049	−0.0052	−0.0091	−0.0013	0.0131**	0.0037
	(0.0065)	(0.0049)	(0.0054)	(0.0050)	(0.0077)	(0.0060)	(0.0053)	(0.0059)	(0.0055)
N	10,599	10,599	10,599	10,599	10,599	10,599	10,599	10,599	10,599
R^2 within	0.005	0.008	0.006	0.006	0.005	0.006	0.005	0.005	0.005

Notes: Each column reports a separate regression for the indicated subgroup interaction. Panels A, B, and C report results for attitudes on spouse autonomy, justification of IPV, and household purchase decision respectively, all measured at the 36–45 window. The main effect coefficient is for degree days >32°C (per 100), and the interaction term shows the additional effect for the subgroup. Subgroups: Columns (1) to (6) represent men's characteristics — Rural (vs urban), Agriculture occupation, Poor (bottom 2 wealth quintiles), Low education (primary or less), Land ownership (vs landless), Alcohol consumption. Columns (7) to (9) represent spouse's characteristics — wife has bank account, wife economically dependent / not working, & wife consumes media (TV/radio/newspaper). All regressions include district and birth cohort fixed effects. Standard set of men's controls on demography and precipitation applied. Standard errors clustered at district level in parentheses. Sample weights applied. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).

towards husband. This reflects the authoritative position of men in these households where customs on wife's deference towards husband is upheld. The index on IPV does not seem to be moved by indicators on sexual coercion and this maybe suggestive of one of the limitations of having self-reported responses on violence. Lastly, although noisy, but component analysis on household decision index in Table A.4 reveal men to be more in charge of daily purchases or major household purchases, confirming a higher financial decision making power of men in these households.

5.3 Mechanism

To explain men's heat-attitude relationship this paper tests three potential mechanisms; mediating roles played by substance use, income insecurity, and marriage-selection in response to men's heat exposure. While prior literature finds association between heat and lapses in self-control through substance use ([Hagger et al., 2010]; [Veilleux et al., 2018]), reduced-form tests of heat exposure on alcohol, edible tobacco, and smoking in the sample find no significant association. Reduced-form tests using men's wealth index, agricultural occupation, type of payment from work (cash vs in-kind) as mediators similarly find no evidence of economic channel in operation that can justify income insecurity to be driving men in endorsing such patriarchal attitudes. Based on evidence from literature that weather shocks can affect marriage-market selection [Corno et al., 2020], it is tested whether heat exposure leads to selection into marriage with more vulnerable partners. A composite wife-vulnerability index is created using women's predetermined characteristics before marriage.[10] The underlying assumption is that men exposed to heat for a prolonged period of time can select marital partners whose characteristics weaken their bargaining position in the households. The reduced form regressions show mixed and inconsistent signs across windows with positive and significant association of heat and wife's vulnerable status in age windows 6-12 and 13-18, but negative and significant association in age 19-25. The inconsistency in signs across windows do not support a coherent marriage-market sorting explanation in which heat during formative years would produce a consistently directional association with wife vulnerability. This paper cannot directly test the psychological pathways including irritability, sleep disruption, or heat-related aggression documented in literature ([Anderson, 2001];[Rony and Alamgir, 2023]) due to limits of NFHS-4 data since it does not collect data that measure stress or psychological state.

[10]This paper defines vulnerable status of women before marriage as them being low educated (primary or less), underage - below 18 years, and having large spousal age-gap, here 6 years, which is the 75th percentile of the distribution. Results derived from reduced-form regressions on premarital age-windows i.e., 0-5 through 26-35.

Identifying this pathway would require longitudinal individual data.

Taken together, the reduced-form results do not provide evidence that heat exposure during ages 36-45 operates through behavioral, economic, or marriage-market channels testable with available data. Although these results do not point towards a clear mechanism at play, heterogeneity analysis reveals one suggestive channel that moderates men's heat-attitude relationship; wife's weak bargaining position through economic dependence on husband. This finding aligns with evidence on how financial dependence on men can worsen women's autonomy and increase marital control [Wang et al., 2025]. Wives who are not employed, spend more time within household, potentially increasing exposure to and internalization of husband's patriarchal attitudes.

5.4 Spillover

Similar to men's attitude on justification of IPV, and spouse's autonomy, to capture the spillover effect of men's exposure to heat and attitude on their spouses, new indices on acceptance of IPV and financial autonomy are created. The index on women's acceptance of IPV replaces men's outcome variable on IPV index with spouse's attitudinal responses on justifying domestic violence in the main specification. Although individually insignificant, both outcomes on wife's attitude on IPV justification and financial autonomy yield directional consistency with the husband-side patriarchal-attitude association with heat. Result in Table 5.3 reveals a positive, insignificant but directionally consistent coefficient to the men's attitude on IPV with heat. To capture spouse's reported financial autonomy, an index that measures if wives have the autonomy to decide on the money that they have alone is created. Result provides a directionally consistent negative but insignificant coefficient. Adding wife's predetermined characteristics (age, education, religion, caste) as controls does not meaningfully change the coefficient on heat exposure (β changes from 0.0297 to 0.0314 for IPV, from -0.0211 to -0.0218 for financial autonomy), nor the standard errors. The stability across specifications suggest wife's characteristics do not absorb substantial confounding variation between heat exposure and reported outcomes.

To assess whether the consistent directional pattern in individual husband and wife outcomes reflect household-level attitudinal shift on IPV justification, a household mean of IPV justification index averaging the spouse's respective responses on heat exposure is regressed on heat. The fixed effects regression returns a positive coefficient but does not reach statistical significance ($\beta = 0.041, SE = 0.029, p = 0.17$). This is suggestive evidence that the heat exposure during husband's late adulthood window is associated with a directionally consistent household-level justification of IPV, with limited statistical power to detect this household-level pattern given the size of the spillover effect. These findings although on a attitudinal scale, align with an essential finding in a study conducted in Peru which provides evidence of how heat waves can lead to greater acceptability of violent behavior among women and increase the incidence of IPV [Kim, 2025].

Table 5.3: Heat Exposure and Wife Outcomes

	Wife justifies IPV		Wife's financial autonomy	
Degree days >32°C (per 100)	(1)	(2)	(3)	(4)
Age 36–45	0.0297	0.0314	-0.0211	-0.0218
	(0.0351)	(0.0350)	(0.0330)	(0.0329)
Controls	Yes	Yes	Yes	Yes
All Controls	No	Yes	No	Yes
N	10599	10599	10599	10599
R^2 overall	0.213	0.218	0.175	0.182

Notes: Wife outcomes on justifying IPV (measured by index - IPV acceptance that includes survey questions on justification of physical violence) and having financial autonomy to make their own financial decisions alone. Age 36-45 window (men). Controls refer to our standard set of men's controls. 'All Controls' include both men's and their spouse's (age, education, religion, and caste). Fixed effects include district and birth cohort effects. Clustered SE at district level. Main effect coefficient is for degree days above 32°C (per 100). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

5.5 Robustness Checks

State Clustering: Standard errors throughout the main specification are clustered at district level, accounting for arbitrary error correlation within districts. To address potential spatial correlation across state boundaries since heat waves, regional shocks, culturally-shared attitudes do not restrict to administrative boundaries, this paper runs the main specification by clustering errors at state level. While spouse autonomy index, and household purchases decision index survive (p=0.018 ; p=0.092), attitude on IPV justification loses significance (p=0.16). This indicates, attitudes on IPV justification which was at the boundary of conventional significance under district level clustering (p=0.08), has more spatial autocorrelation than the indices on spousal autonomy and household purchase decision attitudes. It can be suggestive that attitudes on violence against partners are likely shaped by regional or cultural factors such as legal frameworks, or regional gender norms that operate at state level [Ahmad et al., 2021]. Whereas it can be speculated that attitudes on household level dynamics including controlling spouse's mobility, finances, or making unilateral decisions on household purchases are more individual based circumstances and not necessarily state-wide patterns.

Conley Standard Errors: To further test the spatial correlation across districts for index on IPV justification, Conley standard errors are reported that allow for spatial correlation at 100km, 200km, and 500km bandwidths and arbitrary serial correlation in the error term [Conley, 1999].[11] The point estimate is stable at all bandwidths ($\beta = 0.055$), but standard errors are large which reduce the statistical significance. Considering the index on IPV justification was at marginal significance level, Conley standard errors pushes it to insignificance. This suggests spatial correlation in the error structure and strengthens the claim that attitude on IPV justification show regional autocorrelation in cultural and

[11] Conley standard errors allow errors to be correlated on spatial distance. Observations close in geographic space have correlated errors that decay with distance. Different bandwidths are chosen here for robustness purpose. To implement Conley standard errors, Stata routines from [Colella et al., 2019] has been used.

climate factors. The index on IPV justification is interpreted as suggestive evidence rather than fully robust.

Binned Specification: The joint tests from binned-temperature response confirm the noisy nature of household purchase decision index where its relationship with heat seems to be specification dependent. Its evidence of heat-attitude association is thus mixed; while it survives the state-level clustering but the binned specification shows no clear temperature-dependent pattern unlike the attitude indices on spouse autonomy and justification of IPV. The specification also demonstrates that index on IPV unlike spouse autonomy operates on a broad temperature bandwidth.

Alternate Threshold: Since the binned specification shows evidence of index on IPV justification surviving joint tests in both moderate and extreme temperature, the main specification is run for the index using 28°C as a threshold for degree days. The result returns a positive but insignificant coefficient on 36-45 age-window ($\beta = 0.0261, SE = 0.0214, p = 0.223$) compared to previous outcome ($\beta = 0.0549, SE = 0.0308, p = 0.07$). Since 28°C is almost the 50th percentile, lowering the threshold from 32°C, the degree-days variable now accumulates exposure from much larger portion of the temperature distribution which includes bins that are low-signal bearing (Figure A.2) i.e., 28-32°C. As a result the variable loses significance.

Placebo Test: In order to test the robustness of the findings to ensure that they are simply not noise, this paper runs falsification test or a placebo test on age-window 0-5 and randomly draws 100 subsample of size ∼10,000 from ∼40,000 observations. The selection of the window is based on the assumption that the true heat effect in this window should be zero. Findings as shown in Figure A.3, FigureA.4, and Figure A.5 indicate that all three distributions are centered near zero, consistent with a null true effect in the 0-5 window. Critically, the 36-45 coefficients for spouse autonomy, IPV justification, and household decision all lie beyond the right tail of their respective placebo distributions and none of the 100 placebo draws produce a coefficient of comparable magnitude. This indicates that the 36-45 results are unlikely to reflect small-sample noise and reflect genuine signal specific to 36-45 exposure window.

Pooled Specification: Since due to correlation among exposure windows, the main specification was run by age-specific windows, in addition a pooled regression is also run to jointly estimate late-adulthood-window (26-45) and early-life-window (0-25) heat exposure on men's attitudes. The point of this exercise is to evaluate whether the heat-attitude relationship in 36-45 age window can be explained by a temporal specification. The pooled specification is described in detail in A.3.

6 Conclusion

This study estimates the relationship between cumulative heat exposure and patriarchal attitudes among married men in India. Using a two-way fixed effects specification on a sample of approximately 10,600 married men aged 36-45, it is found that a 100-degree-day increase in exposure above 32°C is associated with 5-7 percentage point increase in endorsement of patriarchal attitudes across three attitudinal dimensions: restriction of spousal autonomy, justification of IPV, and unilateral household purchase decision-making. The evidence is most robust for spouse autonomy, significant at 5% and surviving state-clustering, while IPV justification shows positive association with marginal significance and is sensitive to spatial autocorrelation. Household purchase decisions show a positive but has the weakest functional-form support. The result is concentrated in the 36-45 age window and is not detectable in earlier life-course windows. A placebo test drawing 100 random sub-samples of comparable size from null-effect 0-5 window confirms that the results are unlikely to reflect small-sample noise.

Heterogeneity analyses complement the main results and show a suggestive evidence of women's bargaining channel. This association is amplified in households where women are economically dependent on husbands, consistent with the sample's characteristic of being predominantly male-headed households with non-working wives. It is also found through spillover analyses that a directionally consistent but individually insignificant pattern emerges in wives' reported acceptance of IPV and restricted financial autonomy on attitudinal dimensions, complementing prior evidence from literature on internalization of gender attitudes among women. Further, reduced-form tests find no evidence that the heat-attitude relationship operates through behavioral, economic, or marriage-market channels, though this reflects the limitation of data rather than absence of a mechanism.

This paper makes two contributions to growing literature on climate and gender. First, it shifts the analytical lens from women's reported experience of IPV to men's self-reported normative attitudes, providing first evidence on an association between cumulative heat exposure and male attitudes, the ideological precursors of male coercive authority within marriages. Second, it introduces a life-course exposure design to heat-gender literature, demonstrating a cumulative heat exposure association with attitudes rather than responses to contemporaneous weather shocks.

This paper also acknowledges its limitations. For clear identification of a causal pathway the study acknowledges the need for longitudinal data with within-individual variation in heat exposure. The pooled specification, which jointly estimates adult and early-life exposures, yields null results for both windows, indicating that the precise temporal origin of the association cannot be identified from these data. Concerns on internal migration within India cannot be fully refuted even though the sample of married men is restricted permanent residents of a district. The sample of stable cohabiting couples can ignore couples in temporary separation.

Social norms restricting women's autonomy within households can have macro impacts including women's education, employment, and overall well being [Bandyopadhyay, 2020]. If heat exposure is associated with men's endorsement of patriarchal attitudes, climate adaptation strategies should extend beyond physical and economic harms of the silent disaster to address gender inequality as a compounding vulnerability. Investment in women's economic independence which this study finds to partially buffer the heat-attitude relationship can serve a dual purpose as both challenging entrenched patriarchal norms and strengthening women's bargaining position. While physiological adaptations to heat acclimation is gendered [Wickham et al., 2021], the psychological impacts of heat positions women as recipients of heat-induced male marital control, aggression, and violence. Future research should examine if the attitudinal associations documented here translate into behavioral tendencies in men's conduct within marriage.

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A Appendix

A.1 Figures

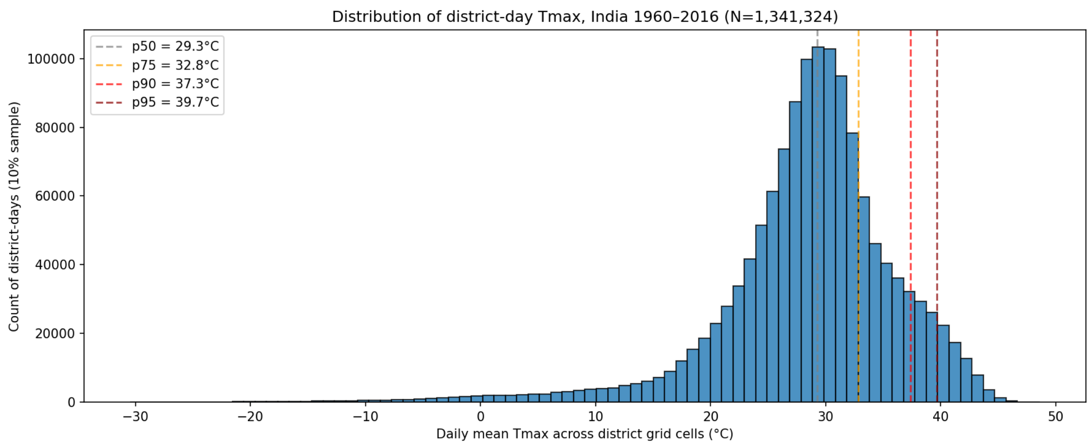

Figure A.1: Distribution of daily maximum temperature across Indian districts, 1960-2016 (N = 1,341,324 district-day observations, 10% subsample). Each district-day observation is the daily mean maximum temperature across grid cells within that district. Vertical lines mark the 50th, 75th, 90th, and 95th percentiles of the distribution. Key heat measure (degree-days above 32°C) captures the upper quartile of district-day temperature exposure (p75 = 32.8°C).The left tail (below 0°C) reflects high-altitude districts; the bulk of district-day observations cluster in the 25-35°C range, consistent with India's predominantly tropical climate. *Source: Author's rendering of merged ERA-5 climate data (1960–2016).*

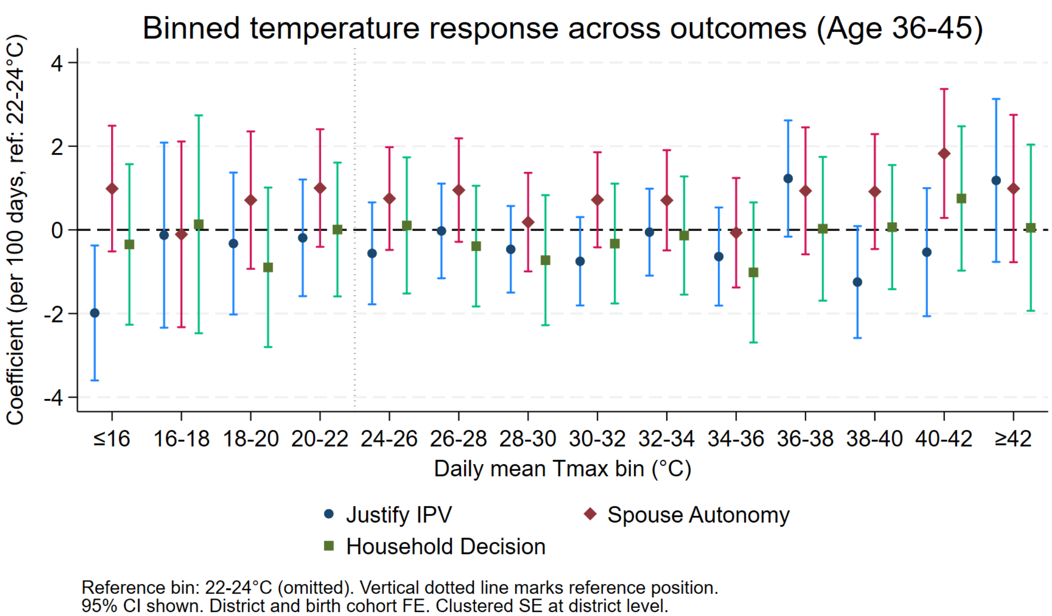

Figure A.2: Binned temperature response across outcomes. Coefficients estimated from a single two-way fixed-effects regression in which the heat exposure measure is replaced by 14 indicator variables for 2°C temperature bins (reference: 22–24°C, omitted). Each coefficient represents the association with 100 additional days in that temperature bin during the ages 36–45 exposure window, relative to the reference bin. 95% confidence intervals shown for the three outcomes. District and birth cohort fixed effects applied. Standard errors clustered at the district level. N = 10,611. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

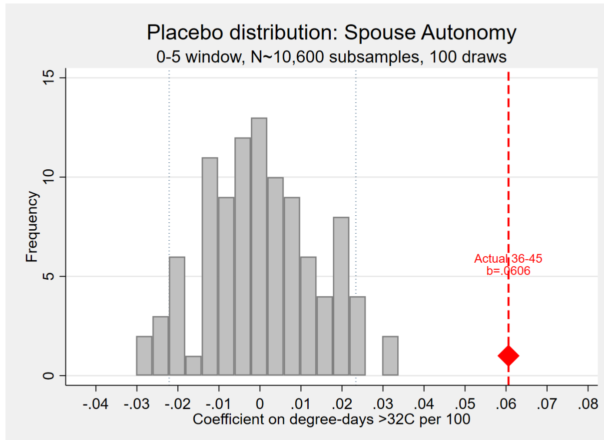

Figure A.3: Placebo distribution of spouse autonomy index on 0-5 age-window. TWFE specification run on each randomly drawn 100 sub samples of N=10,600 from the age 0-5 window, where the true heat-attitude effect is believed to be zero based on the main results. Red dashed line shows actual 36-45 coefficient. Navy dotted lines represent 5th and 95th percentiles of placebo distribution. Placebo distribution centered near zero and actual coefficient lies beyond right tail. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

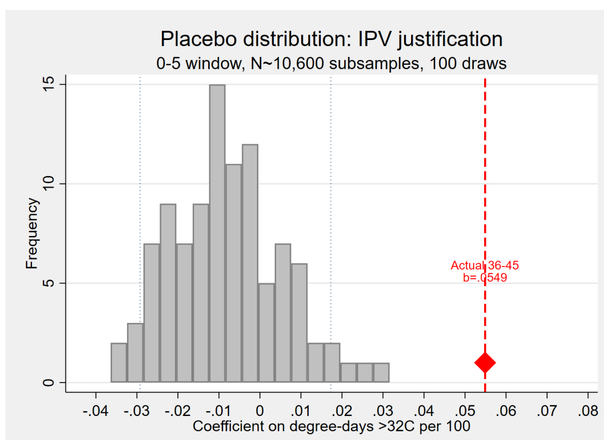

Figure A.4: Placebo distribution of IPV justification index on 0-5 age-window. TWFE specification run on each randomly drawn 100 sub samples of N=10,600 from the age 0-5 window, where the true heat-attitude effect is believed to be zero based on the main results. Red dashed line shows actual 36-45 coefficient. Navy dotted lines represent 5th and 95th percentiles of placebo distribution. Placebo distribution centered near zero and appears slightly left-skewed consistent with negative coefficient in 0-5 age window in main specification. Actual coefficient lies beyond right tail. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

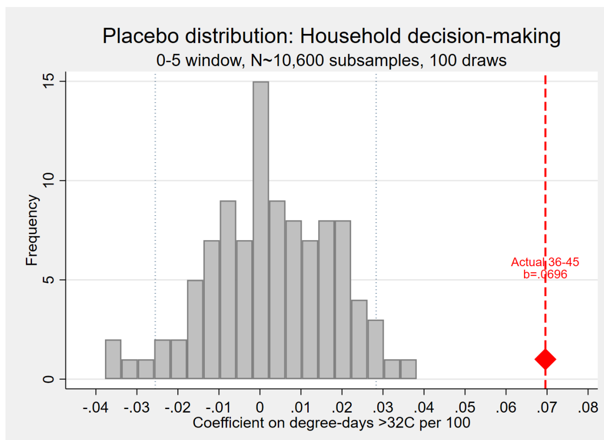

Figure A.5: Placebo distribution of household purchase decision index on 0-5 age-window. TWFE specification run on each randomly drawn 100 sub samples of N=10,600 from the age 0-5 window, where the true heat-attitude effect is believed to be zero based on the main results. Red dashed line shows actual 36-45 coefficient. Navy dotted lines represent 5th and 95th percentiles of placebo distribution. Placebo distribution centered near zero and actual coefficient lies beyond right tail. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

A.2 Tables

Table A.1: Components of patriarchal attitudes indices

(1) *Physical violence justified*	(2) *Sexual coercion*	(3) *Spouse autonomy*	(4) *Household purchase*
Beating justified if wife goes out without telling husband	Husband has right to get angry when wife refuses sex	Husband should decide on visits to wife's family	Husband should have greater say in major household purchases
Beating justified if wife neglects children	Husband has right to refuse financial support when wife refuses sex	Husband should decide what to do with wife's money	Husband should have greater say in daily household purchases
Beating justified if wife argues with husband	Husband has right to use force when wife refuses sex		Husband should have greater say in large household purchases
Beating justified if wife refuses to have sex			
Beating justified if wife doesn't cook food properly			
Domestic violence justified if wife is unfaithful			
Domestic violence justified if wife is disrespectful			

Notes: Items are from the NFHS-4 men's questionnaire. Columns 1 and 2 jointly form the IPV justification index (10 components total: 7 physical violence justification items + 3 sexual coercion items). Cronbach's $\alpha = 0.8$, which demonstrates strong internal consistency supporting the composite index construction. Column 3 forms the spouse autonomy index. Column 4 forms the household purchase index. Each index is a binary indicator equal to 1 if the man endorses any listed item and 0 otherwise. *Source: Author's rendering of NFHS-4 data (2015–2016).*

Table A.2: Heat exposure and component breakdown of Spouse Autonomy Index, by age window

Degree days >32°C (per 100)	(1) Decide on visits to wife's family	(2) Decide what to do with wife's money	(3) Spouse Autonomy Index
Age 0-5	0.002	0.003	0.003
	(0.007)	(0.005)	(0.007)
Age 6-12	−0.009	0.003	−0.005
	(0.007)	(0.007)	(0.007)
Age 13-18	0.004	−0.001	−0.001
	(0.007)	(0.006)	(0.007)
Age 19-25	0.004	0.005	0.007
	(0.009)	(0.008)	(0.010)
Age 26-35	−0.012	−0.001	0.000
	(0.014)	(0.013)	(0.015)
Age 36-45	0.068**	0.038	0.061**
	(0.027)	(0.025)	(0.028)

Notes: Each row reports the coefficient on degree-days >32°C (per 100) for the corresponding age window. Approximate sample sizes by window: 0-5, 6-12, 13-18 windows N≈40,000-40,400; 19-25 window N≈38,000-38,300; 26-35 window N≈24,900-25,100; 36-45 window N≈10,500-10,600. Standard errors clustered at district level in parentheses. District and birth cohort fixed effects. Sample weights applied.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

Table A.3: Heat exposure and component breakdown of IPV Justification Index, by age window

Degree days >32°C	(1) Beating if wife goes out without telling	(2) Beating if wife neglects children	(3) Beating if wife argues with husband	(4) Beating if wife refuses sex	(5) Beating if food not cooked properly	(6) Beating if wife unfaithful	(7) Beating if wife dis-respectful	(8) Angry if wife refuses sex	(9) Refuse financial support if wife refuses sex	(10) Use force if wife refuses sex	(11) IPV Index
Age 0-5	-0.012^{*}	0.004	-0.001	-0.003	0.002	0.003	0.001	-0.001	0.002	0.009^{**}	-0.004
	(0.007)	(0.007)	(0.007)	(0.005)	(0.006)	(0.007)	(0.007)	(0.006)	(0.004)	(0.004)	(0.007)
Age 6-12	-0.010	-0.007	-0.010	-0.007	-0.015^{***}	0.001	-0.008	0.003	0.000	0.004	-0.005
	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)	(0.009)	(0.008)	(0.006)	(0.006)	(0.010)
Age 13-18	-0.007	-0.005	-0.003	-0.011^{**}	-0.008	-0.005	-0.008	-0.003	-0.002	0.001	-0.009
	(0.006)	(0.007)	(0.007)	(0.005)	(0.005)	(0.006)	(0.008)	(0.007)	(0.005)	(0.005)	(0.008)
Age 19-25	0.008	0.006	0.004	0.004	0.002	0.001	-0.003	-0.006	-0.003	-0.011^{*}	-0.001
	(0.008)	(0.008)	(0.008)	(0.006)	(0.007)	(0.009)	(0.010)	(0.008)	(0.006)	(0.006)	(0.010)
Age 26-35	-0.004	-0.004	0.016	-0.005	0.003	-0.019	0.005	0.000	0.005	0.000	0.005
	(0.012)	(0.013)	(0.014)	(0.009)	(0.010)	(0.015)	(0.015)	(0.012)	(0.010)	(0.010)	(0.018)
Age 36-45	0.069^{***}	0.049^{*}	0.039	0.024	-0.009	0.044^{*}	0.053^{*}	0.031	0.006	0.024	0.055^{*}
	(0.022)	(0.028)	(0.028)	(0.023)	(0.020)	(0.026)	(0.029)	(0.024)	(0.019)	(0.018)	(0.031)

Notes: Each row reports the coefficient on degree-days >32°C (per 100) for the corresponding age window. Each column is a separate regression. Approximate N: 0-5, 6-12, 13-18 windows N≈40,000-40,400; 19-25 window N≈37,900-38,300; 26-35 window N≈24,800-25,100; 36-45 window N≈10,400-10,600. Standard errors clustered at district level in parentheses. District and birth cohort FE. Sample weights applied. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

Table A.4: Heat exposure and component breakdown of Household Purchase Decision Index, by age window

Degree days >32°C (per 100)	(1) Greater say in major household purchases	(2) Greater say in daily household purchases	(3) Greater say in large household purchases	(4) Household Purchase Index
Age 0-5	0.008	0.001	−0.003	0.002
	(0.007)	(0.007)	(0.007)	(0.009)
Age 6-12	−0.006	−0.003	0.002	0.007
	(0.009)	(0.007)	(0.009)	(0.010)
Age 13-18	0.009	0.001	−0.017**	−0.011
	(0.008)	(0.006)	(0.008)	(0.009)
Age 19-25	0.004	0.001	0.024**	0.018
	(0.011)	(0.009)	(0.010)	(0.012)
Age 26-35	−0.037**	−0.003	−0.029*	−0.024
	(0.018)	(0.015)	(0.016)	(0.019)
Age 36-45	0.066**	0.074***	0.034	0.070*
	(0.033)	(0.028)	(0.034)	(0.038)

Notes: Each row reports the coefficient on degree-days >32°C (per 100) for the corresponding age window. Approximate sample sizes by window: 0-5, 6-12, 13-18 windows N≈40,200-40,400; 19-25 window N≈38,200-38,300; 26-35 window N≈25,000-25,100; 36-45 window N≈10,500-10,600. Standard errors clustered at district level in parentheses. District and birth cohort fixed effects. Sample weights applied.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*

A.3 Pooled Specification

The pooled specification jointly estimates late-adult-window (26-45) and early-life-window (0–25) heat exposure on men's attitudes. A regression of the following specification is run:

$$Y_{idc} = \alpha + \sum_{w=1}^{2} \beta_w DD_{idc} + \gamma P_{idc} + \eta Z_{idc} + \mu_d + \lambda_c + \epsilon_{idc}$$

where w=1 corresponds to early-life heat exposure in terms of degree days per 100 units in age 0–25, and w=2 corresponds to late-adulthood stage with men aged 26–45. To run this regression, the sample is restricted to men in the main specification age group 36–45 with a size of approximately 10,611 observations. Same controls and fixed effects are retained in the specification. The above equation helps in determining which of the either windows drive heat-attitude relationship. Results in Table A.5 reveal that neither coefficients reach statistical levels of significance for any of the three outcomes. For indices on spouse autonomy and IPV justification, the coefficients are positive in late-adulthood window and negative in early-life window, but for household decision index, both coefficients are positive. This paper does not interpret this sign reversal between periods substantively given that there exists substantial heat exposure variation (demeaned correlation ≈ -0.43) and the joint estimation cannot reliably separate heat effects across age periods.The household decision index with its non-reversing signs in coefficients across periods strengthens the previous claim of it being noisy and failing to show strong temperature-dependence.

The pooled specification's primary contribution is to confirm that this paper cannot statistically isolate adult-window heat exposure from early-life heat exposure in the cross-sectional design.

Table A.5: Heat Exposure and Outcomes (Pooled)

	(1)	(2)	(3)
Degree days >32°C (per 100)	Spouse Autonomy	Justify IPV	Household Decision
Age 26–45	0.0313	0.0300	0.0720
	(0.0357)	(0.0374)	(0.0497)
Age 0–25	-0.0187	-0.0165	0.0306
	(0.0157)	(0.0166)	(0.0233)
N	10587	10591	10599
R^2	0.145	0.224	0.146
R^2 within	0.007	0.019	0.005

Notes: Outcomes by heat exposure. Pooled regression on early-life exposure (age 0–25) and late adulthood (age 26–45). Fixed effects include district and birth cohort fixed effects. Controls refer to standard set of men's controls on demography and precipitation. District and birth cohort fixed effects. Sample weights applied. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Source: Author's rendering of merged NFHS-4 and climate data (1960–2016).*