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ABSTRACT: Even though one in four women worldwide has experienced violence from an intimate partner (IPV) at least once in their lifetime, some of the factors driving it remain poorly understood. This study quantifies the impact of extreme temperatures on IPV seasonality, with a particular focus on its increase during the summer months. Using granular administrative data on IPV in Spain for the period 2006-2022, we find that extreme heat leads to a 6% rise in total IPV offences, with a stronger increase for severe cases. We explore several mechanisms, including increased time exposure to the partner and potential modifications in reporting behaviour. Importantly, we also show that the effects are stronger in areas facing substantial negative labour market shocks. Our projections indicate that a rise in average temperatures would result in 85-190 additional severe IPV offences per year, emphasizing the role of climate resilience for the successful implementation of IPV prevention strategies.

JEL Codes: J12, K38, Q54
Keywords: Intimate partner violence, temperature, climate change, labour market shocks

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1. Introduction

Home remains the most dangerous place for women, as highlighted in the latest UN Women report on femicides (UN Women, 2024). This danger is widespread: one in four women globally experience intimate partner violence (IPV) at least once in their lifetime (Sardinha et al., 2022). Beyond its immediate, devastating effects on victims and their children, IPV imposes immense economic costs, including higher healthcare expenditures (e.g., Duvvury et al., 2013), lost productivity (e.g., Lloyd, 1997; Adams et al., 2012), and increased mental health risks (e.g., Machisa et al., 2016). This broad impact has spurred economic research into IPV's determinants, particularly centered on intra-household risk factors (e.g., Aizer, 2010; Tur-Prats, 2019; Adams-Prassl et al., 2023).

However, recent studies suggest that environmental stressors, such as extreme temperatures, can also substantially influence household dynamics. Evans et al. (2023) identify heat as a significant driver of child neglect in the United States, potentially related to cognitive strain on caregivers during high temperature days. Similarly, an expanding literature establishes a causal relationship between extreme heat and criminal activity (e.g., Ranson, 2014; Heilmann et al., 2021; Colmer and Doleac, 2023; Cohen and Gonzalez, 2024). Therefore, we hypothesize that heat exposure may also increase the risk of intimate partner aggression.

In this paper, we examine the causal impact of extreme temperatures on IPV in Spain, one of the hottest countries in Europe. We first document a pronounced seasonal pattern in IPV, with peaks during the summer months. To assess the extent to which heat contributes to this seasonality, we use detailed administrative data on the universe of IPV-related outcomes across 431 judicial districts in Spain from 2006 to 2022 and estimate a comprehensive fixed effects model, accounting for a set of potential confounders. The longitudinal scope and geographic granularity of our data allow us to leverage substantial spatial and temporal quasi-random variation in temperature.

Our findings show robust and significant temperature effects on IPV. Being exposed to more than 40 days per quarter to temperatures exceeding 30 degrees Celsius (86 degrees Fahrenheit) compared to quarters without days above this threshold increases total reported IPV offences by 6%. Furthermore, we uncover a relatively stronger increase in severe IPV cases, as documented by a 36% rise in severe offences and a 15% increase in health sector reports by healthcare professionals. These effects hold across multiple temperature metrics, sample periods and model specifications. Effects are stronger in low-income districts, which is consistent with lower air conditioning use and higher outdoor temperature exposure at work for individuals living in those areas.

In addition to estimating the direct effect of extreme heat on IPV, we explore a range of mechanisms. Several behavioural elements may explain the effect of hot temperatures on IPV. The psychological literature has established that heat induces physiological stress, lowering aggression thresholds and increasing the likelihood of conflict (Anderson, 2001; Anderson and DeLisi, 2011; Larrick et al., 2011; Baylis, 2020). Heat also strains mental health, exacerbating anxiety and depression, which can lead to conflict (Hansen et al., 2008; Page and Howard, 2010). These two physiological channels may be further compounded by heat-related sleep disruption (e.g., Killgore et al., 2005). Additionally, elevated temperatures may alter daily routines, potentially affecting time spent indoors, where the risk of domestic conflict is higher (Graff Zivin and Neidell, 2014; Cohen and Gonzalez, 2024). Finally, the estimated effects might also reflect changes in reporting behaviour rather than shifts in underlying incidence if higher temperatures increase the likelihood of reporting IPV cases to authorities. In fact, heat has been shown to increase the reporting of violent crime in public spaces (Hsiang et al., 2013; **?**), with unclear implications for intimate contexts.

We test a range of these potential mechanisms using time-use data from Catalonia, one of the largest regions in Spain. In terms of time spent indoors, we confirm that men reduce outdoor leisure time on hot days, spending about an hour more at home. However, since rainy days do not show any significant increase in IPV, we conclude that time indoors alone cannot drive IPV;

rather, we posit that it is the combination of prolonged exposure to the intimate partner, coupled with the physiological stress of heat, that leads to an intensification of the risk of IPV. Although we do not find significant changes in sleep duration for high temperatures, effects on sleep quality remain possible. Finally, by showing that the most extreme cases of IPV also increase during extreme temperatures, we conclude that changes in reporting behaviour alone cannot explain our results, as those violent cases that require treatment are not prone to under-reporting.

In the last part of the paper, we perform an additional exercise showing that the impact of heat on IPV is amplified by household stress factors, particularly financial instability. Economic insecurity can act as a catalyst for IPV, intensifying the physiological and psychological stress induced by heat. This argument aligns well with studies showing that stress increases the likelihood of IPV, such as in the case of unexpected results from football games (Card and Dahl, 2011) or during lockdowns (Bullinger et al., 2021). In support of this interaction, our analysis reveals that after the 2007/08 financial crisis, districts with larger unemployment shocks experienced higher IPV effects due to extreme heat, indicating that economic vulnerabilities can indeed exacerbate the impact of extreme temperatures on IPV.

We contribute to the literature in several ways. First, we add to the literature on the influence of the biophysical environment on aggressive and criminal behaviour. While prior studies show that extreme temperatures increase criminal activity (Ranson, 2014; Blakeslee et al., 2021; Heilmann et al., 2021; Cohen and Gonzalez, 2024), the extent to which this applies to IPV is less clear. IPV differs from other forms of crime as it is more closely tied to power dynamics within intimate relationships and less driven by external motivations like financial gains. For example, Cohen and Gonzalez (2024) find that an increased amount of time outdoors on hot days drives higher crime rates in Mexico, whereas IPV, which occurs primarily at home, would likely exhibit the opposite pattern (e.g., Leslie and Wilson, 2020; Arenas-Arroyo et al., 2021). A small literature focuses on the effect of temperatures on IPV in low-income countries, but might be subject to measurement error and a potential lack of exogenous variation by focusing on yearly data (Nguyen, 2024; Le, 2025).[1]

Our study provides novel evidence on the extent to which within-year variation in heat (as an environmental stressor) influences aggressive behaviour in intimate contexts. The closest related study is Pavanello and Zappalà (2024), which examines how substance abuse regulations mediate the relationship between temperature and IPV in the United States. They find that a 2010 opioid reformulation weakened the link between temperature and IPV in counties with high opioid use. Our study differs in key ways. While Pavanello and Zappalà (2024) rely on a dataset with voluntary IPV reporting by agencies, our data captures the universe of IPV cases in Spain, sourced directly from the judiciary system. This administrative richness enables us to precisely measure not only the level but also the intensity of IPV, as proxied by different outcomes. Additionally, while Pavanello and Zappalà (2024) focus on opioid abuse — specific to the U.S. opioid crisis - we examine broader mechanisms, including household time use and macro-level factors like labor market crises, which are more universally relevant across countries.

Second, we add to the economic literature on IPV, which has focused mainly on within-household risk factors (e.g., Aizer, 2010; Tur-Prats, 2019; Adams-Prassl et al., 2023). Economic theories, such as resource and bargaining theory, have informed our understanding of IPV dynamics, suggesting that limited resources and shifts in bargaining power within households can influence IPV incidence. Empirical studies show that economic stressors, such as job loss or financial instability, increase the risk of IPV by increasing household tensions (Aizer, 2010; Adams-Prassl et al., 2023). We add to this literature by examining extreme heat as a contemporary environmental stressor that interacts with these economic factors.

Finally, we add to the literature on climate change and gender equality. Understanding the impact of rising temperatures on IPV is crucial. Studies indicate that climate change disproportionately affects women, exacerbating gender inequalities through various mechanisms (e.g., Peterman et al., 2017; Henke and Hsu, 2020). Our findings align with these studies,

[1] In addition, the medical literature has uncovered associations between short-term temperature variation and IPV (e.g., Sanz-Barbero et al., 2018; Zhu et al., 2023)

showing that an increase in IPV is an additional such mechanism. This intersection of climate stressors and gender-specific risks underscores the need for policies that address both climate resilience and gender equality, particularly in heat-vulnerable regions like Southern Europe.

2. Institutional Background and Data

2.1. IPV in Spain

Historically, IPV in Spain was concealed and treated as a private matter, shaped by cultural norms and restrictive gender roles. With the transition to democracy in the late 1970s, Spain implemented major social and legal reforms to advance gender equality. The 2004 Organic Law on Integrated Protection Measures against Gender Violence marked a turning point, introducing comprehensive measures to prevent IPV, prosecute offenders, and support victims. This shift made gender equality and IPV prevention key government priorities, with initiatives like public awareness campaigns, the establishment of the Ministry for Equality, and specialized IPV courts (García-Hombrados et al., 2024).

Despite these positive developments, IPV remains a serious concern in Spain. In 2024, 48 women were murdered by their (ex-)partners (Spanish Ministry for Equality, 2025). In addition, according to the latest survey, nearly 3 million women (14.2% of those aged 16 and older) have experienced IPV.[2] Although awareness campaigns have encouraged the disclosure of these abuses, reporting rates remain low, with only 21.7% of IPV incidents reported to police or the court (Spanish Ministry for Equality, 2019; Centro de Investigaciones Sociológicas, 2019).

2.2. Data

The growing public and political awareness has led to closer monitoring of IPV, leading to publicly available and comprehensive data on this matter. We employ a comprehensive admin-

[2] In the Spanish context, Organic Law 1/2004. defines IPV as violence against women by their current or former male partners. This definition excludes the (minority) cases of male victims in order to highlight the structural nature of violence against women embedded in a male-dominated society.

istrative dataset that records all reported instances of IPV in Spain from 2006 to 2022.[3] The unit of analysis is the 431 judicial districts (*partidos judiciales*) across Spain, hereafter referred to as "districts", with data reported at the quarterly level. We merge this dataset with yearly female population data at the judicial district level from the Spanish National Statistics Institute.

Table A.1 presents summary statistics for our main IPV variables of interest, both in total counts and normalized per 100,000 women.[4] *Total offences* include all IPV offences reported to the authorities, whether by the victims, their families, or other public authorities. This is the only outcome available since 2006, providing the most extensive data coverage with 29,300 observations.[5] On average, a judicial district records 87.3 offences per quarter, equating to nearly 120 offences per 100,000 women.[6]

Additionally, we examine two further IPV outcomes focused on the severity of IPV. *Total severe offences* is a small subset of *Total offences*, with only 3,6 severe offences reported on average per district and quarter. These offences reflect cases where the offenders cause physical harm to the victim that requires medical surgery or prolonged medical attention. *Health sector reports* are independently initiated by health authorities when a healthcare professional identifies physical evidence of IPV and files a report to the court.[7] The frequency of these health sector reports is relatively low, with an average of 9.5 reports per 100,000 women recorded each quarter.[8]

The second main dataset comprises weather data collected by the Spanish Meteorological Agency's monitoring stations.[9] We have access to daily readings from over 200 stations, capturing variables such as maximum, average, and minimum temperatures, as well as precipitation

[3] The dataset can be accessed under https://www.poderjudicial.es/cgpj/es/Temas/Estadistica-Judicial/Estudios-e-Informes/Violencia-sobre-la-Mujer/

[4] We winsorize normalized variables to the 99th percentile to correct for measurement error, particularly in small districts.

[5] The original administrative dataset is missing eight district-year-quarter observations.

[6] Offences closely track IPV reports, which can include one or multiple offences. However, as the number of IPV reports are available for a shorter period of time, we use offences to be able to have a larger time span in our sample.

[7] Health sector reports are a subset of total reports, which closely track total offences.

[8] In Spain, the majority of reports are initiated by victims themselves (70%), and an additional 15% come from the police (only if they observe the abuse).

[9] We access the data through the European Climate Assessment & Dataset website: https://www.ecad.eu/

levels. We match weather stations to the 431 district centroids based on proximity and we average daily readings using inverse distance weighting. Finally, we aggregate these daily readings to the quarterly level to align with the frequency of the IPV dataset. Table A.1 also includes an overview of temperature and precipitation variables in Spain during our sample period. It is important to keep in mind that these are quarterly averages, so individual days will report higher values than the reported maximum values.

2.3. Descriptive overview

Panel (a) of Figure A.1 illustrates the evolution of IPV offences per 100,000 women over time during our sample period, highlighting two significant trends. First, a sharp increase post-2015, likely in part due to heightened reporting following the *Ni Una Menos* movement, which originated in Argentina in 2015 and soon gained traction in Europe. Second, a clear seasonal pattern emerges, with IPV cases peaking in summer (the third quarter). Multiple factors might contribute to this pattern, such as extended exposure to intimate partners during the summer break and increased stress induced by childcare responsibilities due to school holidays. In this paper, we focus on whether high temperatures might also be driving part of these effects. Notably, the seasonality pattern is stronger in districts with above-median temperatures (Panel (b)). Additionally, Panel (c) reveals substantial geographical variation in IPV offences, which are particularly frequent in the central and southern parts of Spain.

3. Research design

The principal identification problem for our research question arises because quarterly variation in temperature might be endogenously related to other determinants of IPV. For example, endogeneity might be a result of temperatures and other weather factors being co-determined or be driven by seasonal patterns in IPV unrelated to temperature variation. Our research design builds on previous literature on extreme temperature shocks (e.g., Graff Zivin and Neidell, 2014;

Evans et al., 2023; Cohen and Gonzalez, 2024) and employs a high-dimensional fixed effects model of the following structure to uncover causal effects:

$$Y_{iqy} = \sum_j \beta^j HE_{iqy} + \delta X_{iqy} + \mu_i + \alpha_q + \gamma_y + \sigma_{py} + \rho_{iq} + \epsilon_{iqy} \tag{1}$$

In this model, Y_{iqy} denotes the number of occurrences of an IPV outcome per 100.000 women in district i, quarter q and year y. HE_{iqy} is some (non-linear) measure of heat exposure. As explained below, we employ several metrics to capture extreme temperature exposure over a quarter and make sure our results are robust to the specific metric chosen. The interpretation of our target parameter(s) β^j therefore depends on the specific extreme temperature metric used. Some specifications will include bins of the number of days with severe precipitation (X_{iqy}) as a control variable, allowing us to eliminate concerns for a potential bias in our estimates due to the interplay between precipitation and temperature conditions if precipitation itself affects our outcome of interest.[10] Further, all model specifications include district (μ_i), quarter (α_q), and year (γ_y) fixed effects to account for cross-sectional variation, country-wide seasonality and general time trends. Our main results additionally include province-year fixed effects (σ_{py}) and quarter-district fixed effects (ρ_{iq}). Province-year fixed effects allow us to flexibly account for changes in province-specific policy, societal and economic trends.[11] On the contrary, quarter-district fixed effects accounts for district-specific seasonal patterns. This is particularly necessary in a context where the influx of tourist in hot periods plays an important role. If tourists are more likely to visit districts that on average experience higher temperatures and were to report IPV cases to the local authorities, this might bias our estimates upwards. However, quarter-by-district fixed effects exploits variation within, e.g., the district of Barcelona in the third quarter, eliminating this concern. However, our results remain remarkably robust to different fixed effects model specifications. Finally, ϵ_{iqy} represents the error term, which we cluster at the province

[10] Rainy days are defined as days with precipitation above the 90th percentile, corresponding to daily precipitation over 4.65 mm. Additionally controlling for humidity does not change our point estimates.

[11] There are 50 provinces in Spain, leading to an average of around 9 districts per province.

level for all our analyses.

In our main specification, we define HE_{iqy} as a set of indicator variables that equal one if the number of hot days (defined as reaching temperatures above 30 degrees Celsius or 86 degrees Fahrenheit) experienced in district i in quarter q and year y falls into one of the following four categories: no hot days (base category), up to 10 days, 11-40 days, and more than 40 days. We therefore exploit quasi-random variation in the number of days above 30 degrees Celsius within a quarter-by-district and year-by-province. Alternative specifications will include indicators for different levels of the average maximum temperature or different total counts of degree-days by district i, quarter q and year y.[12] Our results remain robust to all these different model specifications.

Figure A.2 visualises variation across and within districts of our preferred heat exposure metric. Panels (a), (b) and (c) show, for each district, how many quarters fall into the specific extreme temperature category during our sample period. As becomes apparent, coastal districts in the North of Spain and in the Pyrenees experience fewer quarters with extreme temperatures. However, our estimates of β^j for the case of more than 40 days per quarter of maximum temperatures above 30 degrees Celsius are still identified by variation across many different parts of the country.

4. Results

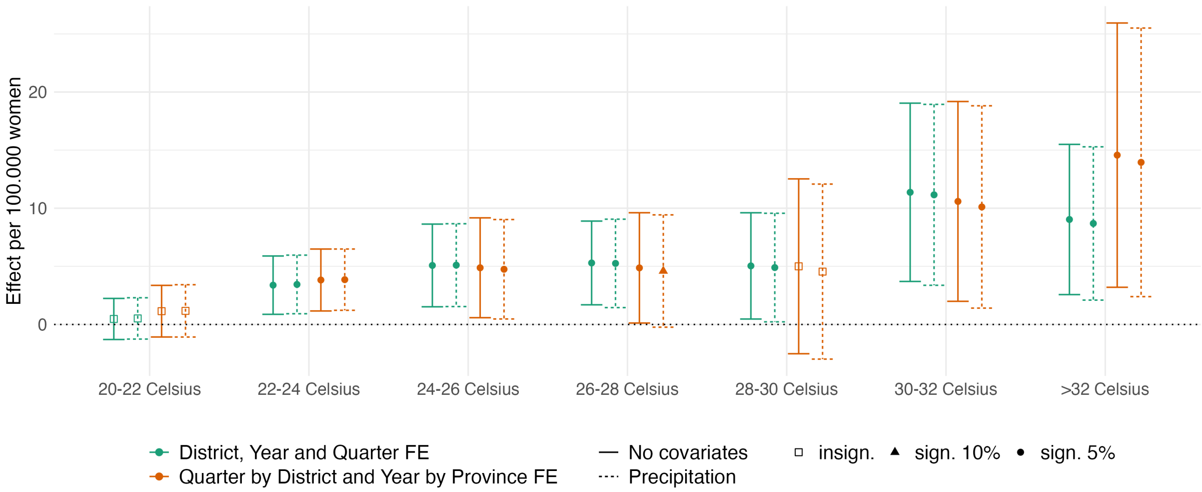
4.1. The effect of heat on IPV

In this section, we present the results of estimating Equation 1 above using various measures of extreme temperature as our main explanatory variable. We begin by discretizing quarterly average maximum temperatures into two-degree bins, starting from 20-22 degrees Celsius up to

[12] We define degree-days on a daily level over a threshold of 30 degrees Celsius. The degrees-days on a particular day are calculated as the difference between the max. temperature on that day minus the threshold (in our case of 30 degrees). If the difference is negative, the day does not enter the sum. We aggregate by summing all daily degree-days at the quarter by district level.

above 32 degrees Celsius (with below 20 degrees Celsius as the reference category). Figure 1 plots the results on total offences per 100,000 women. The figure includes four specifications: the green lines show results with district, year, and quarter fixed effects, while the orange ones represent our preferred specification with granular fixed effects at the district by quarter and province by year level. In addition, dotted lines control for precipitation. We see that the effect of temperature on offences is non-linear, as it becomes positive and significant for temperatures above 22 degrees Celsius, but remains relatively stable until 30 degrees Celsius, when it becomes much more pronounced. Adding comprehensive fixed effects and weather controls does not alter the point estimates, but comes at a cost in terms of precision. Across the displayed specifications, we estimate that average maximum temperatures above 30 degrees Celsius increase IPV offences by 10-15 offences per 100.000 women.

Figure 1: Effect of average maximum temperature on IPV offences



Notes: This figure shows the causal effect of experiencing average max. temperatures of different two-degree bins on IPV offences per 100,000 women. Estimates based on administrative data on the universe of offences of IPV in Spain between 2006 and 2022 at the judicial district level. The base category includes quarter-by-district combinations with average maximum temperatures below 20 degrees Celsius.

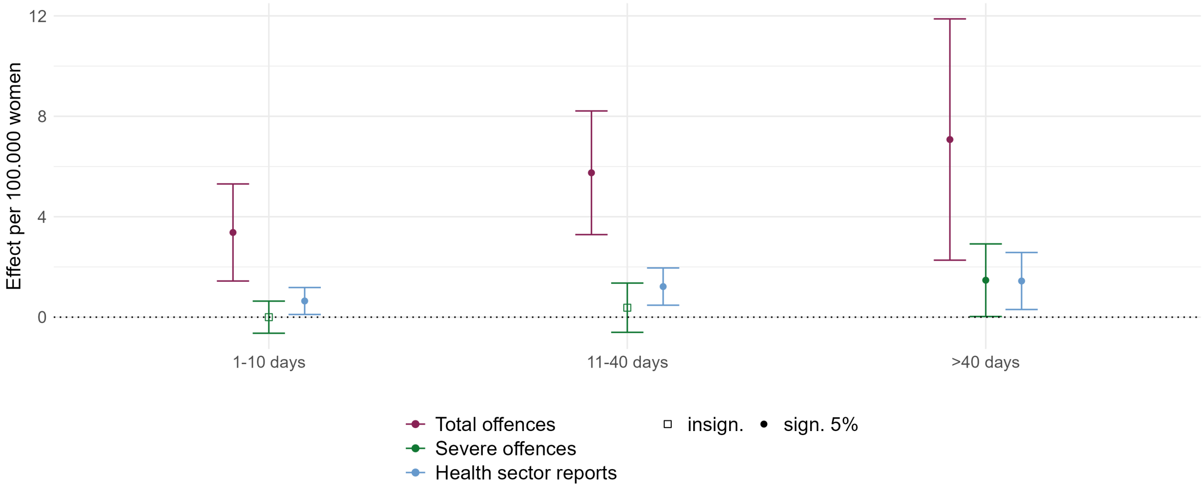
Following up on this first evidence, we next construct our preferred extreme temperature indicators using the 30 degrees Celsius threshold. We categorize quarters into four categories: zero days above 30 degrees Celsius (base category), up to 10 days, 11–40 days, and more than 40 days. Figure 2 shows that IPV offences per 100,000 women increase with the frequency of days above 30 degrees Celsius. Notably, more than 40 days of such temperatures result in approximately 7 additional offences per 100,000 women, a 6% rise relative to the sample mean of 118.8 offences per 100,000 women (see Table A.1).

To assess whether high temperatures also contribute to an increase in severe IPV cases, we conduct the analysis separately for severe offences and reports initiated by the health care system. As described in Section 2, these two outcomes can be considered a proxy for IPV severity. Figure 2 shows that experiencing more than 40 days over 30 degrees Celsius results in an additional 1.5 severe offences and 1.4 health sector reports per 100,000 women, corresponding to a 36% increase in severe offences (relative to a sample mean of 4.2) and a 15% increase in health sector reports (relative to a sample mean of 9.5). This suggests that extreme heat does not only cause an overall rise in IPV incidents but also a relatively stronger increase in reported severe cases. These results point to a potential escalation in IPV severity under sustained high temperatures.

Overall, our main results show a clear and consistent effect of extreme temperatures on IPV outcomes. While our preferred specification includes a rich set of fixed effects, results remain robust to alternative specifications relying on more parsimonious fixed effects specifications (Table A.3).[13] In addition, estimated coefficients remain consistent with our main results when relying on degree-days to capture extreme temperatures (Table A.4) and for a sample period excluding the years affected by the Covid-19 pandemic (Table A.5).

[13] Alternative fixed effects specifications exploit different shares of variation in our extreme temperature indicators. For example, while our main specification only exploits 15% of the total variation in the treatment category ">40 days above 30 degrees Celsius", other specifications in Table A.3 increase that share up to 40%.

Figure 2: Main results - Effect of days above 30 degrees Celsius on IPV



Notes: This figure shows the causal effect of experiencing 1-10, 11-40 or more than 40 days with maximum temperatures above 30 degrees Celsius per quarter on a range of IPV outcomes. Model specifications include quarter-by-district and year-by-province fixed effects as well as precipitation controls. Estimates based on administrative data on the universe of offences (2006-2022), severe offences (2010-2022) and health care sector reports (2009-2022) at the judicial district level. The base category are quarter-by-district combinations with no days with maximum temperatures above 30 degrees.

As a next step, we conduct a heterogeneity analysis to examine whether the effect of extreme temperatures on IPV varies by income. Individuals from lower socioeconomic backgrounds often have reduced access to resources and support networks, which may heighten vulnerability to environmental stressors like extreme heat. Furthermore, the literature documents that low-income individuals are more likely to live in higher-density areas with limited cooling options, potentially intensifying heat-related IPV risks (López-Bueno et al., 2020). We explore variations by average income based on data on the average net income per capita in 2016 for the approx. 8000 municipalities in Spain, which we aggregate to the 431 judicial districts in our dataset.[14] In a second step, we divide these districts according to the resulting median net income per capita. As shown in Figure A.6, the impact of extreme temperatures on IPV offences differs by the income level in the district. For quarters with up to 40 days above 30 degrees Celsius, low-income districts exhibit stronger effects across all outcomes (total offences, severe offences, and health sector reports), suggesting that IPV risks linked to heat are more severe in these

[14]This data is provided by the Spanish National Statistics Institute and can be accessed under https://www.ine.es/dynt3/inebase/index.htm?padre=7132

areas. However, for quarters with more than 40 days above 30C, our point estimates become increasingly imprecise, leading to no clear differences in effect sizes between the two samples.

We close this section by performing a back-of-the-envelope calculation quantifying the extent to which high temperatures can account for the seasonal variation in IPV reports observed between the first and the third quarters of each year (see Figure A.1). We use our estimates as well as the number of days above 30 degrees Celsius by quarter in our sample years to calculate how much total offences per 100,000 women should increase, due to the temperature effect, from the first to the third quarter. Comparing this projected rise (only attributable to the temperature effect) with actual changes in IPV offences, we find that high temperatures account for 37% of the seasonal variation between Q1 and Q3 in our sample.

4.2. Mechanism analysis

In this section, we conduct additional analyses to shed light on the mechanisms through which high temperatures affect IPV. Although our data does not allow for a direct examination of physiological pathways such as the effects of heat on self-control and mental health, we discuss two alternative channels: time exposure to the partner and reporting behaviour.

Time exposure. High temperatures often drive individuals to seek refuge indoors, where cooler environments, such as air-conditioned spaces, offer relief. This shift increases household interactions, potentially raising the risk of conflict within intimate settings (Graff Zivin and Neidell, 2014). Extreme temperatures also reduce opportunities for outdoor leisure and exercise—activities that are essential for stress relief and that may lead to lower conflict levels at home. We investigate changes in daily routines by employing the latest available time-use data from the Spanish region of Catalonia for the years 2010/11. This dataset contains detailed information on time use for around 6,500 individuals in the four Catalan provinces at the daily level (see Table A.2 for a descriptive table).[15]

[15] There is a time-use survey covering the whole Spanish population, but the geographical and temporal disaggregation reported in that survey does not allow us to identify the effects of heat on daily routines. The

We estimate a modification of our main model, regressing the time spent on different activities on the daily maximum temperature bins and including month and province fixed effects as well as rainfall controls.[16] Figure 3 below plots the results using bins of temperatures as explanatory variable and leaving temperatures below 20 degrees Celsius as the omitted category.

Panel (a) and (b) in Figure 3 reveal that women's leisure activities, both at home and outdoors, remain largely unaffected by hot temperatures. In contrast, men spend approximately one additional hour on indoor leisure activities when the temperature reaches 33 degrees or higher.[17] This increase corresponds to an almost equivalent reduction in their outdoor leisure time.[18] In addition, we find a reduction in female labour supply on hot days, but we do not detect any effects on sleep duration. Combining these four results, we argue that exposure to the partner at home is increased during days with high temperatures, suggesting that prolonged exposure to a partner might be a mechanism contributing to the heightened risk of IPV on hot days. Notably, this contrasts with Cohen and Gonzalez (2024), who attribute higher crime rates on hot days in Mexico to increased outdoor activity. This highlights the different dynamics of heat-related conflict in intimate versus public settings.[19]

In an attempt to understand whether the increase in IPV on hot days is only driven by changes in indoor versus outdoor time, we examine the effect of rain, as rain might similarly confine people indoors but without the physiological stress of heat. We classify rainy days by district-quarter-year combination into four categories: below 5 days (base category), 5-10 days, 10-15 days, and above 15 days. If the increase in IPV during heat episodes is purely driven by increased indoor time, we would expect to see similar patterns on rainy days. However, as shown in Figure A.7, the effect of precipitation on our main IPV outcomes of interest is at most small

Catalonian time-use data is provided by the Statistical Institute of Catalonia and can be accessed under https://www.idescat.cat/pub/?id=eut&lang=en.

[16] Given that we are exploiting daily variation, we deviate from our previous model in that we code temperature bins of 30 to 33 degrees Celsius and above 33 degrees Celsius (instead of counting days above 30 degrees Celsius in a quarter).

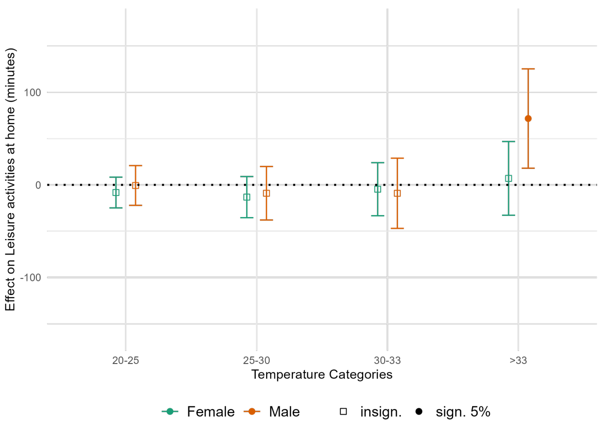
[17] These activities include reading, watching TV, spending time on the computer, and gaming.

[18] These activities include socializing, exercising, and engaging in cultural activities.

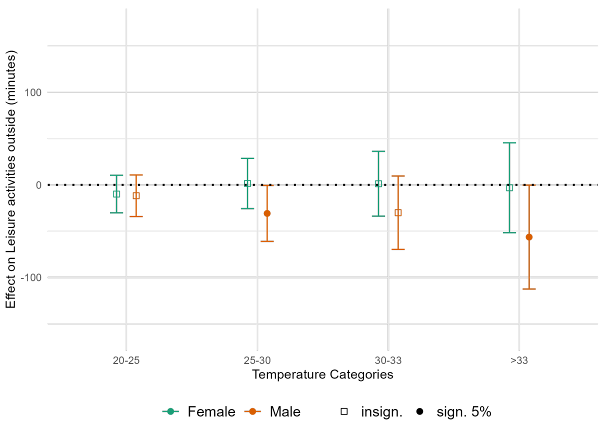
[19] Differences in air conditioner ownership may also help explain the contrasting patterns of time use on hot days between Mexico and Spain.

and mostly statistically insignificant. This finding supports the interpretation that extreme temperature effects on IPV are not only driven by increased partner exposure due to indoor time allocation shifts but rather by the unique combination of prolonged partner exposure and the physiological stress induced by heat.

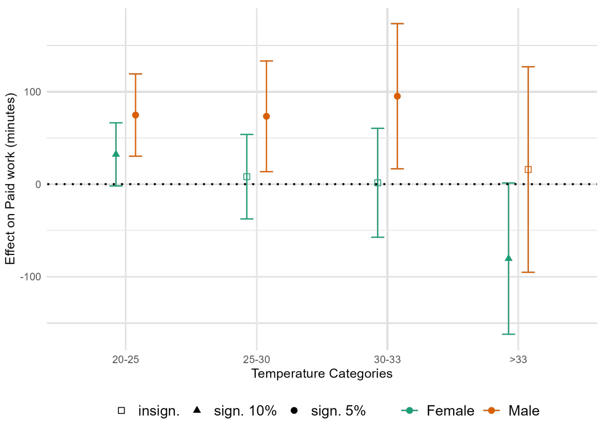
Figure 3: Effect of maximum temperature on time use



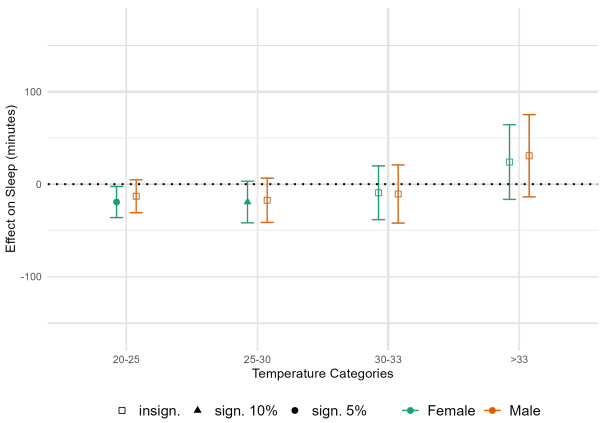
(a) Leisure activities at home



(b) Leisure activities outside



(c) Paid work



(d) Sleep

Notes: This figure shows the causal effect by gender of experiencing a daily maximum temperature within the different temperature bins on time spent on a range of daily activities. Estimates are based on a model controlling for province and month fixed effects as well as rainfall. Leisure activities at home include reading, watching TV, spending time on the computer, and gaming, while leisure activities outside include socializing, exercising, and engaging in cultural activities. Estimates based on the Catalan time-use survey 2010/2011 and weather data from the Spanish Meteorological Agency.

Reporting. As our data comes from IPV reports, our estimates may partially capture increased reporting rather than changes in the underlying incidence of IPV, as higher temperatures could elevate the likelihood of reporting IPV cases to authorities. On hot days, for instance, bruises and other visible signs of violence may be less concealed by clothing, potentially making it more likely for victims or observers to report IPV incidents. While it is generally difficult to disentangle actual IPV incidence from reporting, we take our main results on health sector reports and severe offences (Figure 2) as a strong indication that reporting behaviour alone cannot account for the observed effects. These two outcomes are unlikely to be affected by reporting effects for two different reasons (García-Hombrados et al., 2024). On the one hand, severe offences presuppose the requirement of medical treatment. We argue that these severe cases resulting in major injuries are unlikely to be left unreported and therefore unlikely to be increased through a reporting effect. On the other hand, health sector reports result from an *obligation* of health professionals to report IPV cases to the police if they find evidence for it while interacting with patients. In our context, an increase in this outcome due to reporting effects would imply that health professionals adhere to this obligation more strictly under high temperatures, which we deem is unlikely to be the case. Thus, we interpret the increase in these two outcomes as strong evidence that extreme temperatures genuinely increase IPV incidence, rather than merely enhancing reporting rates. However, as it is common in almost all IPV studies, we cannot rule out that a reporting effect coexists with increased incidence during high temperatures.

4.3. The role of labour market shocks

Economic downturns and labour market shocks heighten household stress, often leading to increased IPV (Aizer, 2010; Schneider et al., 2016; Anderberg et al., 2016; Tur-Prats, 2019; Bhalotra et al., 2024). For instance, Schneider et al. (2016) find that job loss and economic instability significantly predict IPV increases, as financial strain raises household tension and reduces coping capacity. Similarly, Aizer (2010) finds that IPV is more common in high-unemployment settings, especially among vulnerable populations.[20] Hot temperatures may intensify these effects by adding stress to financially strained households, compounding the risk of IPV during

[20]However, evidence on this matter is mixed. Anderberg et al. (2016) suggest male unemployment may decrease IPV by reducing household income and limiting conflict escalation opportunities.

economic insecurity. Therefore, understanding this interaction is crucial for policies targeting both environmental and economic drivers of IPV.

This context sets the stage for our analysis of the joint effects of extreme temperatures and unemployment shocks on IPV. Exploiting the Spanish economic crisis starting in the fourth quarter of 2008 as an economic shock, we use the male unemployment rate at the municipality level to divide districts into high (66th percentile and above) and low (otherwise) unemployment growth rates between 2006 and 2013.[21] Figure A.9 plots descriptive evidence of the evolution of the male unemployment rate in high and low unemployment growth districts. While male unemployment rates evolved in parallel before the crisis for both groups, it increased much more strongly in the high-unemployment increase group, leading to a gap of almost 10 percentage points by the end of 2013.

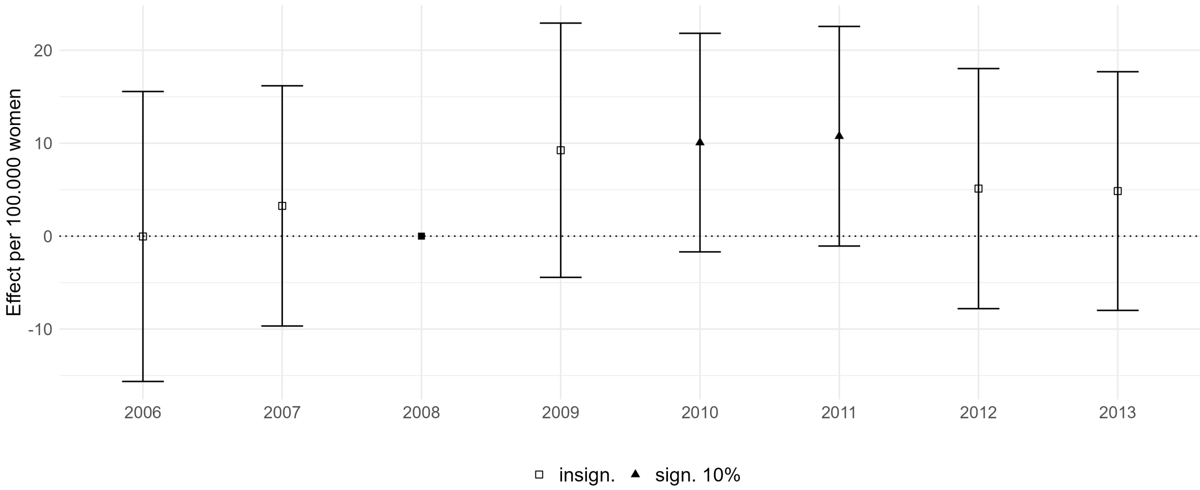
We model the differential impact of extreme heat on total offences per 100,000 women between high and low unemployment districts during the crisis period by expanding our main model specification in Equation 1 into a triple-interaction model (see Equation 2 in the Appendix). In order to increase the precision of our estimates, we combine the three heat categories of our main model into one. Therefore, extreme heat is defined as a binary indicator for whether there were any days with maximum temperatures above 30 degrees Celsius.

Figure 4 presents the results in an event-study setting. While the effect of extreme heat before 2008 was not significantly different in the two groups of districts, post-crisis effects of extreme temperatures on IPV are 9-11 offences per 100,000 women higher in high-unemployment increase areas than in low-unemployment increase areas until 2011. In 2012 and 2013 the difference is reduced to 5 offences per 100,000 women and loses statistical significance. This result is further confirmed in Table A.3, where we collapse the time variation into a binary crisis indicator to increase precision on the estimate of this compounding effect of heat and economic stress on

[21] This period is chosen as national unemployment in Spain peaked in 2013 following the crisis. See Figure A.8 for the geographical distribution of high and low unemployment increase districts across the Spanish territory. We define the male unemployment rate as the number of unemployed men as a share of the total working-age male population. Unemployment numbers are provided by the Spanish Ministry for Employment and can be accessed under https://datos.gob.es/es/catalogo/ea0021425-paro-registrado-por-municipios.

IPV. The positive and significant coefficient for the triple interaction term indicates that the combination of these stressors leads to a substantial increase in IPV. Overall, these findings indicate that, in economically stressed contexts, heat exerts a particularly strong impact on IPV.

Figure 4: Differential effect of heat on IPV offences in low vs. high unemployment increase districts



Notes: This figure shows the estimated interaction effect between an extreme heat and a high unemployment increase binary indicator on IPV offences per 100.000 women between 2006 and 2013. The extreme heat indicator collapses all three categories of Figure 2 into one binary indicator. The high unemployment increase indicator is equal to 1 for the upper third of districts with the highest unemployment increase between 2008 and 2013 and 0 otherwise. Estimates based on administrative data on the universe of IPV offences from 2006 to 2013.

5. Conclusion

Intimate partner violence is a widespread and persistent issue, with rising trends observed in many regions despite increasing policy efforts aimed at prevention and victim protection. In Spain, IPV reporting follows a seasonal pattern, with more reports during the summer months. While multiple factors may contribute to this trend, this study focuses on one key driver: extreme temperatures. As climate change accelerates, extreme heat events are expected to become more frequent and severe, particularly in Southern Europe. This makes it essential to understand their impact on IPV.

Our findings provide robust evidence that extreme heat significantly increases IPV. Using administrative data spanning from 2006 to 2022 and covering over 400 geographical units in

Spain, we estimate that experiencing more than 40 days per quarter with maximum temperatures exceeding 30 degrees Celsius leads to a 6% increase in IPV offences relative to the sample mean. Notably, our results suggest that the effect on severe cases is even stronger, as indicated by a 36% increase in severe offences and a 15% increase in IPV-related health sector reports.

We additionally shed light on the mechanisms behind this causal effect, in particular pointing to increased time exposure to the partner as one important driver. However, other environmental factors prone to increase partner exposure such as rainfall do not yield any effects across our main outcomes. This suggests that the heat-IPV relationship is partially driven by the unique combination of prolonged partner exposure and the physiological stress induced by heat. In contrast, we argue that mechanisms involving changes in reporting behaviour are less relevant. We take our results on severe cases as evidence that changes in reporting behaviour cannot fully explain our effects, as these severe outcomes are unlikely to be under-reported.

Finally, we also document important heterogeneities in the heat-IPV relationship. Low-income districts exhibit stronger effects across all outcomes, suggesting that IPV risks linked to heat are more severe in these areas. Furthermore, building on existing literature that links economic conditions to IPV, we find that extreme heat exacerbates IPV most strongly in regions experiencing economic downturns, where rising unemployment amplifies household stress.

These findings underscore the interplay between environmental and socioeconomic stressors, emphasizing the need for policy approaches that address both economic vulnerabilities and climate-induced risks to effectively combat IPV. From a policy perspective, we estimate the potential future impact of climate change on IPV. Using projected temperature increases under both an optimistic (IPCC RCP 4.5) and pessimistic (IPCC RCP 8.5) scenario, we find that a 2–4 degrees Celsius rise in average temperatures in Spain could result in 85–190 additional *severe* IPV offences per year. Under the assumption that our findings generalize beyond Spain, this suggests that climate change could substantially increase IPV rates in regions highly exposed to extreme heat, reinforcing the urgency of ambitious climate policy and the need to integrate climate resilience into IPV prevention strategies.

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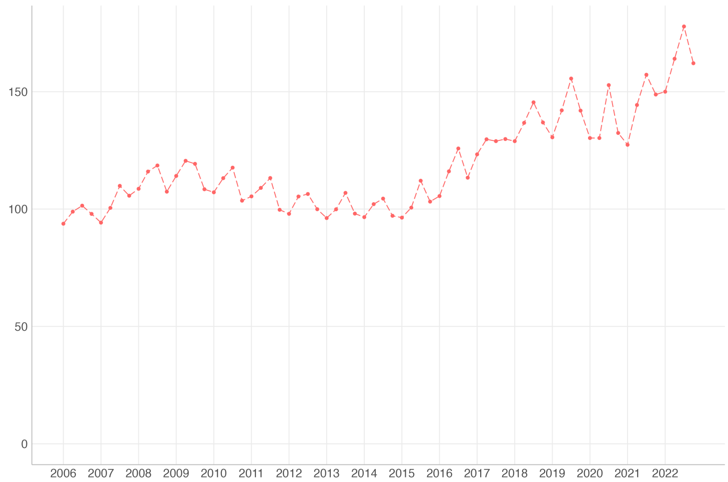
A. Appendix

Table A.1: Descriptive statistics – main dataset

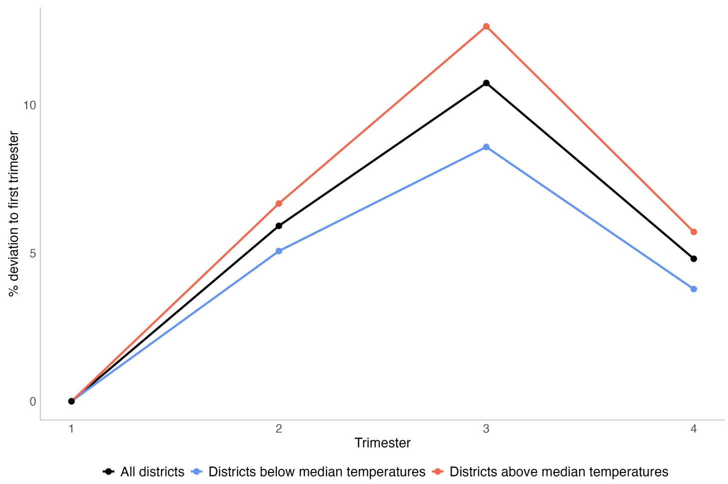
Statistic	N	Mean	St. Dev.	Min	Max
Total offences	29,300	87.3	213.5	0	4,207
Offences per 100k women	29,300	118.8	76.6	0	496.3
Total severe offences	22,412	3.6	15.2	0	394
Severe offences per 100k women	22,412	4.2	11.5	0	92.3
Total health sector reports	24,136	8.7	25.7	0	544
Health sector reports per 100k women	24,136	9.5	16.4	0	100.7
Average max. temperature (Celsius)	29,308	21.3	6.4	1.8	37.3
Average mean temperature (Celsius)	29,308	15.9	5.8	−2.6	28.8
Average min. temperature (Celsius)	29,308	10.6	5.4	−6.7	23.8
Avg. precipitation (0.1 mm)	29,308	16.5	14.2	0	131.3

Notes: This table shows descriptive statistics for the variables used in the main analysis. IPV outcomes are provided by the Spanish judiciary at the quarterly and judicial district level and reported for different time periods: Total offences 2006-2022, Total severe offences 2010-2022, and Total health sector reports 2009-2022. Weather variables are based on daily readings from the network of weather monitoring stations across Spain.

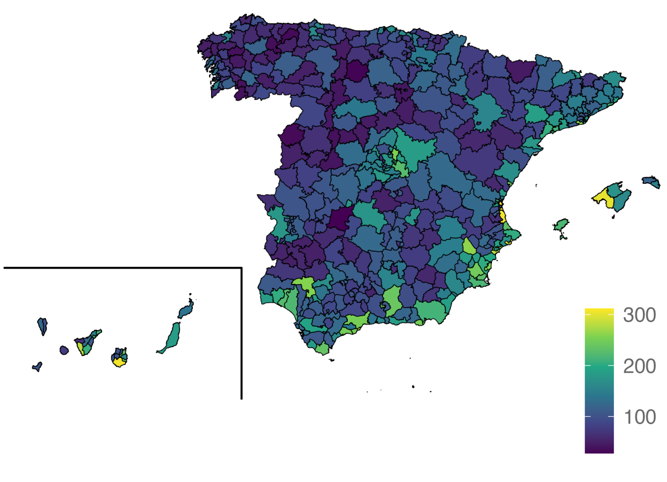
Figure A.1: Descriptive overview of IPV offences per 100.000 women



(a) Seasonality over time



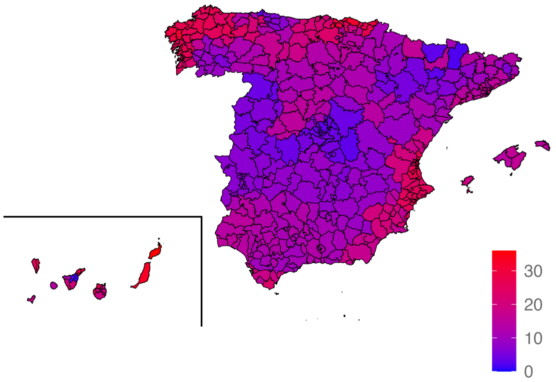
(b) Seasonality by median temperature



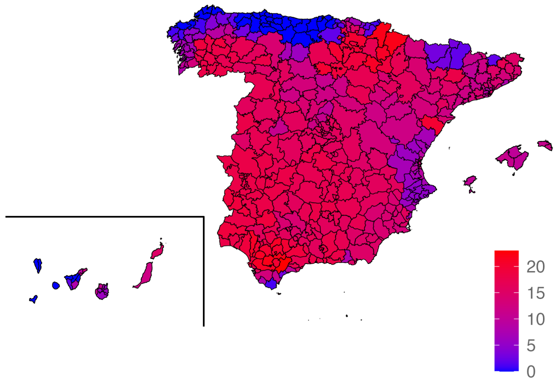
(c) Regional distribution

Notes: This figure presents time-series, seasonal and geographic variation for IPV offences per 100.000 women during our sample period (2006-2022).

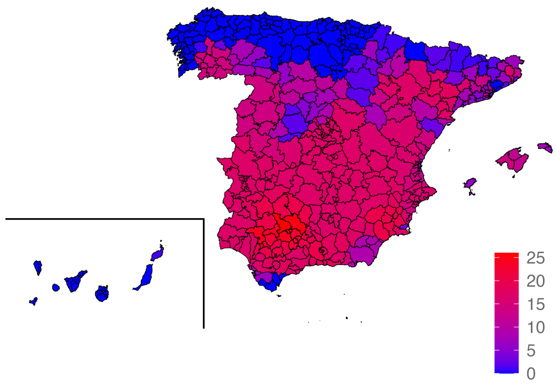
Figure A.2: Exposure to extreme heat by district



(a) 1-10 days with max. temperature >30 degrees Celsius



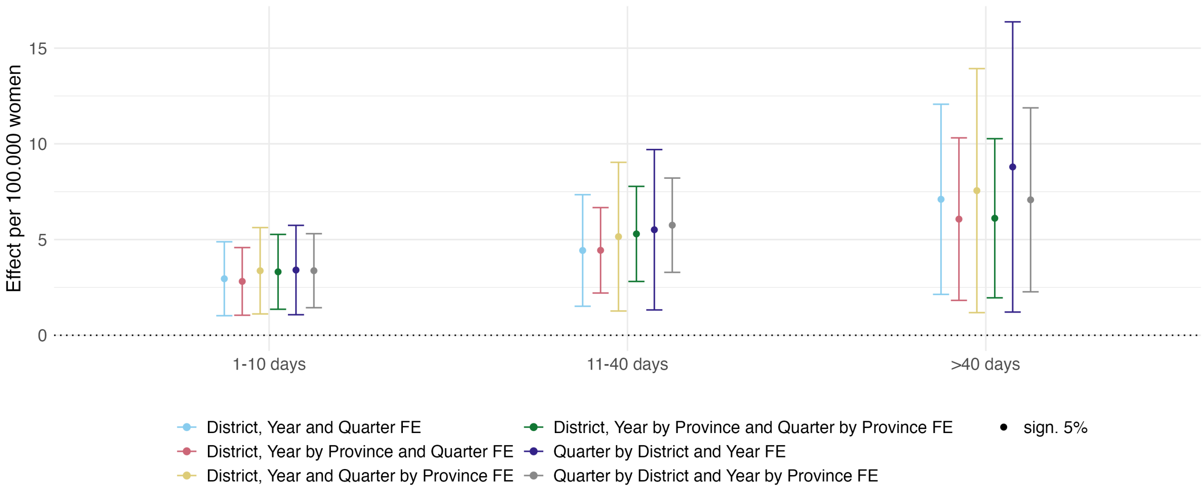
(b) 11-40 days with max. temperature >30 degrees Celsius



(c) >40 days with max. temperature >30 degrees Celsius

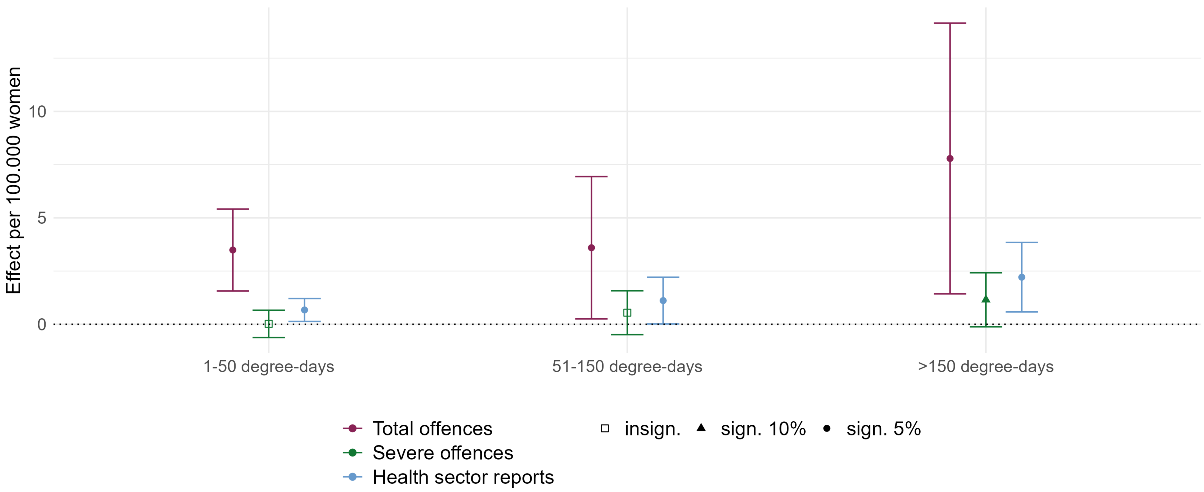
Notes: This figure shows the 431 judicial districts in continental Spain and the two archipelagos of the Balearic and Canary Islands. The colours indicate the number of quarters that each district is exposed to the three different categories of extreme heat that we exploit in our main analysis. We observe each district for 68 quarters.

Figure A.3: Robustness results - additional fixed effects



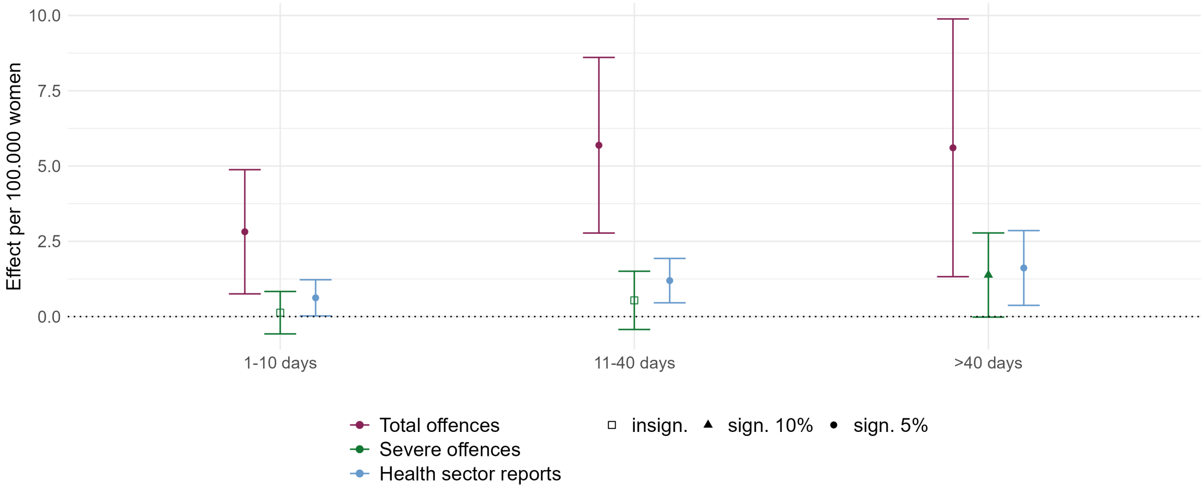
Notes: This figure shows the causal effect of experiencing 1-10, 11-40 or more than 40 days with maximum temperatures above 30 degrees Celsius per quarter on offences per 100.000 women for a range of model specifications. All model specifications control for precipitation. Estimates based on administrative data on the universe of offences (2006-2022) at the judicial district level. The base category are quarter-by-district combinations with no days with maximum temperatures above 30 degrees.

Figure A.4: Robustness results - degree-days measurement



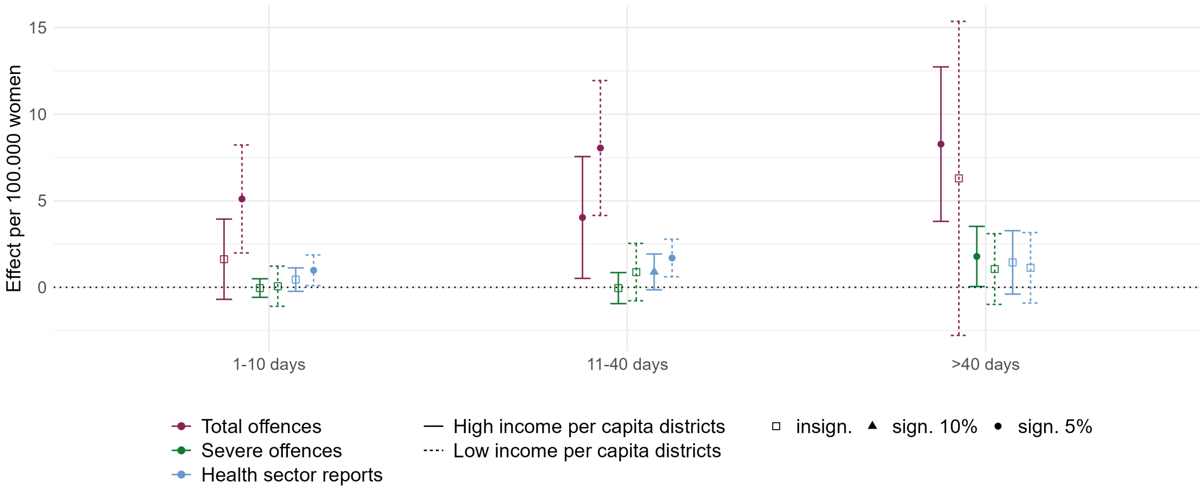
Notes: This figure shows the causal effect of experiencing 1-50, 51-150 or more than 150 degree-days above 30 degrees Celsius per quarter on a range of IPV outcomes. Model specifications include quarter-by-district and year-by-province fixed effects as well as precipitation controls. Estimates based on administrative data on the universe of offences (2006-2022), severe offences (2010-2022) and health care sector reports (2009-2022) at the judicial district level. The base category are quarter-by-district combinations with no degree-days above 30 degrees Celsius.

Figure A.5: Robustness results - excluding Covid-19 years



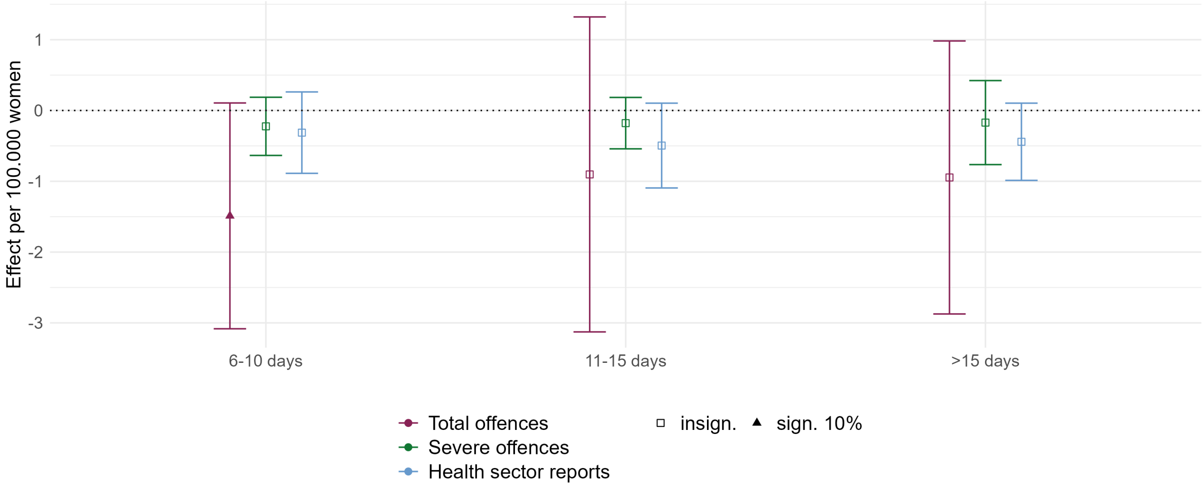
Notes: This figure shows the causal effect of experiencing 1-10, 11-40 or more than 40 days with maximum temperatures above 30 degrees Celsius per quarter on a range of IPV outcomes. Model specifications include quarter-by-district and year-by-province fixed effects as well as precipitation controls. Estimates based on administrative data on the universe of offences (2006-2019), severe offences (2010-2019) and health care sector reports (2009-2019) at the judicial district level. The base category are quarter-by-district combinations with no days with maximum temperatures above 30 degrees.

Figure A.6: Additional results - results by income per capita above/below median



Notes: This figure shows the causal effect of experiencing 1-10, 11-40 or more than 40 days with maximum temperatures above 30 degrees Celsius per quarter on a range of IPV outcomes for districts above and below median net income per capita in 2016. Model specifications include quarter-by-district and year-by-province fixed effects as well as precipitation controls. Estimates based on administrative data on the universe of offences (2006-2022), severe offences (2010-2022) and health care sector reports (2009-2022) at the judicial district level. The base category are quarter-by-district combinations with no days with maximum temperatures above 30 degrees.

Figure A.7: Effect of rainy days on IPV offences



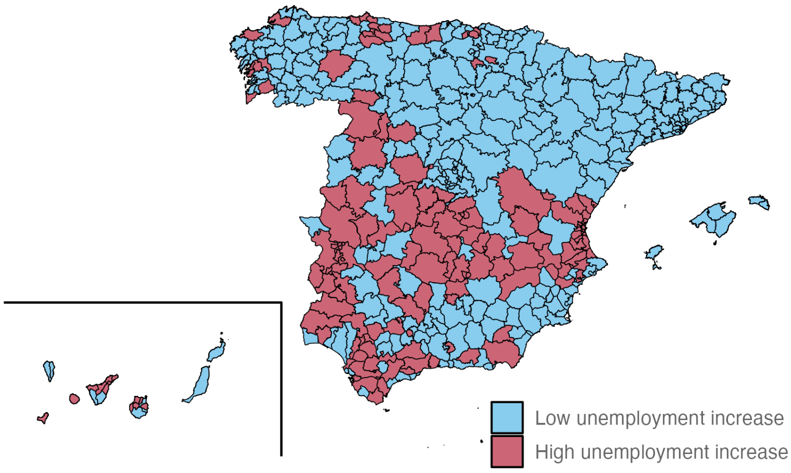
Notes: This figure shows the causal effect of experiencing 6-10, 11-15 or more than 15 rainy days per quarter on a range of IPV outcomes. Model specifications include quarter-by-district and year-by-province fixed effects as well as temperature controls. Estimates based on administrative data on the universe of offences (2006-2022), severe offences (2010-2022) and health care sector reports (2009-2022) at the judicial district level. The base category are quarter-by-district combinations with less than 6 rainy days.

Table A.2: Descriptive Statistics – time-use data

Statistic	N	Mean	St.Dev	Min	Max
Home leisure activities	6,471	160.4	134.4	0	1,090
TV	6,471	113.2	109.0	0	770
Reading	6,471	15.9	41.8	0	850
Computer	6,471	20.5	54.0	0	810
Gaming	6,471	10.8	43.5	0	760
Out-of-home activities	6,471	185.8	137.5	0	980
Social life	6,471	38.4	72.8	0	650
Cultural activities	6,471	8.6	42.5	0	640
Leisure	6,471	27.5	61.4	0	870
Physical activities	6,471	46.7	75.1	0	550
Travel for work	6,471	20.0	36.1	0	410
Travel for study	6,471	3.9	17.9	0	260
Travel to home	6,471	17.7	33.0	0	320
Travel for social life	6,471	11.7	31.3	0	430
Travel for leisure	6,471	11.3	34.7	0	770
Paid work	6,471	144.6	229.1	0	1,380
Sleep	6,471	518.3	117.1	0	1,400

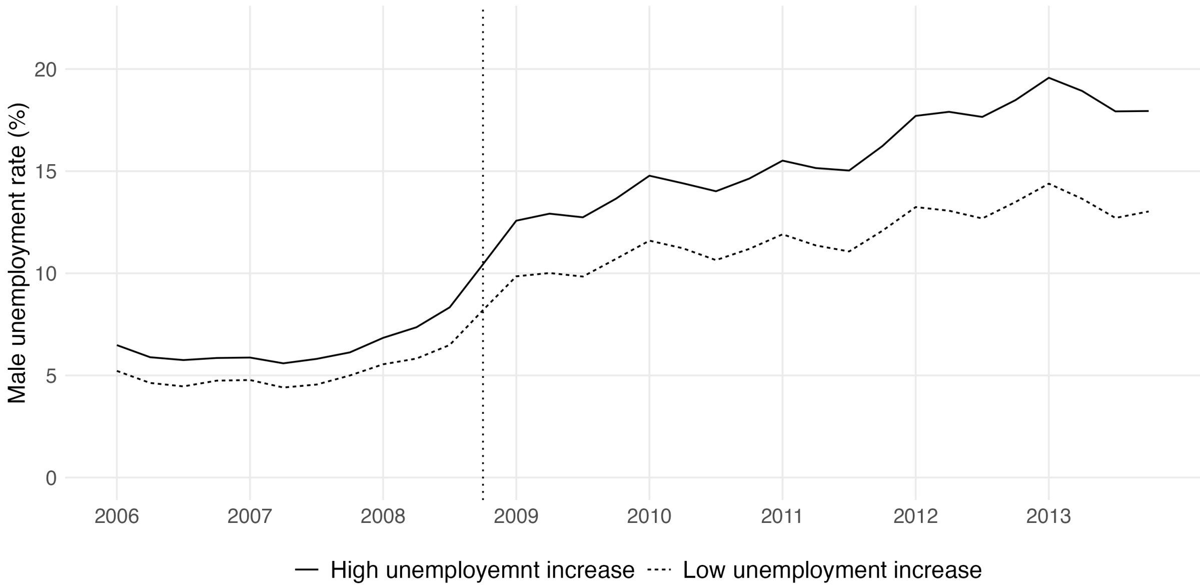
Notes: This table shows descriptive statistics for the variables used for the time-use analysis as provided in the Catalonia time-use survey. The data was surveyed between June 2010 and June 2011. The sample is restricted to partnered adults.

Figure A.8: High vs. low unemployment increase districts



Notes: This map shows districts in the high unemployment increase and low unemployeemnt increase group based on administrative data on male unemployment on the municipality level for the years 2006-2013. High unemployment increase districts are those in the top third of the distribution of male unemployment increase between Q3 2008 and Q3 2013.

Figure A.9: Unemployment rate in high vs. low unemployment increase districts



Notes: This figure shows the evolution of male unemployment for the years 2006-2013 in districts with high unemployment increase and low unemployment increase after the financial crisis. Results are based on administrative data on male unemployment at the municipality level. High unemployment increase districts are those in the top third of the distribution of male unemployment increase between Q3 2008 and Q3 2013. The dotted line represents the begin of the financial crisis shock in Q3 2008.

Table A.3 presents results based on an expansion of our main model specification. In particular, we estimate the following model:

$$
\begin{aligned}
Y_{iqy} = & \beta_1 \hat{HE}_{iqy} + \beta_2 \hat{HE}_{iqy} \times Cri_{iqy} + \beta_3 \hat{HE}_{iqy} \times UR_{iqy} + \beta_4 Cri_{iqy} \times UR_{iqy} \\
& + \beta_5 \hat{HE}_{iqy} \times Cri_{iqy} \times UR_{iqy} \\
& + \delta X_{iqy} + \mu_i + \alpha_q + \gamma_y + \sigma_{py} + \rho_{iq} + \epsilon_{iqy}
\end{aligned}
\tag{2}
$$

In this expanded model, $\hat{HE}_{iqy}$ is a binary indicator for more than one day in district i, quarter q and year y with maximum temperatures above 30 degrees Celsius. Cri_{iqy} is a binary indicator for the crisis period starting in Q4 2008 and UR_{iqy} is a binary indicator for those districts in the top third of the distribution of male unemployment increase between Q3 2008 and Q3 2013. The controls and fixed effects remain unchanged compared to our preferred specification for the main results. The parameter of interest is β_5, which captures the differential evolution during the crisis period of the extreme temperatures' effect on IPV for districts with a strong rise in unemployment compared to those districts that were less affected by unemployment increases. The results presented in Figure 4 are based on the model in Equation 2, but additionally split the Cri_{iqy} binary indicator into yearly binary indicators, with the year 2008 as the base category.

	(1)	(2)
Extreme heat	7.236***	7.215***
	(2.199)	(2.276)
Extreme heat × crisis	-4.501**	-4.338*
	(2.209)	(2.291)
Extreme heat × high UR increase	-3.804	-3.792
	(4.157)	(4.154)
High UR increase × crisis	-6.306	-6.358
	(6.512)	(6.512)
Extreme heat × high UR increase × crisis	7.156*	7.247*
	(3.850)	(3.843)
Province by Year FE	X	X
Quarter by District FE	X	X
Weather controls		X
N	13,353	13,353

Table A.3: Heterogeneous effects by labour market shocks

*Notes: This table shows the results of the triple interaction model based on the sample from 2006 to 2013. Extreme heat is an indicator equal to 1 when there is more than 1 day with max. temperatures above 30 degrees in a quarter-district. Crisis is an indicator equal to 1 from Q4 2008 onwards. High UR increase is an indicator equal to 1 for those districts in the top third of the distribution of male unemployment increase between Q3 2008 and Q3 2013. Weather controls reflect different bins of rainy day counts within a quarter. * p < 0.1, ** p < 0.05, *** p < 0.01*

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