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The impact of environmental shocks due to climate change on intimate partner violence: A structural equation model of data from 156 countries

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Abstract

The impact of climate change on human societies is now well recognised. However, little is known about how climate change alters health conditions over time. National level data around climate shocks and subsequent rates of intimate partner violence (IPV) could have relevance for resilience policy and programming. We hypothesise that climate shocks are associated with a higher national prevalence of IPV two years following a shock, and that this relationship persists for countries with different levels of economic development. We compiled national data for the prevalence of IPV from 363 nationally representative surveys from 1993 to 2019. These representative data from ever-partnered women defined IPV incidence as any past-year act of physical and/or sexual violence. We also compiled data from the Emergency Events Database (EM DAT) on the national frequency of eight climate shocks from 1920 to 2022 within 190 countries. Using exploratory factor analysis, we fit a three-factor latent variable composed of climate shock variables. We then fit a structural equation model from climate shocks (lagged by two years) and IPV incidence, controlling for (log) national gross domestic product (GDP). National data representing 156 countries suggest a significant relationship between IPV and a climate factor (Hydro-meteorological) composed of storms, landslides and floods (standardised estimate = 0·32; SE = 0·128; p = 0·012). GDP has a moderately large cross-sectional association with IPV (estimate = -0·529; SE = 0·047; p = 0·0001). Other climate shocks (Geological: earthquakes/volcanos; Atmospheric: wildfire/droughts/extreme temperature) had no measurable association with IPV. Model fit overall was satisfactory (RMSEA = 0·064 (95%CI: 0·044–0·084); CFI = 0·91; SRMR = 0·063). Climate shocks have a longitudinal association with IPV incidence in global population-based data. This suggests an urgent need to address the higher prevalence of

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IPV likely to come about through climate shocks due to climate change. Our analysis offers one way policy makers could track national progress using existing data.

Introduction

The devastating impact that climate change will have on human societies is now well recognised [1]. An increase in the frequency of acute climate events such as cyclones, flooding, heat waves and droughts are likely to bring about widespread instability and violence globally [2, 3]. More chronic changes, such as increases in average air temperature and rising sea levels will negatively impact on crop yields, reduce dietary diversity and land access [4, 5]. Both acute and chronic changes in the climate will disproportionately affect low- and middle-income countries (LMICs) due to widespread poverty, social inequities and weak health systems [6, 7]

A major concern for global health and wellbeing impacts of climate change is the increased risk of intimate partner violence (IPV) [8], which disproportionately affects women and puts their lives at unnecessary risk. Globally, over 30% of women will experience violence from an intimate partner in their lifetime, albeit with huge variation between countries and regions [9]. Countries that have experienced recent climate shocks are more likely to be among those with the highest prevalence of IPV [10].

Scholars offer different theoretical explanations for an association between climate shocks and IPV. One explanation is that women are disproportionately impacted by climate shocks because of patriarchal gender norms that position them as providers of food and care in many countries and increase their vulnerability to climate shocks [11]. This leads to increasing and unequal obligations on women to deal with the impacts of climate change on household food insecurity, including spikes in food prices, reductions in household income [2, 4, 5], and rising malnutrition and stunting in children [12].

Another potential explanation for the relationship between climate change and IPV is the increase in economic insecurity that arises from climate shocks in contexts where women are often dependent on men's roles as breadwinners [13]. Climate shocks reaffirm existing gender inequalities in households by increasing poverty and insecurity in ways that undermine men's "traditional" roles and consequently their mental health and wellbeing, alongside a decrease in negotiating power for women within the household [14]. This leads to increases in IPV by reducing women's ability to avoid or leave violent situations through constraining their access to land, property and other productive resources [15].

While calls have been made to consider gender inequalities in climate disaster strategies, empirical evidence of the global impacts of climate change on IPV remains weak [2, 7]. In the past three years, five scoping/ systematic reviews have shown potential increases in one or more forms of IPV following climate shocks [8, 16–19]. In their review of disasters from natural hazards and violence against women and girls, Thurston et al [17] find a positive association between hazards and violence in only eight out of 21 studies, highlighting an urgent need for better quality studies to inform policy. Similarly, Van Daalen et al [18] point to associations between gender-based violence and extreme weather events, but also highlight the low quality of the quantitative literature, while Logie et al [8] question the literature's global coverage. The evidence that does exist on climate shocks and IPV is inconsistent, with several studies reporting inconclusive or non-intuitive results (including a decrease in sexual violence and forced marriage following climate shocks) [18].

To help fill current gaps and explore potential measurement opportunities using existing datasets, this study draws on nationally representative datasets covering the years 1993 to 2019 from 156 different countries to examine two key hypotheses: (1) climate shocks are associated with a higher national prevalence of IPV two years following the event, and (2) this relationship exists for countries with very different levels of economic development (i.e. the relationship holds even when controlling for gross domestic product; GDP). Our aim is to contribute to the global evidence base through a robust analysis of these nationally representative secondary data.

Methods

Study design

In this study, we used country-level prevalence estimates from 363 nationally representative surveys, including: Demographic and Health Surveys (DHS); Multiple Indicator Cluster Surveys (MICS); Reproductive Health Surveys; United Nations Multi-country study on Women's Health and Domestic Violence against Women; United Nations Multi-Country study of Men and Violence; International Violence Against Women Surveys, two databases (World Health Organisation (WHO) 2018 estimates on violence against women, the UN Women Global Database on Violence against Women) and one report (Pan American Health Organisation's 2018 publication on Intimate Partner Violence against Women in the Americas). We selected these datasets for similarities in the methods used and comparability across the questions asked about IPV. We then merged these data with national data available on climate shocks from the Emergency Events Database (EM DAT). A full list of sources is provided in the (S1 Table).

As the gold standard of international surveys of IPV, DHS and WHO studies use interviews at household level to ask survey questions of a representative sample of women aged 15 to 49. They draw on similar questions about women's experiences of IPV, asking about past physical and sexual violence in the past 12 months from a recent husband or partner. Questions are broken down into specific acts of violence, including hitting, beating, and kicking. Ethical guidelines in all included studies ensure the safety for individual women experiencing violence, safeguarding procedures for signposting to relevant services, privacy to ensure disclosures, and specific training for field staff.

To account for variation over time in the analysis, we focussed on country-year level data (and data that could be transformed into this format). We disregarded data from country years where our main outcome variable was not present (i.e. where data on IPV has not been collected in that year) and aggregated data from other variables to create a composite score.

Main outcome variable (IPV)

The main outcome variable for the study is a continuous variable representing the proportion of women reporting an experience of physical and/or sexual IPV by a current or former partner in the past 12 months. The DHS and WHO surveys also ask about lifetime violence, however they do so in different ways, leading to non-comparable data and minimising our ability to account for time in the analysis. As an indicator of IPV, past 12-month physical and/or sexual violence is captured as part of country-level reporting on progress towards the Sustainable Development Goals, leading to widespread coverage globally.

Where reports covered a timespan of more than one year, we assigned the end year of a survey, for example, Haiti's 2015–2016 Demographic Health Survey (DHS) was assigned the year 2016, and the United Nations Multi-Country study of Men and Violence (UNMCS) surveys were assigned 2013 as the report indicated they took place between 2010 and 2013 [20]. Where prevalence estimates for multiple age spans were provided, we chose estimates for the widest age spans available, which in most cases was 15–49 years, although this included 18–49 or 18–

50 years in some cases. We used sub-national estimates on 17 occasions where national estimates were not available. This resulted in a dataset of past 12-month physical and/or sexual IPV experience prevalence estimates comprising 363 country-years, reflecting 156 different countries and a timespan covering 1993 to 2019.

Predictor variables

Climate shock was a count variable derived from the Emergency Events Database (EM DAT) produced by the Centre for Research on the Epidemiology of Disasters (CRED) (https://www.emdat.be/). Data includes natural, technological and complex emergency events where there were 10 or more deaths, 100 or more people were affected/injured/homeless, or a declaration by the country was made of a state of emergency and/or an appeal for international assistance. Data were available from 1900 to 2020.

Initially all logged "natural" disaster types were considered for inclusion (storms, floods, droughts, extreme temperatures, landslides, wildfires, earthquakes, glacial lake outbursts, mass movements and volcanoes). Glacial lake outbursts were dropped as no country-years in our timespan had experienced this event. We then narrowed the remaining list down to a subset of key indicators deemed most linked to climate change based on our knowledge of the existing literature. We also kept earthquakes and volcanos due to evidence that earthquakes and volcanos are associated with climatic changes, particularly rising sea levels [21]. This resulted in a final set of eight climate shock indicators: earthquakes, volcanos, landslides, extreme temperatures, droughts, floods, storms and wildfires. We derived new continuous variables for each of these climate shocks separately, each indicating the number of new events in the past two years. Country-years were assigned zero on an indicator if that particular climate shock hadn't been experienced within the last two years. Data were available for 1920–2022, and 190 countries meaning all 363 country-years in the dataset were assigned values for this variable (i.e. no missingness).

Control variables

We used World Bank GDP data provided by the International Comparison Programme (1990–2020) aggregated over a 10-year period, measured as purchasing power parity (current international $). This indicator provides values for gross domestic product (GDP) expressed in current international dollars, converted by a purchasing power parity (PPP) conversion factor. We reshaped the data from wide to long format, and log transformed this continuous variable due to a skewed distribution (Log transformation: 24·5 (23·1–26·2); Original: $42,400m ($10,800m - $230,000m)). We then used this as a control variable in our analyses.

Analysis

All analyses were performed in *Mplus* version 8. Results showed that testing for both multivariate skewness and kurtosis were statistically significant (p = 0·0001). Therefore, the robust maximum likelihood estimator was used to deal with the non-normality of the data. In *Mplus* we applied maximum likelihood missing variance to address data missingness.

We first created a standardised variable for each of the eight climate shock variables, treating the variables as numeric in the analysis. We performed an exploratory factor analysis (EFA) to identify the factor structure, the number of constructs, and the nature of these constructs. This involved extracting the factors and assessing validity of a factor analysis (correlations above 0·3). We then determined the number of factors, using three strategies, including eigenvalues, scree plots, and maximum likelihood. Finally, we tested the overall hold of the model before rotating the model using orthogonal rotation.

Secondly, and to test our first hypothesis, we built a set of structural equation models (SEMs) to assess pathways between the separate relevant climate shocks and IPV. We assessed how well this set of models predicted the sample variance-covariance matrix by examining indices of model fit including the root mean squared error of approximation (with good fit suggested by root mean squared estimate of approximation (RMSEA) $<0{\cdot}08$), comparative fit index (with good fit suggested by CFI $>0{\cdot}90$), and Standardised Root Mean Squared Residual (SRMR; $<0{\cdot}1$ suggestive of acceptable model fit). We also examined AIC and BIC to compare the fit and complexity of maximum likelihood models, where smaller values are considered better fit. Once a theoretically sound and well-fit model was established, we trimmed non-significant paths. Standardised estimates, standard errors (SEs) and p-values are reported.

Once a measurement model fit the data, we adjusted for clustering of country-years and added the GDP (log) variable to the model as a control variable. We then assessed how well the model predicted the sample variance-covariance matrix by examining the same model fit indicators (RMSEA, CFI, and SRMR). P-values less than 0.05 were considered statistically significant. Standardised estimates, standard errors (SEs) and p-values are reported.

Results

The 363 country-year data points over 21 years, from 1993 to 2019, represented 156 countries, with year 2018 having data points for most countries (155 countries and 42·7% of the 363 country-year data points) and Peru having data for 13 of the 21 years while all other countries have five or fewer data points (S2 Table). Fig 1 shows the distribution of IPV for the country-year data points, indicating a distribution skewed to the right with mean (0·138) and median (0·108). The highest IPV values were measured for Democratic Republic of Congo (0·641 in 2007), followed by Ethiopia (0·537 in 2003) and Papua New Guinea (0·476 in 2018). The descriptive data for the eight key climate shock variables by country-year (see S2 Table) indicate that floods (n = 34; 2006 in India) and storms (n = 28; 2000 and 2018 in USA) are the most frequent climate shock indicators. The average aggregated GDP(log) for the 363 country-years was 25·2 (variance = 4·77, median = 25·1, range = 18·97 Marshall islands to 30·71 China).

The exploratory factor analysis (EFA) indicated a three-factor model being the best fit between observed and theoretical data. The confirmatory factor analysis (CFA) showed the model to be composed of: climate shock 1 (earthquakes, volcanos), climate shock 2 (floods, landslides, storms), and climate shock 3 (wildfire, droughts, extreme temperature). Standardised loadings for the measurement model are provided as (S3 Table). We chose not to discard any factors at this stage over concerns that this would lead to an under-specified model.

Conceptually, we understand climate shock 1 as a combination of two geological phenomena tied to the dynamic processes occurring within the earth. Climate shock 2 is a combination of three hydro-meteorological process that involve interactions between levels of atmospheric and surface water. For instance, an unusual level of precipitation in a short period from a storm can lead to floods and landslides [22] Climate shock 3 is a combination of three interconnected atmospheric phenomena with significant implications for ecosystems, agriculture and human health. For example, high temperatures, low humidity, and dry vegetation create favourable conditions for wildfires to ignite and spread [23].

To assess our first hypothesis, a structural model with IPV regressed on the three climate shocks identified in the measurement model was done. The three-climate shock model was satisfactory (RMSEA = 0·079 (95%CI: 0·058–1·000); CFI = 0·85; SRMR = 0·066), however, none of the climate shock variables were significantly associated with IPV (climate shock 1 estimate -0·11, p = 0·394; climate shock 2 estimate 0·16, p = 0·428; climate shock 3 estimate -0·12, p = 0·548).

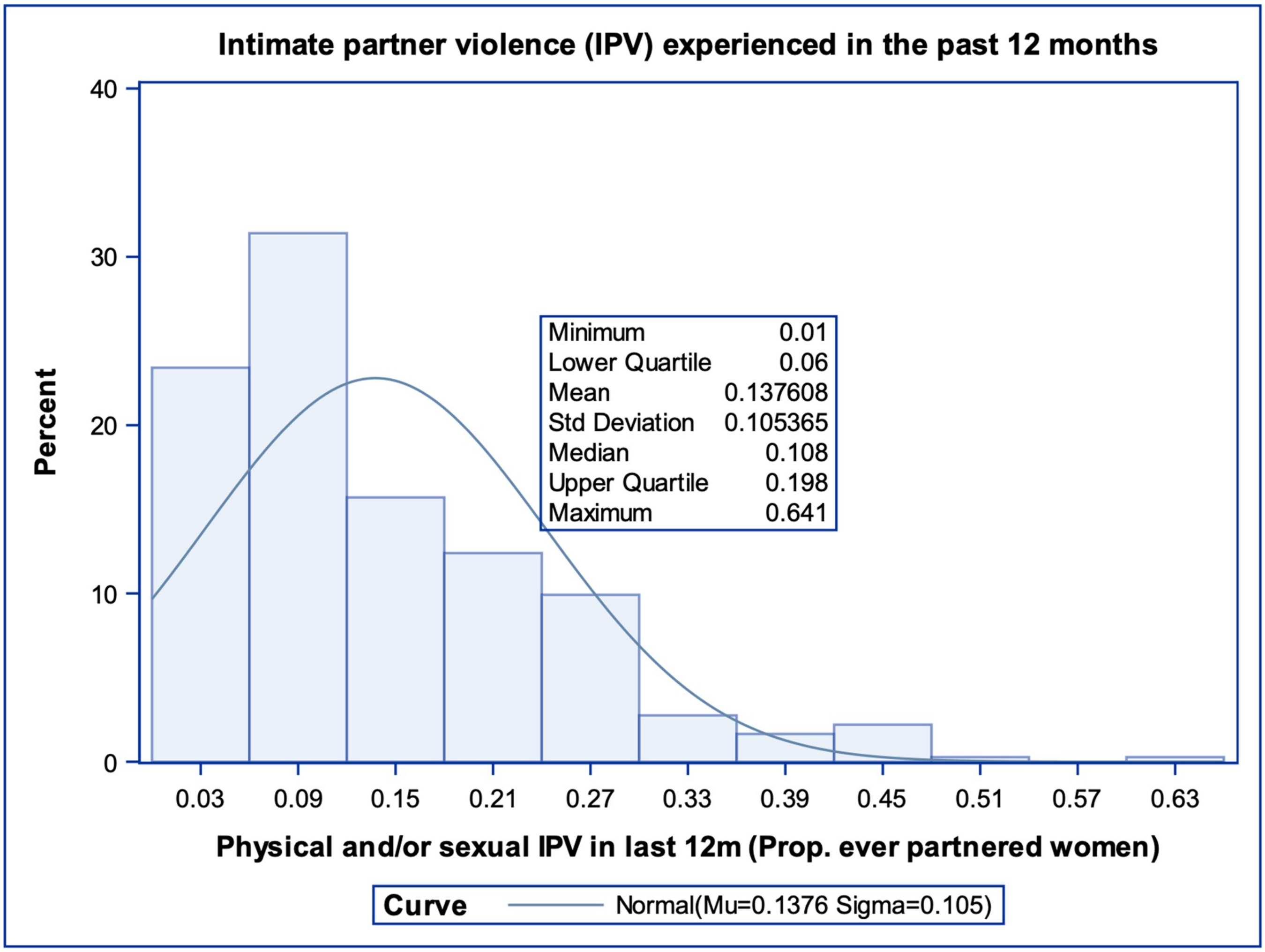

Fig 1. Distribution of IPV for country-year data points.

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We then modelled the same three climate shock variables adjusting for clustering of country-years and the (log)GDP (measured over the past 10 years). A covariance between wildfire and storm was included (estimate = 0·575; SE = 0·165; p = 0·0001, as well as between (log) GDP and extreme temperature (estimate = 0·251; SE = 0·059; p = 0·0001). The model fit indices showed a satisfactorily model fit (RMSEA = 0·064 (95%CI: 0·044–0·084); CFI = 0·91; SRMR = 0·063), and a significant relationship between IPV and climate shock 2, i.e. storms, landslides and floods (estimate = 0·32; SE = 0·14; p = 0·012). This indicates that climate shock 2 lagged by two years had an association with overall intimate partner violence incidence. The association between GDP and IPV incidence was also significant (estimate = -0·529; SE = 0·07; p = 0·0001) indicating that the higher the GDP, the lower the incidence of IPV. Moreover, floods had the highest squared multiple correlation (0·75), showing that more of the variance in the factor is explained by this underlying indicator than by either landslides (0·34) or storms (0·51). Fig 2 and Table 1 show the results of the final structural equation model.

Different climate shocks had different effects on IPV, as shown. Earthquakes and volcanoes (climate shock 1), which are geological and only remotely a result of climate change, were not

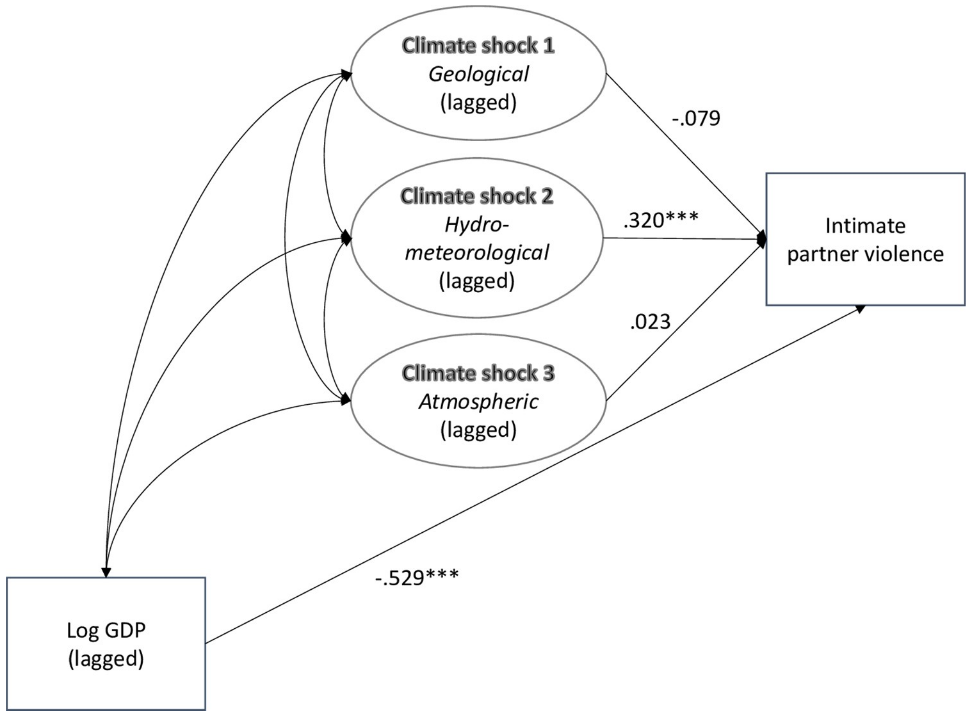

Fig 2. Structural equation model.

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significantly associated with IPV; neither was climate shock 3 (droughts, wildfires and extreme temperatures).

Discussion

National data fit within a model showing an independent, lagged association between some climate shocks (including storms, landslides and floods) and increased IPV. This builds on

Table 1. Structural model: Standardised coefficient, standard error (SE), coefficient/SE, p value, and fit statistics.

Parameter effects	Standardised coefficients	SE	Z	P>|z|
Climate shock 1(lagged)[1] →IPV	-0·079	0·133	-0·590	0·555
Climate shock 2(lagged)[2] →IPV	0·320	0·128	2·505	**0·012**
Climate shock 3(lagged)[3] →IPV	0·023	0·087	0·271	0·787
(log)GDP	-0·529	0·047	-11·241	**0·0001**
Covariances				
Wildfire—Storms	0·575	0·165	3·488	**0·0001**
(log)GDP—Extreme temperature	0·251	0·059	4·268	**0·0001**
Fit statistics				
RMSEA (95% CI)	0·064 (0·044–0·084)			
CFI	0·91			
SRMR	0·063			

[1] Climate shock 1 = earthquakes, volcanos (*geological*)

[2] Climate shock 2 = floods, landslides, storms (*hydro-meteorological*)

[3] Climate shock 3 = wildfire, droughts, extreme temperature (*atmospheric*)

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previous evidence of associations between these climate shocks and IPV, adding to a growing body of literature on how cyclones, typhoons, hurricanes, floods, and landslides impact on IPV prevalence [8, 16–19] This synthesis of multiple timepoints across contexts helps build global evidence of the non-economic social impacts of climate shocks, suggesting that the impacts of these climatic shocks are sometimes felt long after the events and builds a case for policy mobilisation in this area [24]

The lagged country-level analysis in our models helps illustrate potential causality of climate shocks on later IPV incidence. This is one preliminary way of assessing the relationship between climate shocks and health outcomes internationally. However, not all climate events showed an impact on IPV incidence. While the extant literature shows a clear relationship between extreme temperature, wildfires and droughts on IPV [18], a significant relationship was not found in our analysis. This is surprising given evidence of the association between increased temperatures and heat waves on IPV incidence [25], and may be the result of an absence of IPV data for certain years or countries. It could also be that the impact of changes in temperature on IPV occurs more immediately and their impact dissipates with time, while other climatic events also impact IPV over a longer-term. For example, droughts are different from other climate events because of how lower precipitation periods can build up over extended periods of time, often years, and may therefore have impacts on IPV prevalence that are also protracted over longer periods [26]. As with any model, this one should be used with caution and efforts made to improve the availability of IPV data across years and countries where gaps exist.

Our study found a similar magnitude of effect (medium Cohen's *d*) on IPV from the lagged climate change variable composed of storms, landslides and floods (0·320) and log GDP (-0·529) [27]. This highlights that the association between climate shocks and IPV prevalence, may be similar to economic drivers of violence (which are comparatively widely accepted and discussed in the literature) [28]. While there has been an increasing interest in economic interventions to address IPV in LMICs [29], the integration of climate change adaptation and mitigation into IPV prevention interventions is largely non-existent [30]. The implications of this are wide-reaching. If climate shocks present as large a magnitude of effect as GDP for IPV prevalence as suggested by our analysis, then climate changes may undermine otherwise potentially effective IPV prevention efforts in climate-affected areas.

While this study presents the first analysis of its kind, it does have limitations. Our study drew on cross-sectional data, which while it points to causality, it is not true causal mediation and should be interpreted cautiously. The IPV variable of past 12-month physical and/or sexual violence, while chosen for having the best coverage, did not allow us to disentangle the impact of climate shocks on different types of violence. Similarly, lagging the climate change indicators by two years did not allow us to assess events that have a more immediate impact on IPV (i.e. heatwaves and acts of aggression by men) versus longer-term impacts (i.e. impacts on community structures and resilience). Such an analysis will require better overall estimates of different types of violence across countries and years, and improved understandings of how specific climate shocks lead to both short and longer-term impacts on IPV, as an important area for future research. Our structural equation model also has limitations in terms of individual indicators adequately representing composite factors. For example, two of the three indicators for climate shock 3 were good candidates for removal (i.e. with squared multiple correlations below 0.25), however, this would have left only one indicator remaining for this factor. We present an alternative model that showed good fit indices in the (see S4 Table) as evidence that the model we arrived at was the best option conceptually.

Cross-national analyses point to global trends and as such, do not consider differences between countries or contexts. While a cross-national analysis is necessary to provide evidence of the global impact of climate change on IPV prevalence, some countries or regions may experience greater impacts than others, which are not captured by our analysis. Differences in the gendered impacts of particular types of climate events (i.e. specifically droughts and earthquakes) on IPV has produced contradictory evidence, which may stem from different regional impacts or a lack of data available [31, 32]. An absence of data has indeed made it difficult to tease out the impact of different types of climate shocks on different types of IPV at a regional or national level as part of our study. This points to the need for more comprehensive (and ideally longitudinal) datasets better able to unpack interactions between climate change and IPV at the national level.

Recommendations for research and policy

While it will never be ethical or feasible to randomise communities to climate shocks, causal inference and policy analysis methods can help us disentangle the effect of shocks on health outcomes. Our model can be used by policymakers to track progress in the relationship between climate mitigation and adaptation strategies and IPV incidence as an outcome. Future work to bolster the annual or biannual estimates of IPV at country-level is also needed. That Peru as an LMIC has the most robust data on annual rates of IPV suggests the decision to consistently and carefully assess women's safety is as much a political decision as a resource consideration. Other countries should follow suit, which would allow for further analysis about distinct forms of violence. It is a fertile moment for research and programming investments in bolstering household and community-level resilience to climate shocks. As the IPV field has an increasing number of efficacious, and sometimes population-based approaches [33], it is critically important for multilateral donors to pair existing IPV prevention with climate resilience programming. While gender-sensitive climate change programming is increasingly called for, progress has been slow [13, 34]. Both multilateral donors and national governments have an ethical obligation to ensure that climate change policies and programming do not increase IPV as a first step. However, further progress will require ensuring that IPV becomes a key consideration for existing environmental policies.

Conclusions

This study provides new empirical evidence that country-level climate shocks are associated with national prevalence of physical and sexual intimate partner violence. The links between climate shocks and IPV have been challenging to illustrate in ways that are clearly understandable to policymakers, and our study provides a step towards highlighting the importance of this connection. We hope that this will progress current efforts to transform the climate change agenda to be more gender-sensitive and consider the enormous implications of climate-related IPV on women's lives.

Supporting information

S1 Table. Data sources for IPV estimates (women's reports of experiencing physical and/or sexual IPV in the last 12m).
(DOCX)

S2 Table. IPV estimates and frequency of climate shock variables, by country year–arranged alphabetically and chronologically by country and year.
(DOCX)

S3 Table. CFA measurement model for 3 factor model.
(DOCX)

S4 Table. 2-factor structural model considered, standardised coefficient, standard error (SE), coefficient/SE, p value, and fit statistics.
(DOCX)

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