# The Long-Term Human Capital Consequences of Natural Disasters: Evidence from India

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October 2025

- In recent decades, climate change has led to a surge in natural disasters, with both their frequency and severity projected to increase (United Nations 2021)

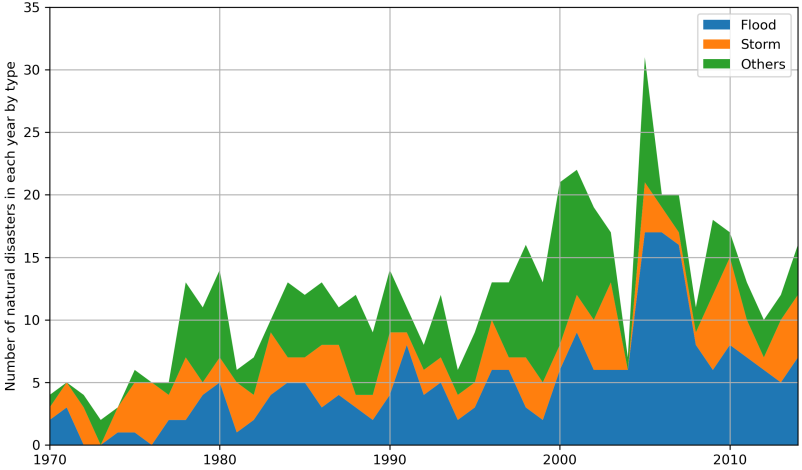


Figure 1: # of natural disasters in India since 1970

- Many studies on disaster and human capital use single events like 2004 tsunami
- In disaster-prone regions, individuals may experience multiple disasters

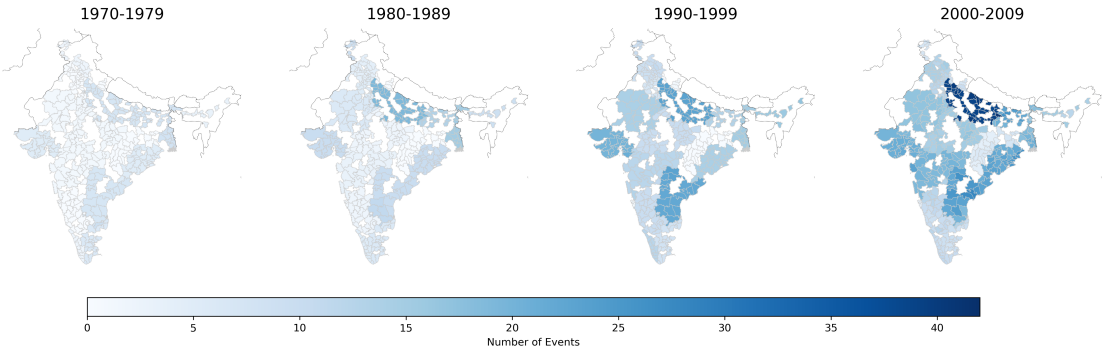


Figure 2: # of natural disasters for districts

*Note:* This considers all disasters recorded in EM-DAT data. Districts not covered in my sample are blank

# This paper

**What are the long-term effects of early-life exposure to natural disasters on human capital during adulthood?**

1. Consider multiple disasters: floods, storms, earthquakes, ...
2. Use data from India, an economically and socially diverse developing country
3. Link about 500 disasters from 1970-2013 to over 59,000 individuals from a nationally representative survey in India
4. Apply Difference-in-Differences strategy to examine effects of early-life disaster exposure on education, health, and labor outcomes for individuals aged 20-40

# Potential mechanisms

- Fetal Origin Hypothesis: Conditions in critical periods of fetal development can have lasting effects on health and well-being
  - Central-nervous systems and brains undergo rapid growth between 8 and 25 weeks post-conception (Almond, Edlund, & Palme 2009)
  - In utero exposure to disaster affects birth outcomes (Glynn et al. 2001; Tan et al. 2009; Torche 2011; Oyarzo et al. 2012; Currie 2013)
- Negative shocks in **early life (in utero to age 2)**
  - Reduce labor productivity and income and worsen health (Almond 2006; Maccini & Yang 2009; Liu et al. 2015; Shah & Steinberg 2017; Karbownik & Wray 2019)
  - Lead to different effects for vulnerable population (Bhalotra 2010; Jayachandran & Kuziemko 2011; Sivadasan & Xu 2021)

# Preview of results

Early-life exposure to severe disasters...

- Significantly affects educational attainment
  - Reduces likelihood of completing primary school
  - Exposure to one additional disaster results in loss of 2 mo. of education
  - Repeated disaster exposure has significant effects
  - Effects observed for both genders
- Exhibit lower likelihood of having long-term disease $\rightarrow$ better health
  - Not observed for men
- Reduces labor force participation for men, particularly in salaried jobs
  - Opposite effect for women

# Related literature and contribution

- Study effects of **multiple disasters** on human capital
  - Expand case studies on single events (Cho & Kim 2023; Ciraudo 2020; Frankenberg et al. 2011; Frankenberg et al. 2020); Fewer studies examine multiple disasters and study specific disaster types (Opper et al. 2023; Currie & Rossin-Slater 2013; Norling 2022)
- Study **long-term effects** of early-life shock
  - Some studies suggest early-life impacts can fade over time (Currie & Almond 2011; Almond, Currie, & Duque 2018), while others argue that childhood harms can increase proportionally as individuals age due to the cumulative nature of human capital production (Hanushek & Rivkin 2012; Todd & Wolpin 2003)
- Explore **heterogeneity** across individual and disaster characteristics
  - Few papers consider intensity of disasters (Caruso 2017)
  - Gender-differentiated effects (Maccini & Yang 2009; Sivadasan & Xu 2021)

# Data overview

- Emergency Events Database (EM-DAT)
- India Human Development Survey (IHDS)

- Link EM-DAT disaster data to IHDS individuals by district and birth cohort
  - Sample construction
  - Measure: disaster characteristics
  - Measure: early-life disaster exposure

# Data on natural disasters

## EM-DAT International Disaster Database from 1900

- Used by 60% of macroeconomic studies in 2000-2013 on disaster and development (Lazzaroni & Bergeijk 2014)
  - GDP growth (Botzen, Deschenes, & Sanders 2019; Klomp & Valckx 2014), income and institutions (Kahn 2005), firm-level outcomes (Leiter, Oberhofer, & Raschky 2009), growth retardation (Thamarapani 2021), poverty and well-being (Edmonds & Noy 2018)
- Sources: UN agencies, insurance companies, research institutes, press agencies
- **One natural disaster event is recorded if it caused**
  - $\geq$ 10 people dead,
  - *or* $\geq$ 100 people affected,
  - *or* declaration of state of emergency,
  - *or* call for international assistance

# Data on natural disasters

## EM-DAT International Disaster Database

- Context variables: disaster type, locations affected (states, districts)
- Impact variables: deaths, affected (injured, missing, homeless)

| DisNo. | Disaster Type | Location | Start Year | Start Month | Start Day | End Year | End Month | End Day | Total Deaths | Total Affected |
|---|---|---|---|---|---|---|---|---|---|---|
| 1984-0124-IND | Earthquake | Cachar district (Assam) | 1984 | 12 | 31 | 1984 | 12 | 31 | 20 | 10900 |
| 1990-0103-IND | Flood | Jammu, Kargil district (Kashmir) | 1990 | 3 | 21 | 1990 | 3 | 22 | 69 | |
| 1990-0580-IND | Storm | Ganjam district (Orissa) | 1990 | 11 | | 1990 | 11 | | 250 | 1,500,000 |

Table 1: Natural disaster examples

# Data on human capital

## India Human Development Survey (IHDS)

- Widely used to explore evolving daily lives of Indian households (Azam & Bhatt 2015; Chatterjee & Sennott 2021; Heyes & Saberian 2022; Mohanty & Gebremedhin 2018)
- Nationally representative panel data
  - Conducted in 2 waves: 2004-2005, 2011-2013
  - Households: $>$ 41,000
  - Individuals: $>$ 150,000
- Geographic information: administrative level 2, district
  - India 2001 Census division: 592 districts
  - Average size and pop of districts in India: 970 to 2.3k $mile^2$; 1 to 2 *million*
  - Comparison: average size and pop of counties in U.S.: 1k to 5.9k $mile^2$, 10k to 1 *million*

# Sample construction and data limitation

- Restrict analysis to natural disasters occurring 1970-2013
  - Location information availability increases significantly since 1970 from 60% to 90%
- Use IHDS wave 2 for older cohorts and longer post-early-life periods
  - Ages: 20-40; Birth cohorts: 1971-1992
  - 68,421 individuals are included
- Limit sample to individuals from households that have not moved across districts
  - Location of birth is not observed
  - Use location of household residence when surveyed as location of birth
  - Keep individuals whose households have not moved across districts (87%): 59,066

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# Sample overview

- Interview time: Oct 2011 to Dec 2012 (88% surveyed in 2012)
- Age: 20-40 with average being 29
- Women: 30,304 Men: 28,762

| | Mean | SD | Mean | SD |
|---|---|---|---|---|
| | **Women** | | **Men** | |
| Years of education (never=0) | 6.36 | 5.10 | 8.23 | 4.56 |
| Complete primary school | 0.53 | 0.50 | 0.70 | 0.46 |
| Diagnosed with long-term disease | 0.08 | 0.27 | 0.05 | 0.21 |
| Worker with any job | 0.47 | 0.50 | 0.87 | 0.33 |
| Salary worker paid monthly or annually | 0.06 | 0.24 | 0.21 | 0.40 |

Table 2: Summary statistics of outcomes

# Measure: disaster characteristics

- There is large variation in severity of disasters
- Define severe disaster
  - Map each disaster event to district-year using time and location
  - For each event, calculate (# of people affected) / (population in districts affected)
  - One disaster is "severe" if it affects more than 4 people out of 100 pop (ranks in top 20%)

| | Deaths | Affected | Deaths per 1 mi pop | Affected per 100 pop |
|---|---|---|---|---|
| 0.6 | 100 | 200,000 | 3 | 0 |
| 0.7 | 161 | 572,680 | 5 | 1 |
| 0.8 | 250 | 2,460,000 | 9 | 4 |
| 0.9 | 669 | 9,836,500 | 41 | 13 |
| 0.99 | 9,710 | 123,240,000 | 682 | 100 |

Table 3: Quantile distribution of disasters regarding human impacts

# Measure: early-life disaster exposure

- For each district-birth cohort, generate early-life disaster exposure
- 38% individuals exposed to severe disasters in early-life
  - 27% exposed to 1 disaster; 9% exposed to 2+ disasters
  - For those exposed, average # of disasters = 1.33

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| **# of severe disasters exposed** | | | | |
| Early-life | 0.51 | 0.74 | 0 | 4 |
| In utero | 0.11 | 0.32 | 0 | 2 |
| Birth year | 0.13 | 0.34 | 0 | 2 |
| Age 1 | 0.13 | 0.34 | 0 | 2 |
| Age 2 | 0.14 | 0.35 | 0 | 2 |

Table 4: Summary statistics of disaster exposures

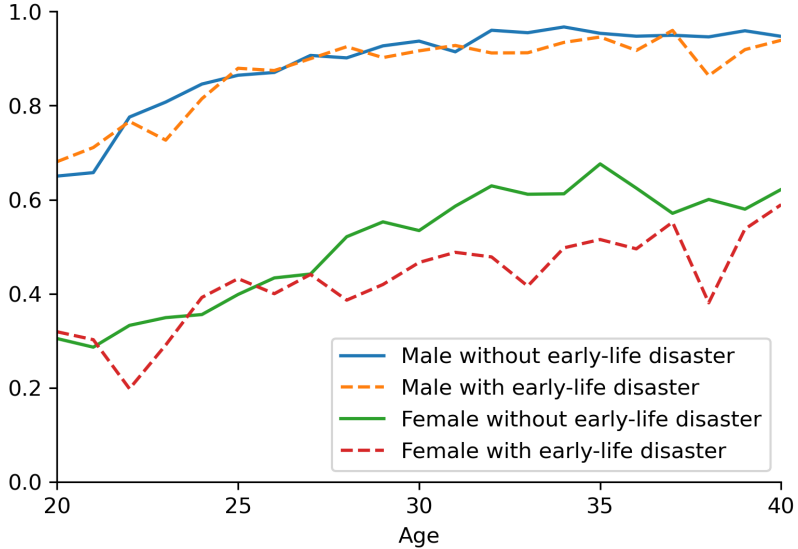



Figure 3: Share of people working for any job

# Estimation strategy

Explore jointly the spatial and temporal variation in early-life disaster exposure

$$Y_{idc} = \alpha + \beta \cdot D_{dc,EarlyLife} + X_i'\theta + \mu_d + \phi_c + \epsilon_{idc} \quad (1)$$

- $Y_{idc}$ - human capital outcomes for individual $i$ in district $d$ of birth cohort $c$
- $D_{dc,EarlyLife}$ - # of disasters experienced from in utero to age 2
- $X_i'$ - individual-specific control variables such as gender, age, caste and religion, interview year and month
- $\mu_d, \phi_c$ - vector of district FE, birth cohort FE, respectively
- $\epsilon_{idc}$ - error term, assumed to be random and idiosyncratic, with standard errors clustered at the district level

# Effects of severe disasters for all individuals

| | (1) Years of education | (2) Complete primary sch | (3) Long-term disease | (4) Work for any job | (5) Salary worker |
|---|---|---|---|---|---|
| | | | **All individuals** | | |
| # of disasters in early-life | -0.147*** | -0.009** | -0.003** | 0.007** | -0.005* |
| | (0.040) | (0.004) | (0.001) | (0.003) | (0.003) |
| Female | -1.887*** | -0.171*** | 0.035*** | -0.405*** | -0.145*** |
| | (0.074) | (0.007) | (0.003) | (0.011) | (0.006) |
| Mean | 7.27 | 0.61 | 0.06 | 0.67 | 0.13 |
| Observations | 58964 | 58964 | 59053 | 59053 | 59053 |

- Each column represents separate regression controlling for gender, age, caste and religion, interview year/mo., with district FE and birth cohort FE
- This assumes being exposed to one additional disaster has linear effect

# Effects of severe disasters: Gender-specific analysis

| | (1) Years of education | (2) Complete primary sch | (3) Long-term disease | (4) Work for any job | (5) Salary worker |
|---|---|---|---|---|---|
| | | | **Women** | | |
| # of disasters in early-life | -0.137*** | -0.011** | -0.006** | 0.013*** | 0.002 |
| | (0.044) | (0.005) | (0.002) | (0.005) | (0.002) |
| Mean | 6.36 | 0.53 | 0.08 | 0.47 | 0.06 |
| | | | **Men** | | |
| # of disasters in early-life | -0.163*** | -0.007 | -0.001 | 0.001 | -0.013** |
| | (0.055) | (0.006) | (0.002) | (0.004) | (0.005) |
| Mean | 8.23 | 0.70 | 0.05 | 0.87 | 0.21 |

- Education burden of exposure is observed for both women and men
- Women exposed show higher prob. of being diagnosed with long-term disease
- Opposite effects are observed on working status across gender

# Non-linear effects

| | (1) Years of education | (2) Complete primary sch | (3) Long-term disease | (4) Work for any job | (5) Salary worker |
|---|---|---|---|---|---|
| | | | **Women** | | |
| Dummy: exposed to 1 disaster | -0.161** | -0.006 | -0.006 | 0.016** | -0.002 |
| | (0.075) | (0.007) | (0.004) | (0.008) | (0.004) |
| Dummy: exposed to 2 disasters | -0.187* | -0.016 | -0.015*** | 0.016 | 0.004 |
| | (0.104) | (0.011) | (0.006) | (0.011) | (0.006) |
| Dummy: exposed to 3+ disasters | -0.672*** | -0.075*** | -0.009 | 0.067*** | 0.021 |
| | (0.226) | (0.020) | (0.014) | (0.025) | (0.014) |
| Mean | 6.36 | 0.53 | 0.08 | 0.47 | 0.06 |
| | | | **Men** | | |
| Dummy: exposed to 1 disaster | -0.221*** | -0.011 | -0.000 | 0.017** | -0.014** |
| | (0.077) | (0.008) | (0.003) | (0.007) | (0.007) |
| Dummy: exposed to 2 disasters | -0.281** | -0.005 | -0.002 | 0.001 | -0.028** |
| | (0.113) | (0.011) | (0.005) | (0.009) | (0.011) |
| Dummy: exposed to 3+ disasters | -0.480 | -0.034 | -0.005 | -0.028 | -0.028 |
| | (0.294) | (0.027) | (0.008) | (0.024) | (0.026) |
| Mean | 8.23 | 0.70 | 0.05 | 0.87 | 0.21 |

# Effects on employment of women controlling for spousal income

| | (1) Work for any job | (2) Salary worker |
|---|---|---|
| Dummy: exposed to 1 disaster | 0.012 | 0.006 |
| | (0.009) | (0.004) |
| Dummy: exposed to 2 disasters | 0.014 | 0.009 |
| | (0.013) | (0.006) |
| Dummy: exposed to 3+ disasters | 0.054* | 0.012 |
| | (0.031) | (0.013) |
| Spouse income 2nd quartile | -0.052* | 0.016* |
| | (0.027) | (0.009) |
| Spouse income 3rd quartile | -0.001 | 0.013 |
| | (0.025) | (0.009) |
| Spouse income 4th quartile | -0.122*** | 0.019** |
| | (0.025) | (0.008) |
| Mean | 0.47 | 0.06 |

- There is U-shaped link between woman being employed and husband's salary (Azim Premji Univ. Report 2023)

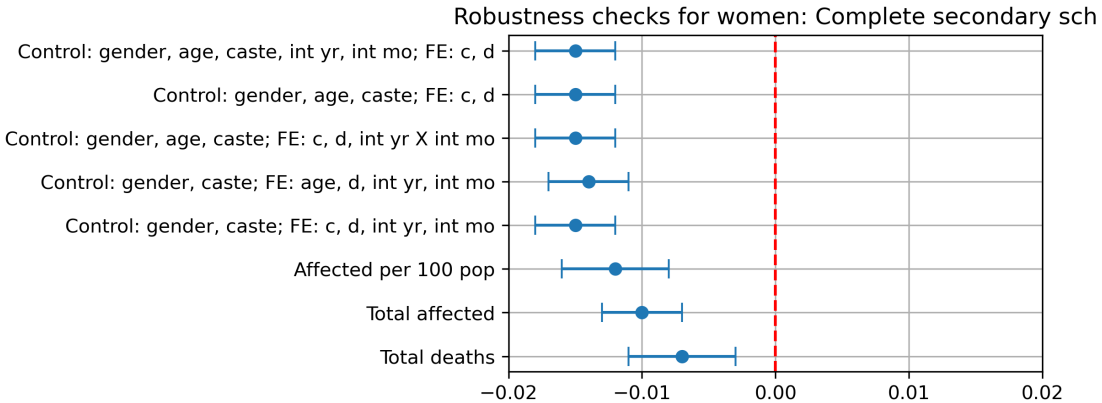
# Heterogeneity by types of disasters

| | (1) Years of education | (2) Complete primary sch | (3) Long-term disease | (4) Work for any job | (5) Salary worker |
|---|---|---|---|---|---|
| | | | **Women** | | |
| Earthquake | -0.148 | -0.004 | -0.038*** | -0.059* | 0.022* |
| | (0.348) | (0.036) | (0.005) | (0.032) | (0.013) |
| Drought | -0.047 | 0.001 | -0.004 | 0.007 | -0.002 |
| | (0.076) | (0.007) | (0.004) | (0.009) | (0.004) |
| Storm | -0.206** | -0.014 | -0.008 | 0.013 | 0.005 |
| | (0.096) | (0.011) | (0.005) | (0.012) | (0.006) |
| Flood | -0.155** | -0.016** | -0.006 | 0.017** | 0.002 |
| | (0.064) | (0.006) | (0.004) | (0.007) | (0.003) |
| | | | **Men** | | |
| Earthquake | 0.419 | 0.021 | 0.027 | -0.024 | -0.007 |
| | (0.320) | (0.016) | (0.035) | (0.068) | (0.013) |
| Drought | -0.063 | 0.009 | 0.000 | 0.005 | -0.009 |
| | (0.068) | (0.007) | (0.003) | (0.006) | (0.007) |
| Storm | -0.246** | -0.006 | -0.004 | 0.029*** | -0.001 |
| | (0.124) | (0.013) | (0.004) | (0.007) | (0.010) |
| Flood | -0.190** | -0.016* | -0.001 | -0.011* | -0.019*** |
| | (0.087) | (0.009) | (0.003) | (0.006) | (0.007) |

# Robustness checks

- Alternative outcomes
  - Complete secondary school, complete high school
  - Have short-term sickness
  - Full-time worker with any job, full-time salary worker
- Alternative specifications
- Alternative definition of severe disasters
  - Use other measures such as deaths, Affected
  - Use other thresholds such as top 10%

# Robustness checks



# Summary of findings

1. Early-life disaster exposure significantly negatively affects educational attainment
   - Reduces likelihood of completing primary school
   - Assuming linear effect, exposed to 4 disasters $\Rightarrow \frac{1}{2}$ year of education loss
2. Women exposed show lower likelihood of being diagnosed with long-term disease
3. Early-life disaster exposure reduces labor force participation for men
   - Particularly in salaried jobs
4. There are cumulative effects of disaster exposure
5. Exposure to repeated exposures has higher impact
6. Floods and storms could be driving effects

# Next steps

- **Labor outcomes**: hours of working, income, and wealth are to be explored
- **Heterogeneity analysis**: Beyond gender differences, examine heterogeneous effects by socio-economic status and urban-rural residency
- **Underlying mechanisms**: Access to health care and additional health indicators for eligible women, such as height and weight, can be explored, but not for men

# Thank you!

Email: yjiezhang@outlook.com

Website: https://yujiezhangecon.github.io/

- About me: Postdoctoral Fellow at Univ. of Pennsylvania
- Explore the intersections between climate change, human capital, and social inequality through transnational comparative studies and large-scale data analysis
- Working papers: (1) Effects of disasters on education (2) Population exposure of extreme temperatures and pollution risks

# Context variables (EM-DAT disaster data)

- Example showing 3 natural disasters in India (continued in next slide)

| **DisNo.** | **Disaster Type** | Event Name | **Location** | Origin | Magnitude | Magnitude Scale | Latitude | Longitude |
|---|---|---|---|---|---|---|---|---|
| 1984-0124-IND | Earthquake | Ground movement | Cachar district (Assam) | | 6 | Moment Magnitude | 24.4 | 92.34 |
| 1990-0103-IND | Flood | Flash flood | Jammu, Kargil district (Kashmir) | Brief torrential rain | | Km2 | | |
| 1990-0580-IND | Storm | Tropical cyclone | Ganjam district (Orissa) | | | Kph | | |

# Impact variables (EM-DAT disaster data)

- Example showing 3 natural disasters in India (continued from last slide)

| **DisNo.** | Start Year | Start Month | Start Day | End Year | End Month | End Day | Total Deaths | No. Injured | No. Affected | No. Homeless | Total Affected | Damage, Adjusted ('000 USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984-0124-IND | 1984 | 12 | 31 | 1984 | 12 | 31 | 20 | 100 | 800 | 10000 | 10900 | |
| 1990-0103-IND | 1990 | 3 | 21 | 1990 | 3 | 22 | 69 | | | | | |
| 1990-0580-IND | 1990 | 11 | | 1990 | 11 | | 250 | | 1500000 | | 1500000 | 263055 |

# Natural disaster across districts

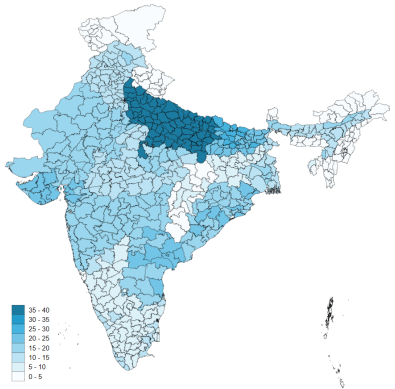



Figure 4: # of natural disasters recorded in EM-DAT 2001-2010

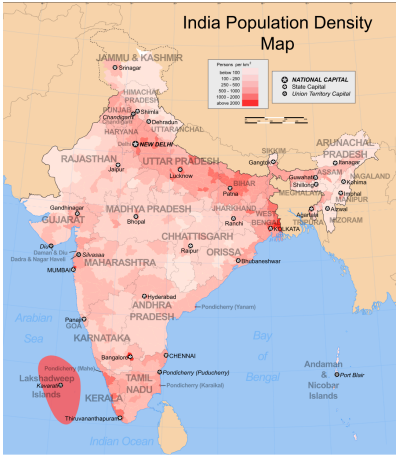



Figure 5: Population density

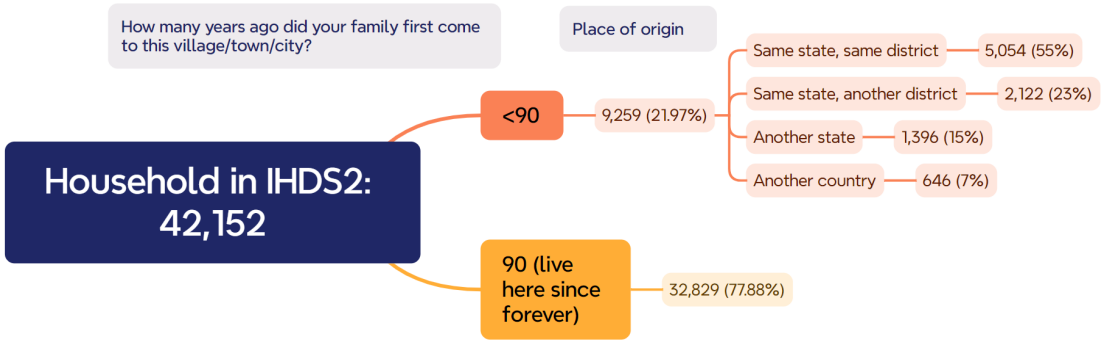
# Disaster events information availability

| Year | Event No. | Share of Events with Location Info | Deaths (Avg.) | Affected (Avg.) |
|---|---|---|---|---|
| 1900-1909 | 3 | 66.67% | 856,667 | NA |
| 1910-1919 | 1 | 100.00% | 300 | NA |
| 1920-1929 | 10 | 60.00% | 358,338 | 347,337 |
| 1930-1939 | 3 | 66.67% | 20,111 | NA |
| 1940-1949 | 8 | 100.00% | 257,801 | 16,000 |
| 1950-1959 | 28 | 50.00% | 277 | 229,565 |
| 1960-1969 | 41 | 63.41% | 44,649 | 5,877,478 |
| 1970-1979 | 58 | 93.10% | 767 | 9,820,981 |
| 1980-1989 | 107 | 90.65% | 314 | 10,783,917 |
| 1990-1999 | 115 | 99.13% | 465 | 4,039,702 |
| 2000-2009 | 184 | 100% | 357 | 4,626,611 |
| 2010-2019 | 162 | 100.00% | 143 | 4,417,043 |

# Location history information in IHDS

## Household-level migration information

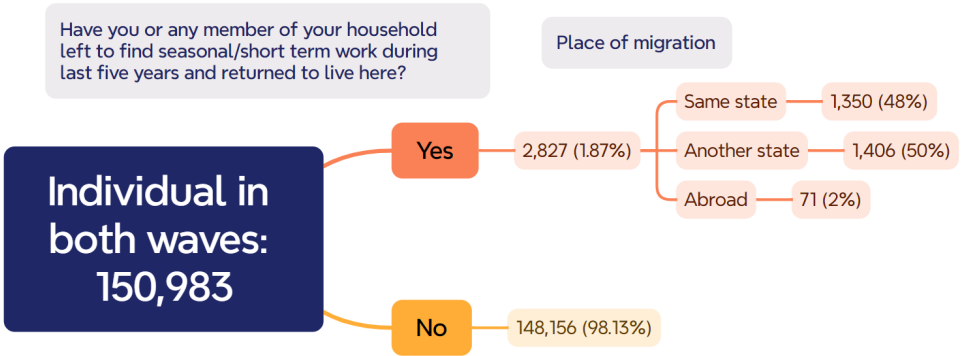
Both IHDS 1 and 2 ask about migration history for households



# Location history information in IHDS

## Individual-level migration information

Only IHDS 2 asks individuals about migration history in recent 5 years



# Sample overview

## Interviewed in 2011-2012

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| Female | 0.51 | 0.50 | 0 | 1 | 59,066 |
| Age | 29.26 | 6.24 | 20 | 40 | 59,066 |
| Interview year | 2011.88 | 0.32 | 2011 | 2012 | 59,066 |
| | | | **Women** | | |
| Years of education (never=0) | 6.36 | 5.10 | 0 | 15 | 30,273 |
| Upper primary school completed | 0.53 | 0.50 | 0 | 1 | 30,273 |
| Have or had long-term disease | 0.08 | 0.27 | 0 | 1 | 30,304 |
| Worker with any job | 0.47 | 0.50 | 0 | 1 | 30,304 |
| Salary worker paid monthly or annually | 0.06 | 0.24 | 0 | 1 | 30,304 |
| | | | **Men** | | |
| Years of education (never=0) | 8.23 | 4.56 | 0 | 15 | 28,704 |
| Upper primary school completed | 0.70 | 0.46 | 0 | 1 | 28,704 |
| Have or had long-term disease | 0.05 | 0.21 | 0 | 1 | 28,762 |
| Worker with any job | 0.87 | 0.33 | 0 | 1 | 28,762 |
| Salary worker paid monthly or annually | 0.21 | 0.40 | 0 | 1 | 28,762 |

| | Deaths | Affected | Deaths per 1 mi pop | Affected per 100 pop |
|---|---|---|---|---|
| 0.1 | 15 | 82 | 0 | 0 |
| 0.2 | 25 | 779 | 0 | 0 |
| 0.3 | 37 | 5,005 | 1 | 0 |
| 0.4 | 50 | 20,000 | 1 | 0 |
| 0.5 | 74 | 50,000 | 2 | 0 |
| 0.6 | 100 | 200,000 | 3 | 0 |
| 0.7 | 161 | 572,680 | 5 | 1 |
| 0.8 | 250 | 2,460,000 | 9 | 4 |
| 0.85 | 386 | 4,045,036 | 16 | 7 |
| 0.9 | 669 | 9,836,500 | 41 | 13 |
| 0.95 | 1,196 | 24,810,000 | 108 | 37 |
| 0.96 | 1,454 | 29,496,127 | 123 | 46 |
| 0.97 | 1,756 | 32,849,040 | 227 | 77 |
| 0.98 | 2,938 | 39,280,000 | 390 | 96 |
| 0.99 | 9,710 | 123,240,000 | 682 | 100 |
| 1 | 20,005 | 300,000,000 | 2,558 | 100 |

Table 5: Quantile distribution of disasters in terms of human impacts

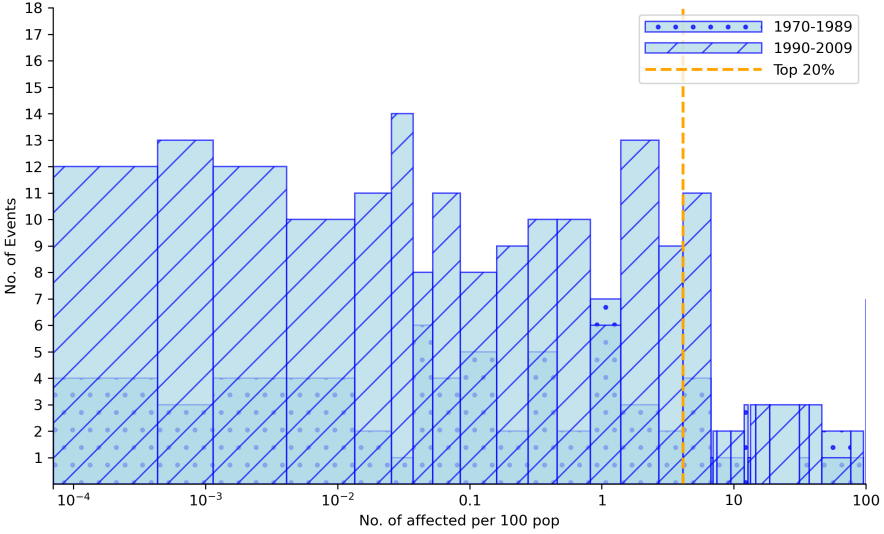



Figure 6: Distribution of disaster events by severity

- Aggregate # of severe events for district over 10-year window

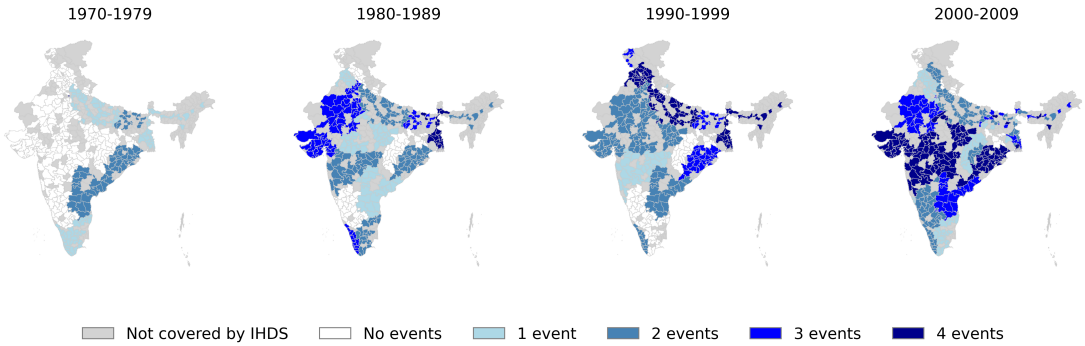



Figure 7: # of severe disasters in India

# Sample overview by gender

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| | | | **Women** | | |
| Age | 29.25 | 6.26 | 20 | 40 | 30,304 |
| Interview year | 2011.88 | 0.32 | 2011 | 2012 | 30,304 |
| Interview month | 5.75 | 2.99 | 1 | 12 | 30,304 |
| Birth year | 1982.63 | 6.26 | 1971 | 1992 | 30,304 |
| Hindu upper caste | 0.20 | 0.40 | 0 | 1 | 30,298 |
| Hindu marginalized caste | 0.64 | 0.48 | 0 | 1 | 30,298 |
| Muslim | 0.14 | 0.35 | 0 | 1 | 30,298 |
| | | | **Men** | | |
| Age | 29.26 | 6.22 | 20 | 40 | 28,762 |
| Interview year | 2011.89 | 0.32 | 2011 | 2012 | 28,762 |
| Interview month | 5.78 | 2.96 | 1 | 12 | 28,762 |
| Birth year | 1982.63 | 6.23 | 1971 | 1992 | 28,762 |
| Hindu upper caste | 0.20 | 0.40 | 0 | 1 | 28,755 |
| Hindu marginalized caste | 0.64 | 0.48 | 0 | 1 | 28,755 |
| Muslim | 0.14 | 0.35 | 0 | 1 | 28,755 |

# Educational and health outcomes

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| | | | **Women** | | |
| Ever attended school | 0.70 | 0.46 | 0 | 1 | 30,274 |
| Years of education (never=0) | 6.36 | 5.10 | 0 | 15 | 30,273 |
| Lower primary school completed | 0.64 | 0.48 | 0 | 1 | 30,273 |
| Upper primary school completed | 0.53 | 0.50 | 0 | 1 | 30,273 |
| Have or had long-term disease | 0.08 | 0.27 | 0 | 1 | 30,304 |
| Sick in last mo. (diarrhea, fever, cough) | 0.16 | 0.36 | 0 | 1 | 30,304 |
| | | | **Men** | | |
| Ever attended school | 0.87 | 0.34 | 0 | 1 | 28,715 |
| Years of education (never=0) | 8.23 | 4.56 | 0 | 15 | 28,704 |
| Lower primary school completed | 0.80 | 0.40 | 0 | 1 | 28,704 |
| Upper primary school completed | 0.70 | 0.46 | 0 | 1 | 28,704 |
| Have or had long-term disease | 0.05 | 0.21 | 0 | 1 | 28,762 |
| Sick in last mo. (diarrhea, fever, cough) | 0.09 | 0.29 | 0 | 1 | 28,762 |

# Labor outcomes

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| | | | **Women** | | |
| Worker with any job | 0.47 | 0.50 | 0 | 1 | 30,304 |
| Salary worker paid monthly or annually | 0.06 | 0.24 | 0 | 1 | 30,304 |
| Full-time worker with any job | 0.08 | 0.26 | 0 | 1 | 30,304 |
| Full-time salary worker paid monthly or annually | 0.03 | 0.18 | 0 | 1 | 30,304 |
| | | | **Men** | | |
| Worker with any job | 0.87 | 0.33 | 0 | 1 | 28,762 |
| Salary worker paid monthly or annually | 0.21 | 0.40 | 0 | 1 | 28,762 |
| Full-time worker with any job | 0.43 | 0.50 | 0 | 1 | 28,762 |
| Full-time salary worker paid monthly or annually | 0.16 | 0.37 | 0 | 1 | 28,762 |

# Summary statistics on disaster exposures

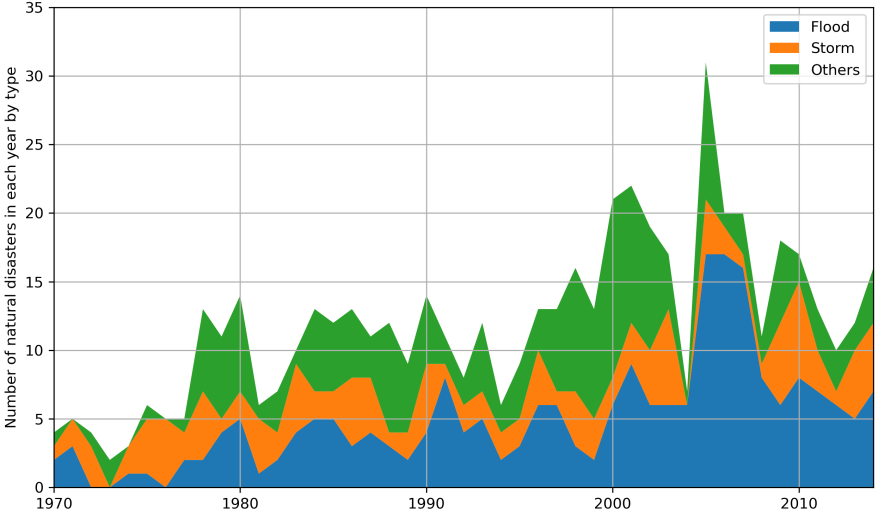
- 38% of individuals are exposed to severe disasters in early-life
- 27% are exposed to 1 disaster; 9% are exposed to 2 disasters
- For individuals exposed, average # of disasters exposed to is 1.33

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| **# of severe disasters exposed** | | | | |
| Early-life | 0.51 | 0.74 | 0 | 4 |
| In utero | 0.11 | 0.32 | 0 | 2 |
| Birth year | 0.13 | 0.34 | 0 | 2 |
| Age 1 | 0.13 | 0.34 | 0 | 2 |
| Age 2 | 0.14 | 0.35 | 0 | 2 |

# Summary statistics on disaster exposures by gender

| | Mean | SD | Min | Max | N |
|---|---|---|---|---|---|
| | | | **Women** | | |
| **No. of severe disasters** | | | | | |
| Early-life | 0.51 | 0.73 | 0 | 4 | 30,304 |
| In utero | 0.11 | 0.32 | 0 | 2 | 30,304 |
| Birth year | 0.13 | 0.34 | 0 | 2 | 30,304 |
| Age 1 | 0.13 | 0.34 | 0 | 2 | 30,304 |
| Age 2 | 0.14 | 0.35 | 0 | 2 | 30,304 |
| | | | **Men** | | |
| **No. of severe disasters** | | | | | |
| Early-life | 0.51 | 0.75 | 0 | 4 | 28,762 |
| In utero | 0.11 | 0.32 | 0 | 2 | 28,762 |
| Birth year | 0.13 | 0.34 | 0 | 2 | 28,762 |
| Age 1 | 0.13 | 0.34 | 0 | 2 | 28,762 |
| Age 2 | 0.14 | 0.35 | 0 | 2 | 28,762 |

# Heterogeneity by types of disasters



| Disasters | # of Events | 1st quartile | Mean | 3st quartile | SD |
|---|---|---|---|---|---|
| **Flood** | 205 | | | | |
| Deaths | | 30 | 276 | 225 | 612 |
| Affected | | 15,000 | 4,857,821 | 3,000,000 | 12,979,584 |
| **Storm** | 117 | | | | |
| Deaths | | 23 | 448 | 117 | 1,901 |
| Affected | | 2,000 | 1,197,424 | 485,910 | 2,882,593 |
| **Epidemic** | 53 | | | | |
| Deaths | | 46 | 298 | 296 | 578 |
| Affected | | 205 | 11,095 | 5,642 | 28,942 |
| **Extreme temperature** | 42 | | | | |
| Deaths | | 82 | 285 | 275 | 443 |
| Affected | | 25 | 25 | 25 | 0 |
| **Mass movement (wet)** | 35 | | | | |
| Deaths | | 26 | 87 | 87 | 96 |
| Affected | | 92 | 239,945 | 8,850 | 662,277 |
| **Earthquake** | 16 | | | | |
| Deaths | | 23 | 3,313 | 1,404 | 6,564 |
| Affected | | 5,712 | 1,900,127 | 526,547 | 5,257,667 |

Table 6: Disaster characteristics 1970-2013

# Effects of any disasters on education and health

| | (1) Ever educated | (2) Years of education | (3) Complete low primary sch | (4) Complete upper primary sch | (5) Long-term disease | (6) Short-term sickness |
|---|---|---|---|---|---|---|
| | | | **All individuals** | | | |
| Early-life shock | -0.002* | -0.009 | -0.002 | -0.001 | 0.001 | -0.000 |
| | (0.001) | (0.015) | (0.001) | (0.001) | (0.001) | (0.001) |
| | | | **Women** | | | |
| Early-life shock | -0.002 | -0.007 | -0.002 | -0.002 | 0.000 | -0.001 |
| | (0.002) | (0.019) | (0.002) | (0.002) | (0.001) | (0.002) |
| | | | **Men** | | | |
| Early-life shock | -0.003* | -0.007 | -0.002 | 0.000 | 0.000 | 0.001 |
| | (0.001) | (0.021) | (0.002) | (0.002) | (0.001) | (0.001) |

# Effects of any disasters on labor force participation

| | (1) Worker with any job | (2) Salary worker | (3) Full-time worker with any job | (4) Full-time salary worker |
|---|---|---|---|---|
| | | **Women** | | |
| Early-life shock | -0.001 | 0.001 | -0.001 | -0.000 |
| | (0.002) | (0.001) | (0.001) | (0.001) |
| Mean | 0.47 | 0.06 | 0.08 | 0.03 |
| | | **Men** | | |
| Early-life shock | -0.005*** | -0.000 | -0.001 | -0.002 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Mean | 0.87 | 0.21 | 0.43 | 0.16 |

# Non-linear effects on education and health

| | (1) Ever educated | (2) Years of education | (3) Complete low primary sch | (4) Complete upper primary sch | (5) Long-term disease | (6) Short-term sickness |
|---|---|---|---|---|---|---|
| | | | **Women** | | | |
| Dummy: exposed to 1 disaster | 0.008 | -0.161** | 0.002 | -0.006 | -0.006 | -0.011* |
| | (0.007) | (0.075) | (0.007) | (0.007) | (0.004) | (0.006) |
| Dummy: exposed to 2 disasters | 0.002 | -0.187* | -0.007 | -0.016 | -0.015*** | -0.010 |
| | (0.010) | (0.104) | (0.011) | (0.011) | (0.006) | (0.008) |
| Dummy: exposed to 3+ disasters | -0.042* | -0.672*** | -0.042* | -0.075*** | -0.009 | -0.016 |
| | (0.024) | (0.226) | (0.024) | (0.020) | (0.014) | (0.018) |
| | | | **Men** | | | |
| Dummy: exposed to 1 disaster | -0.012** | -0.221*** | -0.015** | -0.011 | -0.000 | -0.006 |
| | (0.006) | (0.077) | (0.007) | (0.008) | (0.003) | (0.004) |
| Dummy: exposed to 2 disasters | -0.008 | -0.281** | -0.015 | -0.005 | -0.002 | 0.002 |
| | (0.008) | (0.113) | (0.010) | (0.011) | (0.005) | (0.006) |
| Dummy: exposed to 3+ disasters | -0.024 | -0.480 | -0.037 | -0.034 | -0.005 | 0.000 |
| | (0.017) | (0.294) | (0.025) | (0.027) | (0.008) | (0.016) |

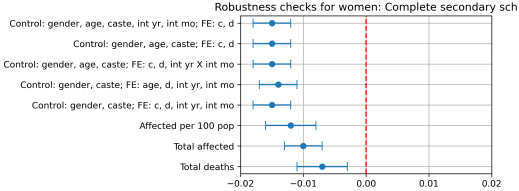
# Non-linear effects on labor force participation

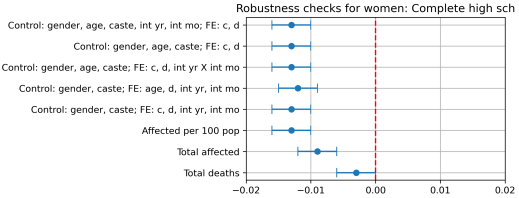
| | (1) Worker with any job | (2) Salary worker | (3) Full-time worker with any job | (4) Full-time salary worker |
|---|---|---|---|---|
| | | **Women** | | |
| Dummy: exposed to 1 disaster | 0.016** | -0.002 | 0.004 | -0.004 |
| | (0.008) | (0.004) | (0.004) | (0.003) |
| Dummy: exposed to 2 disasters | 0.016 | 0.004 | 0.003 | -0.002 |
| | (0.011) | (0.006) | (0.006) | (0.004) |
| Dummy: exposed to 3+ disasters | 0.067*** | 0.021 | 0.033** | 0.011 |
| | (0.025) | (0.014) | (0.013) | (0.012) |
| Mean | 0.47 | 0.06 | 0.08 | 0.03 |
| | | **Men** | | |
| Dummy: exposed to 1 disaster | 0.017** | -0.014** | -0.005 | -0.012* |
| | (0.007) | (0.007) | (0.008) | (0.007) |
| Dummy: exposed to 2 disasters | 0.001 | -0.028** | -0.008 | -0.030*** |
| | (0.009) | (0.011) | (0.013) | (0.010) |
| Dummy: exposed to 3+ disasters | -0.028 | -0.028 | -0.029 | -0.021 |
| | (0.024) | (0.026) | (0.028) | (0.025) |
| Mean | 0.87 | 0.21 | 0.43 | 0.16 |

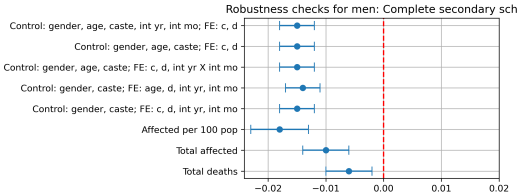
# Control for spousal characteristics, men

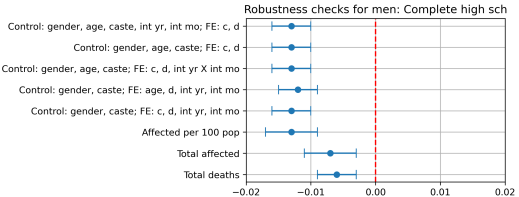
| | (1) Worker with any job | (2) Salary worker | (3) Full-time worker with any job | (4) Full-time salary worker |
|---|---|---|---|---|
| Dummy: exposed to 1 disaster | -0.002 | -0.017** | -0.017* | -0.016** |
| | (0.005) | (0.009) | (0.010) | (0.007) |
| Dummy: exposed to 2 disaster | 0.002 | -0.021* | -0.001 | -0.025** |
| | (0.007) | (0.012) | (0.015) | (0.011) |
| Dummy: exposed to 3+ disaster | -0.023 | -0.001 | 0.019 | 0.005 |
| | (0.021) | (0.029) | (0.040) | (0.028) |
| Spouse year of edu | -0.002*** | 0.015*** | 0.006*** | 0.014*** |
| | (0.000) | (0.001) | (0.001) | (0.001) |
| Spouse work for anything | 0.036*** | -0.054*** | -0.062*** | -0.057*** |
| | (0.005) | (0.009) | (0.012) | (0.008) |
| Spouse income 2nd quartile | -0.001 | 0.034*** | 0.008 | 0.034*** |
| | (0.007) | (0.010) | (0.015) | (0.010) |
| Spouse income 3rd quartile | -0.003 | 0.007 | 0.033** | 0.021* |
| | (0.007) | (0.013) | (0.017) | (0.012) |
| Spouse income 4th quartile | -0.043*** | 0.018 | 0.041* | 0.037** |
| | (0.012) | (0.019) | (0.024) | (0.018) |
| Mean | 0.87 | 0.21 | 0.43 | 0.16 |
| Observations | 18492 | 18492 | 18492 | 18492 |

# Robustness checks: women/men, education

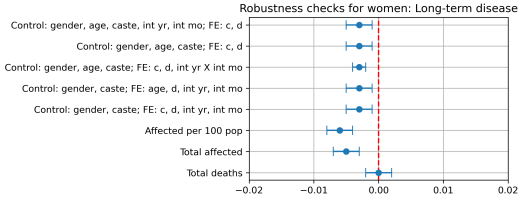


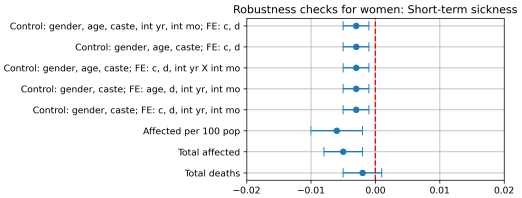



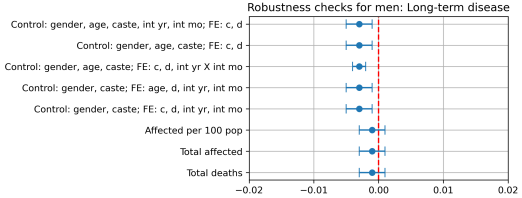



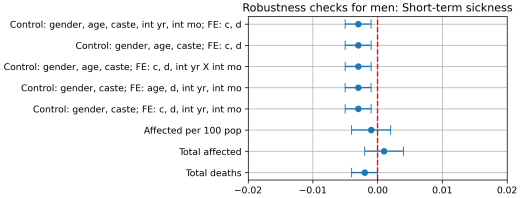



# Robustness checks: women/men, health



# Robustness checks: women/men, labor force participation