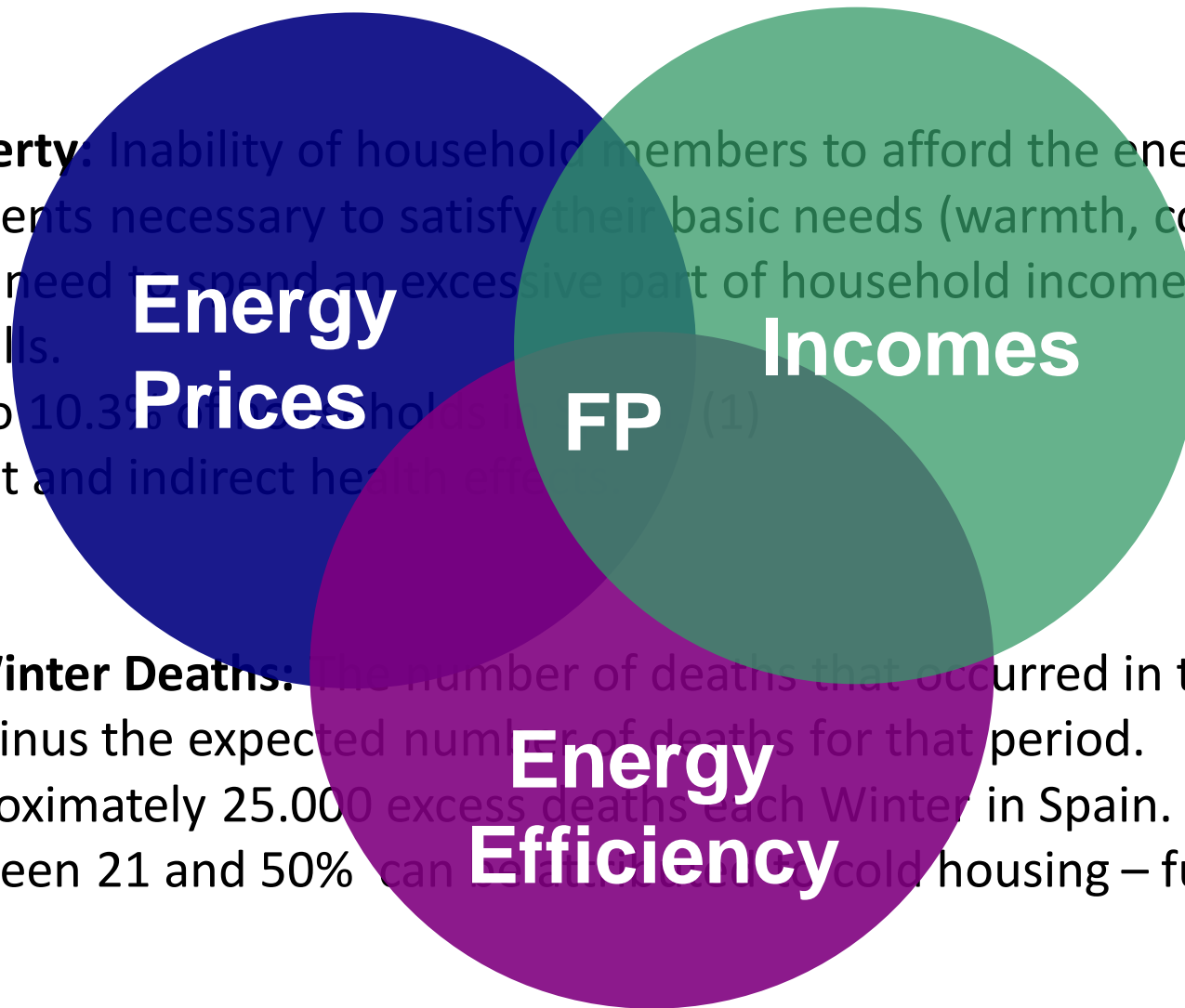


Impact of three decades of energy efficiency interventions in public housing buildings on cold-related mortality: a case-crossover analysis

Andrés Peralta, Lluís Camprubí, Maica Rodríguez-Sanz, Xavier Basagaña, Carme Borrell, Marc Marí-Dell'Olmo



Background



- **Fuel Poverty:** Inability of household members to afford the energy requirements necessary to satisfy their basic needs (warmth, cooking, etc.) or as the need to spend an excessive part of household income to pay for energy bills.
 - 7.1 to 10.3% of households
 - Direct and indirect health effects
- **Excess Winter Deaths:** the number of deaths that occurred in the winter period minus the expected number of deaths for that period.
 - Approximately 25.000 excess deaths each Winter in Spain. (2)
 - Between 21 and 50% can be attributed to cold housing – fuel poverty.




1. Thomson H, et al. Housing improvements for health and associated socio-economic outcomes. Cochrane database Syst Rev [Internet]. 2013 Jan; 2:CD008657.
2. Capdevila I, Linares E, Folch R. Eficiencia energética en la rehabilitación de edificios. Guías técnicas de energía y medio ambiente [Internet]. Barcelona, Spain; 2012.



Data SJO, NOAA, U.S. Navy, NGA, GEBCO
 Image © 2015 Institut Cartogràfic de Catalunya
 Image © 2015 TerraMetrics

Google earth

 2004

Fecha de las imágenes: 5/10/2012 41°24'08.41" N 2°10'10.15" E elev. 40 m alt. ojo 10.45 km 

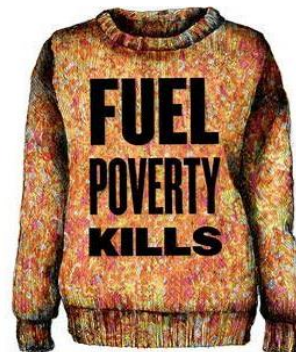
Objectives

- **General**

- Evaluate the impact of the EEFR interventions on the association between cold outdoor temperatures and mortality from neoplasms, circulatory system and respiratory system diseases from 1986 to 2012.

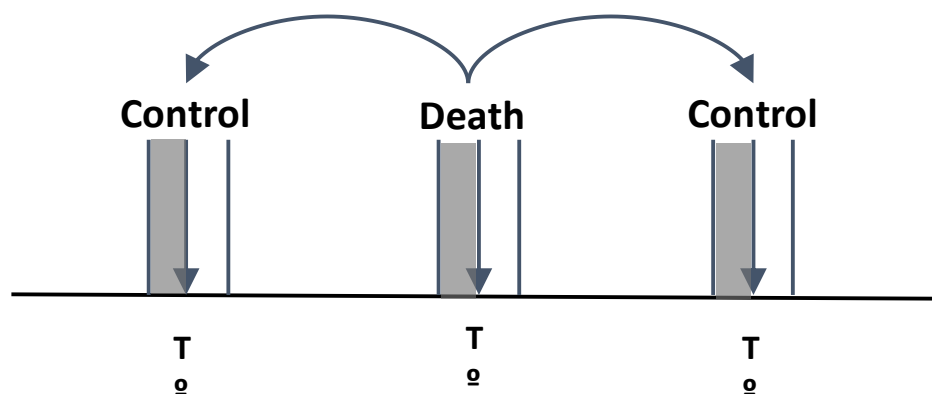
- **Specific**

- Evaluate the impacts by sex, age and educational level
- Estimate the number of deaths avoided by these interventions.



Methods – Case-Crossover Design

- Similar to a paired case – control design, but each case – in other time frames – is used as its own control. Useful to evaluate brief and changing exposures that modify the risk of an acute health event.
 - **Exposure:** Temperature
 - **Outcome:** Death



- Control periods can be selected bidirectionally - minimizes biases due to temporal trends in the exposures, seasonality and day of the week

Methods – Information Sources and Variables

- Minimal Daily **temperatures** in the city were obtained from 1986 to 2012 (www.ecad.eu).
 - Cold months (October to march)
 - **Extremely cold** days (lower 5%)
 - Day of death and 20 previous days (Lag 0 – Lag 20)
- Barcelona's **mortality** register was used to identify all deaths from the selected causes that occurred in the studied blocks.
 - During the cold months (October to march)
 - Death in the city

Methods – Information Sources and Variables

- **Interventions**

- Historical contract registry of Catalonia's Housing Agency (Agència de l'Habitatge de Catalunya).
- A building was considered intervened 6 months after the start date found in the registry.
- Results stratified by:
 - **Sex**
 - **Educational level:** Since 1992.
 - **No Studies:** No formal education.
 - **With Studies:** incomplete primary, primary, secondary and university education.
 - **Age:**
 - Less than 70 years.
 - 70 – 79 years.
 - 80 or more years.

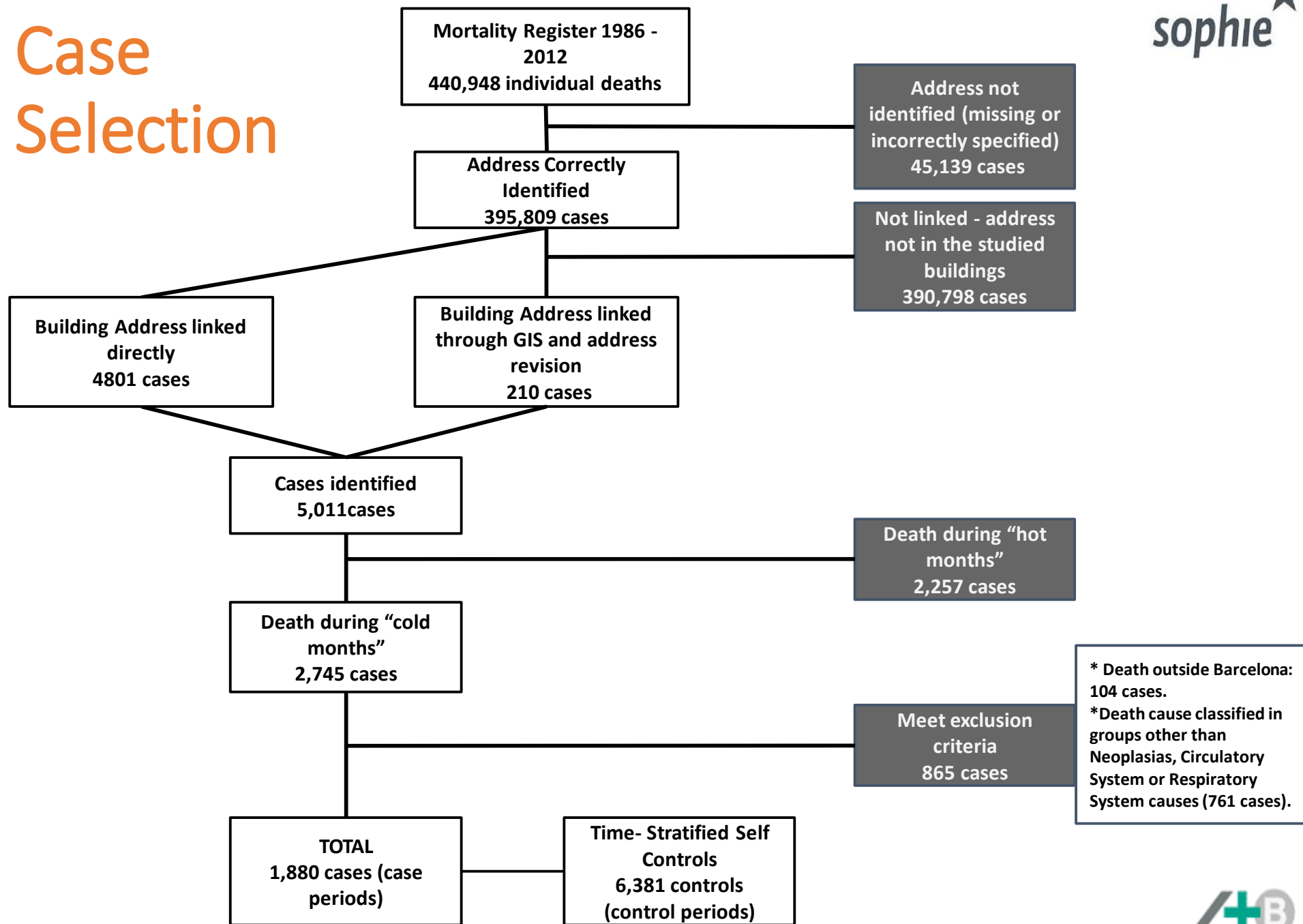
Methods – Statistical Analysis

- Controls (self - controls) were selected by time stratification
 - Same day of the week, month and year.
- **Conditional logistic regression models** were fitted to analyse the relationship between mortality and cold temperatures.
 - Temperatures for the day of death and the 20 previous days (Lag 0 – Lag 20)
- The **interaction between temperatures and the intervention status** was added to the models to analyse the effect of interventions on the death – cold temperature associations.
- Initially stratified by sex
 - Also stratified analyses by educational level and age groups.
- Finally, the preventive fractions and number of potential deaths avoided by the interventions were estimated.

RESULTS

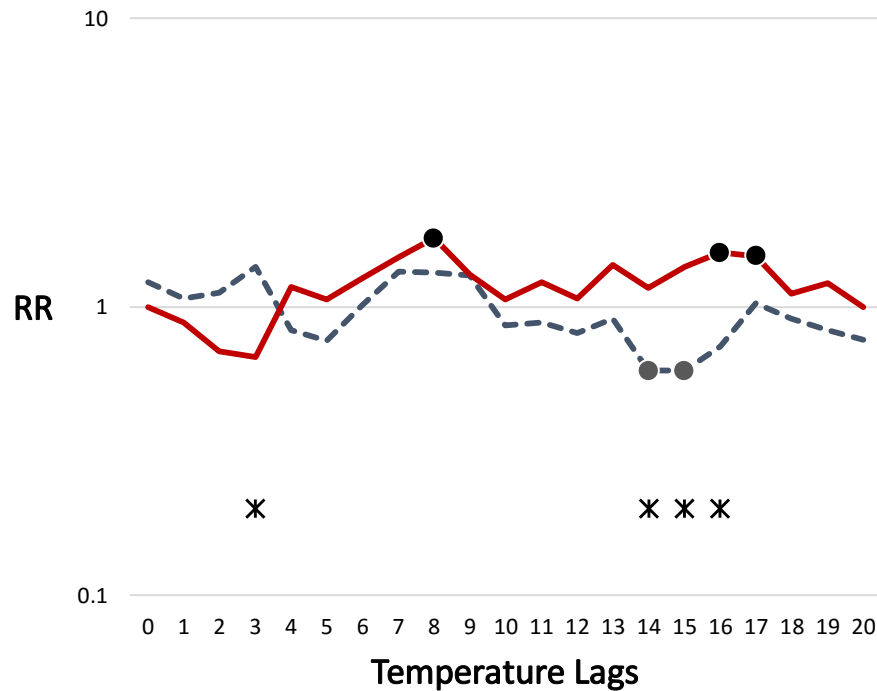


Case Selection

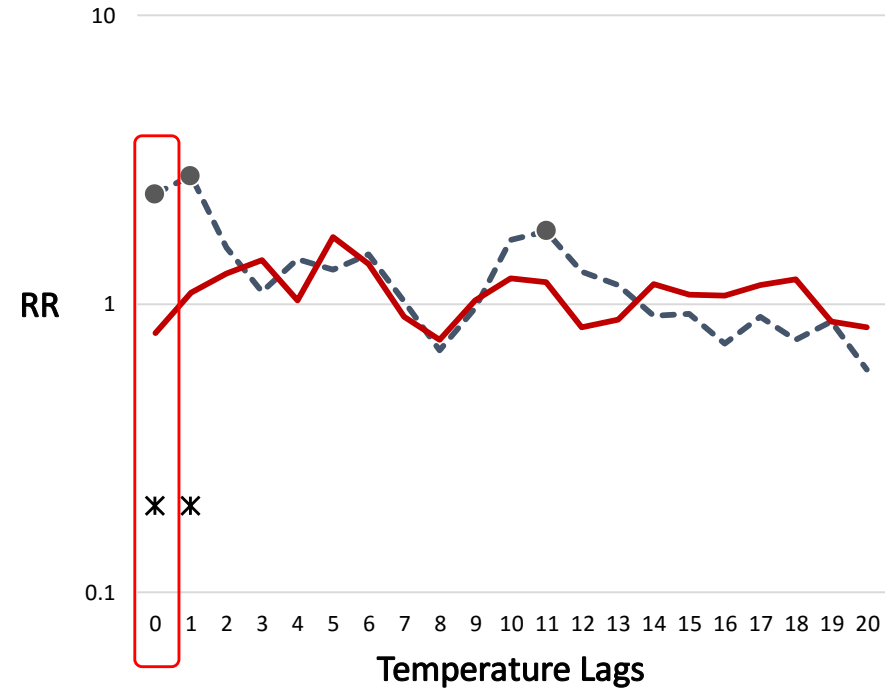


RR of death in extremely cold days in the Intervened and Non-Intervened groups

Men – Three Causes



Women – Three Causes

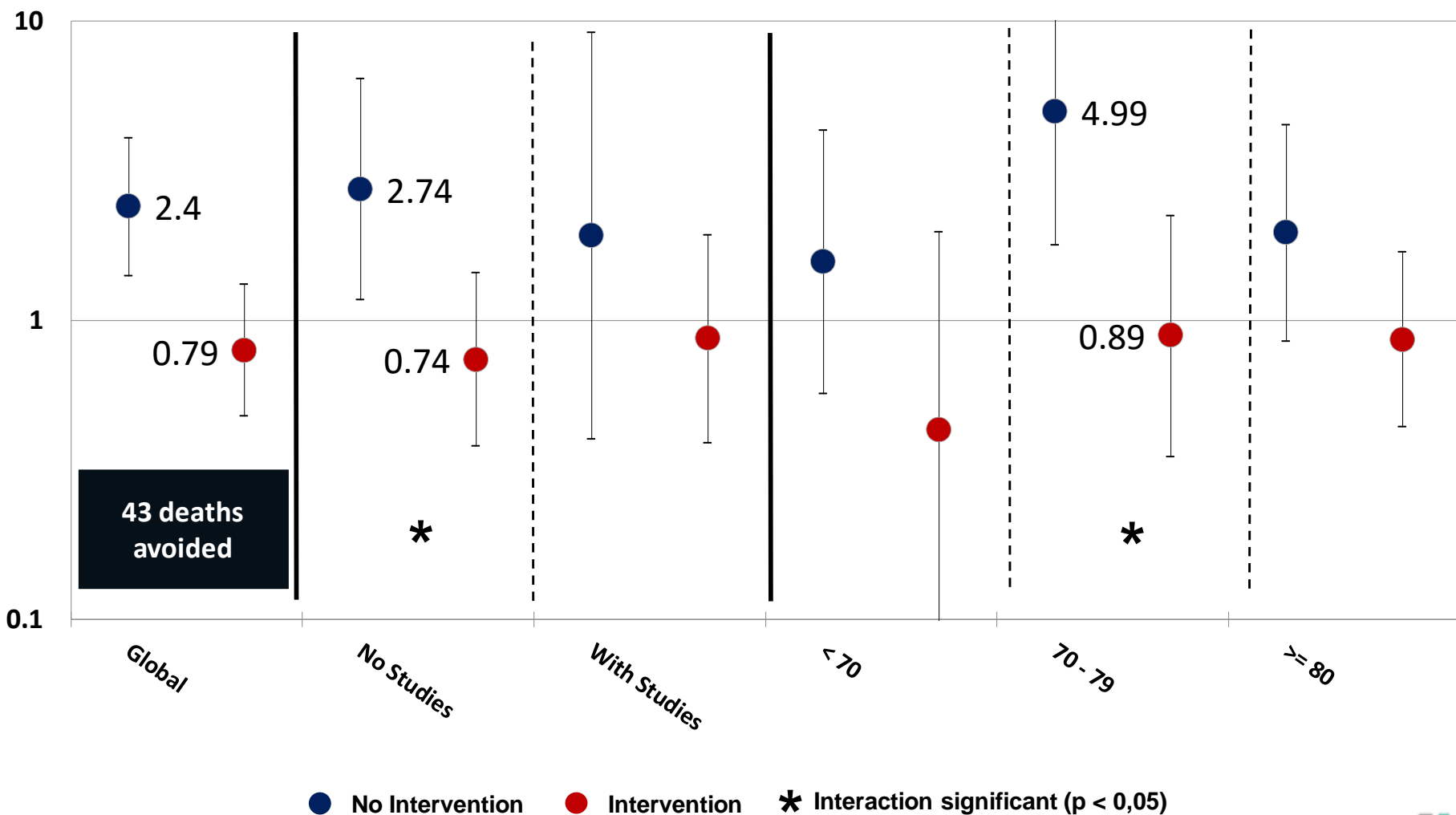


----- No Intervention — Intervention

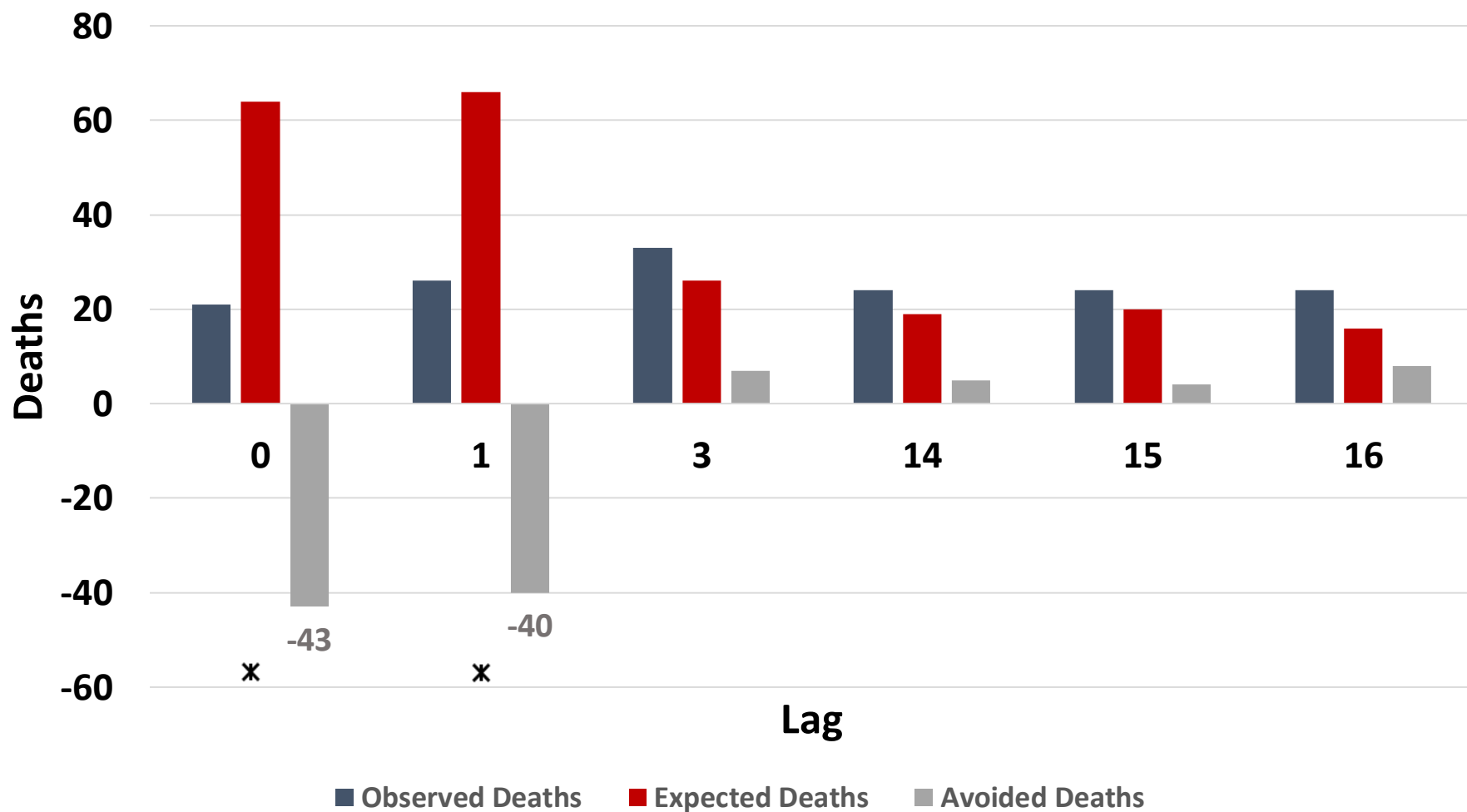
● Significant association between extreme cold and death

✱ Intervention modifies the extreme cold – death association significantly

RR of Death in Extremely Cold Days in Intervened and Non Intervened Women – Lag 0

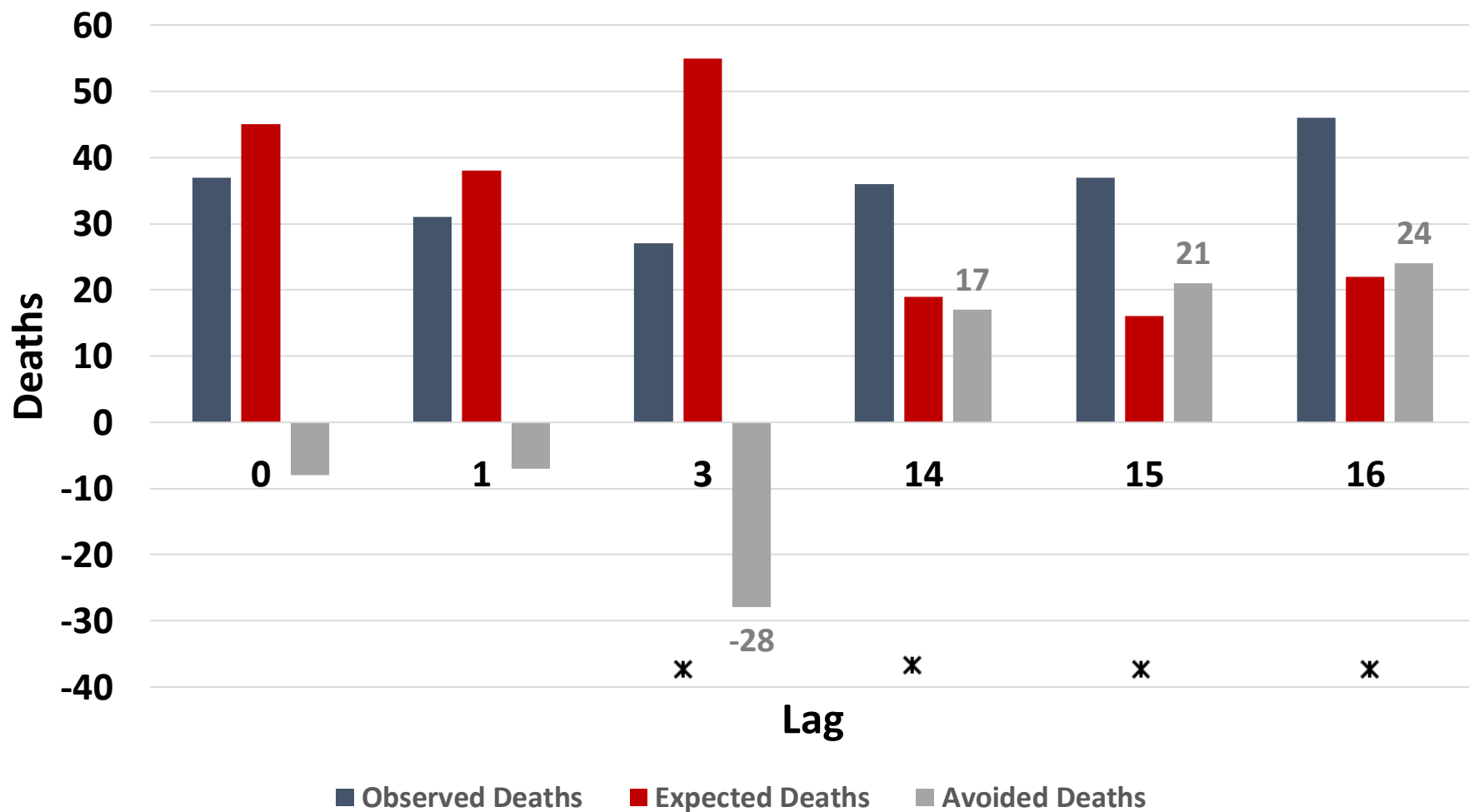


Deaths Avoided - Women



* Intervention modifies the extreme cold – death association significantly

Deaths Avoided - Men



* Intervention modifies the extreme cold – death association significantly

Discussion

- **First evaluation of the impact of energy efficiency interventions on cold – related mortality.**
 - Impacts different among sex, age and educational level groups.
 - In women, a high percentage of the deaths associated with extreme cold could have been avoided by the interventions.
- Investing in EEFR interventions can have positive impacts on health.
 - Specially in women.
 - Adverse effects should be monitored and studied – specially in men.
- More research needed in order to assess other potential long term health impacts of the interventions (morbidity, determinants etc.).
 - Know how to prioritize funds.
 - Which groups should receive interventions first?

Strengths and Limitations

- **Strengths**

- “Natural Experiment”
- Design controls individual characteristics and stational and temporal variations in exposures.
- Analysis by educational level.

- **Limitations**

- Information source change - Adresses.
- Interventions carried out for almost 30 years.

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