

# IS THERE SYNERGY IN THE TEMPERATURE AND AIR POLLUTION EFFECTS ON HEALTH? RESULTS FROM THE CIRCE PROJECT IN 10 MEDITERRANEAN CITIES

**Antonis Analitis**, *Department of Hygiene, Epidemiology and Medical Statistics, Medical School, University of Athens, Greece*

**Klea Katsouyanni**, *Department of Hygiene, Epidemiology and Medical Statistics, Medical School, University of Athens, Greece*

**Paola Michelozzi**, *Lazio Region Department of Epidemiology, Rome, Italy*

**Daniela D'Ippoliti**, *Lazio Region Department of Epidemiology, Rome, Italy*

**Francesca de'Donato**, *Lazio Region Department of Epidemiology, Rome, Italy*

**Michela Leone**, *Lazio Region Department of Epidemiology, Rome, Italy*

**Tanja Wolf**, *WHO Regional Office for Europe, Climate change, green health services and sustainable development, Rome, Italy*

**Bettina Menne**, *WHO Regional Office for Europe, Climate change, green health services and sustainable development, Rome, Italy*

**Background and Aims:** Climate, meteorology as well as air pollution are known to affect health. There is accumulating evidence for synergy between temperature and air pollution. Within the framework of the CIRCE project (Climate Change and Impact Research: the Mediterranean Environment) we studied the joint effects of apparent temperature and air pollution on mortality.

**Methods:** Mortality, meteorological and air-pollution data from 10 cities around the Mediterranean were available (Athens, Bari, Barcelona, Istanbul, Lisbon, Palermo, Rome, Tel Aviv, Tunis and Valencia). We used GEE models to estimate the confounding and synergistic effects between temperature and air-pollution on total natural and cause-specific mortality. The effect of apparent temperature on mortality was estimated before and after adjustment for air-pollution. To investigate possible synergy we included interaction terms between each pollutant, alternatively and apparent temperature.

**Results:** The effect of temperature on mortality was consistently smaller when we adjusted for air-pollution. The largest difference was observed when we controlled for PM<sub>10</sub> which resulted in a reduction of about 15% in the temperature effect estimate. We observed a higher temperature effect in days with higher PM<sub>10</sub> and ozone concentrations. The synergistic effect was significant in the elderly. Specifically, in a day with low PM<sub>10</sub> levels (25<sup>th</sup> percentile of the PM<sub>10</sub> distribution) the increase in mortality associated with an increase of 1°C in temperature was 2.37% (95%CI: 1.15-3.60) whilst the increase in days with high PM<sub>10</sub> levels (75<sup>th</sup> percentile) was 3.02% (95%CI: 1.71-4.35). The increase in mortality associated with an increase of 1°C in low and high ozone days was 3.56% (95%CI: 2.36-4.78) and 4.03% (95%CI: 2.65-5.43), respectively.

**Conclusions:** There is evidence for a synergistic effect between PM<sub>10</sub>, ozone and high temperature on mortality. Adjustment for particles should be applied in the estimation of the effect of temperature on mortality.