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Short-term departures from an optimum ambient temperature are associated with increased risk of out-of-hospital cardiac arrest

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ABSTRACT

Background: Associations have been reported between daily ambient temperature and all-cause and cardiovascular mortality. However, the potential harmful effect of temperature on out-of-hospital cardiac arrest (OHCA) is insufficiently studied.
Objectives: The objective of this study was to investigate the short-term association between ambient temperature and the occurrence of OHCA.
Methods: In 5961 cases of OHCAs treated by Emergency Medical Service occurring in Stockholm County we investigated the association between the preceding 24-h and 1 h mean ambient temperature, obtained from a fixed monitoring station, and OHCA using a time-stratified case-crossover design.
Results: We observed a V-shaped relationship between preceding mean 24-h and 1-h ambient temperature and the occurrence of OHCAs. For mean 24-h temperature we observed an odds ratio (OR) of 1.05 (1.00–1.11) for each 5 °C below the optimum temperature and 1.05 (0.96–1.18) for each 5 °C above the optimum. We observed similar results for 1-h mean temperature exposure. Results for temperatures above the optimum temperature showed evidence of confounding by ozone.
Conclusion: Ambient temperature below an optimum temperature was associated with increased risk of OHCA in Stockholm. Temperature above an optimum temperature was not significantly associated with OHCA.

1. Introduction1

The yearly number of EMS-treated Out-of-hospital cardiac arrest (OHCAs) in the US (Mozaffarian et al., 2015) and in Europe (Atwood et al., 2005) have been estimated to 320,000 and 275,000 OHCAs respectively, with very high death rates. Coupled with a universal exposure to changes in temperature and a changing climate, understanding the relationship between temperature and OHCA is of great public health interest.

Exposure to ambient temperature has demonstrated a U- or V-shaped association with daily all-cause mortality, i.e. mortality increases with departures from a most favorable temperature (Curriero et al., 2002; Baccini et al., 2008; Group, 1997; Barnett et al., 2012). This optimum ambient temperature have been shown to vary substantially between different regions (Gasparrini et al., 2015) and has been estimated to be 12–18 °C in Stockholm, Sweden (Gasparrini et al., 2015; Rocklov and Forsberg, 2008). The difference in optimum ambient temperature between regions may reflect several factors, including different building standards, air conditioning, central heating and physical adaptation (Curriero et al., 2002; Baccini et al., 2008). The association between ambient temperature and cardiovascular disease (CVD) mortality has shown a similar pattern (Group, 1997; Cheng and Su, 2010; Medina-Ramon

Abbreviations: OHCA, Out-of-hospital cardiac arrest; CVD, Cardiovascular disease; MI, Myocardial infarction; PM, Particulate matter; EMS, Emergency Medical Service.

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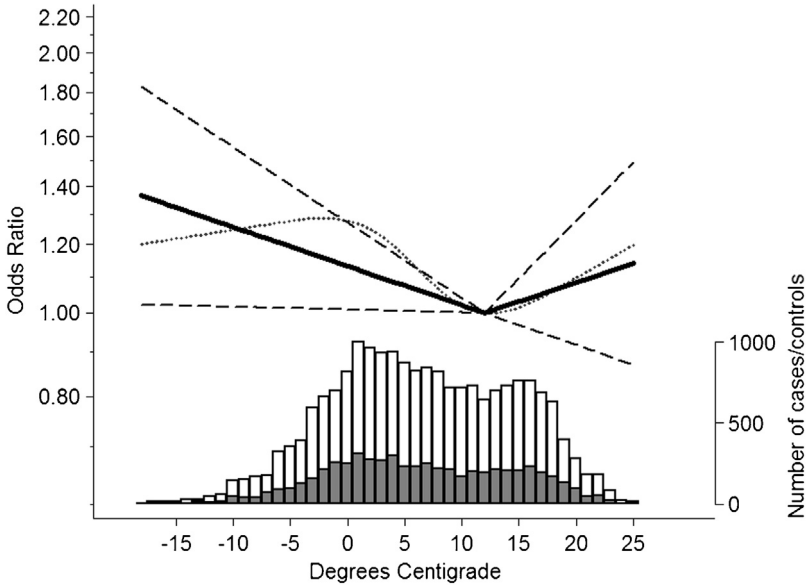

Fig. 1. Association of preceding 24-h mean ambient temperature and OHCA. Restricted cubic spline model (dot) with four knots, piece-wise linear spline model (solid), with one knot set at 12 °C including confidence intervals (dash). The value of 12 °C was used as referent for the spline models. All estimates were obtained with a conditional logistic regression model. The odd ratio on left axis is plotted on the log-scale and the histogram describing the distribution of out-of-hospital cardiac arrests cases (grey) and controls (white) by 24-h mean ambient temperature.

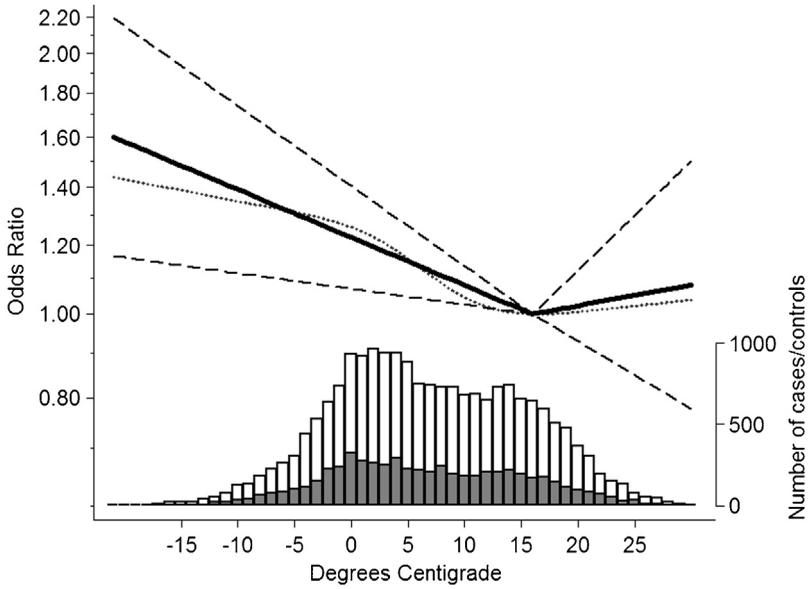

Fig. 2. Association of preceding 1-h mean ambient temperature and OHCA. Restricted cubic spline model (dot) with four knots, piece-wise linear spline model (solid), with one knot set at 16 °C including confidence intervals (dash). The value of 16 °C was used as referent for the spline models. All estimates were obtained with a conditional logistic regression model. The odd ratio on left axis is plotted on the log-scale and the histogram describing the distribution of out-of-hospital cardiac arrests cases (grey) and controls (white) by 1-h mean ambient temperature.

and Schwartz, 2007). Furthermore, studies have reported an association between colder temperature and myocardial infarction (MI) mortality (Bhaskaran et al., 2009, 2010; Wolf et al., 2009; Barnett et al., 2005).

There are a few time-series studies investigating the relationship between ambient temperature and (OHCA) or sudden cardiac death that have suggested an association between temperature and OHCA (Nishiyama et al., 2011; Kvaløy and Skogvoll, 2007; Gerber et al., 2006; Dai et al., 2015; Chen et al., 2014). One large case-crossover study examined the association between temperature all-cause mortality including cardiac arrest mortality in 50 US cities. The study reported increased cardiac arrest mortality at temperatures below a temperature optimum the day before the event, with stronger associations on extreme temperature days. No association was found for temperatures above the optimum temperature (Medina-Ramon and Schwartz, 2007).

Previous studies regarding ambient temperature and OHCA have estimated time of cardiac arrest within a 24-h interval rather than within minutes and have not investigated the possible effect modifying effect of particulate matter (PM) and ozone.

The objective of this study was to investigate the association between ambient temperature and the occurrence of OHCA using

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