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Hot weather and suicide: a real risk or statistical illusion?

Page *et al* (2007) reported an association between increased risk of suicide and hot weather. We believe it is important that this finding is compared with similar associations reported in other countries and under similar conditions, particularly for countries with hotter climates but also for those moving through a period of climatic change.

We are a little disappointed that despite the authors' excellent statistical analyses and effective display of results, they determined the shape of their natural cubic splines 'visually' instead of using some model selection criterion, for example likelihood ratio tests, Akaike's information criterion (AIC), etc. Page *et al* also stated that Yip *et al* (2000) 'failed to show any significant seasonality with recent UK data'. This may not be entirely accurate as we believe that Yip *et al* (2000) showed a decreasing seasonal pattern but not that the pattern had vanished.

The 'unexpected' reduction in suicide during the heatwave of 2003 reported by Page *et al* is difficult to explain on the basis of temperature alone, particularly as there was a 13.5–33% increase in general mortality during the 2003 heatwave (Kovats *et al*, 2006). It is clear that the association of increased mortality with high temperature is not specific to suicide. Hajat *et al* (2002) reported an almost identical increase in all-cause mortality of 3.34% (95% CI 2.47–4.23) for every 1°C increase in mean temperature above 18°C compared with the 3.8% increase in suicide reported by Page *et al*. This raises the possibility of an unaccounted confounder linking suicide, total mortality and daily mean temperature above 18°C. Such factors include climatic and non-climatic factors, whether acting independently or as interaction terms, for example number of sunshine hours (Salib & Gray, 1997), relative humidity, rainfall, unusual weather conditions, stress resulting in changes in the hypothalamic–pituitary–adrenal axis or even changes in the solar wind as measured by satellites (Richardson *et al*, 1994). Chronomics of suicides (Halberg *et al*, 2005) which do not rely on calendar year but on periodicity of solar wind (Richardson *et al*, 1994) may provide a plausible and alternative explanation to the findings of Page *et al*.

Perhaps the only conclusion that can be drawn from reading Page *et al*'s paper is that high temperature may be associated with increased all-cause mortality. Given the very similar rate of increase in all-cause mortality and in suicide, the mechanism by which high temperature affects the rate of suicide should not be expected to differ from that operating for other causes of death.

Although high daily mean temperature may increase suicide risk, this is not an independent risk factor and may not have the implications for public health policy in relation to global warming that Page *et al* indicated.

Hajat, S., Kovats, R. S., Atkinson, R. W., et al (2002) Impact of hot temperatures on death in London: a time series approach. *Journal of Epidemiology and Community Health*, **56**, 367–372.

Halberg, F., Cornélissen, G., Panksepp, J., et al (2005) Chronomics of autism and suicide. *Biomedicine and Pharmacotherapy*, **59** (suppl. 1), S100–S108.

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Page, L. A., Hajat, S. & Kovats, R. S. (2007) Relationship between daily suicide counts and temperature in England and Wales. *British Journal of Psychiatry*, **191**, 106–112.

Richardson, J. D., Paularena, K. I., Belcher, J., et al (1994) Solar wind oscillation with 1.3 pear period. *Geographical Research Letters*, **21**, 1559–1560.

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Yip, P. S. F., Chao, A. & Chiu, C. W. F. (2000) Seasonal variation in suicides: diminished or vanished. Experience from England and Wales, 1982–1996. *British Journal of Psychiatry*, **177**, 366–369.

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Authors' reply: We agree that our findings need to be replicated in other populations and climates. Salib *et al* may have misinterpreted our analysis of suicides during the 2003 heatwave, as our finding of −1.8% (95%CI −17.8 to 18.4) change in suicides from expected is consistent with no change rather than a reduction. We discuss reasons for this lack of effect and point out that the lack of power in this calculation leads to an imprecise estimate.

We disagree with Salib *et al*'s assertion that the effect of high temperature on all-cause mortality (rather than suicide specifically) is a reasonable explanation for our findings. We only examined deaths from suicide and undetermined intent, so it is not possible for other causes of death to have 'confounded' our results. We considered carefully which confounders to include in our models. Individual-level confounders, for example the effect of individual stress on the hypothalamic–pituitary–adrenal axis, are irrelevant in a time-series analysis as they do not vary day to day across a population. Sunshine hours were sufficiently accounted for by including a term for hours of daylight. We think it unlikely that any of the other potential confounders mentioned by Salib *et al* could be sufficiently associated with both temperature and suicide to explain our findings. Also, humidity, rainfall and unusual weather conditions (e.g. thunderstorms) tend to vary regionally more than temperature, meaning that exposure misclassification would be a problem in a countrywide analysis. The role of solar winds in the aetiology of suicide is highly speculative.

Higher temperatures affect mortality through a range of mechanisms (Bouchama & Knochel, 2002). Cardiovascular and respiratory deaths during periods of high temperature are caused by physiological changes, including increased coagulation,