Mortality in southern England during the 2003 heat wave by place of death

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More than 2000 deaths were attributed to the August 2003 heat wave in England and Wales. We analysed excess mortality in southern England during the heat wave by place of death. Excess mortality was 33 per cent in those aged 75 and over and 13.5 per cent in the under 75 age group during the 10 day heat wave. Among those aged 75 and over, deaths at home increased by 33 per cent and deaths in nursing homes increased by 42 per cent. Around one quarter of the heat wave attributable deaths occurred in care homes, but this is likely to be an underestimate as some residents may have been admitted to hospital before death. There is a need for further research to assess the risk of heat-related mortality in hospital in-patients and the residents of care homes in order to improve prevention strategies.

Introduction

England experienced a record-breaking heat wave in August 2003, especially in southern and eastern England, as a high pressure system brought prolonged sunshine and high day- and night-time temperatures.[1] Temperatures topped 30°C for 10 days in a row and exceeded 35°C in many places on the 6, 9 and 10 August. The highest absolute temperatures were observed in the south east, and particularly in London. High concentrations of air pollutants (particulates and tropospheric ozone) were also experienced during the episode.[2]

Previous studies have shown that 2,091 excess deaths have been attributed to the heat wave in England and Wales, which is a 17 per cent increase in total mortality during the period 4 to 13 August, as previously reported in *Health Statistics Quarterly*.[3] The excess mortality was greatest in the London region, and those aged 75 and over. There remain important questions about who is most at risk of dying in a heat wave and to what extent these deaths can be prevented.

In this article, we examined patterns of excess mortality by place of death for those regions most affected by the heat wave.

Methods

We extracted data from the mortality database held by the Office for National Statistics. We restricted analyses to deaths in the Government Office Regions for the South East, South West, East of England, and London. This is where the heat wave was greatest and where three-quarters of all total excess mortality in England and Wales occurred.[3] Place of death is recorded at death registration. We have analysed mortality using six broad categories of place of death: own home; general hospital; hospice; nursing home; residential home; and other (Annex 1).

The heat wave period was defined as 4-13 August 2003, in accordance with previous studies of this event.[3] The baseline (expected mortality) was derived from the average mortality by place of death over the years 1998-2002. Excess mortality was estimated as the difference between observed and expected mortality for each place of death category. Confidence intervals for the excess were calculated by assuming a Poisson distribution for the observed number of deaths.

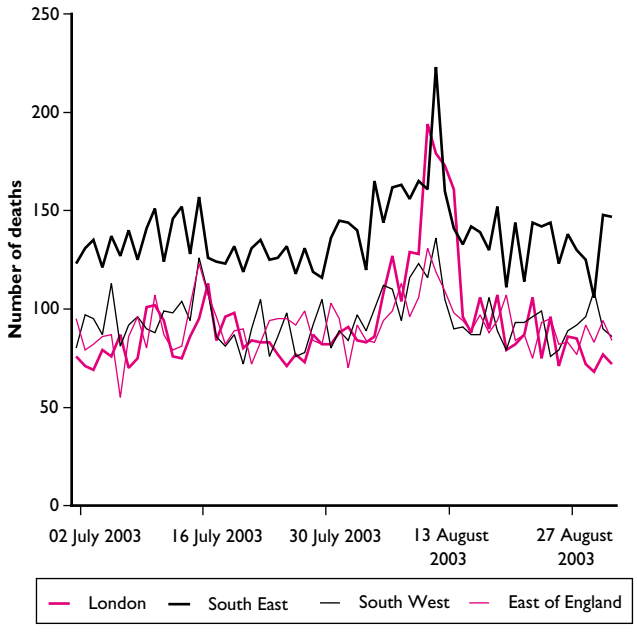
Results

The heat wave in 2003 was associated with a marked short-term increase in mortality in the elderly in the first two weeks of August (Figure 1). Table 1 shows the impact of the heat wave by place of death for two age groups. In the elderly (75 and over age group), the excess mortality as a proportional increase was fairly evenly distributed between deaths at home, deaths in hospital, and deaths in nursing or residential homes. The excess was greatest in nursing homes where deaths increased by 42 per cent during the heat wave, compared to an overall increase of 33 per cent.

There was greater disparity in the heat wave effect for mortality in the under-75 age group. An excess mortality of 72 per cent was observed in residential homes, although the confidence interval was wide due to the small number of deaths in this age group.

The greatest number of deaths attributable to the heat wave took place in hospital (n= 901, 56 per cent of the attributable deaths). Approximately 24 per cent (392/1,599) of the heat wave attributable deaths occurred in care homes. In contrast, very few heat wave related deaths took place in hospices. The distribution of excess mortality was similar, but not identical to the distribution of deaths in the baseline period of 1998–2002. Among under 75s more of the excess was distributed in residential and nursing homes and 'other places' than would have been expected from the distribution of deaths in the baseline period. Among those aged 75 and over more of the excess was distributed in general hospitals and nursing homes.

Figure 1 **Daily mortality in the 75 and over age group during summer 2003 in southern England,* by government office region**



* Deaths to residents of Government Office Regions for the South East, South West, East of England and London.

Table 1 **Increases in mortality during August 2003 heat wave in southern England,* compared to to expected summer mortality, by place of death and age group**

	Age under 75 years		Age 75 years and over	
	Percentage increase (95 per cent confidence interval)	Estimated number of excess deaths	Percentage increase (95 per cent confidence interval)	Estimated number of excess deaths
Own home	13.2 (4.3, 22.0)	73	33.2 (23.8, 42.7)	191
General Hospital	11.3 (5.3, 17.4)	134	36.5 (31.5, 41.5)	767
Hospice	8.6 (-6.4, 24.1)	16	0.2 (-17.1, 17.1)	0
Nursing Home	49.6 (15.5, 82.5)	25	42.2 (31.8, 52.4)	214
Residential Home	71.6 (17.0, 133.0)	15	28.8 (18.6, 39.0)	138
Other places	19.6 (-0.5, 40.2)	22	3.8 (0.7, 19.8)	5
Total	13.5 (9.0,18.2)	284	33.4 (29.8, 37.0)	1,315

* Deaths to residents of Government Office Regions for the South East, South West, East of England and London.

Discussion

Frail persons are more at risk of dying during a heat wave. Certain conditions, medications and impaired cognitive ability are also important determinants of heat-related illness and death.[4] The impact of the heat wave was greatest in the elderly, and this is consistent with reports from other heat waves and other populations.[5, 6] The impact in the non-elderly population (284 excess deaths) needs to be investigated further. High temperatures may represent additional stress in persons who are already very ill.

For heat wave deaths in the elderly, excess mortality was similar in deaths at home, deaths in hospital and deaths in care homes (nursing and residential), and no effect of the heat wave was apparent for deaths in 'other places' or deaths in hospices. Although case control studies have identified socially isolated individuals who live alone as at very high risk of heat wave mortality,[7] there is no information available in this study to assess whether or not deaths at home were mostly in people who live alone.

Our results show excess mortality for residents of nursing and residential homes during the heat wave in 2003, especially for non-elderly persons in residential care. There was no effect in hospices, however. Possible explanations for this may include more intensive patterns of care, the fact that many patients in hospices have cancer, which shows very little seasonality in mortality, or that hospices may be more likely to have air conditioning (see below). However, it is not possible from the data available in this study to assess the reasons behind this pattern.

In France, mortality in 'retirement homes' increased by 100 per cent during their more extreme August 2003 heat wave.[8] Similarly, mortality in nursing homes in northern Italy increased by 150 per cent, and increases in heat-related morbidity, as well as failures in care were reported. In 2003, nursing homes in France and Northern Italy were unlikely to have air conditioning.[9] In contrast, in the United States, most care homes are air conditioned and excess mortality during heat waves has been attributed to the failure or absence of air conditioning.[10, 11]

Ecological studies have found that the effects of high temperature on mortality are greater on 'out of hospital' deaths compared to 'in-hospital' deaths.[12, 13] Place of death is only an approximate indicator of where the person was living when the heat wave occurred. It is plausible that some care home residents, and people living in their own homes, were admitted to hospital during the heat wave and therefore the excess mortality is an under-estimation of the risk associated with long-stay

care in this country. Further, it is not possible to distinguish between deaths in hospital of inpatients and those that may have been emergency admissions due to heat stress or conditions exacerbated by heat stress. An increase in mortality in geriatric inpatients was reported during the 1976 and 1983 heat waves in England.[14, 15] A previous study has shown that hospital admissions only increase moderately at high temperatures, and this is largely confined to admissions of the elderly for respiratory conditions.[16] During August 2003, a 16 per cent increase in hospital admissions in those aged 75 and over in London was reported during the heat wave, but little excess was apparent in other regions or age groups.[3]

In conclusion, more research needs to be undertaken in order to identify individuals at high risk of heat related mortality. Our research has shown that prevention activities, as outlined in the Department of Health's Heat wave Plan for England,[17] should include vulnerable individuals at home as well as those in residential and nursing care.

Key findings

- Excess mortality in the elderly due to the heat wave was apparent in deaths at home, deaths in nursing and residential homes, and deaths in hospitals.
- After accounting for the usual pattern of mortality by place of death, a larger than expected proportion of the excess deaths in the elderly occurred in hospitals and nursing homes.
- In the non-elderly population, there was a large excess of mortality observed in nursing and residential homes, although the absolute numbers of deaths were small.

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Annex 1

How the place of death categories were derived

The place of death categories used in this analysis have been derived from two variables stored on the deaths database:

- **Communal establishment code:** Distinguishes between deaths in communal establishments (which are given a code specific to the institution name) and those at home or occurring elsewhere
- **Establishment type:** This classifies communal establishments into different types, of which there are 84 recorded on the deaths database.

Table A shows how the place of death categories used in this analysis were derived.

Table A **Derivation of place of death codes**

Place of death code	Communal Establishment code	Establishment type
Own home	Home	
General hospital		General hospital or Multi-function site
Hospice		Hospice
Nursing home		Homes for the chronic sick, Medical nursing home, Private nursing home or Private nursing home (aged)
Residential home		Residential home (private) or Residential home (local authority)
Other places	Elsewhere	All other codes