



## SECTION 2

### HOW DIFFERENT MEASURES OF COLD WEATHER AFFECT CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) HOSPITAL ADMISSIONS IN LONDON

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**WINNING ABSTRACT:** Many COPD sufferers find that their symptoms become worse during colder weather, which can lead to an exacerbation resulting in hospital admission. This study investigates different measures of cold, assessing which most strongly relate to COPD admissions and whether they can be used to forecast risk of exacerbation.

COPD admissions (ICD10 J40–J44) for the five Strategic Health Authorities (SHAs) in London and corresponding meteorological data were extracted for October–March 1997–2003. Correlations and regressions were used to compare the effects on admissions of:

- daily mean, maximum and minimum temperature;
- significant drops in temperature;
- weekly average maximum temperature;
- “cumulative cold”, summing the number of degrees the daily maximum temperature was below a threshold across a week;
- different windchill indices.

All measures of cold showed significant negative correlations with COPD admissions. Daily relationships were weaker than weekly ones ( $R = -0.19$ ,  $p < 0.001$  for daily maximum temperature,  $R = -0.36$ ,  $p < 0.001$  for weekly average maximum temperature) but are most significant with an 8-day lag. Windchill had the strongest correlation with one-week lag ( $R = -0.397$ ,  $p < 0.001$ ) accounting for 20% of the variation in admissions. “Cumulative cold” is also significant at  $p < 0.001$ , ranging from  $R = 0.28$  for a  $3^{\circ}\text{C}$  threshold to  $R = 0.36$  for  $18^{\circ}\text{C}$ .

Cold measures explain sufficient variation in COPD hospital admissions to be used in a forecast model of risk of exacerbation. The Met Office uses such a model in a health forecasting and anticipatory care service in England.



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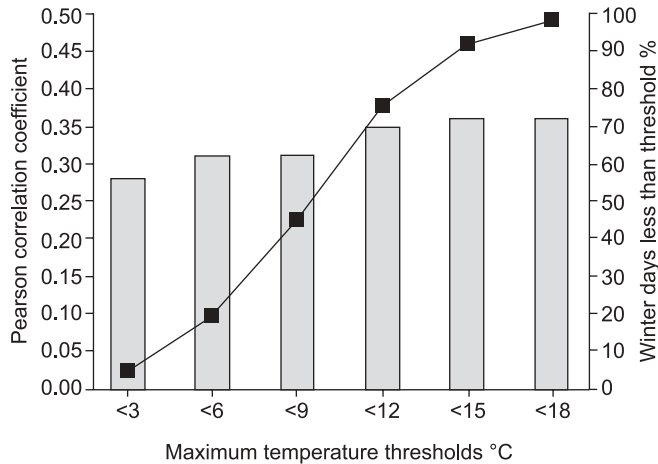
#### MY JOB AND THE UNIT IN WHICH I WORK

I work within the Health Forecasting team at the Met Office (Exeter), the UK's national meteorological service. The Met Office is perhaps best known for forecasting weather but is now considering forecasting the impacts of weather, as there have been clear links established between the weather and human health. The team was established in 1999, initially developing a “Forecasting the Nation's Health” project under

the Government's “Invest to Save” initiative. More detailed work into the links between weather and health identified a strong correlation with chronic obstructive pulmonary disease (COPD). COPD health forecasting targets anticipatory care can help reduce hospital admissions, and helps people with COPD improve their health and well-being during periods of greatest risk. The Met Office works closely with the National Health Service (NHS) to develop the health forecasting anticipatory care framework. We are also investigating other areas of health forecasting, such as: the links between thunderstorms and the occurrence of asthma; meteorological effects on mental health; and weather's possible modification of influenza transmission. Our work combines academic research, statistical analysis and service development.

#### MY WINNING POSTER AS PART OF MY RESEARCH

Part of my role is to continue to develop our COPD forecasting model. The model, developed initially by H.A. Watkins, W. Bird and M. Gibbs, combined a seasonal boosting factor, a cold contribution factor and a weighting factor for the amplitude in admissions identified over the Christmas and New Year period. This was derived from an initial analysis showing a clear seasonal pattern in COPD admissions, peaking in December/January, based on Hospital Episode Statistics for eight Strategic Health Authorities involved in the pilot study. The effects of cold on the symptoms of COPD are well known:



**FIGURE 1.** ■: Pearson correlation coefficient R; ■: days less than the threshold (%) with correlation values of weekly cumulative cold values.

for example, increases in general practitioner consultations for respiratory infections occur if the temperature drops below 5°C [1]; both the cooling of facial skin and direct airway effects are thought to cause bronchoconstriction in patients with COPD [2]; and, as the human thermoregulatory system becomes less effective with age, older people are less able to maintain a core body temperature in cold weather [3, 4]. The COPD model includes a cumulative cold index, calculated by taking the daily maximum temperature over the preceding 7 days and summing the number of degrees below a threshold temperature. My investigations into different measures of cold are intended both to understand more clearly the correlations between cold weather and COPD admissions, and to update the COPD model, if applicable, with the most appropriate cold measure. As well as the effects of different measures of temperature, lag periods and threshold values, different wind chill indices, and the combined effects of cold and wind were also analysed. Investigations are informed through consultation with our expert COPD Advisory Group and through patient questionnaires, which are administered as part of the evaluation of the COPD service, in which people are asked about the effects of different weather elements on their symptoms.

#### MY RESEARCH AS PART OF MY WORKING GROUP/ RESEARCH TEAM

Improving the COPD forecast model allows a more accurate forecast of risk of admission for healthcare providers and patients themselves. Depending on the forecast, different

intervention measures can be taken for patients with varying degrees of risk, based on the UK's National Institute for Health and Clinical Excellence (NICE) guidelines. The service is provided at Primary Care Trust level on a twice-weekly basis between October and March. The overall team is led by Dr Tish Laing-Morton, with the health research team headed by Clare Bryden. Much of our work is in collaboration with universities and the NHS but we are exploring partnerships to investigate potential service internationally.

We work closely with users in the NHS, both directly and *via* service developers, to understand the needs and feasibility of providing interventions, whilst also assessing whether the health outcome of interest is forecastable. We take a multi-disciplinary approach, using our strengths in analysis, modelling, forecasting, round-the-clock service provision, climate change, dispersion modelling and clinical knowledge. There are many parallels between weather forecasting and health forecasting, including balancing scientific rigour with a clear, accessible message for the public.

Further information on the team and its work is available at [www.metoffice.gov.uk/health](http://www.metoffice.gov.uk/health).

#### THE IMPACT OF MY WORK ON CLINICAL OR RESEARCH PRACTICE

This research has further established the relationship between cold weather and COPD hospital admissions. It also demonstrates that people are more vulnerable if cold weather lasts for a week or more. It provides additional evidence for an intervention to ensure that those suffering from COPD take appropriate steps to minimise the effects of cold and reduce the risk of an exacerbation. The ability to forecast risk of admission based on a model including cold is therefore valuable in the management of COPD care.

#### REFERENCES

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