PHASE

Public health Adaptation Strategies to extreme weather events

SCIENTIFIC SUMMARY for Public health.

Health effects of Cold

What is known on the health effects of cold

Cold weather may adversely affect human health, with both indoor temperatures and outdoor weather conditions having an impact on health. Mortality displays a seasonal pattern, with highest values during winter. The higher number of winter deaths depends on temperatures, the level of disease (especially influenza) in the population and other factors. Low temperatures have been associated with short-term increases in mortality in a linear way. Effects seem to be smaller and more prolonged (up to two or three weeks) than for heat and with the greatest impact on respiratory causes. In Europe deaths due to hyperthermia are a small proportion of winter deaths. Falls and injuries increase in winter due to snow, ice and heavy rainfall.

Few multi-city studies from Europe and the US are available and have documented a geographical variability in the impact of cold on mortality, with a greater effect in populations residing in warmer regions. The Eurowinter study was the first European study to show that cold is also a risk factor in warmer climates especially when people are unprepared, have inadequate clothing habits and insufficient household heating.

Similarly, the PHEWE project conducted on 15 European cities for the period 1990-2000 provided new evidence on the effects of cold on mortality and hospital admissions for cardiovascular and respiratory diseases, among the elderly and adults. The greatest impact was in milder Mediterranean cities where local populations are less acclimatized to cold weather conditions.

This greater susceptibility is in part explained by the inadequate indoor conditions in countries with milder winter climates, i.e. lack of adequate insulation or heating. In winter, people spend more time indoors with less exchange of air and in overcrowded environments favoring the spreading of infections and the increase in respiratory infectious diseases. Cardiovascular diseases contribute substantially to cold-related mortality, particularly due to ischemic and cerebrovascular events that occur immediately or within a week of the onset of the cold weather.

Subgroups of the population most at risk

Cold-related health effects are far from simple to explain and risk factors include socio-demographic, economic and health conditions as well as housing characteristics.

Subgroups at risk in winter due to cold and extreme weather events include subjects with impaired thermoregulatory responses, such as very young children, the elderly and people with specific diseases or under specific pharmacological treatment.

People with chronic cardiovascular or respiratory diseases, exposed to low temperatures may trigger disease exacerbations. Cold-related vasoconstriction causes a series of changes in blood pressure, blood clotting and cardiac workload that suddenly precipitate coronary events The same mechanism of impairment of respiratory mucociliary function through which cold exposure triggers respiratory infections, may also increase susceptibility to air pollutants as the clearance of pollutants from the airways inhibited. Cerebrovascular events are delayed by some days after cold exposure while respiratory events occur up to two-three weeks after the event due to the different underlying mechanisms.

Socioeconomic conditions play a major role in cold-vulnerability. Specifically, economic factors as well as housing characteristics and heating efficiency are determinants of cold effects. Scarce housing insulation is an important risk factor of cold-related effects in milder countries where building material and heating systems are less efficient. In colder climates, fuel poverty is a risk factor for cold-related health effects.

Lifestyle factors, as the level of physical activity, alcohol consumption, wearing less protective clothing, may also contribute to the risk of cold-related risks.

Table 1. Susceptibility factors to cold and strength of the evidence from scientific literature

Susceptibility factor	Susceptible subgroup	Strenght of evidence
Age	Children (age 0-4)	+
	Elderly (65+) and very elderly	+++
Gender	Women	++
Socioeconomic status	Low-income, low education level	++
	Living alone	+
Health condition	Cardiovascular disease (e.g.coronary attacks, stroke)	+++
	Respiratory disease (e.g.respiratory infections, asthma exacerbations)	+++
	Diabetes mellitus	+
	Mental disease	+
	Neurological disease	+
	Renal disease	+
Pharmacological treatment	People assuming sedatives, anxiolytics, phenothiazines, and tricyclic antidepressants	+++
Environmental conditions	lack of insulation, scarce heating efficiency, air pollution,	+
Other risk factors	Lifestyle factors (e.g.alcohol, physical activity, dressing habits), outdoor occupation (e.g.agriculture, fishing)	++

What the PHASE project has contributed (results from case studies and work carried out in PHASE)

A time series study on the effect of cold and variations in the effect of low temperatures was carried out in PHASE in 9 European cities (Athens, Barcelona, Budapest, Helsinki, London, Paris, Rome, Stockholm, Valencia) by age, cardiovascular and respiratory causes in a 20 year period (1990-2010).

Results confirm a linear relationship between cold and mortality, with smaller estimates compared to heat. The effect of low temperatures on mortality was more prolonged up to 20 days. Effects are more contained in colder cities that are more acclimatized compared with Mediterranean cities which are less not prepared to cope with cold spells.

The temporal variation in the 20-year period was smaller compared to that shown for heat and observed mainly among the very old (75-84, 85+) population. Analyses by respiratory and cardiovascular causes showed a reduction in cardiovascular disease in Barcelona and an increase in Paris; while for respiratory disease a reduction was observed in Budapest, Barcelona, Athens especially among the elderly.

A variation in the persistency in the effect of cold was observed in most cities between the two periods; in Athens, Budapest, Paris and Stockholm the effect is shorter in recent years while in Rome and Barcelona the effect is more delayed.

Interesting to note that in the warmer cities where an increase in the effect for cold temperatures was observed, extreme winter temperatures have become colder thus making populations in these areas more at risk to weather conditions they are not typically acclimatized to.

Considering climate change scenarios predict more variable and extreme conditions also in winter, public health measures for cold plans should be introduced in the warmer regions of Europe.

Implications for Public health (key public health messages for your EWE)

Key public health messages for cold include:

- The effects of cold and cold spells on health are significant and represent an avoidable burden especially among some vulnerable subgroups.
- Even if climate change scenarios predict a general warming, sudden extreme events (snow storms, heavy rainfall and cold spells) are likely to increase and preparedness is crucial.
- Communication campaigns are a key tool for both the public, front line responders and health care services to increase awareness on risks and help response and adaptation
- Cold plans should include specific measures in the energy and housing sectors to address the problem of inadequate indoor heating during winter especially for most vulnerable groups
- Public health attention should be focused on specific actions to reduce the health effects among susceptible subgroups especially the elderly, subjects with chronic illnesses, young children, socially isolated and economically disadvantaged individuals.

- Research should focus on identifying susceptible subgroups, finding the best outcome indicators to estimate the effects (eg. Children: ER visits, GP visits; chronic disease patients: medical prescriptions, hospital admissions etc)
- Cold warning systems should be implemented also were cold weather is less common (Southern European) but where cold spells have greater impact
- The temporal variation in the effects due to adaptation (introduction of prevention plans) and changes in the pool of vulnerable people should be considered.
- Policies to lower air pollution levels should be considered during cold spells, to reduce the synergistic effect on health of these environmental stressors
- Adequate planning and a multi-sectorial approach is required to effectively minimize the health effects of cold.

Preparedness and response tools necessary to define a Prevention Plan

A cold prevention plan should include:

- A Cold Warning system based on the temperature-mortality relationship, and not only on temperature thresholds, where possible
- A Communication campaign to raise awareness before the start of the cold season and during severe cold spells on the health risk associated to cold weather. An effective communication strategy addressed to the different stakeholders should be identified to provide relevant, timely, accessible and coherent information on risks, available prevention measures and social/health care services.
- The identification of susceptible subgroups to whom public health prevention measures and good practice should be targeted.
- "Good practice" interventions have to be identified considering the most appropriate for the specific target subgroups and on the basis of available local resources and infrastructures. Sustainability and cost-effectiveness of interventions should be the guiding principle for decision-making.
- The promotion of influenza and pneumococcal vaccination in certain at-risk groups.
- The implementation of cold help lines
- A Surveillance systems to monitor the impact of cold spells on health outcomes
- The planning interventions in the energy and transport sectors to avoid interruptions during cold emergencies and allow civil protection measures at local level
- Medium and long-term city planning especially towards the improvement of heating and indoor conditions of the building stock (improved thermal performance of building envelope, switching to low-carbon heating systems, improved natural ventilation and prevention of dampness).

References and hyperlinks to published results:

- Analitis A, Katsouyanni K, Biggeri A, et al. Effects of cold weather on mortality: results from 15 European cities within the PHEWE project. Am J Epidemiol. 2008 Dec 15;168(12):1397-408.
- Bone A, Wookey R, Austyn K. (eds) The Cold Weather Plan for England 2013: Protecting health and reducing harm from cold weather. Public Health England, London 2013
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- Laaidi K., Economopoulou A. , Wagner V., Pascal M., Empereur-Bissonnet P., Verrier, A., Beaudeau P. Cold spells and health: Prevention and warning. Public Health, 2013. 127(5): 492-499.
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