



## The big chill: diseases exacerbated by exposure to cold

Caralee E. Caplan, MD

It is well known that in all except equatorial regions, the death rate increases in winter. However, it is estimated that only about 1% of cold-related excess deaths are due to hypothermia.<sup>1</sup> Although no one is immune to the effects of hypothermia, frostbite and seasonal, infections and injuries, people with certain conditions are at special risk for exacerbations or complications of their diseases when exposed to cold winter air. In most of these conditions, the underlying mechanism is believed to be primarily vascular, but the precise pathophysiology remains poorly understood.

Raynaud's disease is a classic, if relatively benign, example. On exposure to cold, intense vasospasm of the small arteries and arterioles causes the digits of the hands and feet to undergo a triphasic colour change — from white (ischemic) to blue (cyanotic) and finally red (hyperemic) — usually accompanied by paresthesias or pain. Occurring largely in young healthy women with no organic arterial lesions, the condition is believed to represent an exaggeration of the normal vasomotor response to cold or emotion. Its occurrence in patients with migraines and variant angina has suggested a common predisposing cause for vasospasm.<sup>2</sup> In Raynaud's phenomenon, arterial narrowing occurs secondary to scleroderma, lupus or other systemic diseases, and patients are more likely to suffer long-term sequelae, including chronic skin and nail changes and muscle atrophy. In some patients, Raynaud's phenomenon may be due to chronic cold agglutinin disease, characterized by clotting and hemolysis in tissues exposed to cold and chronic hemolytic anemia exacerbated by low temperatures.<sup>1,2</sup>

Most asthmatic patients know the hazards of breathing cold air, particularly during exercise. Post-exertional obstruction increases at higher levels of exertion and when the inspired air is cold and dry. Winter activities like ice hockey, skating and cross-country skiing are thus more likely to induce asthma attacks than activities of similar intensity performed in warm environments.<sup>2</sup> Although smooth-muscle contraction and mucus accumulation may be involved, many experts have hypothesized a role for the bronchial vasculature. Nonetheless, the precise mechanism of the cold-induced changes — vascular engorgement, osmotic effects with mediator release or a "Raynaud's phenomenon of the lung" involving pulmonary vasoconstriction and reactive hyperemia — continues to be hotly debated.<sup>3-5</sup>

About half of cold-related excess deaths are due to coronary and cerebral thrombosis.<sup>1</sup> British data suggest that the rate of acute myocardial infarction is higher in winter and at lower temperatures,<sup>6</sup> peaks in deaths from this cause occurring about

24 hours after cold days.<sup>1</sup> Most excess thrombotic deaths appear to be due to brief outdoor exposure rather than to prolonged exposure in inadequately heated homes.<sup>1</sup> Thus, although seasonal patterns in respiratory infections and in behavioural and humoral factors may play a role, what occurs acutely on exposure to the cold appears important.<sup>7</sup> It is believed that normal physiologic responses occurring rapidly on exposure to cold — increases in erythrocyte count, platelet count, blood viscosity, plasma cholesterol and fibrinogen, platelet aggregation and sympathetic tone — result in an increase in the risk of thrombosis and in myocardial oxygen demand.<sup>1,6,7</sup> Furthermore, patients with underlying coronary artery disease are thought to be more prone to coronary artery spasm in response to cold.<sup>8</sup> These hemostatic and circulatory changes, particularly when superimposed on exertion, may explain why patients frequently present to emergency departments with myocardial infarction after shovelling snow and why deaths from coronary thrombosis increase after heavy snowfalls.<sup>2,7</sup>

The best prevention is, of course, avoidance. Patients with Raynaud's disease should wear mittens or gloves and should also protect the trunk and head with warm clothing to prevent cold-induced reflex vasoconstriction.<sup>2</sup> Asthmatic patients who do not wish to forego all winter sports should be made aware of the potential for attacks and should have access to inhaled bronchodilators at all times during these activities. Finally, physicians should advise patients with known coronary artery disease to avoid unnecessary exposure to cold air, particularly when they engage in exertional activities. During such activities, a light face mask can help to maintain a favourable air temperature and humidity.<sup>8,9</sup>

Dr. Caplan is CMAJ's Editorial Fellow.

### References

1. Keatinge WR. Cold, drowning, and seasonal mortality. In: Weatherall DJ, Ledingham JG, Warrell DA, editors. *Oxford textbook of medicine*. 3rd ed. Oxford (UK): Oxford University Press; 1996. p. 1182-5.
2. Isselbacher KJ, Braunwald E, Wilson JD, Martin JB, Fauci AS, Kasper DL. *Harrison's principles of internal medicine*. 13th ed. New York: McGraw-Hill; 1994. p. 1138-40, 1169.
3. McFadden ER Jr. Hypothesis: exercise-induced asthma as a vascular phenomenon. *Lancet* 1990;335:880-3.
4. Giesbrecht GG, Younes M. Exercise- and cold-induced asthma. *Can J Appl Physiol* 1995;20(3):300-14.
5. Regnard J. Cold and the airways. *Int J Sports Med* 1992;13(Suppl 1):S182-4.
6. Marchant B, Ranjadayalan K, Stevenson R, Wilkinson P, Timmis AD. Circadian and seasonal factors in the pathogenesis of acute myocardial infarction: the influence of environmental temperature. *Br Heart J* 1993;69:385-7.
7. Enquesslassie F, Dobson AJ, Alexander HM, Steele PL. Seasons, temperature and coronary disease. *Int J Epidemiol* 1993;22(4):632-6.
8. Houdas Y, Deklunder G, Lecroart JL. Cold exposure and ischemic heart disease. *Int J Sports Med* 1992;13(Suppl 1):S179-81.
9. Last JM, editor. *Maxcy-Rosenau public health and preventive medicine*. 12th ed. Norwalk: Appleton-Century-Crofts; 1986. p. 1176-7.