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Cardiovascular mortality and altitude

Studies of populations in the Andes suggest that both coronary artery disease and myocardial infarction are uncommon among residents at high altitude. Ramos *et al*¹ found no case of myocardial infarction or of even moderate coronary artery disease in a consecutive series of 300 necropsies carried out at 14 000 feet; and epidemiological studies² in South America have shown that both angina of effort and electrocardiographic evidence of myocardial ischaemia are less common at such altitudes than at sea level. Similar findings have been reported in native residents of the Himalayas.³

Genetic differences and the absence or low frequency of known coronary risk factors among non-Western peoples affect the interpretation of comparisons between their mortality experience and that of whites; so the relation between cardiovascular mortality and residence at high and low altitudes needs to be examined in white populations as a separate study. Recent American research has yielded interesting results.

Mortimer *et al*⁴ looked at the variation in mortality from arteriosclerotic heart disease in whites in relation to altitude in the State of New Mexico. With increasing altitude they found a declining age-adjusted mortality from arteriosclerotic heart disease in men but not in women. They argued that the trend for men could not be explained by urban-rural differences, differences in cigarette smoking, racial mix (Spanish-Americans or other Americans), or by hardness of the water supplies, which in New Mexico is inversely related to altitude. Nevertheless, Buechley *et al*⁵ contended that the controls for racial differences had been inadequate, and that this factor rather than altitude accounted for the trend.

Most recently Voors and Johnson⁶ examined age-adjusted mortality from arteriosclerotic heart disease in whites by sex according to altitude in 99 of the 100 largest cities in the USA. The correlation between the two was modest and negative ($r = -0.43$), but was derived from extremely skewly

distributed observations and is therefore open to challenge on statistical grounds. Similar doubts apply to the use of partial correlation techniques to show the absence of any relation between water hardness and arteriosclerotic heart disease mortality once altitude is accounted for. Nevertheless, none of the eight cities above 1300 feet (400 m) had an age-adjusted mortality for either sex as high as the median of the distribution for all 99 cities, and there was some evidence within water-hardness groups of declining mortality with increasing altitude.

The effects of selection for residence at altitude presumably have a larger part to play in New Mexico than across the major cities of the United States: in New Mexico the range of altitude and the maximum absolute elevation are both greater. These factors suggest that occupational selection in particular may help to explain the disparate findings for the sexes in New Mexico.

The implications of the American findings for residents of most European countries are less than clear. There are few major cities in Europe, east or west, above 2000 feet (600 m), and permanent residence virtually ceases at altitudes much below those of inhabited New Mexico. The scope even for observing an "altitude effect" in Europe is thus severely limited. Furthermore, any cross-European studies would be confounded by cultural and genetic differences. Despite this caution, some types of inquiry perhaps deserve attention. Within those countries with a moderate range of altitude it may be worth repeating the analysis of Voors and Johnson.⁶ Spain, France, and West Germany possibly have sufficiently homogeneous populations to enable this to be done. Next, information might be obtained from Caucasian populations living outside Europe at widely differing altitudes but in otherwise homogeneous conditions: thus East and South Africa may be natural laboratories. Finally, some Russian reports exist of investigations in the Caucasus and the Pamirs, where there is a moderate range of altitude of major residential centres, though less than in the United States. Much of this work is inaccessible to the average Western reader, but it may be worth exploring.

This is, however, a research topic of little practical importance to the British. None of our cities are as high even as 1000 feet (300 m) and the highest village in Britain is at less than 1500 feet (450 m). There is little prospect of reducing mortality from arteriosclerotic heart disease by relocating Milton Keynes, say, on the top of Dartmoor.

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