Savitz et al. (1) recently published results of an analysis of cardiovascular disease mortality among electric utility workers in which they investigated mortality risk in relation to magnetic field exposure. They subclassified deaths from cardiovascular disease according to the death certificate codes. In particular, they considered arrhythmia-related deaths (International Classification of Diseases, Ninth Revision (ICD-9), codes 426 and 427), acute myocardial infarction (ICD-9 code 410), atherosclerosis-related mortality (ICD-9 code 440), and chronic/subchronic coronary heart disease (ICD-9 codes 411–414) (2). Their aim was to identify causes of death likely to be reflective of changes in cardiac autonomic control. Savitz et al. state that the first two groupings are most likely reflective of changes in autonomic control and that the latter two classifications are not (1). It is my opinion that the death certificate is an unreliable and nonspecific source of information about autonomic control, and that it is not possible to draw any etiologic conclusions based upon these classifications.

First consider ICD-9 code 426, conduction disorders. From a physiologic viewpoint, the disorders listed under ICD-9 code 426 are primarily related to damage to the cardiac conduction system that is attributable to arteriosclerosis and coronary artery disease, not to loss of autonomic control. Many of the disorders included in ICD-9 code 427, cardiac dysrhythmias, are also primarily related to coronary artery disease. Atrial fibrillation is a common, chronic disorder associated with coronary heart disease; ventricular fibrillation is commonly seen during acute coronary occlusion and is usually related to ischemia, not to disorders of autonomic control.

Savitz et al. attempt to distinguish between acute myocardial infarction and chronic coronary heart disease. This is largely an artificial distinction, because the majority of individuals who die of acute myocardial infarction probably have chronic coronary artery disease. I would imagine that most individuals who die suddenly of a heart attack outside of a hospital or within hours of arrival at the emergency room would have their deaths coded as being due to acute myocardial infarction. Many of these individuals will have previously suffered from angina or have recovered from previous heart attacks; that is, prior to their deaths they would have been diagnosed with chronic coronary heart disease.

The underlying pathophysiology for the majority of these disorders is cardiac ischemia, usually chronic, due to coronary arteriosclerosis. It makes little biologic sense to distinguish between them when considering exposure latency, as the authors have done in some of their analyses. I conclude that the outcome classifications that Savitz et al. have used lack validity and reliability, thus calling into question their interpretation of the results. I believe that the lesson for epidemiologists is that consultation with physicians is appropriate when diagnosis and classification of disease are an important aspect of a research study.

References

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The Authors Reply

We thank Dr. Finkelstein for expressing his views (1). Dr. Finkelstein questions the accuracy of using death certificate codes for the study of subtypes of cardiac disease and whether disruption of cardiac autonomic control plays a role in the etiology of either cardiac arrhythmia or acute myocardial infarction.

We acknowledge that death certificate information is inherently limited for making mechanistic inferences. In order to take advantage of a large cohort mortality study to explore a possible association of magnetic field exposure with cardiovascular disease, we classified cardiovascular disease mortality into the four categories described, based on the hypothesis that magnetic fields might affect cardiac autonomic balance (2). Dr. Finkelstein correctly notes that atherosclerosis is most likely present in a large proportion of all of the causes of death we examined. However, probabilistically, altered autonomic control is most likely to contribute to mortality from arrhythmia-related causes, is somewhat less certain to contribute to death from acute myocardial infarction, and is least likely to contribute to atherosclerosis and chronic coronary heart disease death. Even in the presence of atherosclerotic changes, there are substantial differences in the types and extent of lesions and associated precipitating factors found in cases of acute myocardial infarction as compared with sudden coronary death or unstable angina, as has been documented with detailed morphometric analyses (3).

While our limited ability to accurately distinguish between deaths that were and were not mediated by loss of cardiac autonomic control would constitute a plausible explanation for a failure to observe the hypothesized pattern, even if a mechanism linking magnetic fields to autonomic control were present, it is difficult to attribute the pattern we did observe to such misclassification. Through an effect of magnetic fields on cardiac autonomic control, some other etiologic process, or biases in the study methods, we found a stronger, graded association between magnetic fields and...
Arrhythmia-related death and death from acute myocardial infarction, as contrasted with little or no association between magnetic fields and chronic coronary heart disease and atherosclerosis-related death.

Dr. Finkelstein's second contention is counter to recent research on the role of autonomic control in sudden cardiac death, specifically in triggering mechanisms. As was noted in the review of a recent National Heart, Lung, and Blood Institute workshop, "epidemiological evidence strongly implicates activation of the sympathetic component of the autonomic nervous system as a causal link in the onset of cardiovascular disease" (4, p. 3234). We noted in our paper (2) that previous epidemiologic studies have indicated a clear association between reduced heart rate variability and sudden death (5–7), supported by clinical evidence captured in ambulatory electrocardiography; that reduced heart rate variability precedes fatal ischemic episodes (8, 9); and that autonomic changes precede coronary spasm (10) and ventricular ectopy and tachycardia (11).

We agree that further research based solely on cause of death information is unlikely to establish a mechanism, although such analyses would help to identify study biases that may have yielded spurious associations. Other approaches to examining a potential effect of magnetic fields (or other workplace factors) on cardiac autonomic control are called for, including direct examination of acute response to magnetic field exposure in laboratory and field settings.

REFERENCES


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