Harvard Center for Risk Analysis

APRIL 1998

Volume 6
Issue 4

# Risk in Perspective

## Ranking Risks in the Home

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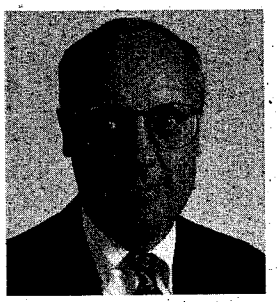
***The public tends to receive information about risks one at a time, without the benefit of any comparative perspective. We have made a case that all reported risks in the home were not created equal.***



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Each day the mass media confronts people with new information about dangers in life. Of particular interest is the barrage of stories about risks that families face, sometimes unknowingly, in their own homes. Some of these dangers are real and important and thus should be a priority at public health agencies and among residents. Yet it is not clear that all of these risks are equally important from a public health perspective and, in some cases, it is possible that the reported risks are of minor significance or are simply "phantom" dangers.

In this issue of RISK IN PERSPECTIVE, we offer a judgmental ranking of ten potential hazards in the home that have been "in the news" over the past year and have relevant risk information. The ranking is based primarily on three considerations: the weight of scientific evidence that any hazard exists, the number of Americans who might die each year (assuming the hazard is real), and the annual chance of premature fatality faced by individuals who are highly exposed and/or highly susceptible to the danger (again, assuming the hazard is real). These special populations were chosen based on the availability and specificity of current data.

A more complete analysis would consider a variety of nonfatal health effects but here we focus on risk of premature death. We also leave psychological, emotional, and ethical factors for consideration by our readers. Although this ranking is based solely on home exposure, we recognize that exposures to these hazards can occur through other pathways, such as occupational. If additional risk dimensions such as nonfatal health effects and other exposure pathways were considered for these hazards, the risk estimates would inevitably differ, and the risk rankings might change.

Before reading our ranking, we urge readers to perform their own ranking of the following ten potential hazards: accidentally falling, accidentally firing a gun, inhaling insulation fibers, exposure to fire and burns, poisonings, inhaling radon gas, suffocation, exposure to electric and magnetic fields from power lines, inhaling environmental tobacco smoke, and inhaling formaldehyde emitted from building materials. Our focus is unintentional hazards in the home and thus (for now) we ignore issues of violence to oneself or others. With this in mind, please rank each of these ten hazards in terms of overall public health significance in

the United States, taking into account mortality consequences.

Now we present our ranking of these ten potential hazards based on a reading of recent scientific literature. The "bottom-line" determinations are summarized in Table 1. The weight of evidence classifications are based on a review of the current scientific literature proving that the hazard actually presents a risk. "Population risk" refers to the number of annual excess deaths per year while "individual risk" quantitates annual risk to a highly exposed and/or highly susceptible population. For each of the hazards, the risk estimates are based on different types of data. For example, poisoning risk estimates are taken from poison control databases while formaldehyde risk estimates are based on extrapolations from experimental studies of rodents. We also provide for each hazard a judgmental uncertainty interval (e.g., the real population estimate for number of lung cancer deaths attributable to inhaling radon gas in the home may be 2 times lower or higher than 15,000). We recognize that there are many scientific uncertainties associated with such a ranking as well as numerous legitimate points of scientific dispute.

## 1. INHALING RADON GAS

The weight of the scientific evidence suggests that inhalation of radon gas can cause fatal cases of lung cancer. There is strong evidence concerning lung cancer risk among uranium miners exposed to radon, particularly miners who were also smokers. There is also some direct evidence of elevated lung cancer risk among home residents exposed to naturally occurring levels of radon gas but this body of evidence, while not inconsistent with projections from the experience of miners, is somewhat equivocal. According to one estimate, about 15,000 cases of fatal lung cancer are caused by indoor home radon exposure each year. The average annual risk to the general population is 5.8 per 100,000 persons but most of this average risk is incurred by smokers. This subset of the population, whose death rate from radon exposure is 20 deaths per 100,000 smokers, is estimated to account for approximately 85% of the 15,000 lung cancer deaths per year.

## 2. FALLING

Falling can result in fatal injury. About 8,200 Americans die of falls each year, resulting in an average annual risk of 3.1 per 100,000 persons. For persons over the age of 75, the annual risk is much larger, about 36 per 100,000 persons. Head injuries account for a majority of the fatalities. The most common type of fatal fall occurs on stairways.

## 3. POISONING

Ingestion or inhalation of liquids, gases, or solids can kill people. About 8,200 Americans die each year of poisonings, which corresponds to an average annual risk of death of 3.1 per 100,000 persons. Persons between the ages of 25 and 44 experience an elevated level of risk that is roughly twice the national average, or about 6.0 per 100,000 persons. The majority of unintentional poisonings at home (approximately 80%) are due to a variety of drugs and medications including analgesics, antipyretics and antirheumatics. Some of these incidents may be misclassified suicides.

## 4. FIRES AND BURNS

The consequences of fires and burns in the home can be fatal. About 2,900 people are killed by fires and burns each year, for an average annual risk of 1.1 per 100,000 persons. Residents over the age of 75 face annual risks around 4.9 per 100,000 persons.

## 5. SUFFOCATION

Suffocation, whether through ingested objects that obstruct respiratory passages or mechanical strangulation, can kill people. About 2,100 people die from suffocation each year, for an average annual risk of 0.8 per 100,000 persons. Residents over age 75 again face elevated risks, in the vicinity of 4.5 per 100,000 persons.

## 6. FIREARMS

Bullets fired from guns kill people, even when bullets are released during cleaning or playing incidents. About 800 deaths are caused by accidental firings each year, for an average annual risk of 0.3 per 100,000 persons. Among young people ages 15-24, the annual risk is more than twice as large (0.7 per 100,000 persons).

## 7. ENVIRONMENTAL TOBACCO SMOKE

The weight of the scientific evidence suggests that inhalation of environmental tobacco smoke by nonsmokers can increase the risk of fatal lung cancer. The evidence is not entirely convincing because exposure to environmental tobacco smoke is not measured directly in the critical studies and the possibility of confounding by unmeasured variables still hampers conclusive cause-effect determinations. If the hazard is real, the annual number of excess deaths in the United States due to home exposures may be in the vicinity of 900, though this figure could be too small or too large. Women who never smoked yet live with heavy smokers are at elevated risk.

## 8. FORMALDEHYDE GAS

Formaldehyde gas emitted from home building materials has been raised as a health concern. Inhalation of formaldehyde can cause nasal cancer in rodents although the available health data on workers exposed to formaldehyde are subject to differing interpretations. If the hazard to humans is real and if there is no threshold in the dose-response function, then the annual number of respiratory cancers attributable to formaldehyde exposures in the home is probably less than 400, or an average annual risk of 1.3 per 100,000 persons exposed. Among some mobile home residents, who experience larger formaldehyde exposures, the elevated risk could be as large as 3.9 per 100,000 persons. These estimates of elevated risk are unlikely to be understated but could be exaggerated by a large margin, particularly if the dose-response function relating cancer risk to formaldehyde exposure is nonlinear.

## 9. INSULATION FIBERS

Concern about the dangers of asbestos fibers has stimulated concern that other insulation fibers, which are inhaled and retained in the respiratory system in a similar manner to asbestos, may also be associated with fatal cancer. However, these fibers, used in the manufacturing of glass and rock wool insulation, differ enormously in toxicity in comparison to asbestos fibers. Animal and human evidence on the carcinogenicity of non-asbestos

TABLE 1
Risk Estimates for Lethal Unintentional Home Hazards

| RANKING OF UNINTENTIONAL HAZARDS | WEIGHT OF EVIDENCE | POPULATION RISK ESTIMATE[1] | | INDIVIDUAL RISK ESTIMATE[1] | | | UNCERTAINTY INTERVAL |
|---|---|---|---|---|---|---|---|
| | | Deaths per year (USA) | Death Rate per 100,000 persons per year | Population | Deaths per year (USA) | Death Rate per 100,000 persons per year | |
| 1. Radon Gas | suggestive | 15,000 | 5.8 | Smokers | 13,300 | 20 | x/÷2 |
| 2. Falls | definitive | 8,200 | 3.1 | Elderly (75+) | 5,500 | 36.2 | x/÷1.2 |
| 3. Poisoning | definitive | 8,200 | 3.1 | Ages 25-44 years | 5,020 | 6.0 | x/÷1.2 |
| 4. Fires and Burns | definitive | 2,900 | 1.1 | Elderly (75+) | 750 | 4.9 | x/÷1.2 |
| 5. Suffocation | definitive | 2,100 | 0.8 | Elderly (75+) | 680 | 4.5 | x/÷1.2 |
| 6. Firearms | definitive | 800 | 0.3 | Teens/Young Adults | 250 | 0.7 | x/÷1.2 |
| 7. Environmental Tobacco Smoke | suggestive | 900 | 2.4[2] | Never smoker (female) | 500 | 2.4 | x/÷5 |
| 8. Formaldehyde Gas | plausible | 400 | 1.3 | Mobile home residents | 100 | 3.9 | x/÷10 |
| 9. Insulation Fibers | plausible | 20 | 0.01 | High fiber levels | NA[3] | 0.02 | x/÷10 |
| 10. Electric and Magnetic Fields | weak | NA[4] | NA[4] | NA[4] | NA[4] | NA[4] | NA[4] |

Notes:

a. Bold type indicates estimate is based on actuarial data; regular type means true risk could plausibly be zero.

b. Numbered notes:
1. Population and individual risk estimates assume that risk is "real".
2. Due to limited data on the general population, the population risk estimate was adopted from the individual risk estimate for never smoker females.
3. NA = Not Available due to insufficient data.
4. NA = Not Applicable due to weak weight of evidence

insulation fibers is inconclusive. If the hazard to people is real, then workers who regularly install insulation fibers may experience an annual cancer risk of 0.6 per 100,000 persons. Because there is little research examining residential exposure, we manipulated the occupational risk estimate to be more representative of average residential exposure levels. The resulting annual cancer risk of 0.01 per 100,000 persons suggests that fewer than 20 deaths per year are attributable to exposure to insulation fibers. Also, due to the severe lack of information, it was infeasible to identify a specific at-risk population. As a default, we derived an individual risk estimate (0.02 deaths per 100,000 persons) for one of the highest insulation fiber concentrations measured in homes. It is not clear how many homes contain these high fiber levels and thus we were unable to calculate the number of deaths per year for highly exposed persons.

## 10. ELECTRIC AND MAGNETIC FIELDS FROM POWER LINES

Children in some communities who live in homes near electric powerlines experience elevated rates of various forms of childhood cancers. Some studies of electrical workers found elevated rates of brain cancer, breast cancer, and leukemia. However, over ten years of epidemiological and laboratory research throughout the world has provided only a little support for the hypothesis that exposure to electric and magnetic fields from powerlines are a risk factor for cancer. For example, the National Research Council concluded after reviewing over 500 papers that the studies when taken as a whole neither proved nor disproved that electric and magnetic fields cause cancer. Although research on this speculative hypothesis continues, our judgment is that this potential hazard is best regarded as a "phantom risk".

## LIMITATIONS

Any exercise in risk ranking can be questioned. Value judgments must be made about which potential hazards should be ranked, which criteria should be employed when rankings are made, what types of adverse health effects should be considered, how scientific uncertainties should be taken into account when rankings are made, and how much weight should be given to overall population risk compared to the risks faced by highly exposed or sensitive subpopulations. We urge readers to compare their rankings to our rankings and then consider what may have caused any differences in the rankings.

## CONCLUSION

The public tends to receive information about risks one at a time, without the benefit of any comparative perspective. We have made a case that all reported risks in the home were not created equal. They differ in public health significance. Among ten potential hazards in the home recently covered in the media, there are significant differences in the weight of scientific evidence, the number of excess deaths per year (assuming the hazards are real), and the risks faced by special subpopulations (again assuming the hazards are real). If you know of friends or neighbors who worry more about the health effects of power lines than the health effects of radon, then we urge you to supply them a copy of this simple analysis for reflection.

**FURTHER READING**

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