

# Optimistic Biases in Public Perceptions of the Risk from Radon

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**Abstract:** Survey data were obtained from a random sample of 657 homeowners in New Jersey and also from 141 homeowners who had already monitored their homes for radon. People who had not tested tended to believe that they were less at risk than their neighbors, and they interpreted ambiguous predictors of home radon levels in ways that supported their beliefs of below-average risk. Residents who had already tested their homes were relatively

accurate about the probability of health effects. In both groups less than half of those who knew that radon can cause lung cancer were willing to admit that it would be serious if they suffered health effects from this source. The optimistic biases of the public may hamper attempts to encourage home radon monitoring and to promote appropriate mitigation measures in homes with elevated radon concentrations. (*Am J Public Health* 1988; 78:796-800.)

## Introduction

In both theoretical models<sup>1-6</sup> and empirical investigations<sup>7,8</sup> beliefs about susceptibility to harm and about the severity of potential health effects are key determinants of precautionary behavior. People are seldom willing to take preventive measures unless convinced that their own risk is significant and that effects would be serious. Since personalized risk information is rarely available, we should not be surprised to find that individuals' perceptions of risk are frequently in error. But the errors are not simply random. Instead, people often display "unrealistic optimism." Regardless of their view of the average risk, they show a consistent tendency to assert that their own risk is less than the risk faced by their peers. Past research has not only demonstrated the existence of such optimistic tendencies for a wide range of health and safety risks,<sup>9-15</sup> but has identified characteristics of hazards that determine the amount of bias evoked by different threats.<sup>16-20</sup>

In this paper we offer data concerning the existence of optimistic biases about radon gas, a carcinogen whose presence as a home air pollution problem first became apparent late in 1984. Naturally occurring, radioactive radon is believed to pose a significant lung cancer risk in the United States, with a preliminary estimate\* that 12 per cent of all homes have concentrations exceeding the action level of 4 picocuries per liter of air (pCi/l) suggested by the US Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC). Lifetime exposure to the action level is believed to present a lung cancer risk of approximately 1-2 per cent.<sup>21</sup> Because radon levels vary greatly from house to house, owners must test their own dwellings to find out whether radon levels are elevated. A tendency to believe that one's own risk is relatively low or that illness caused by radon would not be serious may interfere with appropriate self-protective behavior and may indicate the need for programs to encourage public monitoring and mitigation.

Evidence of unrealistic optimism about radon would also be important because radon problems differ in several respects from the types of problems that have been associated with high levels of optimism in past studies.<sup>20</sup> In other types

of problems, much of unrealistic optimism appears to reflect attempts to maintain or enhance self-esteem (leading, for example, to particularly high levels of personal optimism about avoiding alcoholism, mental illness, and venereal disease). But radon is not an issue that should threaten self-esteem: radon is naturally occurring, not the result of a homeowner's action; only recently did anyone realize that radon was a threat in homes, so citizens cannot be blamed for having purchased a house with a problem.

Unrealistic optimism also arises when people reason because they do not have a problem at present, they are unlikely to develop the problem in the future (examples are asthma, diabetes, and epilepsy). However, one cannot infer that a home is free from high levels of radon without testing. Even if inhabitants have experienced no physical symptoms and do not smell or otherwise sense anything unusual, a home may still have excessive radon levels. If residents are aware of these facts about radon, it should be difficult to claim that their risk is low because no signs of radon have yet been observed.

Finally, the level of risk from radon is mainly a function of nonbehavioral factors like soil and house construction, while the strongest optimism about personal risk generally occurs in reference to behavioral risk factors.<sup>19</sup> However, optimistic biases tend to occur when people have little experience with a hazard, so some optimism with regard to radon might be expected on this count. If the data collected do reveal optimistic biases about the risk from radon, such biases should be expected for many other naturally occurring environmental hazards.

## Method

Two surveys were conducted in order to understand public perceptions of radon and to guide public information programs in the State of New Jersey. Separate reports are available describing the public's attitudes toward radon, emotional responses, home testing plans, and mitigation activities.\*\* The first survey (hereafter called the random sample) polled a set of New Jersey residents, randomly selected from telephone directories, who lived on or near a geological formation named the Reading Prong. The investigation focused on the Reading Prong because it was thought by state officials to pose a particularly high radon risk. Furthermore, because radon had received considerable me-

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\* Press release, Office of Radiation Programs, US Environmental Protection Agency, Washington, DC, August 14, 1986.

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\*\* 1) Weinstein ND, Sandman PM, Klotz ML: Public response to the risk from radon, 1986. Final report on research contract C29543 to the New Jersey Department of Environmental Protection, Trenton, NJ, January, 1987; 2) Klotz ML, Weinstein ND, Sandman PM: Promoting remedial response to radon: Are information campaigns enough? Both of these reports are available from the authors. See also reference 22.

dia attention in this part of the state, it was the area of greatest public awareness. The survey was conducted in April 1986. Participants were restricted to owners of single-family homes who indicated during the initial phone contact that they had at least heard of radon. Of candidates who met these selection criteria, 78.3 per cent agreed to participate and were sent a questionnaire through the mail. Completed questionnaires were returned by 657 (78.7 per cent of those who had agreed to take part).

Because the radon issue was so new, it seemed unlikely that more than a handful of random sample members would have monitored their homes. A second survey contacted homeowners who had already monitored their homes for radon, had received a reading at or above the EPA's recommended action level of 4 picocuries per liter, and had contacted the New Jersey Department of Environmental Protection (NJDEP) for a second measurement to confirm the initial test result. This survey took place in June 1986. Hereafter this will be called the confirmatory monitoring sample.

All information about confirmatory monitoring program participants was confidential, so direct contact could not be made. Instead, an initial letter was sent by NJDEP asking members of this group to volunteer to participate in the survey. Of the 359 households contacted, 47.3 per cent agreed to take part. Questionnaires were mailed to these households, and were completed and returned by 141 (91.5 per cent) of the volunteers. Because of the recruitment procedure followed, this group is not a random sample of those who have tested. Obtaining a second measurement and agreeing to participate in our survey suggest that these people are more concerned about the issue and more open to information than others. In fact, other data show that these individuals are very well educated (66 per cent have college degrees) and score quite well on a test of knowledge about radon.

To avoid repetition, the wording of the questions used to assess optimism will be presented in the next section along with the results.

## Results

### Risk Likelihood and Comparative Risk

To determine whether people tend to underestimate the likelihood of having a radon problem, we focused on random sample members who had not yet tested their homes.

We asked respondents to make an explicit risk comparison: "Compared to other homes in your community, do you think the radon level in your home is likely to be: much less than average, less than average, about average, more than average, or much more than average." (Such a question could not be used to assess biases about home radon concentrations in the confirmatory monitoring sample. The NJDEP program was designed for people who had obtained a test result exceeding 4 pCi/l through a private testing company, so the radon levels of this sample are not representative of the communities in which they live or of those individuals who have tested their homes.) At this early stage in public awareness of the issue, about half the sample, 48.1 per cent, said they had "no idea." Another 9.0 per cent claimed "there is no radon in my community" (itself an optimistic and incorrect answer since appreciable amounts of radon are present in all parts of the region studied). The distribution of those who had formed an opinion was strongly skewed: 50.6 per cent believed that their risk was less or much less than average, 43.7 per cent believed that their risk

TABLE 1—Reasons for Believing One's Home Radon Level is Above or Below Average (random sample)

Topic Mentioned	Reported Effect on Risk	
	Decreases Risk	Increases Risk
<b>Geographical Location</b>		
Know/don't know of people or homes with problem	42	4
Near/far from problem	31	11
On/off Reading Prong	19	11
Distance from industry	4	1
Other house/community location	3	1
<b>Specific Setting</b>		
Soil/rock around house	13	3
House on hill	4	2
Other house physical setting	5	1
<b>House Construction</b>		
Natural ventilation/air tightness	55	2
Foundation	18	5
House older	13	1
House newer	5	0
Has no basement	5	0
Has basement	2	0
Number of cracks in basement	9	2
Type of construction (unspecified)	5	0
Insulation	1	1
Other house characteristics	6	0
<b>Actions</b>		
Keep doors/windows open/closed	10	0
Other actions taken	2	0
<b>Other</b>		
Health effects noticed/not noticed	3	0
State has/hasn't been here	2	0

Note: Entries indicate the number of people listing each type of reason. Respondents could list more than one reason.

was about average, and only 5.8 per cent said their risk was more or much more than average.

Next, an open-ended question asked respondents to explain why they thought their risk was above or below average. (Respondents who stated that their risk was average, who said there was no radon in their area, or who had "no idea" about their risk were not asked to explain their answers.) The answers given are displayed in Table 1. Because more people claimed below-average risk than above-average risk, it is not surprising that risk-reducing reasons predominate. Nevertheless, the answers given demonstrate that optimistic biases cannot be explained away as a limited misunderstanding about the radon issue. Instead, optimism permeates respondents' risk perceptions. Whether one focuses on explanations relating to the general geographical location of the house, the specific physical setting, the attributes of the house itself, or the actions of residents, there is a clear optimistic bias present.

Other survey answers indicated that respondents were not claiming their risk is low because they did not smell radon (81.8 per cent realized that it has no odor) or because they had not experienced any physical symptoms (people who knew that there are no warning symptoms for radon health effects were just as optimistic as people not aware of this fact).

Two additional questions dealt with the likelihood of radon problems, asking whether "radon is likely to be a problem in any homes in your community" and whether "radon is likely to be a problem in your own home." Answers were recorded on seven-point scales, ranging from "no chance" to "certain." Radon knowledge (as assessed by 15 true-false questions) was related to these beliefs about risk likelihood. Calculations revealed that better informed people

TABLE 2—Distribution of Radon Risk (confirmatory monitoring sample)

Probability of Lung Cancer from Radon Exposure	Percentage of Sample at each Risk Level	
	Respondents' Self-perceptions	Objective Estimates <sup>a</sup>
0 to < 1/1000	13.2	11.0
1/1000 to < 1/100	35.8	12.4
1/100 to < 1/10	33.0	65.7
1/10 to CERTAIN	18.0	11.0

Note: N = 106. Chi-squared goodness of fit = 69.5, *df* = 3, *p* < .0001.

<sup>a</sup>Estimates of excess lung cancer deaths expected from lifetime exposure to respondents' first floor radon levels. Values derived from EPA-CDC risk probabilities at different levels of exposure.<sup>22</sup>

were somewhat more likely to believe that homes in their community have problems,  $r(487) = .16$ ,  $p < .001$ , but knowledge had little effect on ratings of the likelihood of a radon problem in the respondent's own home,  $r(480) = .06$ ,  $p > 0.05$ .

A second index of optimism can be derived from this pair of questions. The difference between the answers to the two items indicates whether people tend to believe that their own risk is greater than, the same as, or less than the risk faced by others in the community. The result suggests a strong optimistic bias. Of those who answered both questions (27.9 per cent said they had no opinion), 51.5 per cent rated their own risk less than that of the community in general, 45.4 per cent considered their risk no different from the community, and only 3.2 per cent rated their risk greater than that faced by other homes in the community. Strictly speaking, however, the likelihood of *some* home in the community having a problem is never less than the probability of a problem in a particular home. We believe that most respondents saw the question about radon in their community as referring to a typical home. But we have no evidence that this is so. The results from this measure of optimism are very similar to those obtained directly from the comparative risk question, but readers should bear in mind that the wording of the community likelihood item leaves the interpretation of this second index of optimism open to question.

#### Risk Likelihood and Personal Susceptibility

Confirmatory monitoring sample members somewhat underestimate the risk posed by the radon measured in their homes. A fixed-choice question asked respondents about the probability that negative health effects would arise from their measured radon concentrations if no remedial actions were taken. The answers they selected are compared in Table 2 with estimates derived from their first-floor radon levels using risk probabilities published by EPA and the Centers for Disease Control (CDC).<sup>21</sup> More people underestimate than overestimate the risk, but the discrepancies are mainly between the two adjacent rows in the middle of the Table 2. Many informational materials available at the time of the surveys did not give risk estimates at different radon levels, although comparisons to the risk from smoking were often included in media discussions of the radon problem. (Members of the sample who had sought out such probabilities would most probably have encountered the EPA-CDC estimates, since these were the figures more readily available.) A similar underestimation of illness likelihoods has been reported by Johnson and Luken<sup>23</sup> in a study of Maine house-

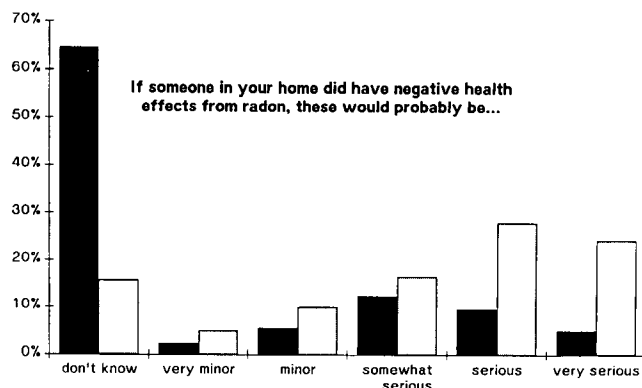


FIGURE 1—Perceived Seriousness of Radon-caused Health Problems.

\*Solid bars refer to the random sample; open bars refer to the confirmatory monitoring sample.

holds that had received both home radon test results and a booklet designed to explain the risk.

The confirmatory monitoring sample was also asked about personal susceptibility to radon: "Compared to other people who have the same radon level as you, would you say you're any more or less likely to have your health affected?" No optimistic bias appeared on this item. About one person in five, 21.4 per cent, was unable to express an opinion. Of the remainder, 74.5 per cent thought their risk was average; 10.0 per cent indicated that they were more likely to become ill, and 15.5 per cent said they were less likely to become ill.

#### Risk Severity

Most theories of preventive health behavior separate beliefs about the likelihood of experiencing an illness from beliefs about the seriousness of the harm that would result from that illness.<sup>1-6</sup> The latter beliefs were examined in this research by asking members of both samples to estimate the seriousness of radon's potential effects on family members: "If someone in your home did have negative health effects from radon, these would probably be: very minor, minor, somewhat serious, serious, or very serious." Since the only established effect of radon is an increased risk of lung cancer, and since lung cancer is fatal in most instances, we regard answers of "serious" or "very serious" as properly reflecting the potential health consequences of radon. The responses selected are shown in Figure 1. Only 13.5 per cent of the random sample and 52.6 per cent of the confirmatory monitoring samples said the health problems produced by radon would be serious or very serious, although many had no opinion.

To determine whether the failure to recognize the seriousness of radon's health effects merely indicated a lack of information, a health knowledge variable was created to indicate the number of correct responses to three questions: radon's effects on lung cancer, on skin cancer (no known effect), and on eye and throat irritation (no known effect). Disregarding "don't know" answers, perceived seriousness increased with health knowledge,  $r(223) = .27$ ,  $p < .001$  and  $r(117) = .23$ ,  $p < .01$ , in the random and confirmatory monitoring samples, respectively. Nevertheless, if we restrict our attention to those who knew the correct answers to all three questions, only 36.6 per cent of the random sample and 55.3 per cent of the confirmatory monitoring sample

acknowledged that the health effects they might experience would be serious or very serious.

### Discussion

Although radon had only recently been recognized as a home health threat, it had received considerable media attention in the region of New Jersey covered by the present surveys. Newspaper articles had referred to numerous factors that can influence radon levels, including uranium concentrations in soil, soil porosity, house ventilation rates, cracks and openings in foundation walls and floors, home appliances that create reduced air pressure in basements, and other topics. None of these factors is highly diagnostic, and no radon expert would make a decision about the need for remediation without testing. Nevertheless, our data suggest that people take these ambiguous risk factors and use them in a biased fashion to reach an optimistic conclusion about their own susceptibility to harm.

Compared to factors influencing household radon levels, little had appeared in the media about what might make individuals differentially susceptible to health consequences from radon. We suspect that the reason why respondents did not claim that they were less likely to become ill than others at the same radon level is simply because they could not think of any way to support such claims. If less had been written about factors affecting home radon levels, respondents might not have shown unrealistic optimism about radon problems in their dwellings either. In other words, when risk factor information is ambiguous (in terms of which factors are most important, how factors interact, or what represents "high-risk" status on a given factor), the first effects of providing such information may be to create optimistic biases about vulnerability. Data reported above show that increased knowledge about radon increased respondents' readiness to acknowledge risks within the community, but had no effect of their willingness to admit that their own homes might be dangerous.

There were some discrepancies in the confirmatory monitoring sample between perceived and objective illness probabilities, primarily underestimation of risk. However, the accuracy of the objective estimates is limited by scientific uncertainty about radon and by the fact that these objective estimates did not take into account respondents' past or expected length of residence. Because discrepancies were primarily between two adjacent categories of intermediate risk, rather than a tendency to underestimate risk across all categories, it does not seem appropriate to cite the differences in Table 2 as evidence of an optimistic bias.

Nevertheless, substantial proportions of both samples underestimated the seriousness of radon's health effects. Even respondents who knew that radon can cause lung cancer were reluctant to acknowledge that it would be serious if they became sick because of radon. We do not know how people would justify their claim that radon-caused illnesses in their families would be relatively minor, but this finding is consistent with the optimism in their other responses.

Since completion rates in both surveys reported here were appreciably less than 100 per cent, there may be significant differences between the opinions of our respondents and those of the populations they were intended to represent. Nevertheless, it seems unlikely that people who believe the radon issue does not concern them or believe the risk from radon is small will be overrepresented among individuals who agree to complete lengthy mail questionnaires. Thus, our data may overestimate the recognition of

personal susceptibility and risk seriousness in the broader population.

The results we have presented provide a possible explanation for the public's generally apathetic response to the risk from naturally occurring radon. Even though information may convince people that a radon problem can be serious, many appear to resist the belief that they themselves are at risk or that radon would be serious in their own case.

The problem of overcoming such apathy-producing beliefs is common to many public health and safety issues. In contrast, the public seems to overreact to many pollution hazards, becoming extremely fearful about clusters of cancer cases that appear insignificant to epidemiologists or about levels of carcinogens in water supplies that represent risks much lower than those posed by radon. It appears that the public takes risks more seriously when blame for the problem and responsibility for remediation fall on industry or government. Geological radon is an environmental hazard, but it is naturally occurring and responsibility for reducing radon levels rests with individual homeowners. Although our data refer only to radon, we believe that similar optimistic biases will tend to be associated with environmental health threats whenever individuals must deal with their own problems. Rather than acknowledge a threat to health or property values and invest time and expense in testing and remediation, it is easier to reinterpret the situation so as to minimize the need for action.

Efforts to encourage self-protective behavior need to recognize the prevalence of such optimistic tendencies and be prepared for the fact that audiences may misinterpret risk factor information in order to justify their inaction. To counteract these tendencies, public health programs need to pay particular attention to the messages they send. In the case of radon, it is important to make explicit what regions are and are not at risk, to stress that no homeowner in a region with radon can be confident of his or her own level without testing, and to emphasize the seriousness of lung cancer. At the same time, information about testing and remediation must be readily available to minimize procrastination and prevent feelings of helplessness from developing. The available data suggest that without vigorous attempts to encourage public action, few people will reduce their risk from radon.

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## NIH Consensus Development Conference: Urinary Incontinence in Adults

Urinary incontinence is the subject of an upcoming consensus development conference sponsored by the National Institutes of Health and other agencies. The conference is scheduled for October 3-5, 1988, in the Masur Auditorium of the NIH Clinical Center in Bethesda, Maryland, and is open to the public.

Urinary incontinence is a major clinical problem, especially among older persons, affecting an estimated 35 per cent of women over age 60 and 15 per cent of men above that age. There are some 38 million Americans over 60.

Considerable controversy exists over what the proper diagnostic techniques and therapies are for urinary incontinence. In recent years, the body of research on this topic has grown and this conference will review these data in an effort to reach consensus on the most appropriate ways to address urinary incontinence, a problem that effects one-third to one-half of the nearly 2 million persons now in nursing homes in this nation. The purpose of the conference is to reach agreement on important issues in urinary incontinence.

The conference will bring together geriatricians, urologists, gynecologists, nurses, mental health care providers, other health professionals, and the public. The conference is sponsored by the National Institute on Aging, the National Institutes of Health Office of Medical Applications of Research, the National Institute of Neurological and Communicative Disorders and Stroke, the National Center for Nursing Research, the National Institute of Diabetes and Digestive and Kidney Diseases, and the Veterans Administration.

To register for the urinary incontinence in adults consensus conference or to obtain further details, contact:

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