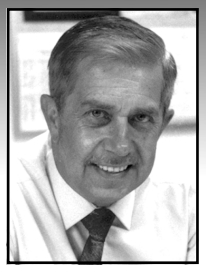

Fact or Fiction?

Jack W. Dini • 1537 DeSoto Way
Livermore, CA 94550 • E-mail: jdini@earthlink.net

Radiation Hormesis

Radiation exposure extends lifespan! There is no question that high amounts of radiation are harmful, but low amounts are beneficial to humans and animals. This is the concept of *hormesis*, which applies throughout nature and was discussed in a previous column (*P&SF*, May 1999). Hormesis means that high and low doses produce opposite effects, with low doses providing beneficial effects and high doses the opposite.

Let's talk about models that have been used with radiation. The linear model (no threshold) states that all radiation is harmful. The hormesis model says small and large doses produce opposite results. Figure 1 compares the two, showing the effects of dose on cancer rates.[1] The difference between imperceptible harm predicted by the linear model and the benefits noted with the hormesis model suggests that, for every 1,000 cancer mortalities predicted by linear models, there will be 1,000 decreased cancer mortalities and 10,000 persons with improved life quality.[1] Yet, current cost/benefit estimates related to radiation protection (*e.g.*, regarding the consequences of population exposures after accidents such as Chernobyl) and large decommissioning and waste management and remediation programs continue to be based on the linear no-threshold hypothesis.

As Becker[2] discloses: "With the average background in Europe fluctuating substantially, and being exceeded by a factor of 10 to 100 in areas of Brazil, India and Iran without any detectable detrimental health effects over many generations, it would make little sense to consider evacuation of whole towns or regions in Saxony, Finland or Cornwall, or to close down mining operations in southern Africa which could be required if current radiation policy were to be applied uniformly."

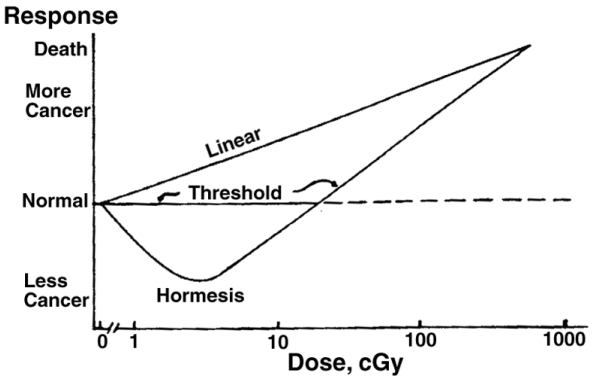

Fig. 1—Influence of linear (no threshold) and hormesis dose models on cancer rates. Adapted from Luckey, ref. 1.

Jaworowski[3] suggests that the psychosomatic disorders observed in the 15 million people in Belarus, Ukraine and Russia who were affected by the April 1986 Chernobyl accident are probably the accident's most important effects on public health. These disorders could not be attributed to the ionizing radiation, but were assumed to be linked to the popular belief that any amount of man-made radiation—even minuscule doses—can cause harm. This is the assumption that gained wide acceptance in the 1950s, arbitrarily, as the basis for regulations on radiation and nuclear safety.[3]

Prior to the development and use of atomic bombs, bio-positive effects of small doses of ionizing radiation were accepted by radiobiologists. The bombings of Hiroshima and Nagasaki, however, allowed the world to be mesmerized into acceptance of the thesis that "all doses of ionizing radiation are harmful."[1]

Continuing media and monetary support of this thesis continues after half a century. Yet, a survey by Luckey[1] contains more than 1,200 literature references on studies, both on animals and on humans, confirming the beneficial effects of low-level radiation, including enhanced growth, improved reproductive capacity, improved immune responses, lower cancer rates and longer lifespan.

In spite of the overwhelming data supporting the hormesis model, the nature of health effects of low-level ionizing radiation continues to be the subject of considerable controversy. Some examples showing the value of low levels of radiation include the following:

- Japanese survivors of atomic bomb attacks on Hiroshima and Nagasaki in 1945 who received low doses of radiation were compared with the population of Japan as a whole. The survivors had lower general mortality rates and lower cancer mortality. Also, the infant mortality among their offspring was significantly below Japan's national average.[4]

- Workers at Los Alamos exposed to threefold higher amounts of plutonium than the maximum currently recommended by the National Council on Radiation Protection have been studied for the past 50 years.[5] Standard mortality ratios of the exposed workers, when compared to the general population and to unexposed contemporary Los Alamos workers, were 0.43 and 0.77 respectively. This means that the number of exposed workers who have died as compared with these two groups is less by 57 percent and 23 percent. The second comparison is especially relevant, since it avoids systematic differences in lifestyle between Los Alamos workers and the general population.[6]
- One of the most detailed epidemiological studies found definitive reductions in lung cancer with increasing radon exposure. Cohen[7] used this work to test the linear no-threshold theory for 1,601 U.S. counties. More than 50 confounding factors were used in his statistical analysis with the only possible explanation for the results being the failure of the linear no-threshold theory for carcinogenesis from inhaled radon.

There is no evidence of increased mutation, genetic diseases or cancer in animals or humans following exposure to hormetic doses of ionizing radiation—even in Hiroshima and Nagasaki—in spite of extremely thorough and intensive investigations.[1, 8]

Summary

A large body of evidence shows conclusively that whole-body exposures to low doses of ionizing radiation reduce cancer mortality rates when compared with control populations in both experimental animals and humans. The decreased cancer incidence and mortality in animal experiments in the nuclear industry, in army observers of atomic explosions, and in Japanese bomb victims is consistent.[1]

As Sagan[9] points out, "Literally tens of billions of dollars are being sought by one federal program alone for the purpose of reducing exposure to low levels of radiation and chemical wastes on the basis of largely hypothetical health risks." The consistency of the results and the statistical significance of much of the data from human experiences and animal experiments destroy two myths:

1. All radiation is harmful.
2. The linear model is valid for low doses of ionizing radiation.

The effects of low doses of radiation appear to be comparable with those of a great variety of toxins: High and low doses give diametrically opposite results. Becker[2] sums it up best: "Ten thousands of millions of dollars are spent every year worldwide in decommissioning, remediation or nuclear waste programs, which could obviously be used much more beneficially in other areas of public and individual health, in rich, and even more so in poor countries of the world."

Misuse of the linear no-threshold model portends spending in excess of $1 trillion in the U.S. alone for negligible health benefits, just for government environmental cleanup programs, while truly significant public health protections are unfunded.[10] P&SF

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