Afraid of Radiation? Low Doses are Good for You

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Fearful of the harm that radiation can do, the citizens of Sacramento, in a public referendum, had the city shut down its Rando Seco nuclear power plant. The Sacramento Municipal Utility District put up windmills instead, which on a windy day produces 1 percent of the power the nuclear plant did, and built a photovoltaic solar plant that generates one-third of one percent of that power. Eight nuclear power plants have been decommissioned in the U.S. since 1990. None of the ones ordered after 1974 were completed, and no orders have been placed in this country for a nuclear power plant since 1978. The 109 nuclear reactors in the U.S. that remain operational produce 7.6 percent of the nation's energy, as electricity. There are 442 nuclear power plants worldwide, with 35 under construction—24 of them in Asia.

The Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NCR), two federal entities charged with addressing radiation safety, hold the view that exposure to any amount of ionizing radiation, no matter how small, is harmful. No amount of radioactivity can be proclaimed safe. Accordingly, the EPA and the NCR have set extremely stringent safety standards for radiation—15 and 100 mrem (millirem)/year respectively. This is the level of cleanup radioactive sites have to achieve, for example, before they can be released for public use. The initial standard for radiation safety, observed fifty years ago, was 36 rem, and with the advent of nuclear powered ships, where sailors would be in close proximity to nuclear reactors for extended periods of time, it was reduced to 15 rem, or 15,000 mrem. (The rad, rem, Sievert, and Grey are, for practical purposes, interchangeable measures of radiation, where 1 rad = 1 rem, 1 Sievert = 1 Grey, and 100 rad or rem = 1 Sievert or Grey. A millirem—mrem—is $1/1000^{th}$ of a rem.)

Along with the EPA and NRC, elected government officials, newspaper science writers, TV reporters and journalists, and, consequently, most Americans believe that low doses of radiation are harmful. People have "radiophobia"—the fear that any level of ionizing radiation, no matter how small, is dangerous. Why? For one thing, the news media fosters it because fear sells. Scary stories about the dangers of radiation keep people tuned in. Another reason, which lies deeper in the collective psyche, is that this phobia expresses the deep-seated sense of revulsion that Americans feel over the devastation and loss of life caused by the atomic bombs that its country dropped on Hiroshima and Nagasaki at the end of World War II. A third, more correctable reason is that the relationship between radiation dose and its biological effects is believed to conform to the "Linear (No-Threshold) Hypothesis," or "model." Regulators use this model to predict the number of cancer deaths that low doses of radiation are assumed to cause and then cite these predictions to justify their draconian radiation safety standards.

The linear hypothesis works this way: After America developed the atom bomb, tested it, and dropped two on Japan investigators learned that 600 rem—600,000 mrem—of radiation constitutes a (100 percent fatal) lethal dose, and 50 percent of people exposed to 400 rem will die of radiation sickness. Signs and symptoms of radiation sickness—such as vomiting, diarrhea, bleeding, sore mouth, weakness, and hair loss—appear when a person receives 100 rem. This hypothesis assumes that there is no threshold beneath which the deleterious effects of radiation cease to appear. Even very small doses will cause cancer in some people, if a large enough group is exposed. This hypothesis predicts, for example, based, in a linear fashion on the mortality rate seen at higher doses, that people exposed to a 500 mrem dose will have a 0.00625 percent mortality rate. Although this is a very low rate for this very small dose, when applied to a large group of people it gets scarier. For a population of one million people who are exposed to 500 mrem of ionizing radiation, the linear hypothesis predicts (in a simplified form) that 6,250 people will die from radiation-induced cancer. If 10 million people, in a city like New York, are exposed to this dose, 62,500 deaths will occur.

Regulators acknowledge that a prediction like "there will be 62,500 deaths in 10 million people exposed to 500 mrem of radiation" is an assumed risk. It is based on the *assumption* that "any exposure to ionizing radiation carries with it some risk," as the ALARA (As Low As Reasonably Achievable, below a maximum permissible dose of 5 rem/year) regulation puts it. Known and documented health-damaging effects of radiation—radiation sickness, leukemia, and death—are only observed with doses of 100 rem and greater. The risk of doses less than 100 rem is a black box into which regulators put "extrapolated data." There are *no* valid epidemiologic or experimental data to support linearly extrapolated predictions of cancer resulting from low doses of radiation. (Proponents argue that some studies support this model, but they "capriciously misrepresent" the data in those studies and apply the linear hypothesis in an *a priori* fashion to make the data fit, ignoring data that does not.)

Contrary to what is perceived to be true, the actual truth is that ionizing radiation in low doses does not cause cancer. It, in fact, has a beneficial effect on one's health. There are epidemiological studies and scientific data on health effects from low to moderate doses of ionizing radiation that show it *decreases* the risk of cancer. Government authorities and regulators—along with the news media—ignore this data.

The average American is exposed to 200 mrem of natural and medical radiation per year. Natural background radiation comes from cosmic rays, isotopes of uranium and thorium in the bricks, plaster, and concrete of buildings, and radioactive potassium. Radioactive potassium in our bodies generates about 25 mrem of radiation per year—more than the EPA safety limit. It comes from potassium-40, a naturally occurring radioactive isotope of potassium. People that suffer from radiophobia and think that they would be better off without that source of radioactivity in their bodies can take comfort in knowing that organisms grown in the laboratory consuming only non-radioactive potassium-39, with no potassium-40 in their diet, develop severe growth defects. The radiation that potassium-40 in our cells provides is vital for our health.

People who live in Ramsar, Iran, a resort on the Caspian Sea, are exposed to natural background radiation of 79,000 mrem per year, 5,266 times more than what the EPA's 15-mrem/year radiation safety standard allows. The local river and its streams have a high concentration of radium, which is 15 times more radioactive than plutonium. Its 2,000 residents do not have an increased incidence of cancer, as the linear hypothesis would predict, and their life span is no different than that of other Iranians. Fortunately, for that resort, EPA regulations don't apply there, or to people in Guarapari, Brazil, who get 17,500 mrem of radiation per year with no ill effect.

One place with high background radiation where EPA regulations do apply is a park in Santa Fe, Fountainhead Rock Place. It has radioactive rock of volcanic origin that emits 760 mrem of gamma radiation, 14 times the amount allowed by the EPA. Regulators, however, have chosen to make an exception here and have not closed the park off to the public.

A process known as radiation hormesis mediates the beneficial effect that radiation has on health. Investigators have found that small doses of radiation have a stimulating and protective effect on cellular function. It stimulates immune system defenses, prevents oxidative DNA damage, and suppresses cancer.

Epidemiological studies that document the beneficial effects of radiation include one done on atom bomb survivors. Despite what you might expect, atom bomb survivors in Nagasaki who received 1,000 to 19,000 mrem of radiation have a *lower* incidence of cancer, especially with regard to leukemia and colon cancer, than the non-irradiated control population. And it is turning out that Japan's atom bomb survivors are living longer. They have a death rate after the age of 55 that is lower than matched Japanese people not exposed to radiation. (Don't expect to hear this on the evening news.)

Another important epidemiological study has tracked the cancer mortality in people exposed to radiation from a thermonuclear explosion in 1957 in the Eastern Urals in the former Soviet Union. Investigators followed 8,000 people who were irradiated in that explosion for the next 30 years. The group exposed to 12,000 mrem (120 mSv) had a substantially lower cancer mortality compared with a non-irradiated control group that only was exposed to a normal 100 mrem of background radiation. The group that received a considerably higher dose of 50,000 mrem (500mSv) had a not quite as good but still statistically significant decrease in

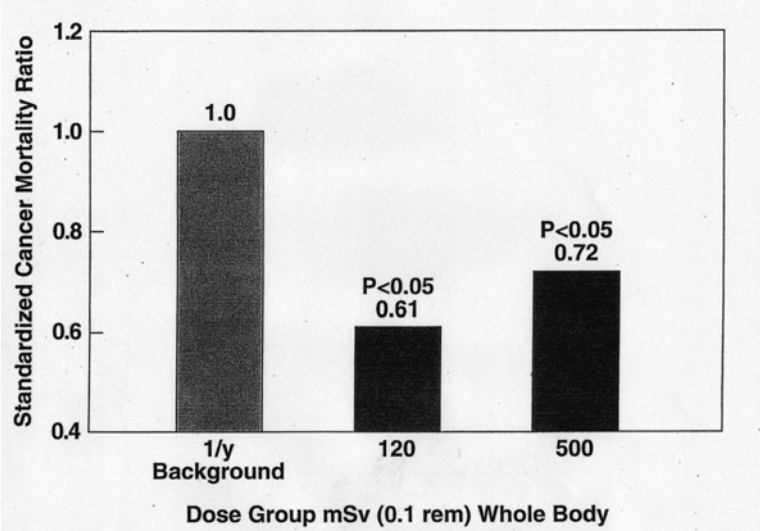

Figure 1. Standardized cancer mortality ratio in 3 exposure groups followed for 30 years after a thermal explosion. Jaworowski Z, 1995.

cancer mortality.

The same thing is seen with shipyard workers. Those that work on nuclear powered ships have a lower all cause mortality than non-nuclear workers. Investigators matched 29,000 nuclear workers (many received more than 5,000 mrem of radiation) with 33,000 non-nuclear workers. The linear hypothesis predicts that the non-nuclear workers will live longer. Just the opposite happened.

The radiation hormesis model also explains why residents of radon spa areas (in Japan, Germany, and central Europe) and people who live in homes that have high radon levels have a decreased incidence of cancer. But perhaps the most impressive study that shows just how good low dose radiation can be for you is one just published in the Spring 2004 issue of the *Journal of American Physicians and Surgeons*.

In Taiwan (in the early 1980s), 180 apartment buildings were built with recycled steel that was accidentally contaminated with Colbalt-60. The buildings' occupants, 4,000 people, lived in them for more than 10 years before their radioactive state was discovered. The amount of radiation they received ranged from 100 mrem to more than 1,500 mrem per year. (Colbalt-60 has a half-life of 5.3 years.) Very few of these people got cancer. Their cancer mortality over a 20 year period was *97 percent less* (3.5 deaths per 100,000 person years) than that of the general population of Taiwan (116 deaths per 100,000 person years). Even the incidence of congenital heart malformations in the children they bore was reduced. This carefully done study shows that, as its authors put it, "chronic radiation [far below EPA limits] is an effective prophylaxis against cancer."

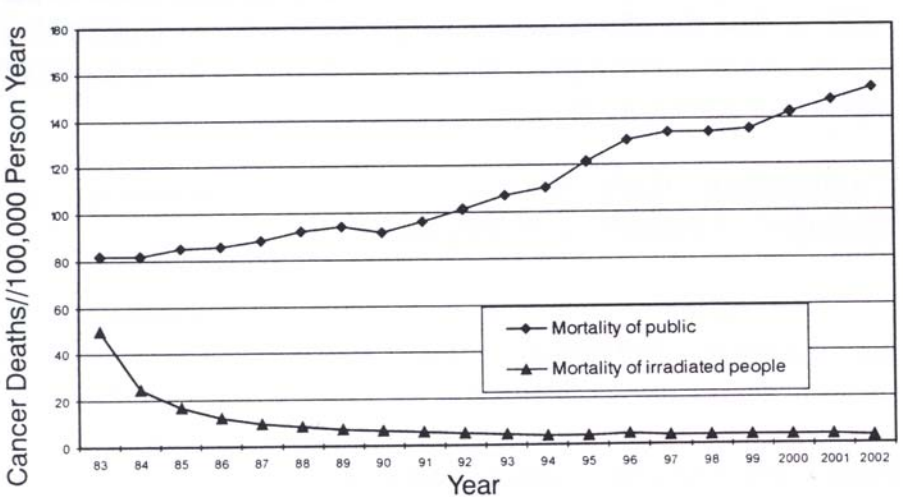

Figure 1. Cancer Mortality of the General Population and of the Exposed Population

Two of the leading scientists in this field, who study radiation hormesis and have been instrumental in disproving the linear hypothesis, are Bernard Cohen, Emeritus Professor of Physics, University of Pittsburgh and Myron Pollycove, Emeritus Professor of Nuclear Medicine, University of California at San Francisco. I first learned about radiation hormesis from talks they gave at meetings of Doctors for Disaster Preparedness (the doctors in this group include PhD. physicists, other PhD.s, and M.D.s). Their work stimulated me to study

this subject. Most physicians, however, know little or nothing about radiation hormesis and have not examined the scientific evidence that validates it. Whole-body low-dose radiation for cancer is a case in point. There is good evidence that it will slow the progression of different kinds of cancer. Most oncologists, however, not knowing anything about radiation hormesis, dismiss the idea out of hand. (It's not part of the "standard of care.") If you have cancer, the next time you see your oncologist, show him or her this *study* on low dose whole-body radiation as a treatment for cancer (along with a copy of this article).

One final point: Another problem with the absurdly low EPA and NRC radiation safety levels, in addition to a negative health benefit and the huge regulatory costs they incur, is that they will aid terrorists who use "dirty bombs"—conventional bombs wrapped with radioactive material. Even the most potent one wrapped with cobalt-60 will deliver only a few hundred mrem of radiation within a one-half mile radius of its detonation, an amount that kept those apartment dwellers in Taiwan from getting cancer—and is present in that still open park in Santa Fe. If federal authorities follow the EPA's 15 mrem/yr radiation safety regulation, they will order people to evacuate the city where the bomb goes off and shut the city down. As the data reviewed here shows, this will be completely unnecessary and serve only to further the terrorists' aims.

The citizens of Sacramento need to know that low to moderate doses of radiation are not harmful—and that there is even good evidence it will prevent cancer. And people who are afraid of nuclear power plants need to know that nuclear power is the safest and cleanest form of energy the planet has for producing electricity. That will be the subject of another article.