Meta-Review of 46 Studies: Even the Lowest-Level Radiation Is Damaging to Human Health

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Even *Miniscule* Amounts of Radiation Can Be Dangerous

A major new scientific study proves that low-level radiation can cause huge health problems.

Science Daily reports:

> Even the very lowest levels of radiation are harmful to life, scientists have concluded in the Cambridge Philosophical Society's journal Biological Reviews. Reporting the results of a wide-ranging analysis of 46 peer-reviewed studies published over the past 40 years, researchers from the University of South Carolina and the University of Paris-Sud found that variation in low-level, natural background radiation was found to have small, but highly statistically significant, negative effects on DNA as well as several measures of health.
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> The review is a meta-analysis of studies of locations around the globe …. "Pooling across multiple studies, in multiple areas, and in a rigorous statistical manner provides a tool to really get at these questions about low-level radiation."
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> Mousseau and co-author Anders Møller of the University of Paris-Sud combed the scientific literature, examining more than 5,000 papers involving natural background radiation that were narrowed to 46 for quantitative comparison. The selected studies all examined both a control group and a more highly irradiated population and quantified the size of the radiation levels for each. Each paper also reported test statistics that allowed direct comparison between the studies.
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> The organisms studied included plants and animals, but had a large preponderance of human subjects. Each study examined one or more possible effects of radiation, such as DNA damage measured in the lab, prevalence of a disease such as Down's Syndrome, or the sex ratio produced in offspring. For each effect, a statistical algorithm was used to generate a single value, the effect size, which could be compared across all the studies.
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> The scientists reported **significant negative effects in a range of categories, including immunology, physiology, mutation and disease occurrence**. The frequency of negative effects was beyond that of random chance.
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> "When you do the meta-analysis, you do see significant negative effects."
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> "It also provides evidence that **there is no threshold below which there**

> **are no effects of radiation**," he added. "A theory that has been batted around a lot over the last couple of decades is the idea that is there a threshold of exposure below which there are no negative consequences. These data provide fairly strong evidence that there is no threshold — radiation effects are measurable as far down as you can go, given the statistical power you have at hand."
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> Mousseau hopes their results, which are consistent with the "linear-no-threshold" model for radiation effects, will better inform the debate about exposure risks. "With the levels of contamination that we have seen as a result of nuclear power plants, especially in the past, and even as a result of Chernobyl and Fukushima and related accidents, there's an attempt in the industry to downplay the doses that the populations are getting, because maybe it's only one or two times beyond what is thought to be the natural background level," he said. "But they're assuming the natural background levels are fine."
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> "And the truth is, if we see effects at these low levels, then we have to be thinking differently about how we develop regulations for exposures, and especially intentional exposures to populations, like the emissions from nuclear power plants, medical procedures, and even some x-ray machines at airports."

(We will address the question blow as to how most of us can remain healthy if even small doses of background radiation may be harmful.)

Numerous Other Studies Show the Danger of Low-Level Radiation

Indeed, the *overwhelming* consensus among radiation experts is that repeated exposure to low doses of radiation can cause cancer, genetic mutations, heart disease, stroke and other serious illness (and seethis.)

The top government radiation experts – like Karl Morgan, John Goffman and Arthur Tamplin – and scientific luminaries such as Ernest Sternglass and Alice Stewart, concluded that low level radiation can cause serious health effects.

A 20-year study involving 110,000 workers who engaged in cleanup work related to the Chernobyl nuclear plant disaster in 1986 found that even low-level radiation causes a significant increase in the risk of leukemia.

A military briefing written by the U.S. Army for commanders in Iraq states:

> Hazards from low level radiation are long-term, not acute effects… Every exposure increases risk of cancer.

(Military briefings for commanders often contain less propaganda than literature aimed at civilians, as the commanders have to know the basic facts to be able to assess risk to their soldiers.)

The briefing states that doses are cumulative, citing the following military studies and reports:

- ACE Directive 80-63, ACE Policy for Defensive Measures against Low Level Radiological Hazards during Military Operations, 2 AUG 96
- AR 11-9, The Army Radiation Program, 28 MAY 99

- FM 4-02.283, Treatment of Nuclear and Radiological Casualties, 20 DEC 01
- JP 3-11, Joint Doctrine for Operations in NBC Environments, 11 JUL 00
- NATO STANAG 2473, Command Guidance on Low Level Radiation Exposure in Military Operations, 3 MAY 00
- USACHPPM TG 244, The NBC Battle Book, AUG 02

Many studies have shown that repeated exposures to low levels of ionizing radiation from CT scans and x-rays can cause cancer. See this, this, this. this, this, this, this, this, this and this.

Research from the University of Iowa concluded:

> Cumulative radon exposure is a significant risk factor for lung cancer in women.

And see these studies on the health effects cumulative doses of radioactive cesium.

As the European Committee on Radiation Risk notes:

> Cumulative impacts of chronic irradiation in low doses are … important for the comprehension, assessment and prognosis of the late effects of irradiation on human beings ….

And see this.

The New York Times' Matthew Wald reported in May:

> The Bulletin of the Atomic Scientists['] May-June issue carries seven articles and an editorial on the subject of low-dose radiation, a problem that has thus far defied scientific consensus but has assumed renewed importance since the meltdown of the Fukushima Daiichi reactors in Japan in March 2011.
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> This month a guest editor, Jan Beyea [who received a PhD in nuclear physics from Columbia and has served on a number of committees at the National Research Council of the National Academies of Science] and worked on epidemiological studies at Three Mile Island, takes a hard look at the power industry.
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> The bulletin's Web site is generally subscription-only, but this issue can be read at no charge.
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> Dr. Beyea challenges a concept adopted by American safety regulators about small doses of radiation. The prevailing theory is that the relationship between dose and effect is linear – that is, that if a big dose is bad for you, half that dose is half that bad, and a quarter of that dose is one-quarter as bad, and a millionth of that dose is one-millionth as bad, with no level being harmless.
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> The idea is known as the "linear no-threshold hypothesis,'' and while most

scientists say there is no way to measure its validity at the lower end, applying it constitutes a conservative approach to public safety.

Some radiation professionals disagree, arguing that there is no reason to protect against supposed effects that cannot be measured. But **Dr. Beyea contends that small doses could actually be disproportionately worse.**

Radiation experts have formed a consensus that if a given dose of radiation delivered over a short period poses a given hazard, that hazard will be smaller if the dose is spread out. To use an imprecise analogy, if swallowing an entire bottle of aspirin at one sitting could kill you, consuming it over a few days might merely make you sick.

In radiation studies, this is called a dose rate effectiveness factor. Generally, a spread-out dose is judged to be half as harmful as a dose given all at once.

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Dr. Beyea, however, proposes that doses spread out over time might be more dangerous than doses given all at once. [Background] He suggests two reasons: first, some effects may result from genetic damage that manifests itself only after several generations of cells have been exposed, and, second, a "bystander effect," in which a cell absorbs radiation and seems unhurt but communicates damage to a neighboring cell, which can lead to cancer.

One problem in the radiation field is that **little of the data on hand addresses the problem of protracted exposure**. Most of the health data used to estimate the health effects of radiation exposure comes from survivors of the Hiroshima and Nagasaki bombings of 1945. That was mostly a one-time exposure.

Scientists who say that this data leads to the underestimation of radiation risks cite another problem: **it does not include some people who died from radiation exposure immediately after the bombings.** The notion here is that the people studied in ensuing decades to learn about the dose effect may have been stronger and healthier, which could have played a role in their survival.

Still, the idea that the bomb survivor data is biased, or that stretched-out doses are more dangerous than instant ones, is a minority position among radiation scientists.

Dr. Beyea writes:

Three recent epidemiologic studies suggest that the risk from protracted exposure is no lower, and in fact may be higher, than from single exposures.

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Conventional wisdom was upset in 2005, when an international study, which focused on a large population of exposed nuclear workers, presented results that shocked the radiation protection community—and foreshadowed a sequence of research results over the following years.

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It all started when epidemiologist Elaine Cardis and 46 colleagues surveyed some 400,000 nuclear workers from 15 countries in North America, Europe, and Asia—workers who had experienced chronic exposures, with doses measured on radiation badges (Cardis et al., 2005).

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This study revealed a higher incidence for protracted exposure than found in the atomic-bomb data, representing a dramatic contradiction to expectations based on expert opinion.

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A second major occupational study appeared a few years later, delivering another blow to the theory that protracted doses were not so bad. This 2009 report looked at 175,000 radiation workers in the United Kingdom ….

After the UK update was published, scientists combined results from 12 post-2002 occupational studies, including the two mentioned above, concluding that protracted radiation was **20 percent more effective in increasing cancer rates than acute exposures** (Jacob et al., 2009). The study's authors saw this result as a challenge to the cancer-risk values currently assumed for occupational radiation exposures. That is, they wrote that the radiation risk values used for workers should be increased over the atomic-bomb-derived values, not lowered by a factor of two or more.

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In 2007, **one study—the first of its size—looked at low-dose radiation risk in a large, chronically exposed civilian population**; among the epidemiological community, this data set is known as the "Techa River cohort." From 1949 to 1956 in the Soviet Union, while the Mayak weapons complex dumped some 76 million cubic meters of radioactive waste water into the river, approximately 30,000 of the off-site population—from some 40 villages along the river—were exposed to chronic releases of radiation; residual contamination on riverbanks still produced doses for years after 1956.

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Here was a study of citizens exposed to radiation much like that which would be experienced following a reactor accident. About 17,000 members of the cohort have been studied in an international effort (Krestinina et al., 2007), largely funded by the US Energy Department; and to many in the department, this study was meant to definitively prove that protracted exposures were low in risk. **The results were unexpected**. The slope of the LNT fit turned out to be higher than predicted by the atomic-bomb data, providing additional evidence that protracted exposure does not reduce risk.

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In a 2012 study on atomic-bomb survivor mortality data (Ozasa et al., 2012), l**ow-dose analysis revealed unexpectedly strong evidence for the applicability of the supralinear theory**. From 1950 to 2003, more than 80,000 people studied revealed high risks per unit dose in the low-dose range, from 0.01 to 0.1 Sv.

A major new study of atomic bomb data by the official joint U.S.-Japanese government study of the Hiroshima and Nagasaki survivors found that low dose radiation causes cancer and genetic damage:

And Dr. Peter Karamoskos notes:

> The most comprehensive study of nuclear workers by the IARC, involving **600,000 workers** exposed to an average cumulative dose of 19mSv, showed a cancer risk consistent with that of the A-bomb survivors.

It's not just humans: scientists have found that animals receiving low doses of radiation from Chernobyl are sick as well.

Ignore the Voodoo Science Pushers

If radiation is so dangerous, why do government and nuclear energy officials pretend that radiation is harmless?

Because governments have been covering up the danger of radiation for 67 years in order to protect the nuclear arms and nuclear energy industries.

But If Naturally-Occurring Radiation Is Bad For Us, Why Are Most of Us Healthy?

If background radiation is harmful, how have so many people remained healthy?

Initially – as we have previously pointed out – there was *no* background radioactive cesium or iodine before above-ground nuclear testing and nuclear accidents started.

Wikipedia provides some details on the distribution of cesium-137 due to human activities:

> Small amounts of caesium-134 and caesium-137 were released into the environment during nearly all nuclear weapon tests and some nuclear accidents, most notably the Chernobyl disaster.
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> **Caesium-137 is unique in that it is totally anthropogenic**. Unlike most other radioisotopes, caesium-137 is not produced from its non-radioactive isotope, but from uranium. **It did not occur in nature before nuclear weapons testing began**. By observing the characteristic gamma rays emitted by this isotope, it is possible to determine whether the contents of a given sealed container were made before or after the advent of atomic bomb explosions. This procedure has been used by researchers to check the authenticity of certain rare wines, most notably the purported "Jefferson bottles".

As the EPA notes:

> Cesium-133 is the only naturally occurring isotope and is non-radioactive; all other isotopes, including cesium-137, are produced by human activity.

Likewise, iodine-131 is not a naturally occurring isotope. As the Encyclopedia Britannica notes:

> The only naturally occurring isotope of iodine is stable iodine-127. An exceptionally useful radioactive isotope is iodine-131…

(Fukushima has spewed much more radioactive cesium and iodine than Chernobyl. Fukushima is still spewing radiation into the environment, and the amount of radioactive fuel at Fukushima dwarfs Chernobyl.)

As such, the concept of "background radiation" is largely a misnomer. Most of the radiation we encounter today – especially the most dangerous types – did not even exist in nature before we started tinkering with nuclear weapons and reactors. In a sense, we are all guinea pigs.

Moreover, internal emitters – radioactive particles which end up inside of our lungs or gastrointestinal track, as opposed to radiation which comes to us from outside of our skin – are *much* more dangerousthan general exposures to radiation. See this, this, this and this.

For example, the head of a Tokyo-area medical clinic – Dr. Junro Fuse, Internist and head of Kosugi Medical Clinic – said recently:

> Risk from internal exposure is **200-600 times greater** than risk from external exposure.

There are few *natural* high-dose internal emitters. Bananas, brazil nuts and some other foods contain radioactive potassium-40, but in *extremely low* doses.

True, some parts of the country are at higher risk of exposure to naturally-occurring radium than others.

But the cesium which was scattered all over the place by above-ground nuclear tests and the Chernobyl and Fukushima accidents has a much longer half life, and can easily contaminate food and water supplies. As the New York Times noted recently:

> Over the long term, the big threat to human health is cesium-137, which has a half-life of 30 years.
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> At that rate of disintegration, John Emsley wrote in "Nature's Building Blocks" (Oxford, 2001), "it takes over 200 years to reduce it to 1 percent of its former level."
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> It is cesium-137 that still contaminates much of the land in Ukraine around the Chernobyl reactor.
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> Cesium-137 mixes easily with water and is chemically similar to potassium. It thus mimics how potassium gets metabolized in the body and can enter through many foods, including milk.

As the EPA notes in a discussion entitled " What can I do to protect myself and my family from cesium-137?":

> Cesium-137 that is dispersed in the environment, like that from atmospheric testing, is impossible to avoid.

Radioactive iodine can also become a potent internal emitter. As the Times notes:

> Iodine-131 has a half-life of eight days and is quite dangerous to human health. If absorbed through contaminated food, especially milk and milk products, it will accumulate in the thyroid and cause cancer.

The bottom line is that there is some naturally-occurring background radiation, which can – at times – pose a health hazard (especially in parts of the country with high levels of radioactive radon or radium).

But cesium-137 and radioactive iodine – the two main radioactive substances being spewed by the leaking Japanese nuclear plants – are not naturally-occurring substances, and can become powerful internal emitters which can cause tremendous damage to the health of people who are unfortunate enough to breathe in even a particle of the substances, or ingest them in food or water.

Unlike low-levels of radioactive potassium found in bananas – which our bodies have adapted to over many years – cesium-137 and iodine 131 are brand new, extremely dangerous substances.

And unlike naturally-occurring internal emitters like radon and radium – whose distribution is largely concentrated in certain areas of the country – radioactive cesium and iodine are being distributed globally through weapons testing and nuclear accidents.

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