Low Dose Radiation Health and Medical Benefits: A Century of Hard Data and Soft Science

Doctors for Disaster Preparedness

Las Vegas, July 17, 2005

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Independent Individuals Knowledgeable in Radiation Science and Public Policy

Committed to Change Radiation Science Policy in the Public Interest

Center for Nuclear Technology and Society at WPI

Worcester Polytechnic Institute

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Committed to Research and Education, on:

- **Public benefits and costs**
- **Public decision processes**

Program Areas:

- ***Technology Assessment for Public Policy***
- ***Engineering Design / Analysis Standards***
- ***Societal Decision-making in the Public Interest***

ABSTRACT:

Low-Dose Radiation (LDR) has always stimulated biopositive effects. It is biologically essential! It enhances immune and other functions. Medical use prevents / cures some cancers, infections, inflammatory diseases, and other conditions.

Rad protection policy (e.g., NCRP-136, BEIR VII) doesn't consider LDR data, since 1930s. It prevents medical use, causing deaths.

Rad protection research policy constrains relevant research. Rad protection-funded research, and closed, biased, "reviews" (e.g., BEIR VII) misrepresent data, to support the LNT.

These policies cause massive public costs with NO public benefits; and even a LARGE public detriment.

WE MUST: Document the contradictory science; Challenge 'scientific misconduct;' Change radiation limits/rules; Apply LDR for health and medical treatment – clinical trials.

CONCLUSIONS:

POLICY ACTIONS:

- Investigate 'scientific misconduct'.
- Create independent, open, unbiased, international, science review.
- Challenge rules; Inaugurate government agency rule-makings.
- Defer extreme, costly, radiation protection projects / programs.
- Conduct LDR clinical trials; research to optimize modes / doses.

PRACTICE ACTIONS:

- Reform "risk analysis" methods.
- Reform rad protection practices (Professionalise HP).
- Reform rad design standards (Cost-effective engineering).

CREATE: A "level playing field" on health and enviro risks.

PRODUCE A LEGACY: A world not at risk of conflict / war over oil supplies, and destructive human health and environmental costs, for your children and grandchildren (vs. LNT 'profits').

Low-Dose Radiation (LDR): Stimulates Biological Functions

- From 1896
- 1,000s of studies, plus extensive human experience in medical LDR treatments
  - Generally, dozens of studies each year!
- To 2005

First reports: "The Electrical Engineer," August 19, 1896: "EXPERIMENTS WITH X-RAYS UPON GERMS.

"Some experiments have been made by Dr. William Shrader, of the Missouri State University, to test the effect of the Röntgen rays upon various disease germs. In nearly every instance these are reported to have met with success and prove conclusively that the rays are invaluable in the treatment of these diseases. Among the first experiments were those made with the diphtheria bacilli…

"…two guinea pigs were inoculated with a solid culture of diphtheria, prepared in the bacteriological laboratory of the university. These pigs weighed 210 and 185 grams respectively. One was exposed to the rays for four hours in a wooden box, having a rubber cover, and is alive today after eight weeks, and no trace of the disease can be found. The other pig, not exposed to the rays, died within 28 hours after the injection of the poison. The post-mortem examination showed that his death was due to the diphtheria germs."

First reports: “The Electrical Engineer,” August 19, 1896:
“EXPERIMENTS WITH X-RAYS UPON GERMS.

- Direct radiation of bacillus had no effect on germs (although killed at high doses)
- Report bacillus being “engulfed” (macrophages)
- Repeated experiments, same results
- Later experiments show death with double the bacillus injection

In the editorial section: **“PHYSIOLOGICAL EFFECTS OF X-RAYS.”**

“…we print elsewhere a note concerning some experiments made by Dr. William Shrader, of the Missouri State University, on the effect of Rontgen rays on disease germs... The experiments with diphtheria bacilli appear to be conclusive, and from other sources we have heard of a number of equally successful experiments in treating consumptive patients with X-rays, but in the face of such contradictory evidence it is necessary to suspend judgment for a time, until more data on the subject is brought to light.”

La Nature, Revue des sciences et de leurs applications aux arts et al'industrie. Journal hebdomedaire illustre. 24th year, 1896, second half-year, page 65.

"Monsieur Lortet of Lyon sends us a note on the attenuation of tuberculosis infections by Roentgen rays. …he inoculated 8 guinea pigs (cobaya) and submitted 3 of them to X-rays. Every day the inoculated area of body of the three injected animals was exposed to X-rays. After six weeks, he observed considerable differences in the three animals... The untreated animals displayed ulcerous sores at the point of inoculation; the ganglions were thickened, their general condition was bad and made worse by loss of weight. …the three treated animals had no such sores, the ganglions were well delimited, their general condition was excellent as shown by a gain of weight. The three animals were not sacrificed."

Lortet and Genoud, Académie des sciences, 1896, pp 1511-1512

PATHOLOGIE EXPÉRIMENTALE. — *Tuberculose expérimentale atténuée par la radiation Röntgen.* — Note de MM. **L. Lortet** et **Genoud**, présentée par M. A. Chauveau.

« Toutes les personnes qui s'occupent de Microbiologie connaissent les remarquables recherches de M. Arloing d'une part, de M. Duclaux d'autre part, sur l'influence atténuante et destructive de la végétabilité qu'exerce, à l'égard de certaines bactéries, une exposition plus ou moins prolongée à l'influence de la radiation solaire.

» Il était donc permis de croire que les rayons Röntgen, qui impressionnent si énergiquement la plaque photographique, ne resteraient point inactifs s'ils étaient mis en présence de bactéries pathogènes. Mais l'expérimentation ne pouvait se faire que sur des animaux vivants, car nous avions constaté la résistance considérable que les tubes à cultures, même très minces, opposent à la pénétration des rayons X.

» L'expérience suivante montre que nous ne nous étions pas trompés :

» Le 23 avril 1896, huit cobayes de taille moyenne et à peu près du même âge sont inoculés au pli inguinal droit, après les précautions d'usage d'une antisepsie rigoureuse, avec du bouillon dans lequel on a trituré une rate d'un cobaye manifestement tuberculeux.

» Le 25 avril, trois cobayes pris au hasard dans ce lot d'animaux inoculés sont attachés sur une planchette, les jambes écartées, couchés sur le dos, et présentant au tube radiant la région inguinale injectée.

» La même opération est répétée chaque jour, pendant une heure au moins, depuis le 25 avril jusqu'au 18 juin.

» Le 9 juin, les cinq cobayes témoins présentent au membre inoculé des abcès ganglionnaires qui se sont ouverts spontanément et qui laissent écouler une suppuration blanchâtre. Les ganglions inguinaux du côté malade sont mous, empâtés au milieu des tissus circonvoisins.

» Les trois animaux traités n'ont point d'abcès et leurs ganglions inguinaux sont durs, régulièrement circonscrits.

Caffrey, W. and Wilson, N., "Medicinal Properties of Röntgen Rays," *Electrical World,* Jan. 9, 67, (1897).

"He was suffering from rheumatism to such an extent that a grain of morphine each night was necessary to enable him to sleep, and for five nights he had not had his clothes off. We exposed the affected hand for one half hour to the rays and that night he slept splendidly, the pain having almost entirely ceased. The next night we again treated him for 30 minutes and the following day he went to work. In a few days the swelling ceased entirely, and since then he has had no return of the rheumatism."

Caffrey, W. and Wilson, N., "Medicinal Properties of Röntgen Rays," *Electrical World,* Jan. 9, 67, (1897).

"The next case was a lady about 50 years old, who had lost the use of the fingers on her left hand, due to rheumatism, the disease being of five months standing. We treated her in precisely the same manner and she immediately recovered the use of her fingers."

Caffrey, W. and Wilson, N., "Medicinal Properties of Röntgen Rays," *Electrical World,* Jan. 9, 67, (1897).

"The next case was a little girl brought …to have a hand amputated. A sore had developed on the back of her hand, …continually giving off pus. We made a radiograph of the hand and discovered three pieces of glass lying next to the joint. Owing to the cramped condition of the fingers we were obliged to make a second negative, using a film in the place of a glass plate. Immediately after this treatment she sat upon her father's knee and fell asleep in his arms, not having been able to sleep before for several days. At the end of two weeks her father returned and brought a piece of bone which had sloughed out and reported that the inflammation had entirely disappeared and that the sore had healed over. From the time of the making of the radiograph to the present time she has had no pain."

Caffrey, W. and Wilson, N., "Medicinal Properties of Röntgen Rays," *Electrical World,* Jan. 9, 67, (1897).

"The next case was one of bronchitis of 30 years standing. We are still treating this gentleman, and the results so far have been remarkable. For 25 years he had not slept the entire night without waking up almost choked. But after the second treatment he was enabled to sleep all night, and now the pain has ceased entirely, the cough has been reduced over one half, the expectoration is not nearly what it was, and it is quite apparent that the treatment has killed the germs of fermentation, as the expectorated matter has no taste or odor. He can now use his voice immediately upon arising where, heretofore, it was several hours before he could speak above a whisper. His entire demeanor has changed..."

Caffrey, W. and Wilson, N., "Medicinal Properties of Röntgen Rays," *Electrical World*, Jan. 9, 67, (1897).

"[The above communication was received some two months ago, but for obvious reasons was not published. Personal inquiry has, however, led us to believe that Messrs. Wilson and Caffrey are perfectly sincere in their statements... –ED]"

C. S. Gager, "Effects of the Rays of Radium on Plants," *Mem. N.Y. Bot. Garden,* IV, (1908).

"The broadest, and at the same time the most definite generalization warranted by the work so far done is that the rays of radium act as a stimulus to metabolism. If this stimulus ranges between minimum and optimum points, all metabolic activities, whether constructive or destructive, are accelerated, but if the stimulus increases from the optimum toward the maximum point it becomes an over-stimulus, and all metabolic activities are depressed and finally completely inhibited. Beyond a certain point of over-stimulus recovery is impossible, and death results."

Pusey, W.A., The Biological Effects of Radium, *Science,* N.S. XXXIII, 861, June 30, 1911, 1001-1005.

"Similar results have been obtained by several observers from exposures of numerous forms of protozoa. Their growth is at first stimulated, then inhibited, and after intense exposures they are destroyed.

"In plants the results of experiments may be summarized briefly as first stimulation of growth, and under stronger application, retardation or complete inhibition of growth.

"This consideration has been directed to the effects of radium rays. As to the emanations [i.e., radon -JM], it may be stated briefly that experiments with the emanations upon young mice, upon bacteria, and upon protozoa show results quite like those from exposure to the rays."

SCIENCE

FRIDAY, SEPTEMBER 3, 1915

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RECENT STUDIES ON THE BIOLOGICAL EFFECTS OF RADIOACTIVITY[1]

X-RAYS were discovered in 1895 and the first of the publications which placed Madame Curie, the discoverer of radium, in the position of foremost woman of science, appeared in 1898. The application of these results to biology, a matter of great importance, was brought about through accident. A knowledge of the physical properties of radio-active substances would lead one to expect that the physiological action would be acute, and that fact was accidentally proven to be true.

A. Richards, "Recent Studies on the Biological Effects of Radioactivity," *Science*, XLII, 1079, 287-300 (1915)

"In general, it may be said that when living cells are exposed to action of radioactivity, the vital functions are retarded or depressed and a permanent injury may result… When the intensity of the radiation is great, …for a long time, the effects are much more injurious than when the intensity is less. Indeed, numerous cases have been reported where a qualitative difference results from a slight radiation as contrasted with one of great intensity, for frequently stimuli which will retard growth if of high degree will be found to accelerate it if weak enough."

A. Richards, "Recent Studies on the Biological Effects of Radioactivity," *Science,* XLII, 1079, 287-300 (1915)

"The facts, as they are at present known in regard to the effects of radioactivity on living matter, show that life processes are subject to marked changes under the influence of the radiation, a slight exposure being accelerative in most cases while a more intense treatment is inhibitive or destructive."

Low-Dose Radiation (LDR): Stimulates Biological Functions

- Early studies on infections and physiology, e.g.
  - **http://cnts.wpi.edu/rsh/docs/earlystudies.html**
- Early studies on immunity in cancer, e.g.
  - **http://cnts.wpi.edu/rsh/docs/earlyimmune.html**
- See also:
  - **http://cnts.wpi.edu/RSH/Docs/LiuANS_Nov2002.htm**
  - http://cnts.wpi.edu/RSH/Docs/LiuAmherst2002ppt_files/v3_document.htm **(PowerPoint slide presentation converted for the Web)** **Dr. Shu-Zheng Liu, Amherst MA, BELLE Conf, June 2002.**

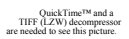
J. Murphy, "The Effect of Physical Agents on the Resistance of Mice to Cancer," PNAS, Vol 6 (1920)

"…repeated small or single large doses would destroy the lymphoid tissue, a single small exposure to a ray of suitable quality would stimulate the lymphocytes."

"By this treatment we increased the resistance [to replants of their own spontaneous tumors] from 3.4% in controls to 50%."

"(We)…expose mice to a stimulating dose of x-rays and then inoculate them [and controls] with a transplantable cancer a week later…"
Average of 3 series: 27.5% vs. 75.1% controls

1942


QuickTime™ and a
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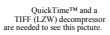
are needed to see this picture.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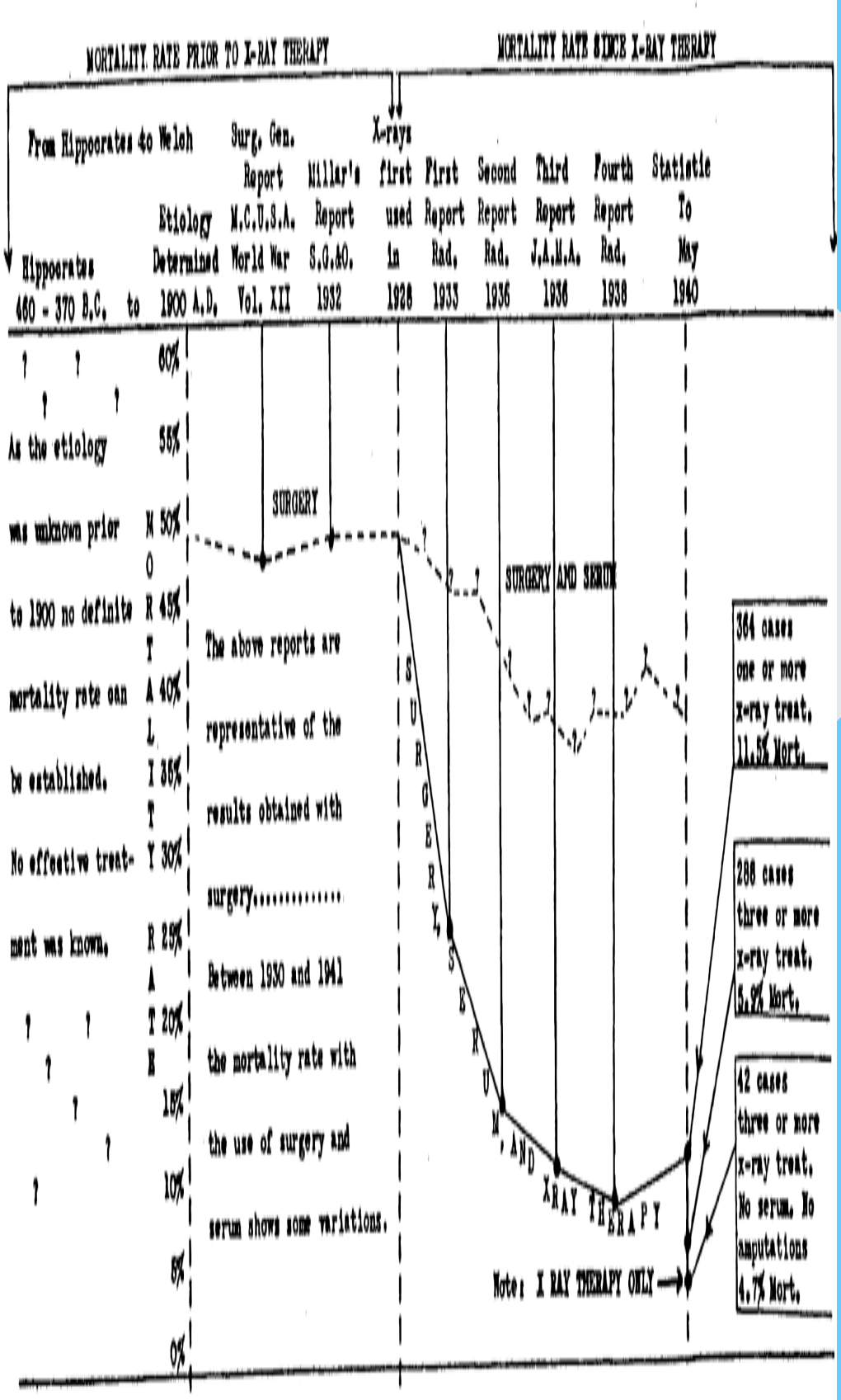


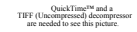
FIG. 15.—The end of gas bacillus infection as a serious infection (if x-ray therapy is used).

Low-Dose Radiation (LDR): Stimulates Biological Functions

- **Enzymes: Improve DNA repair (of billions of times more DNA damage from metabolism than LDR); including "double strand breaks"**
- **Apoptosis: Improves removal of damaged cells**
- **Immunologically important proteins and genes: p53, BAX, c-fos, Bcl-2, etc. etc.**
- **Immune system cells and molecules: Macrophages, IL-2, IL-4, CD-4, CD-8, etc. etc.**

Liu, S.Z.

2000



Dose-response curves of signal molecules in the thymus after whole-body X-irradiation

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Molecular changes after whole-body irradiation with low versus high doses
A. Cell survival related genes—mRNA transcription (odd numbers for thymus and even numbers for spleen); B. Cell survival related genes—protein expression (in thymus except columns 10 and 14 which stand for Peyer's patch); C. Signal transduction molecules of thymus; D. Interleukin genes—mRNA (odd numbers for thymus and even numbers for spleen)

Low-Dose Radiation (LDR): Stimulates Biological Functions

Shu-Zheng Liu, Center for Radiobiology and Molecular Biology, Changchung China, Ministry of Public Health, Jilin Univ., Norman Bethune School of Medical Sciences, 1997

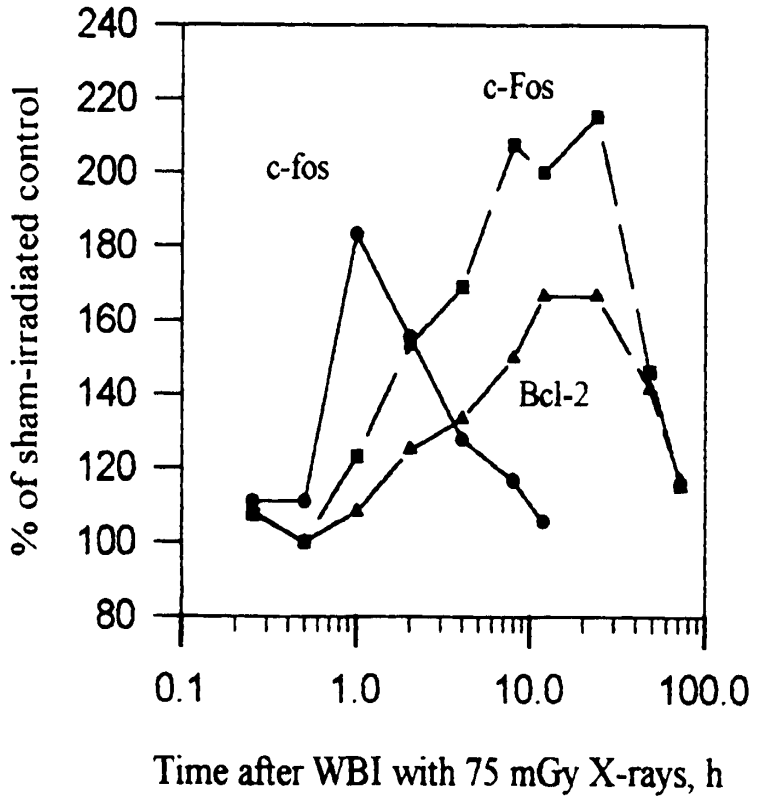
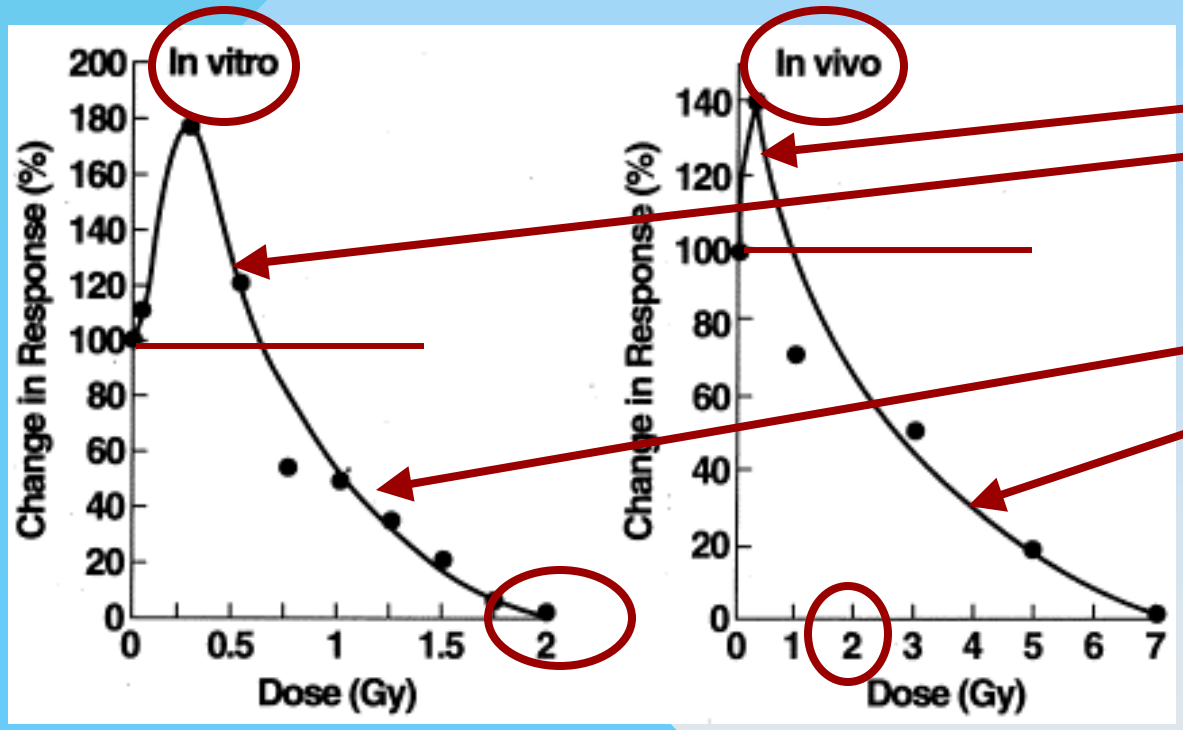


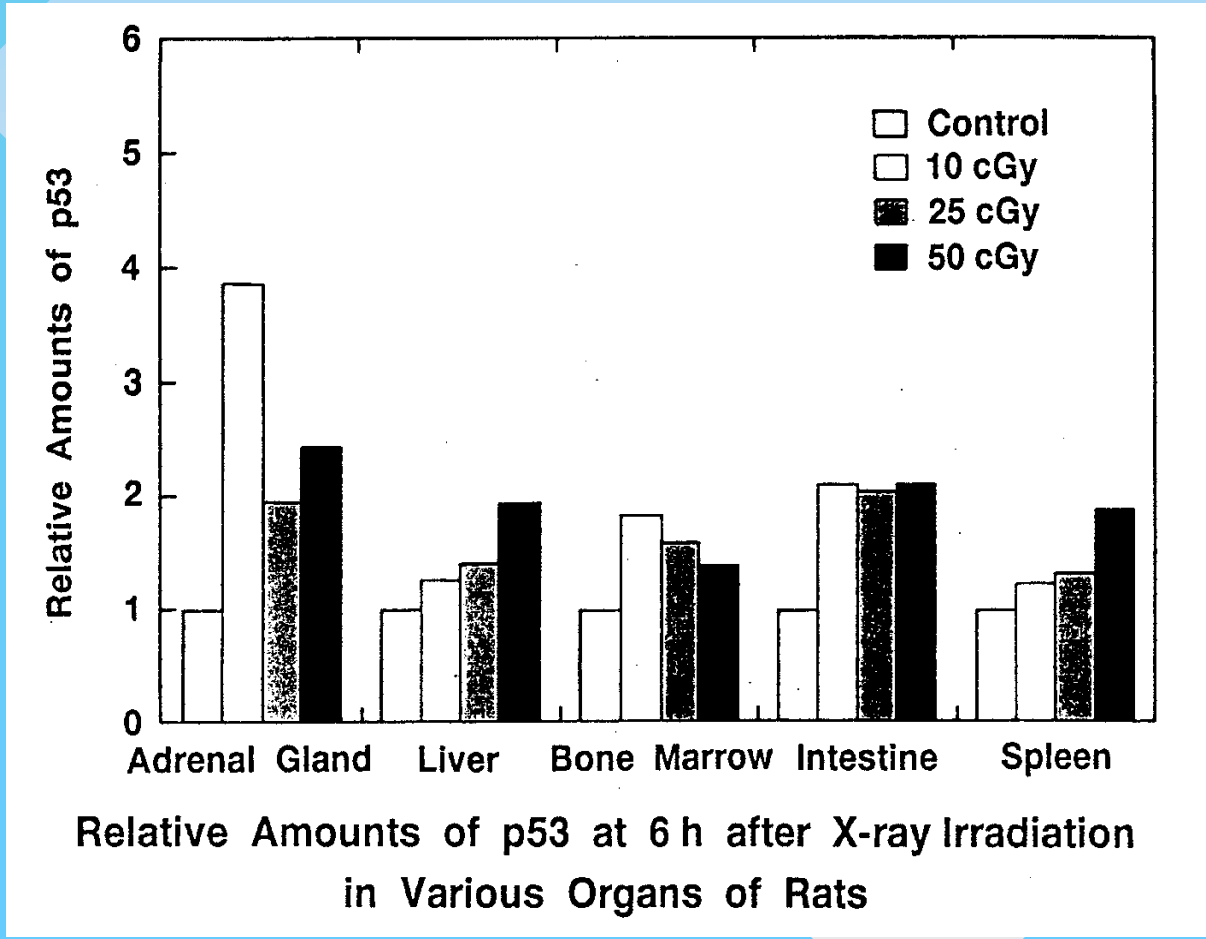
Fig. 8. Induction of c-fos and expression of c-Fos and Bcl-2 proteins in the thymus after LDR

Low-Dose Radiation (LDR): Stimulates Biological Functions



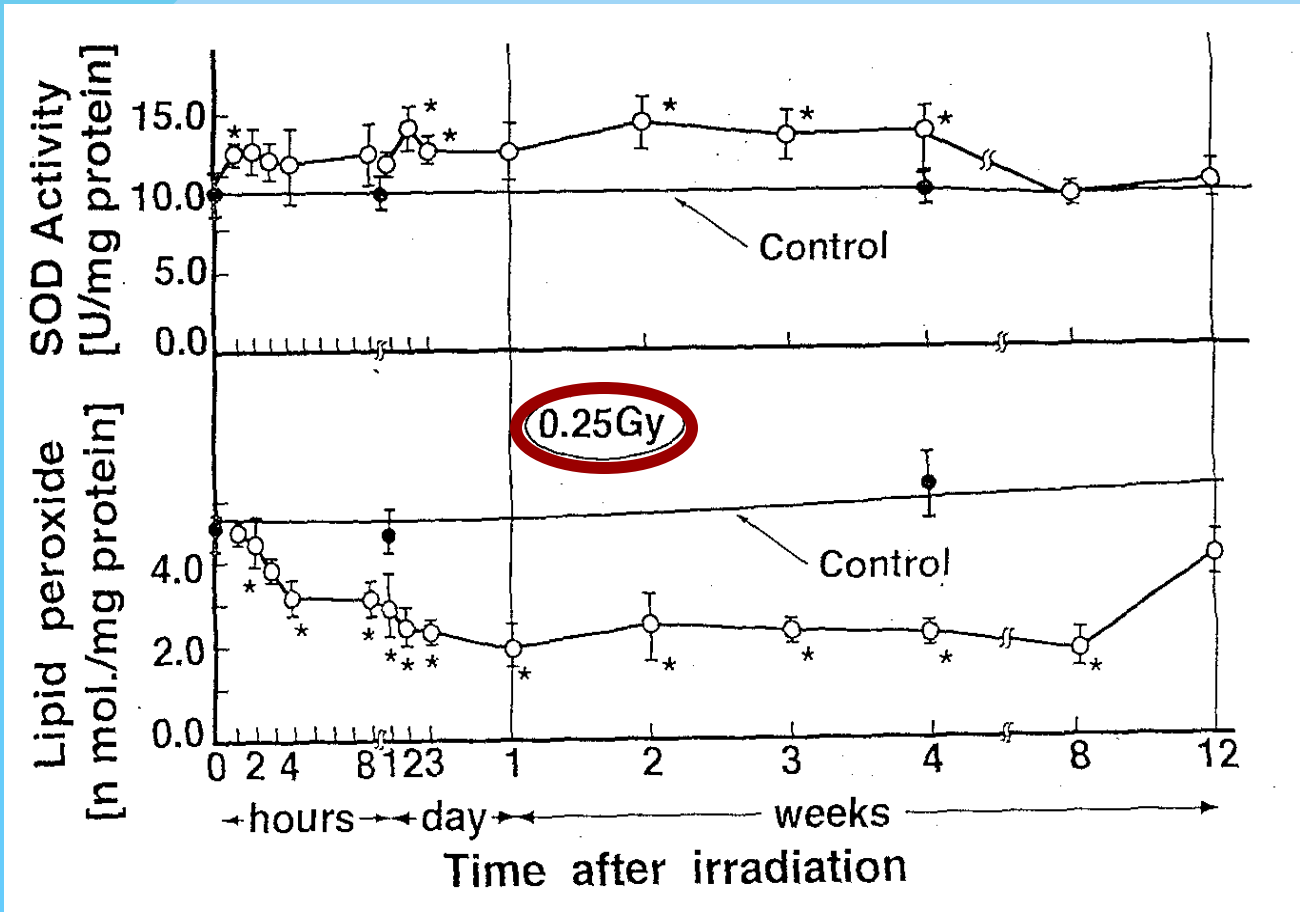
Takashi Makinodan and Jill James, UCLA, 1990: Immune system response, mouse splenic cells induced with sheep red blood cell antigen

Low-Dose Radiation (LDR): Stimulates Biological Functions



Relative Amounts of p53 at 6 h after X-ray Irradiation in Various Organs of Rats

Low-Dose Radiation (LDR): Stimulates Biological Functions



Yamaoka, K., 1991, Free Radical Biology and Medicine

Low Dose Radiation (LDR): Stimulates Biological Functions - GPx and SOD

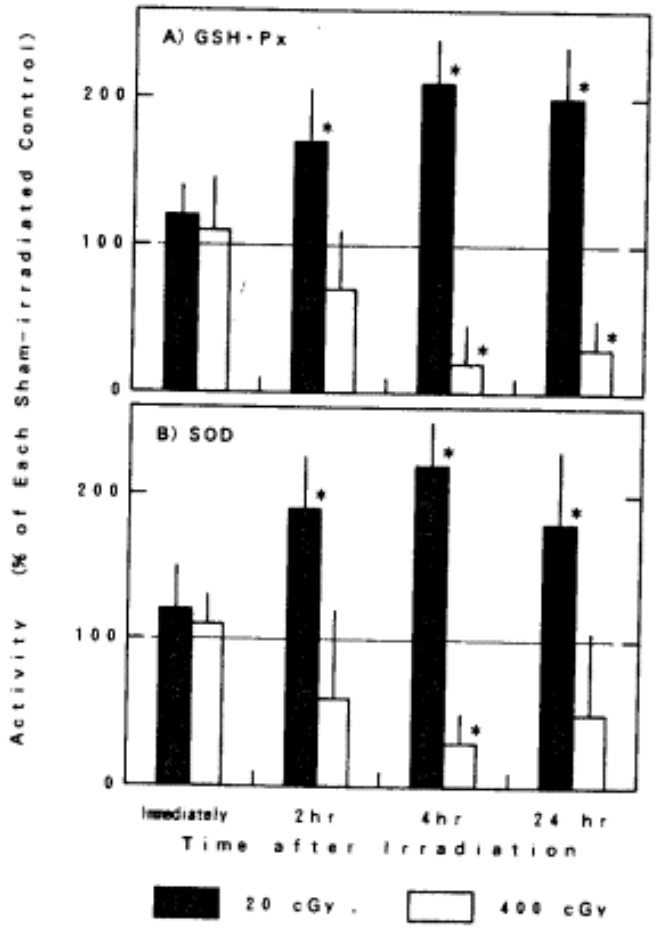


Fig. 1. Dose- and time-dependent changes in the activities of glutathione peroxidase and superoxide dismutase in BALB/c mice spleens after X-irradiation. The percentages of measured values at various intervals after irradiation as compared with the values at the same intervals after sham irradiation are shown. Each value indicates the mean ± SEM. The number of mice per experimental point is 8–12. *, $P < 0.05$ by t-test, irradiated group values vs. sham-irradiated group value at same intervals.

Low dose - stimulate

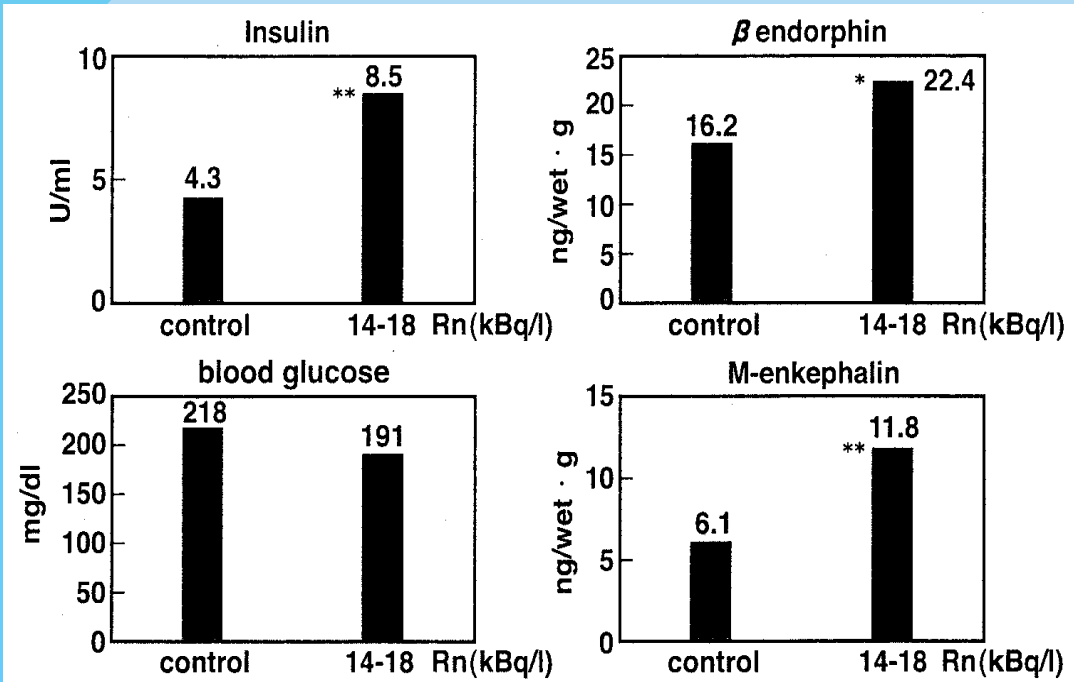
High dose - suppress

Opposite response!

Yamaoka 1998, Japan, Biochim Biophys Acta

Low Dose Radiation (LDR): Stimulates Biological Functions

- Diabetes-Related and Pain Relief Hormones: Radon inhalation rabbits



Number of rabbits : 9-10/experiment *:P<0.05, **:P<0.01 vs control.

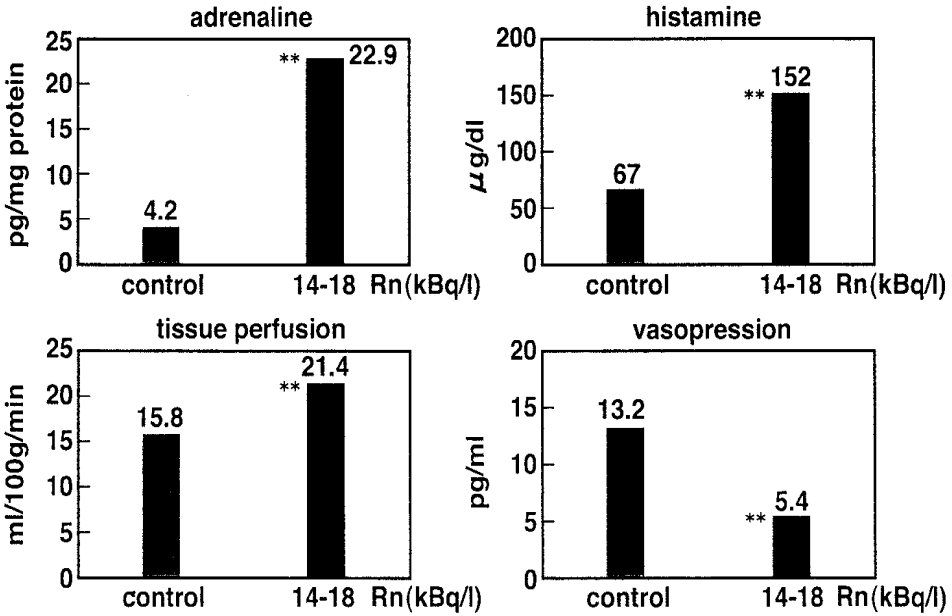
Diabetes Associated and Pain Relief Hormone Changes after Inhalation

Experiment of Radon Inhalation on Rabbits

(Yamaoka, Suzuka, Komoto, Okayama, Univ.)

1993, Arch Biochem Biophys

Low Dose Radiation (LDR): Stimulates Biological Functions - Vitalizing and Blood Pressure Hormone Responses: Radon inhalation rabbits



Number of rabbits : 8-15/experiment **:P<0.01 vs control.

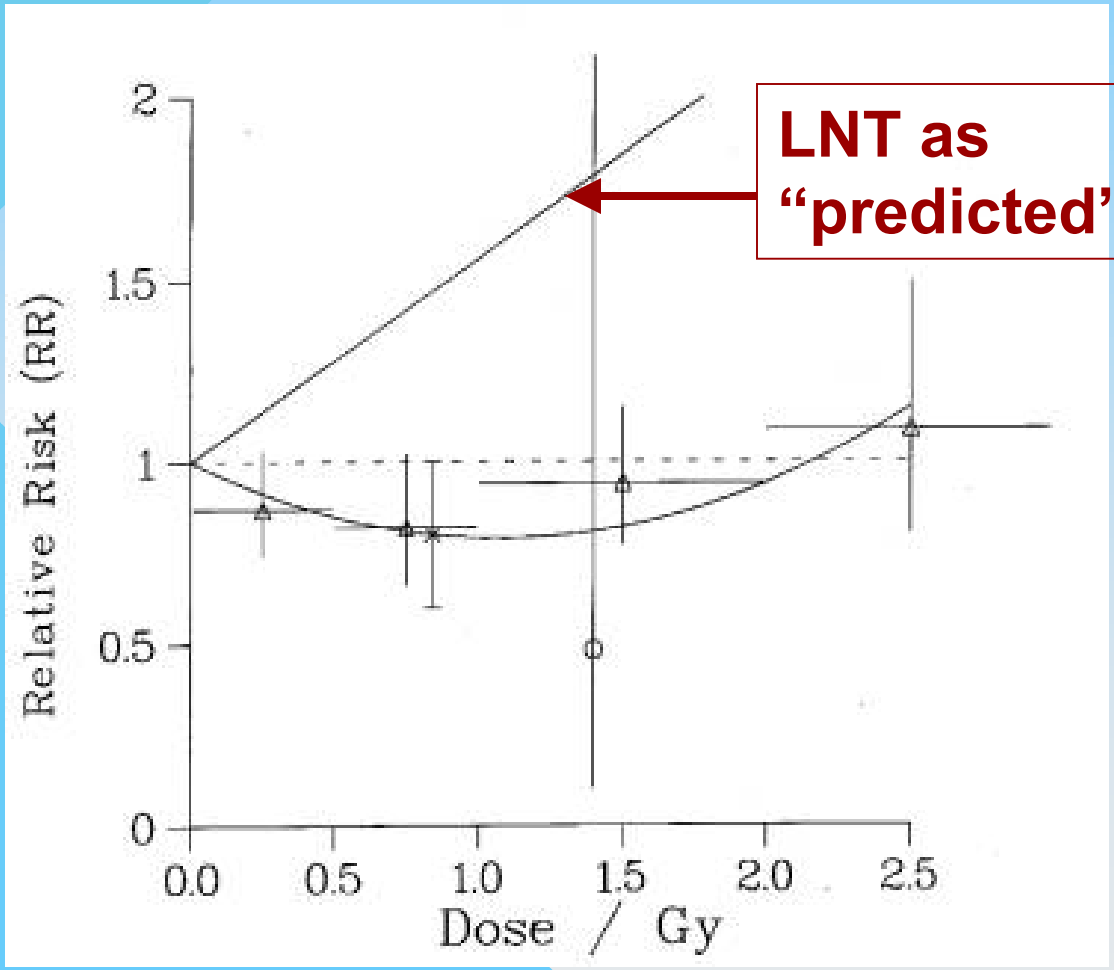
Vivification and Change of Vasoactive Hormone after Inhalation

Experiment of Radon Inhalation on Rabbits
(Yamaoka, Suzuka, Komoto Okayama Univ.)

Recent example of human data

"Izv Akad Nauk Ser Biol. 2005 Jan-Feb;(1): 9-17 **Response of the glutathione system to chronic irradiation of human population after the Chernobyl accident** [in Russian]
A complex relationship between plasma glutathione level in human population (children living in radionuclide-contaminated regions and the Chernobyl liquidators) exposed to chronic low-level radiation after the Chernobyl accident was demonstrated. The obtained experimental data indicate different responses of the human glutathione system to low (from 0.1 to 20 cSv) and high (from 20 to 150 cSv) doses of ionizing radiation."

LDR Data: Contradict the LNT

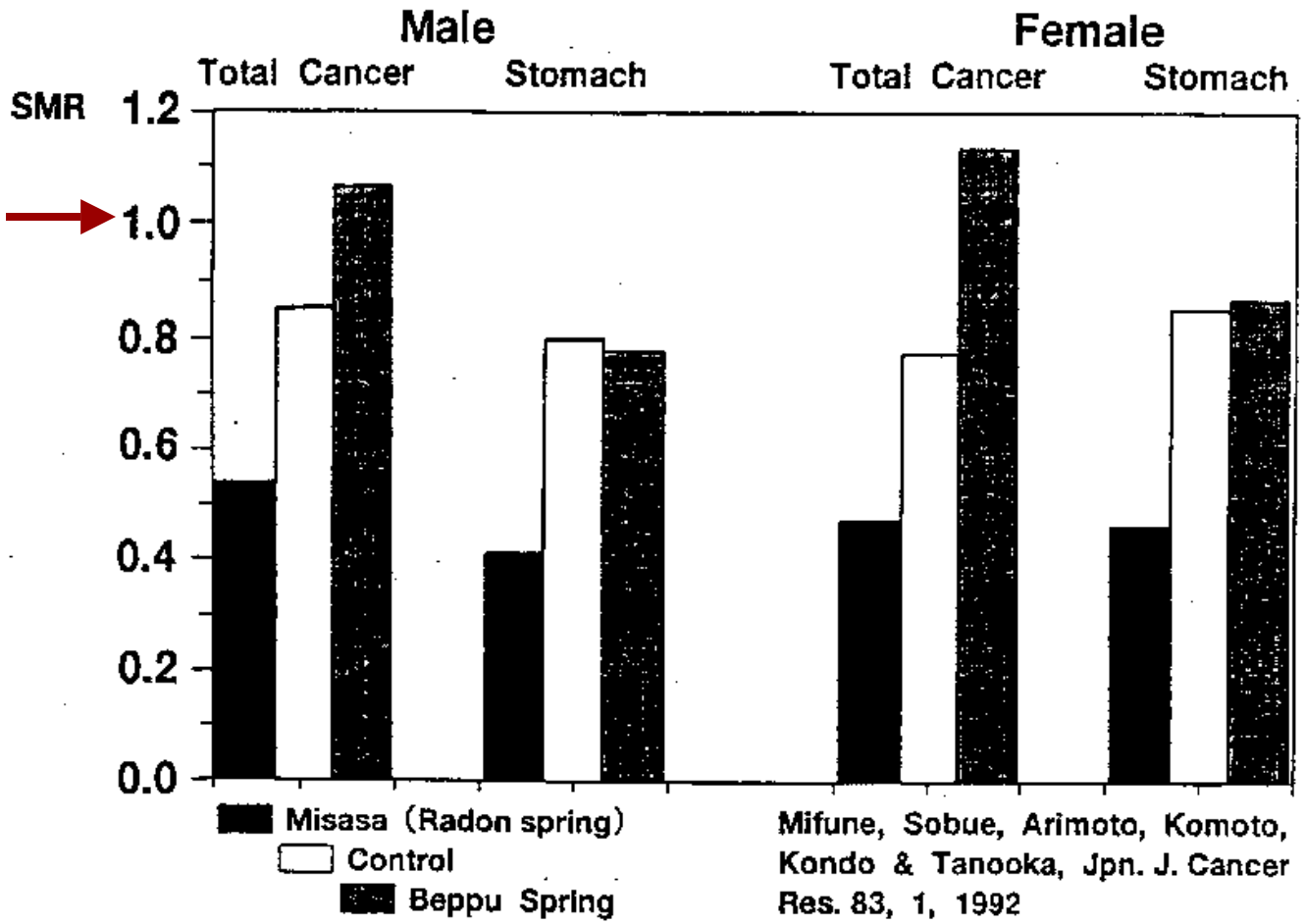


Harald Rossi (BEIR III Committee) and Marco Zaider (NCRP), 1997 and 1999

- <u>all</u> the data (26 refs) on lung cancer vs. external dose (x-ray)

LDR Data: Contradict the LNT

Japan rate



Comparison of standardized mortality ratio, Misasa / control area, lowest correspond to Misasa.

LDR Data: Contradict the LNT

- **Manhattan Project animal studies, e.g.:**
  - **External rad, inhalation & ingestion groups live longer.**
- **Hugh Henry (Oak Ridge) 1961, JAMA**
  "No adverse effects in ALL known 'low-dose' studies!" (Defined as < 1 R / day!)
- **Dr. Rosalyn Yalow, Nobel Laureate:**
  "No adverse effects at medical diagnostic doses."
  (Millions of people!)
- **Hundreds such reviews of the science!**

LDR Data: Contradict the LNT

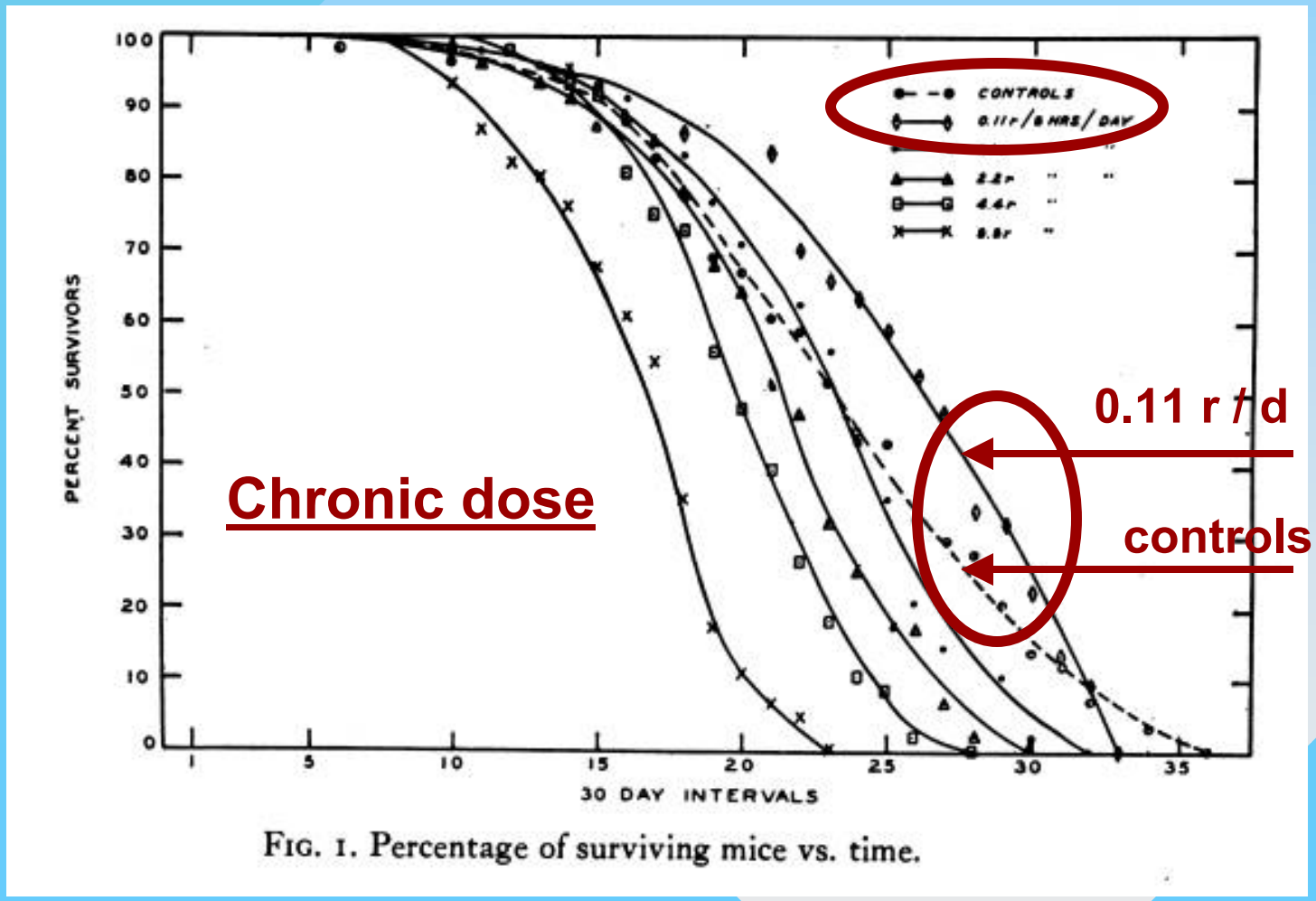


FIG. 1. Percentage of surviving mice vs. time.

Egon Lorenz 1950, National Cancer Institute

Earlier studies had 0.044 r / d groups, with greater life spans. These were deleted.

LDR Data: Contradict the LNT

Egon Lorenz 1950, National Cancer Institute.

Earlier studies had 0.044 r / d groups, with greater life spans.

TABLE I

MEAN SURVIVAL TIME AND MEAN ACCUMULATED DOSE OF LAF_1 MICE

Number of Animals	Dose Level (r)	Mean Survival Time (days)*	Mean Accumulated Dose (r)†
45	8.8	488	4300
48	4.4	591	2600
47	2.2	630	1400
48	1.1	684	775
45	0.11	761	107
59	Controls	703	—

* Data on mean survival time are significant only in the 8.8 r to 2.2 r groups.

† Mean accumulated doses in the 0.11 r group are somewhat higher than doses calculated from mean survival time as some animals of all groups received additional acute exposures of 12.5 r or 50 r respectively. These additional exposures had no effect on the mean survival time even in the 0.11 r group.

LDR Data: Contradict the LNT

- Egon Lorenz 1950, National Cancer Institute
- Earlier studies had 0.044 r / d groups, with greater life spans.
- Drawing straight lines through non-linear data!?

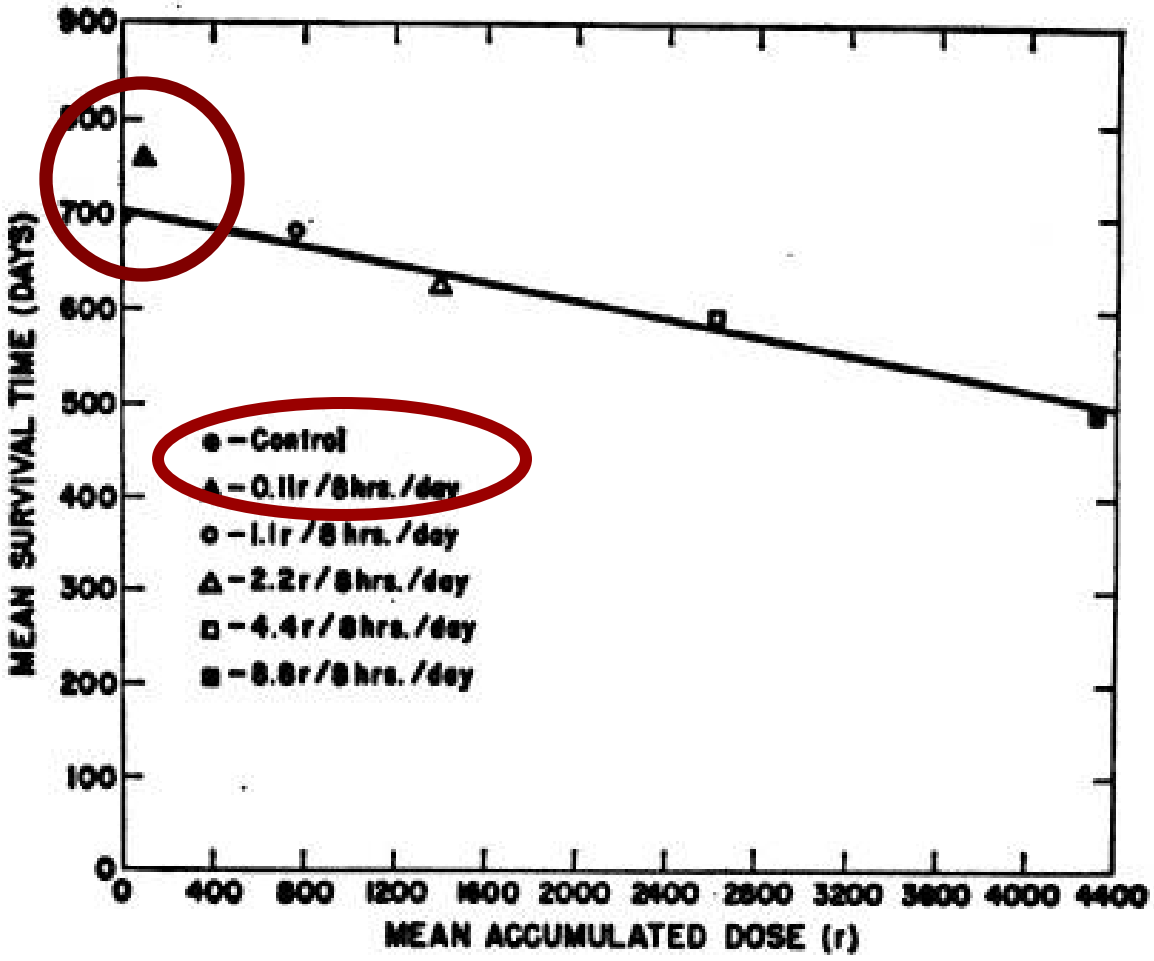


FIG. 2. Mean survival time vs. mean accumulated dose for mice.

LDR Data: Contradict the LNT

Egon Lorenz 1950, National Cancer Institute

Similar results in Guinea pigs.

TABLE II

MEAN SURVIVAL AND MEAN ACCUMULATED DOSE OF HYBRID GUINEA PIGS

Number of Animals	Dose Level (r)	Mean Survival Time (days)*	Mean Accumulated Dose (r)†
18	8.8	187	1700
18	4.4	653	2900
18	2.2	987	2200
17	[illegible]	[illegible]	1400
17	0.11	1457	180
24	Controls	1400	—

* Data on mean survival time are significant only in the 8.8 r to 2.2 r groups.

† Mean accumulated doses in the 0.11 r group are somewhat higher than doses calculated from mean survival time as some animals of all groups received additional acute exposures of 12.5 r or 50 r respectively. These additional exposures had no effect on the mean survival time even in the 0.11 r group.

LDR Data: Contradict the LNT

300 animals in each group

Table 3. ST_{50} values

	ST_{50}	95% confidence intervals of ST_{50}
Weighted probits		
Controls	549.6	536.9–562.3
7 cGy/year	673.1**	659.8–686.4
14 cGy/year	673.6**	660.7–686.5
Weighted logits		
Controls	553.8	540.8–566.7
7 cGy/year	684.6**	671.7–697.6
14 cGy/year	680.7**	668.1–693.4

ST_{50} values are similar using weighted probits or weighted logits:
** $p \leq 0.01$.

- Caratero et al. (France), Gerontology 1998

LDR Data: Contradict the LNT

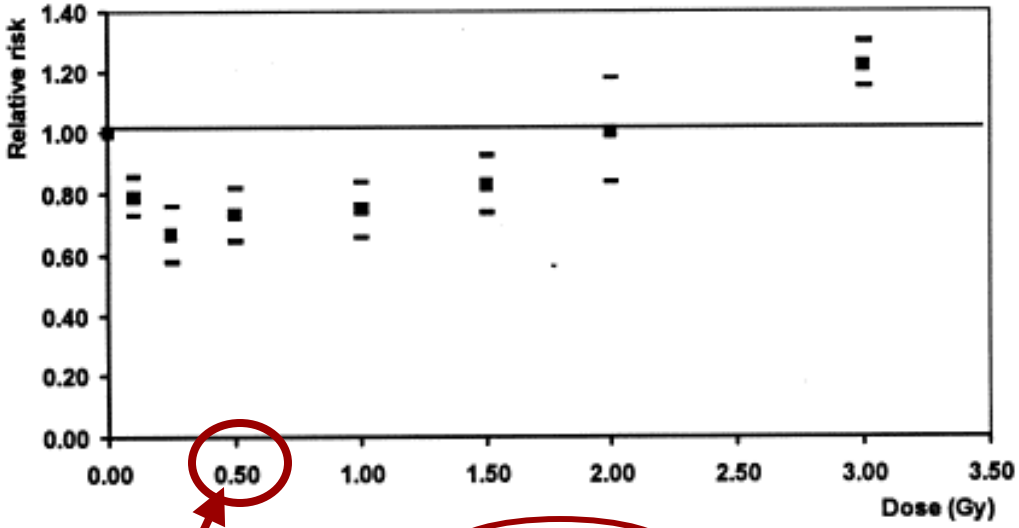


Figure 4. Relative risk of lung cancer in mice following exposure to gamma radiation
(Ullrich and Storer 1979)

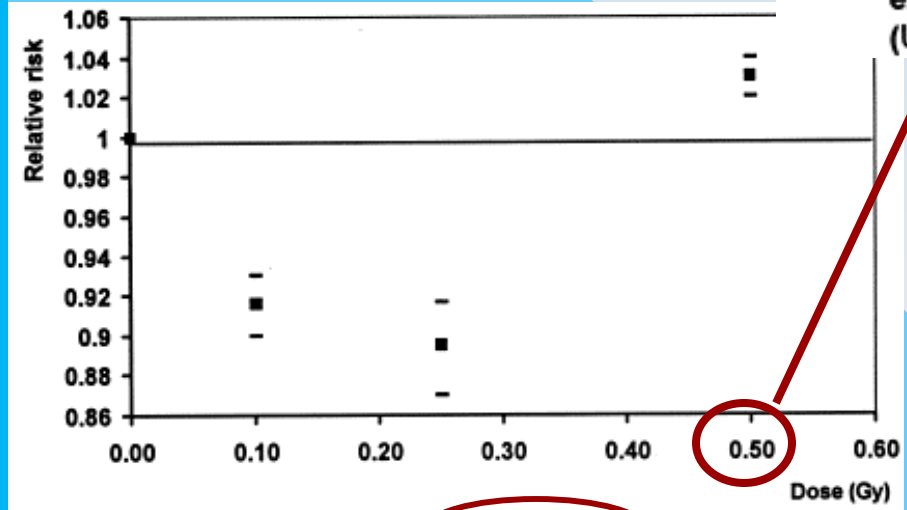


Figure 3. Relative risk for all neoplasms (reticular tissue and solid cancers) (Ullrich and Storer 1979a & b)

Radiation Research, 1979

LDR Data: Contradict the LNT

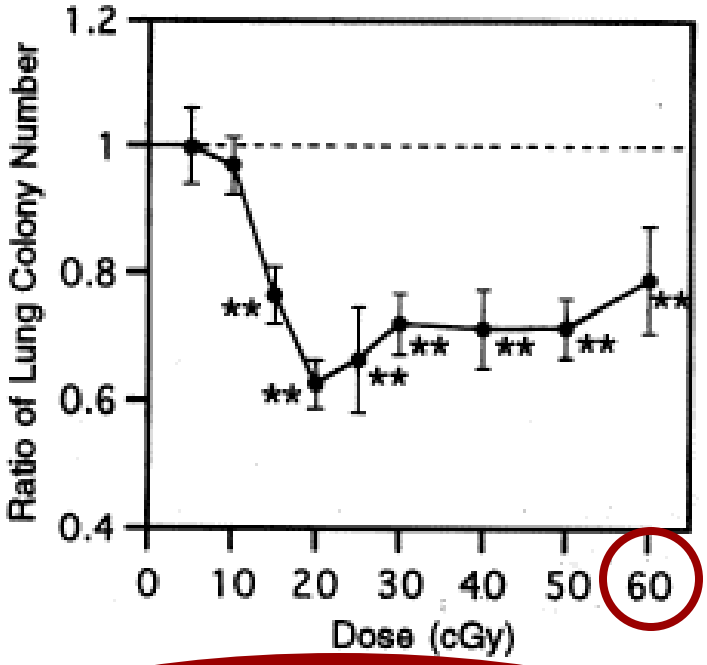


Fig. 1. Effect of low dose TBI on artificial lung metastasis. Mice were irradiated with 5-60 cGy immediately before the tumor cell injection. Data were expressed as the ratio of the number of lung colonies observed in irradiated mice to that in sham-treated mice. Bars indicate SE of 20-40 mice for each point. *; $p<0.05$, **; $p<0.01$.

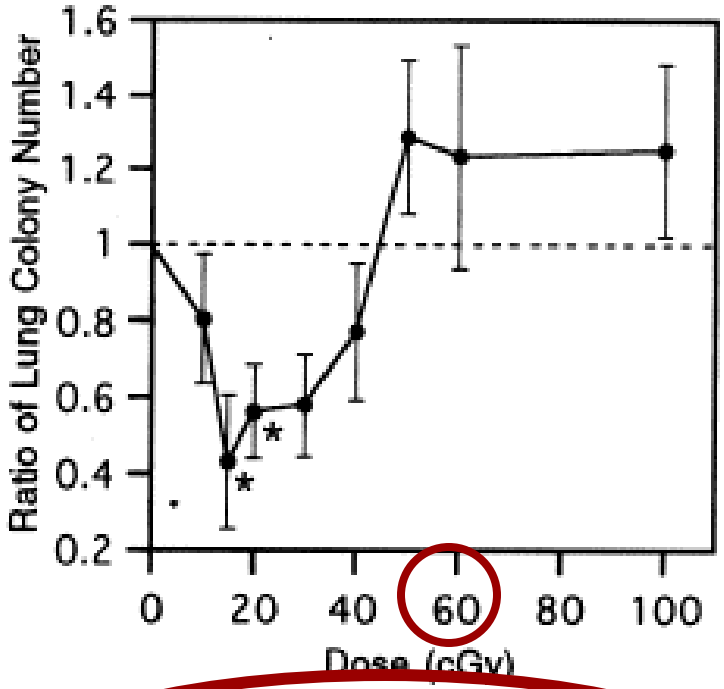


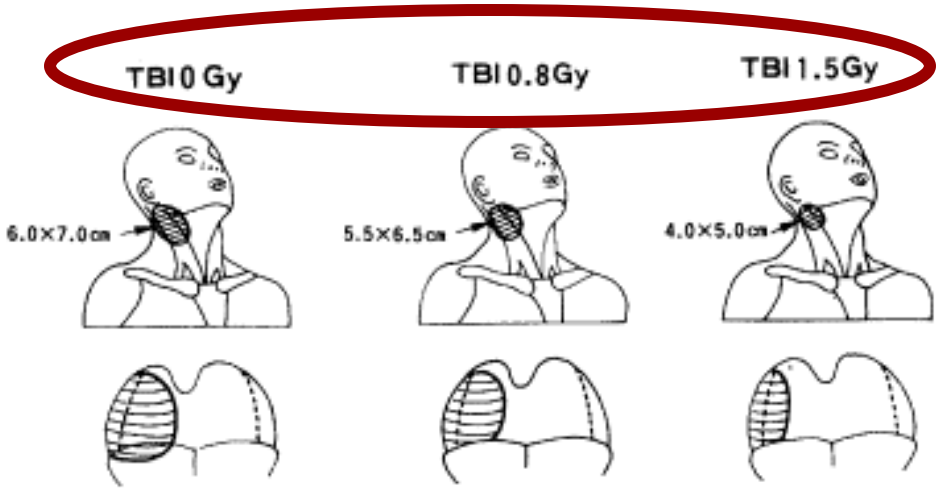
Fig. 4. Effect of 5-100 cGy TBI on spontaneous lung metastasis. Mice were irradiated with 10-100 cGy 12 days after tumor injection into a hind limb. Symbols as in Fig. 3.

Hosoi 1997, Japan, in Low Doses of Ionizing Radiation: Biological Effects and Regulatory Control

LDR Data: Contradict the LNT

Takai 1991, Japan, J. Jpn. Soc. Ther. Radiol. Oncol.

Study on 9 patients of more than 250 successfully treated using LDR by Dr. Kiyohiko Sakamoto



Two-color (%)			
T_H	16.7	18.6	32.4
T_{HI}	18.0	21.1	32.9
T_S	15.6	14.1	14.3
T_{SI}	7.9	7.2	8.8
T_C	22.8	28.0	24.3
T_H/T_S	1.07	1.32	2.27
WBC	5700	4700	3800
RBC	525	494	494
Plt.	22.6	23.3	14.2
Lymph.	2200	1700	1200

Fig. 5. Clinical course and the changes of the proportion of functional subsets of lymphocytes in case 8.

LDR Data: Contradict the LNT

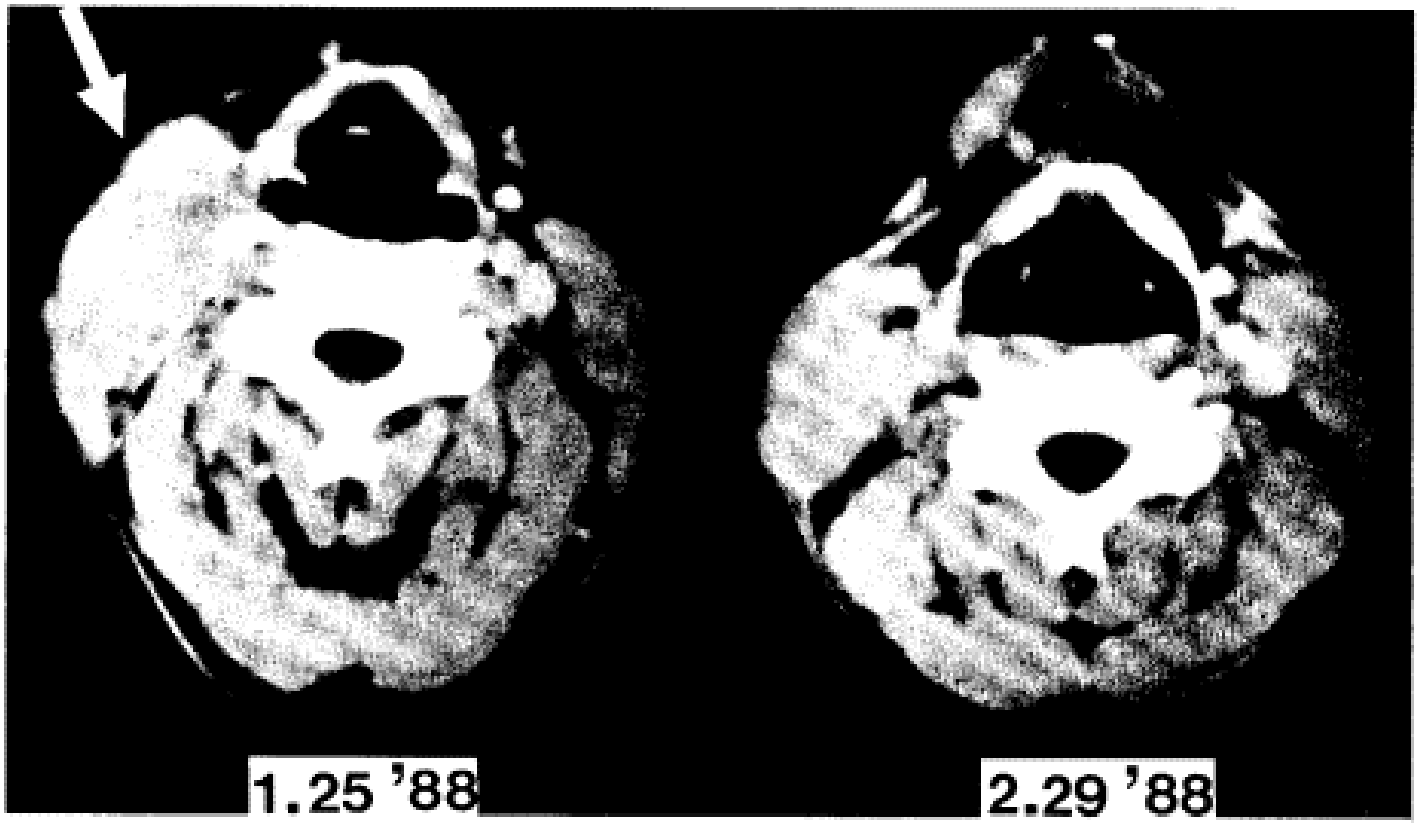


Fig. 6. CT scans of neck lymphnodes before and after low dose TBI in case 8. Arrow indicate a swollen lymphnode in the upper neck.

Takai 1991, Japan, J. Jpn. Soc. Ther. Radiol. Oncol. Study on 9 patients of more than 250 successfully treated using LDR by Dr. Sakamoto

LDR: Biologically Essential?

- Suppressing natural background radiation **always** has detrimental biological effects.
- U.S. NRC's Charlie Willis, CHP, HPS Fellow
  - Mar 1996 NRC transcript: **"In 1958, at the lab (Oak Ridge), with K-40 removed from potassium, cells didn't function... The results weren't published, an effect of the LNT paradigm."**
  - No NRC inquiry! Despite requests.

LDR Data: Contradict the LNT

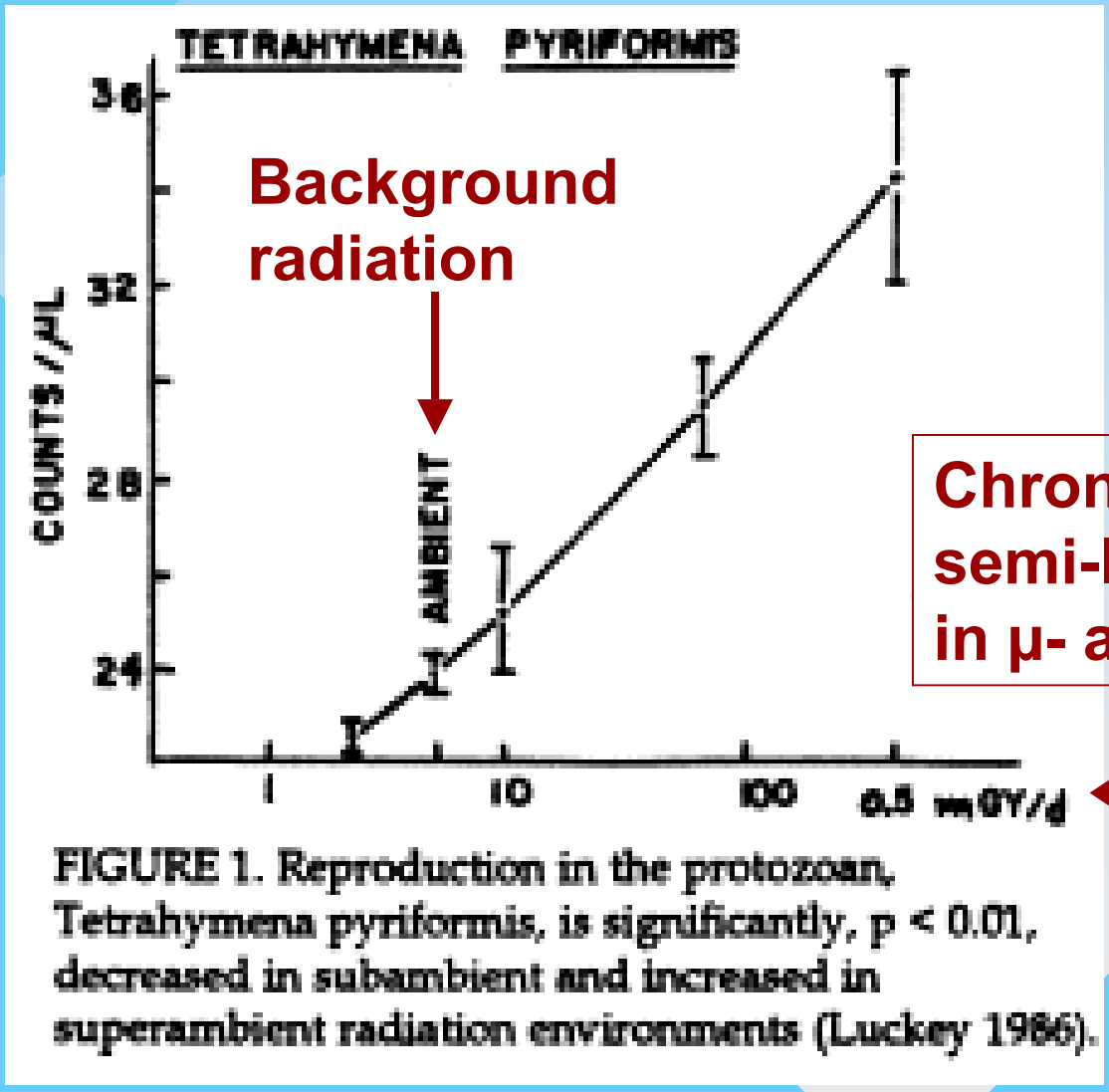


FIGURE 1. Reproduction in the protozoan, Tetrahymena pyriformis, is significantly, $p < 0.01$, decreased in subambient and increased in superambient radiation environments (Luckey 1986).

Chronic dose: semi-log plot, in µ- and mGy / d

LDR Data: Contradict the LNT

Planel 1987, France, Health Phys J.

Organisms shielded from background radiation fail to grow, reproduce, or otherwise function normally. Supplementing radiation causes them to return to normal functions.

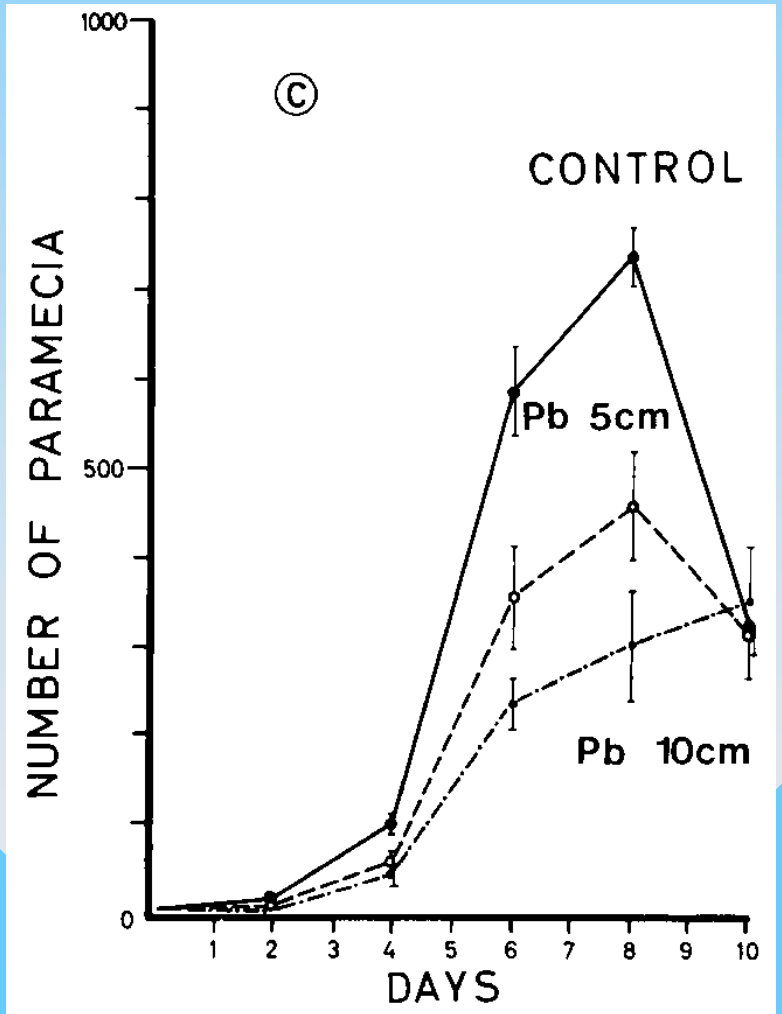


Fig. 1. Effect of shielding on proliferation of paramecia.

NO data support the LNT:

- **NCRP-121, 1995:** "Few experimental studies, and essentially *no human data*, can be said to prove, or *even provide direct support for the concept*…It is *conceptually possible, but with a vanishingly small probability*, that any of these [Ed: adverse health] effects *could* result from the passage of a single charged particle…It is a result of this type of reasoning that a linear non-threshold dose response relationship *cannot be excluded."* (p. 45) (emphasis added)
- **[Ed: such "reasoning" is obviously faulty vs. actual biological responses]**

NO data support the LNT:

- **NCRP-136, 2001: "It is important to note that the rates of cancer in most populations exposed to low-level radiation have not been found to be detectably increased, and that in most cases the rates have appeared to be decreased." (p. 6) [Emphasis added]**

Science Data / Researchers Refute LNT: NO Assessment

- Despite **constraints on research and publication:** extensive results are in the science literature.
- Data are **ignored / misrepresented** in ICRP/NCRP/UNSCEAR/BRER-BEIR Group "reviews" (e.g., BEIR V, VI, VII; NCRP-136; ICRP; etc. etc.)
- See comments on NCRP-136 at:

http://cnts.wpi.edu/RSH/Docs/Correspondence/NCRP136/NCRP136Index.htm

Rad Protection Researchers Misrepresent Data / Falsify Results in Literature for LNT

- Show dose-response linear despite data, e.g.:
  - Miller et al. 1989, Canadian women TB fluoro-scopy, breast cancer, BEIR V, NCRP-136
  - Cardis et al. 1995, Nuclear workers, NCRP-136
- Manipulate dose groups, e.g.,:
  - Mays & Lloyd, radium dial painters, BEIR IV
  - Howe & McLaughlin 1996, women TB fluoroscopy breast cancer, NCRP-136

Canadian TB Fluoroscopy Study: Miller 1989 vs. Howe 1996

TABLE I
Breast Cancer Mortality in the Canadian Fluoroscopy Cohort Study (1950–1980)
Standardized Mortality Rates by Dose Category

	Nova Scotia	Other Provinces	
Dose (Gy)		Deaths	SMR
0-0.09		288	585.8
0.10–0.19		29	389.0
0.20–0.29		24	497.8
0.30–0.39		17	630.5
0.40–0.69		19	632.1
0.70–0.99			
1.00–2.99			
3.00–5.99		14	873.1
6.00–10.00			
≥10.00			

Adapted from Miller AB, Howe GR, et al. (1989)

TABLE II
Breast Cancer Mortality in the Canadian Fluoroscopy Cohort Study (1950–1987)
Relative Risks by Dose Category

	Nova Scotia	Other Provinces	
Dose (Sv)		Number of Deaths	Relative Risk (95% Confidence Interval)
<0.01		309	1.00
0.01–0.49		112	1.05 (0.84, 1.30)
0.50–0.99		67	1.04 (0.80, 1.36)
1.00–1.99		61	1.22 (0.93, 1.61)
2.00–2.99		15	1.24 (0.73, 2.08)
3.00–3.99			
4.00–6.99			
7.00–9.99		14	2.24 (1.31, 3.83)
≥10.00			

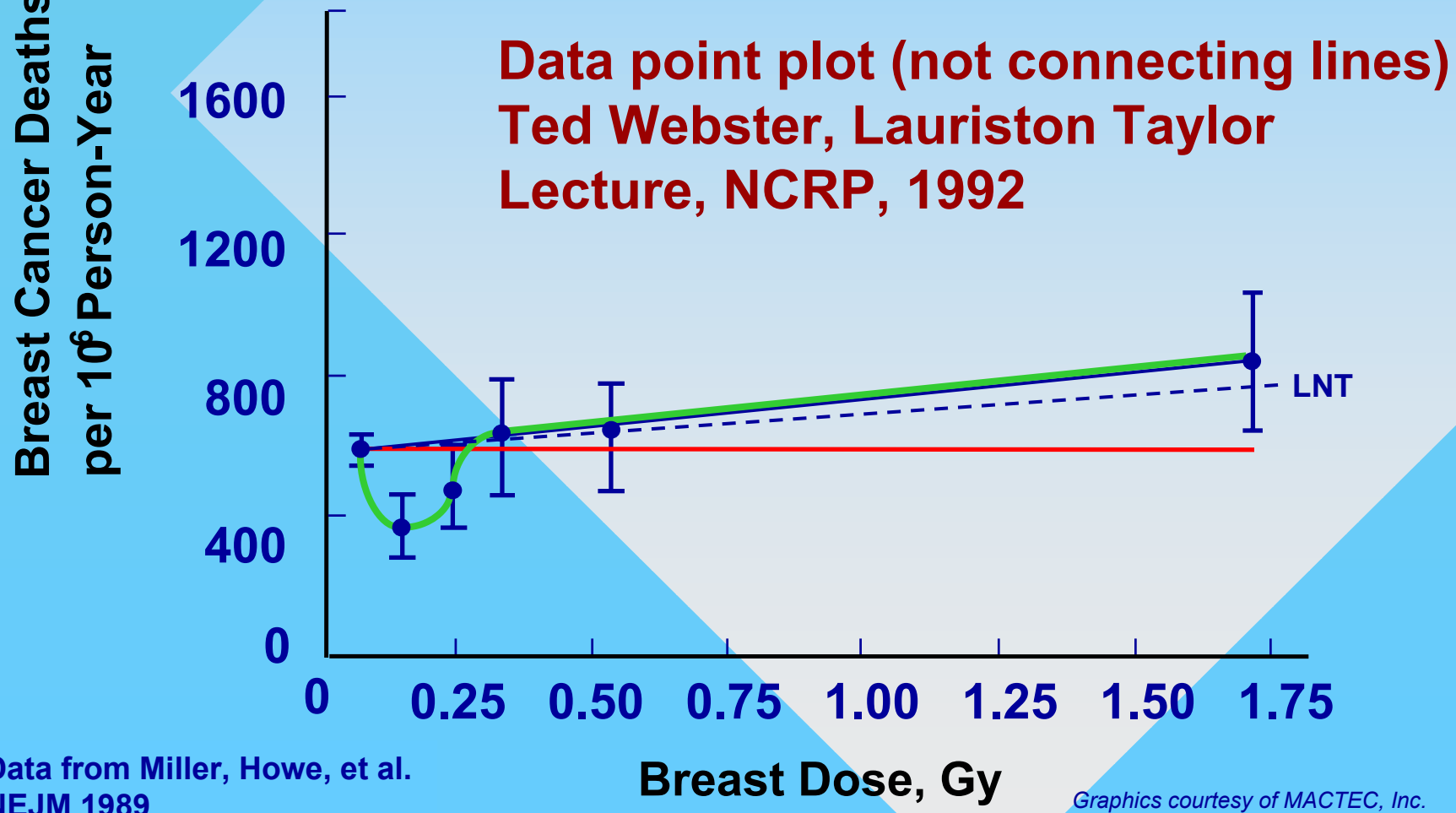
Adapted from Howe GR, McLaughlin J. (1996)

All significant low-dose groups collapsed to one –

Author acknow-ledges misleading result

Canadian TB Fluoroscopy Study

Breast Cancer vs. Breast Dose



Data point plot (not connecting lines)
Ted Webster, Lauriston Taylor Lecture, NCRP, 1992

Data from Miller, Howe, et al.
NEJM 1989

Graphics courtesy of MACTEC, Inc.

“Radium Dial Painter” Data

- Robley Evans, MIT Emeritus, 1974
- Bob Rowland, CHR Director, 1983
- Bob Thomas, DOE / CHR Director, 1994
- Bob Rowland, Retired / Consultant, 1997
- and many others

Radium Dial Painter Data

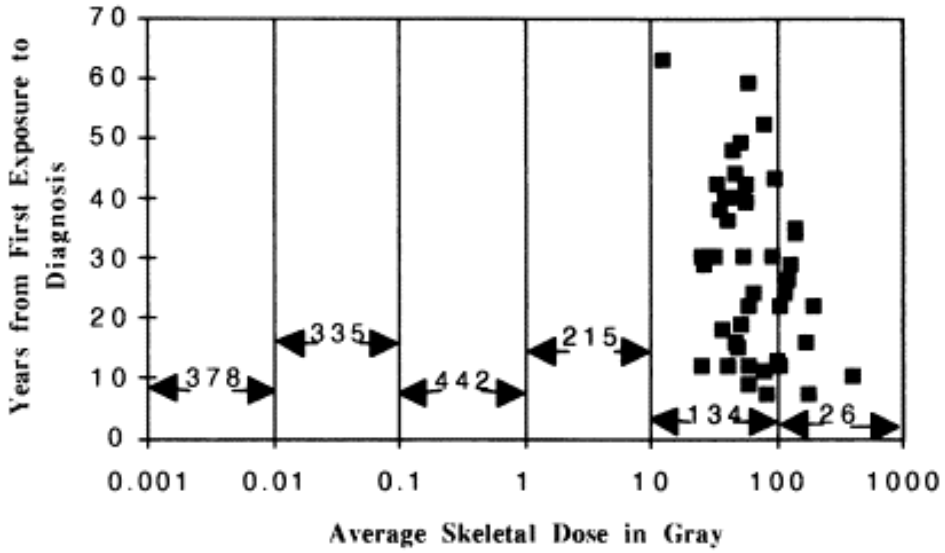


Figure 1. The 46 bone sarcomas in the cohort of 1530 female dial workers are plotted as black squares, indicating their appearance time and dose for each sarcoma case. The total number of cases in each decade of dose are also indicated.

Bob Rowland 1997 (retired head of Center for Human Radiobiology, Argonne National Laboratory)

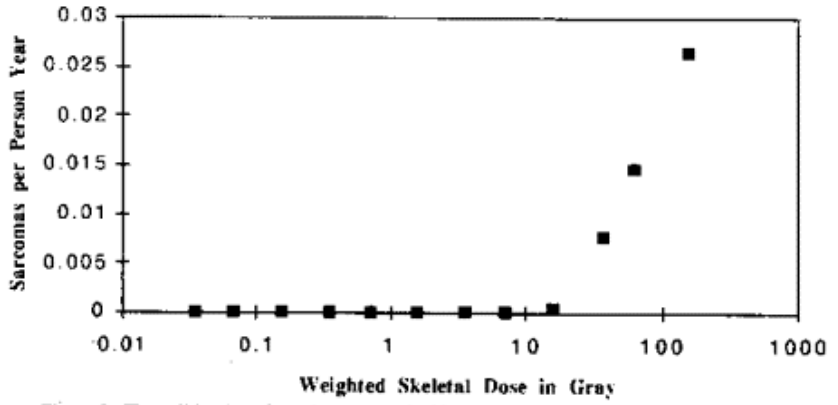
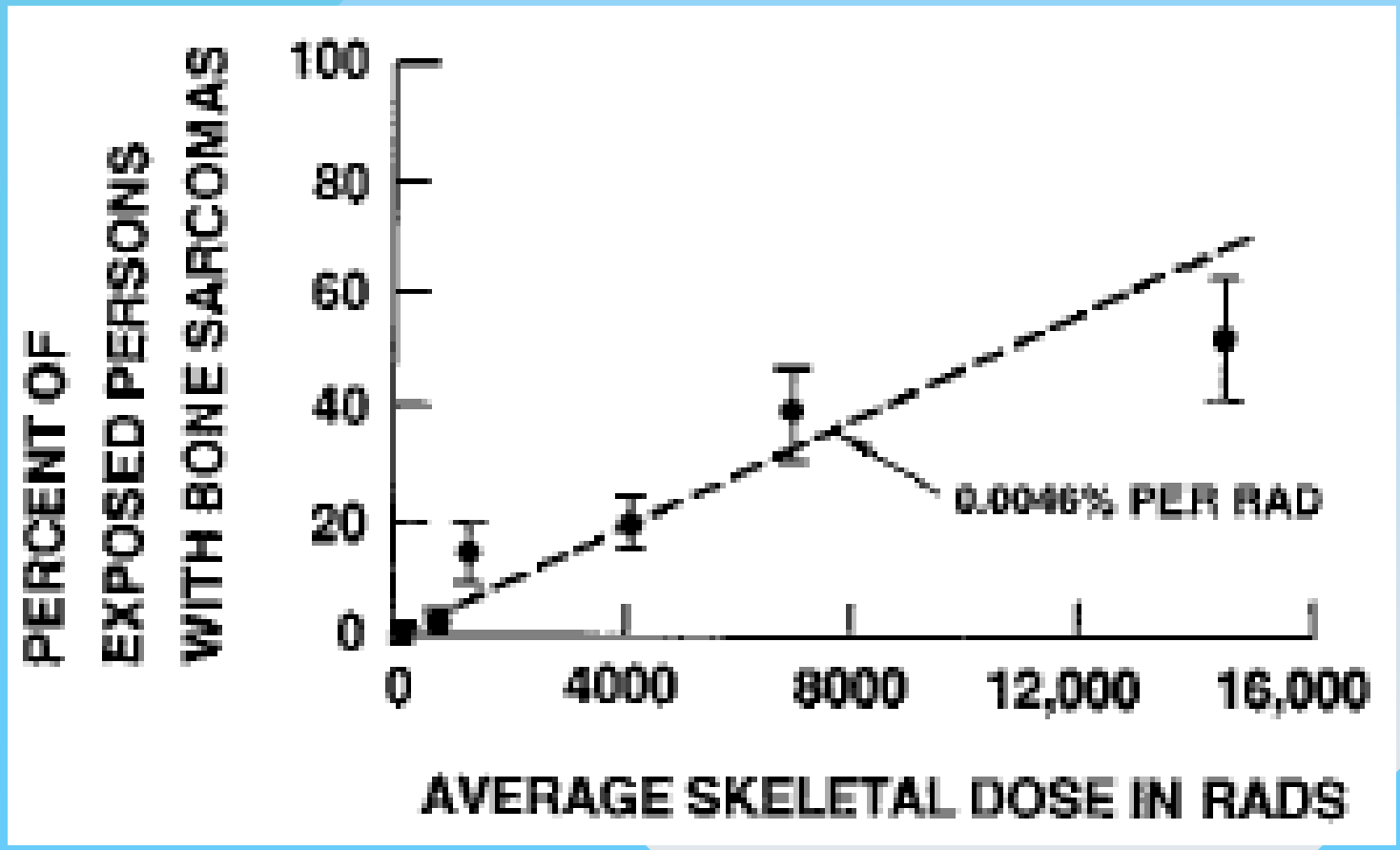


Figure 3. The solid points show the sarcoma incidence in each of the 12 dose groups from Table 1.

Radium Dial Painter Data



Mays and Lloyd 1972, in Radiobiology of Plutonium, from BEIR IV, p. 198
- fabricating a straight line from non-linear data

Mays & Lloyd, radium dial painters, BEIR IV

Email, Dr. Otto Raabe, Radiobiologist UC Davis,
President Health Physics Society:

"By grouping the Evans data into six non-uniform dose groups selected so that only one dose group included no bone cancer cases (one with average skeletal alpha doses from zero to about 500 rad or 10,000 rem)and so that the next highest dose group included a few cases of bone cancer (cases were only observed for average skeletal alpha radiation doses that exceeded 1,000 rad or 20,000 rem), Chuck Mays and Ray Lloyd created the appealing, but mis-leading, linear plot shown on page 198 of BEIR IV. In their plot the "threshold" region, which is below 1,000 rad, is obscured near the origin since the abscissa is extended to 16,000 rad and only one dose group was assigned to this region. Their plot proves nothing about linearity. Evans's analysis shows that no linear model fits these data.

"Otto"

DOE / IARC 3-Country Nuclear Workers Study

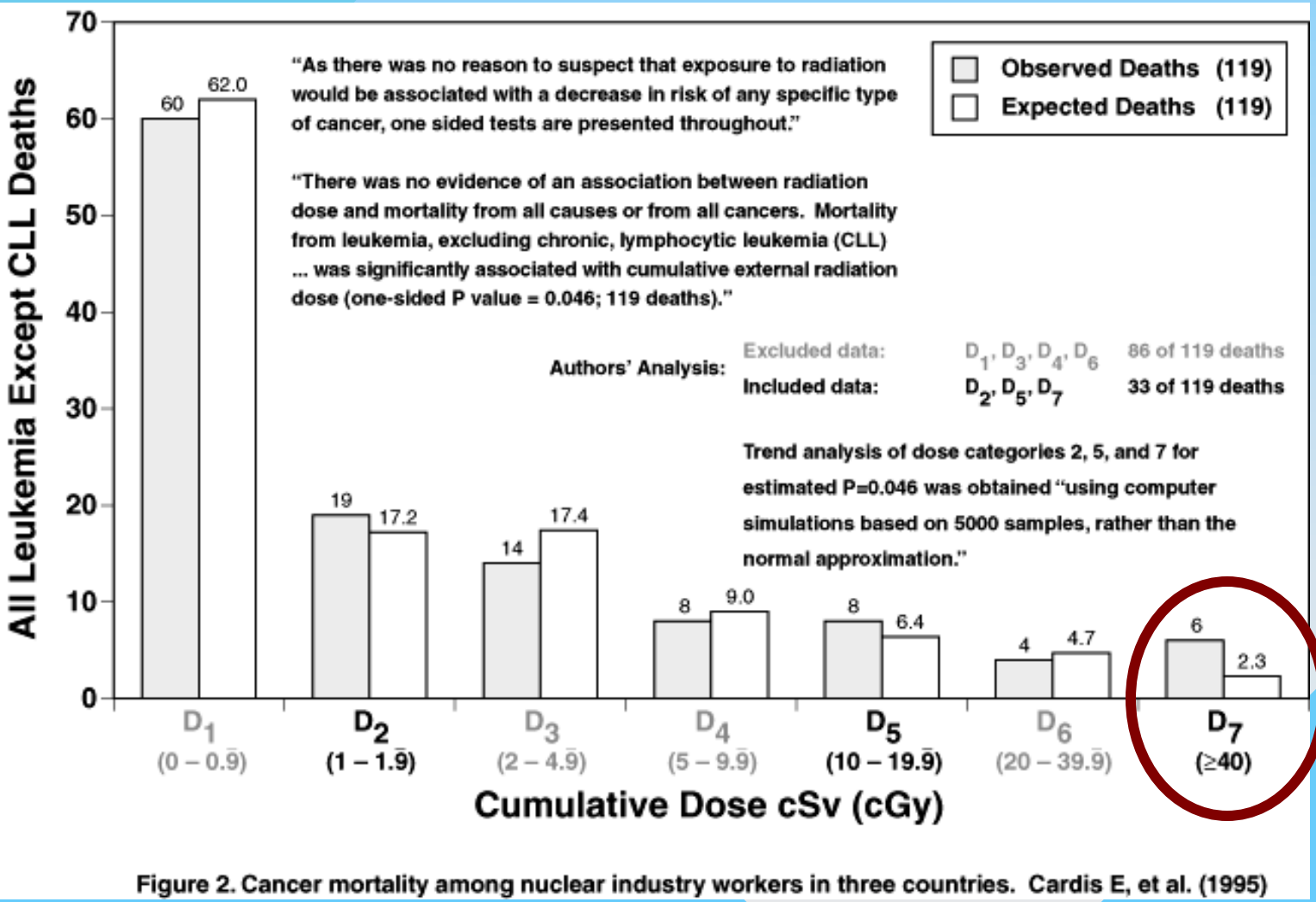


Figure 2. Cancer mortality among nuclear industry workers in three countries. Cardis E, et al. (1995)

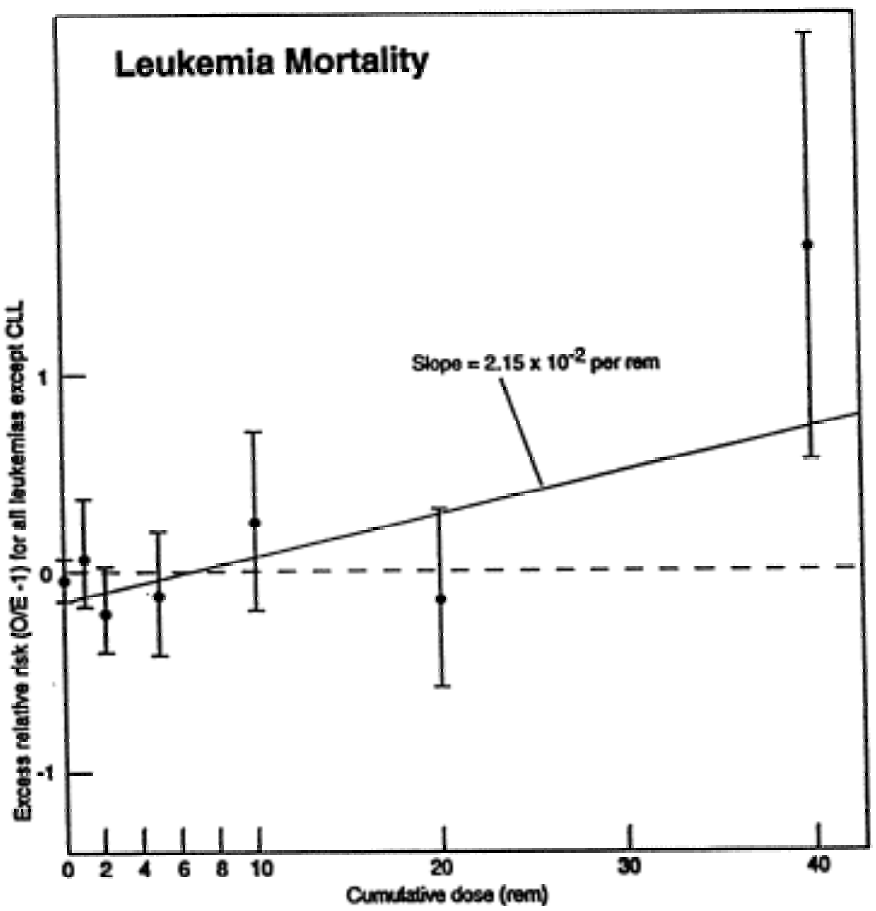
Pollycove 1998

DOE / IARC 3-Country Nuclear Workers Study

Schillacci 1996

Fabricating a straight line from non-linear data

6 deaths only at >40 cGy, (1 too many) out of 15,000+; in one cancer type; reject data from points below zero



Excess relative risk for mortality for all leukemias, excluding chronic lymphocytic leukemia, versus cumulative dose for 96,000 nuclear industry workers in the United Kingdom, the United States, and Canada. The error bars correspond to plus and minus one standard deviation. Forcing a straight-line fit to all of the data yields a relative risk factor of 2.15×10^{-2} per rem. However, if the highest-dose data point is excluded, the remaining data show no increase of risk with increasing dose. (Data from E. Cardis, et al., 1995, *Radiation Research* 142: 117-132.)

LDR: Data Ignored / Suppressed

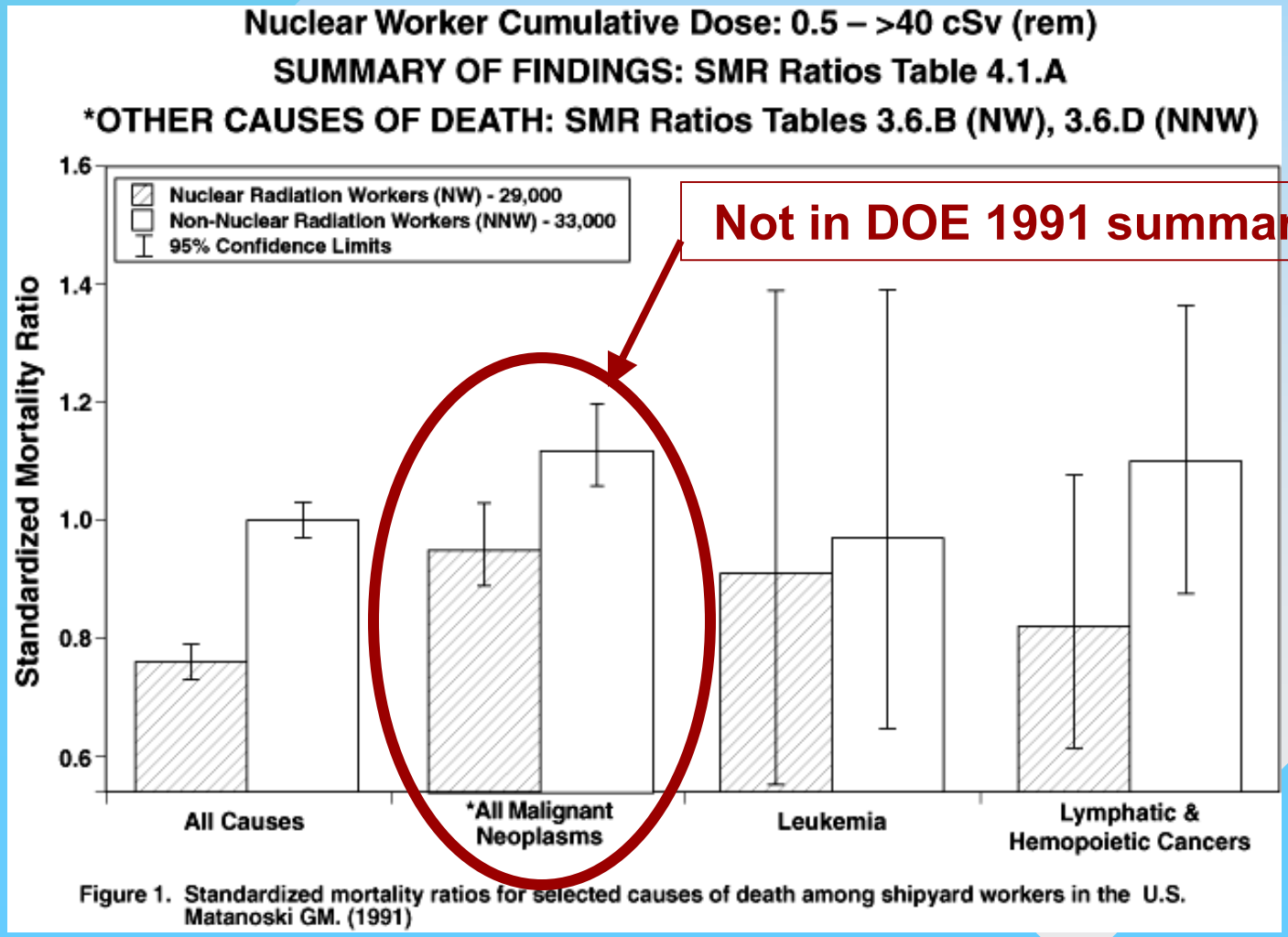
Mar 1996: We presented voluminous data to the US NRC re funding NCRP-136 (of "data ignored in BEIR V 1990," with the same chairman). ACNW letter/NRC Chairman direction to NCRP to "address all the data."

Mar 1999: NCRP-136 draft ignores relevant data; ACNW won't hold NCRP accountable, they say they are "under pressure," won't get NRC staff review - Commissioner Dicus acts to suppresses inquiry (appointed to ICRP).

LDR: Data Ignored / Suppressed

- ICRP/NCRP/UNSCEAR/BRER-BEIR Reports (Single interlocking well-funded, gov't agency-funded, self-selected group)
  - Selects committees and gov't officials.
- Regulators claim they can not be reviewed.
- **Research that refutes LNT is terminated,** e.g., Argonne: US background radiation, CHR radium dial painters; DOE Nuclear Shipyard Workers; AEC/DOE high-dose workers; Manhattan Project studies; K40 removed from K; shielding animals from background radiation; etc., etc.

LDR: Data Ignored / Suppressed: DOE Nuclear Shipyard Workers



Pollycove 1998

Never published; Constrained by DOE

Medical / Health Benefits of LDR Ignored / Suppressed

- LDR prevents / reduces cancer, other diseases / debilities:
  - **Animal studies:** LDR prevents & treats
  - **Human experience:** Japan: Sakamoto, Yamaoka, others - non-Hodgkins lymphomas, colon cancer; US: Harvard, Johns Hopkins; Europe, etc.
  - **Taiwan - Co-60, since '82:** few cancers vs. ~160 expected in >10,000 persons in 15+ years. (Massive medical follow-up, but won't provide age data!)
- **Rad protection agencies constrain studies**

Medical / Health Benefits of LDR Ignored / Suppressed

LDR prevents / reduces AIDS? E.g., Shen et al. show protection from Friend virus form of murine AIDS (1980s-1990s). Del Regato initiated human trials.

Policies constrain research and applications, which constrain LDR treatment of infections and inflammatory diseases, and cancer and AIDS?, in favor of drugs

Few Scientists Object Outside of "Closed" Science Venues:

- Critics readily ignored / rejected; No "debate."
- Critics risk science careers, grants, appointments, by gov't agencies.
- Critics leave/quit; Find more rewarding work.
- Rad protection officials & policy-makers ignore / suppress science objections.

"Outside" Orgs Ignore Science / Objections:

- Congress funds studies -- No inquiry of results / terminations, nor science objections.
- Medical / health users are not affected: Moderate doses, no health threat - 'it's safe' - e.g., thallium stress test, PET scan, etc.
- "Nuclear industry" does not assess data
  - Does no research; Reviews no data.
  - Profits from public funds for "rad protection" - $100s billions

Actions: Revise Rules; Apply LDR to Health / Medical Benefits

- Gov't agency rule-makings:
  - Challenge 'arbitrary and capricious' rules.
  - Participate in, and Petition, rule-makings.
- Challenge 'scientific misconduct.'
- Apply LDR for health / medical treatments.
- Revise extreme / costly radiological design / operations standards.

Achieve Massive Benefits

Refute policies that generate 'Radiophobia.'
(The public understands when radiation effects are explained.)

- Stop massive waste of public funds for extreme 'clean-up' and waste disposal, for no benefit.
- Public benefits of radiation technologies.
- Provide cost-effective medical / health applications.
- Greatly expand nuclear power – to reduce world conflict, potential war, and environmental costs, from fossil fuels.

Supplemental Benefits:

- Apply credible science:
  - Enhance public credibility of “science” (now being damaged).
  - Enhance public support for science.
  - Influence correcting other biased science.
- Improve government credibility:
  - Public perceives biased, self-serving, agencies and ‘politicians.’

"Level the Playing Field"

- Objectively quantify radiation "risks."
- Design and operate **cost-effective / competitive nuclear technologies** - producing enormous public **benefits - reduce human and environmental costs.**
- **Do not** leave your children and grandchildren a polluted world, at war over oil (even for LNT profits)!

"Level the Playing Field"

- Objectively quantify radiation benefits.
- Implement **cost-effective / competitive LDR medical applications** - producing enormous public **benefits - reduce human health costs and drug company profits.**
- **Do not** leave your children and grandchildren a diseased world (even for drug company profits)!

Radiation, Science, and Health

1. Provide Science Resources

   "Data Document" - Web site:

   http://cnts.wpi.edu/rsh/docs ("3rd Edition" link)

   Topical Summaries of Existing Science

2. Provide Policy Responses

   Advise organizations and officials

   Challenge misrepresentations

   Allege scientific misconduct by individuals