

RADIOBIOLOGY DECEPTIONS REJECT HEALTH

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ABSTRACT

Radiobiology data shows that biological functions are stimulated at low doses of ionizing radiation, while high doses result in detrimental effects. This results in improved health, and successful treatment of medical conditions, by low to moderate radiation doses, as shown in numerous studies, in both animal experiments and human epidemiological studies.

Public policy, and the public, are misled by deceptions in conducting and reporting research. The unfounded assumption that dose-response is “not inconsistent with” the “Linear No-Threshold” (LNT) hypothesis, is supported to expand radiation protection programs and funding, for no public health benefits.

Deceptions occur in numerous categories, in both radiobiology and epidemiology research. Categorization and preliminary examples of such deceptions are provided.

INTRODUCTION

The Hormesis Thesis recognizes:

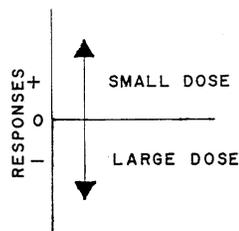
“The dose is everything.” Paracelsus, 1540

Large and small doses elicit opposite results.

Large doses inhibit; they are usually harmful.

Small doses stimulate; they may be beneficial.

Fig. 1.



BENEFITS FROM IRRADIATION

INCREASED
DEVELOPMENT
REPRODUCTION
IMMUNITY
RADIORESISTANCE
ACUITY
MEAN LIFESPAN

DECREASED
INFECTIONS
STERILITY
HEART DISEASE
LUNG DISEASE
MENTAL
CANCER DEATHS
PREMATURE DEATH

Definitions:

“Hormo” = I excite

“HORMOLOGY” is the study of excitation in biology.

“HORMESIS” is the stimulation of any system by low doses of any agent.

“RADIATION HORMESIS” is the stimulation of any system by low doses of ionizing radiation; other kinds of radiation are not excluded.

The dose-response curve has a threshold called the zero equivalent point (ZEP) for most agents.

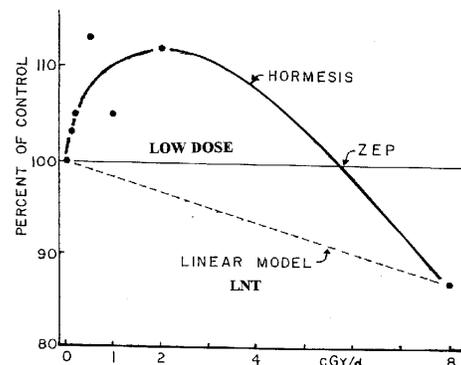
Low dose is defined as any dose between background radiation and the ZEP.

Low doses of most agents are stimulatory.

Doses greater than the ZEP are harmful

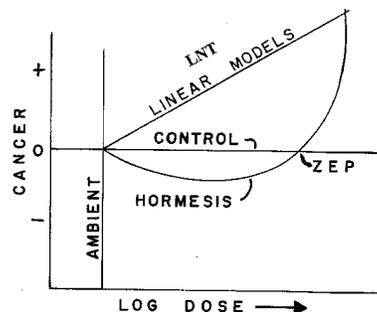
Variants of the Linear No-Threshold (LNT) curve have no threshold.

Fig. 2.



Cancer curves are the inverse of most others. Hormesis and LNT curves represent opposite viewpoints for low dose effects.

Fig 3.



In occupational exposure studies, nuclear workers have significantly better health than the general population. However, workers exposed to occupational carcinogens have higher cancer rates than the general population. (Monson, 1986)

But supporters of the Linear No-Threshold (LNT) hypothesis claim that the consistent lower cancer rates in radiation workers are due to an undefined "Healthy Worker Effect" which reflects better health in workers compared to the general population.

However, the "Healthy Worker Effect" is eliminated by the internal control in studies of nuclear vs. non-nuclear workers.

LNT supporters ignore low-dose radiation health benefits.

For example, LNT-supporters claim evidence of increased cancer in workers.

LNT Quote:

"For external radiation dose with a 10-year lag, the excess relative risk was...1.45 per Sv (95% CI-0.15, 3.48) for all cancer." (Gilbert, 1997)

Hormesis Response:

"Radiation decreased cancer death rates from 7 million person-years (P-Y) in nuclear workers. (Luckey, 1991)

NUCLEAR WORKER CANCER DEATH RATE

COHORT	PER-YEAR	DEAD/1 000		
		EXP	CON	%
BRITAIN	3,237,378	2.8	9.9	28
US NUCLEAR	2,132,046	20.8	34.8	60
US SHIPYARD	1,591,832	9.8	13.4	73
LOS ALAMOS	457,000	17.7	20.5	86
CANADA	268,320	20.3	23.7	86

TOTAL 7,686,576

PERSON-YEAR WEIGHTED AVERAGE = 52%

PREDICTION:

Eventually families of the 200,000 people with premature cancer deaths per year (USA) will understand the NCRP disaster. Prosecutors may use the data that NCRP has ignored.

Finally, NCRP will drop risk and death as their major criteria and consider people's health

FORMAT:

LNT Statement and Non-LNT Rebuttal, e. g.

Linear No-Threshold (LNT) Quote:

"...strictly speaking, we do know very little about the effects of doses below a few (cGy) per year. yet this is because **the effects, if they occur at all,** occur so infrequently that **they cannot be measured,** even with the best of clinical and epidemiological techniques." (Eisenbud and Gesell, 1997)

Hormesis Rebuttal Response:

More than 3, 000 references on radiation hormesis exist in the peer-reviewed scientific literature, without direct support.

See, e.g., the "RSH Data Document," with about 1,300 references. (Muckerheide et al. Ed., 1998, 1999, 2000)

Radiation Hormesis, with 1,018 references. (Luckey, 1991)

Hormesis with Ionizing Radiation, with 1,269 references. (Luckey, 1980).

CATEGORIES:

Studies used by LNT-supporters have scientific deficiencies that can be classified in the following categories:

1. Ignore Health Benefits
2. Lump Data - No Dose-Response Information
3. Data Misrepresentation
4. Misinformation
5. Data Omission
6. Single Tailed Statistics
7. Use Median Instead of Mean
8. Block Publication
9. Interpolate to Background with LNT
10. Extrapolate from Cells to Organisms
11. Promulgate False Cliches
12. Radiation Harms Reproduction
13. No Low Dose Category
14. No, or Poor, Controls
15. Use Old Animals for Growth
16. Use SPF Animals Without Challenge
17. Misuse a Subjective Unit, Sv
18. Ignore Vital Research
19. DNA Repair vs. Immune Competence

1. Ignore Health Benefits

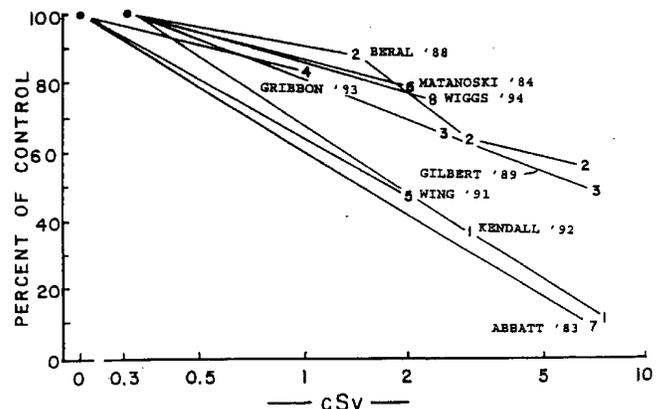
a. LNT Quote:

"For external radiation dose with a 10-year lag, the **excess relative risk** was ...1.45 per Sv (95% CI= 0.15, 3.48) **for all cancer**" (Gilbert, 1997)

Hormesis Response:

Radiation decreased cancer death rates- 7 Million P-Y nuclear workers. (Luckey, 1991)

Fig. 4.



2. Lump Data - No Dose-Response Info

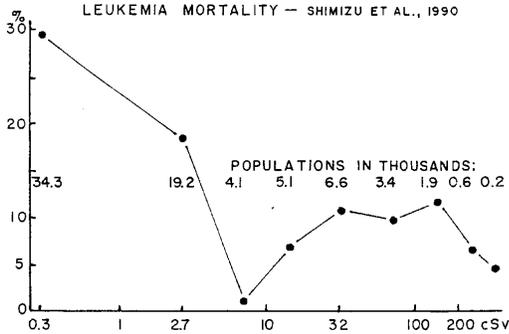
a. LNT Quote:

“...estimated the risk per unit absorbed dose to be about 200 to 250 **excess cancer deaths**/10⁴ person Gy in the first ten years of life, with one-half of these malignancies being **leukemias**, and one-quarter tumors of the nervous system.” (BEIR V, 1990, p. 354)

Hormesis Response:

Low Dose Irradiation Reduces Leukemia Deaths.

Fig 6.



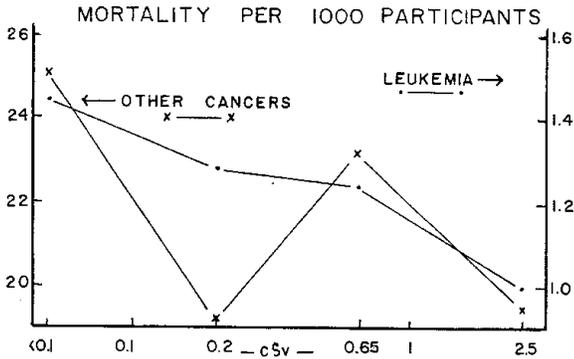
b. LNT Quote:

“... more than 30 biostatistical-epidemiologic studies whose data show significant adverse health effects at doses in the vicinity of 5 rem.” (Bross, 1987)

Hormesis Response:

“Cancer rates decrease with increased exposures in military observers.” (Robinette, 1985)

Fig. 7.



3. Data Misrepresentation

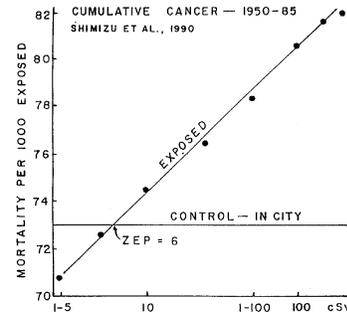
a. LNT Quote:

“In general, the dose response ...failed to suggest the existence of radiation hormesis.” (Shimizu, 1992, pg. 74)

Hormesis response:

Cumulative data from 86,000 Japanese survivors show radiation hormesis in leukemia death rates.

Fig. 8.



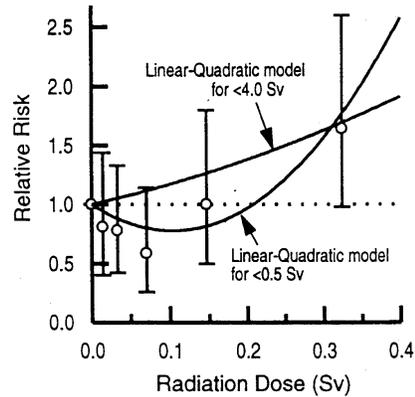
b. LNT Quote:

“In general, the dose response ...failed to suggest the existence of radiation hormesis.” (Shimizu, 1992, pg. 74)

Hormesis Response:

Cumulative data from 86,000 Japanese survivors show radiation hormesis in cancer death rates

Fig. 9.



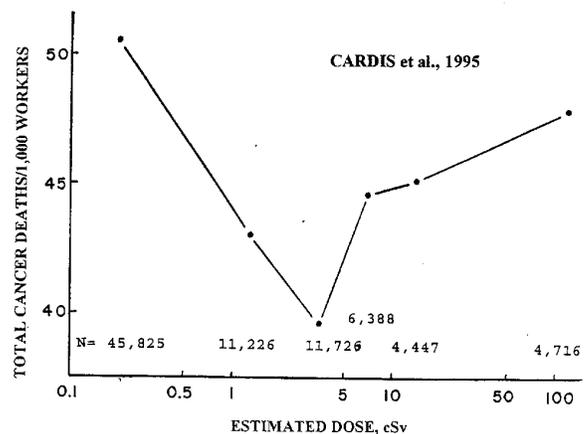
c. LNT Quote:

“There was no evidence of an association between radiation dose and mortality from all causes or from all cancers.” Cardis et al., 1995

Hormesis Response:

As shown by the graph, the above statement is an obvious misinterpretation of their own data.

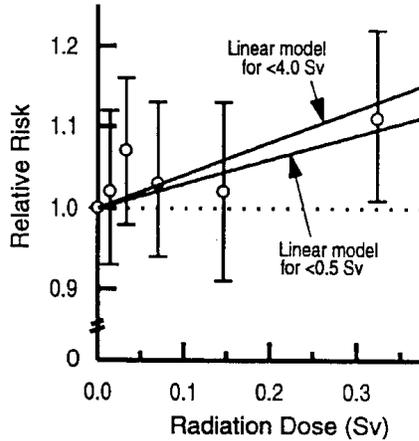
Fig. 10.



d. LNT Quote:

“For all the cancers other than leukemia, (Figure 1b), the risk smoothly increased in the 0.01-0.19 Sv region,...” See graph. (Shimizu, 1992., p. 73)

Fig. 11



Hormesis Response:

Note: All values on the graph are positive. Their data, see table below, shows the actual cancer mortality rate. At 0.019 Sv the risk is negative, 94% of the controls. *ibid.*

<u>Dose,Sv</u>	<u>0.010</u>	<u>0.019</u>
Number	45,149	7,430
Deaths	3,246	498
Dead/1000	71	67
Percent	100	94

4. Misinformation

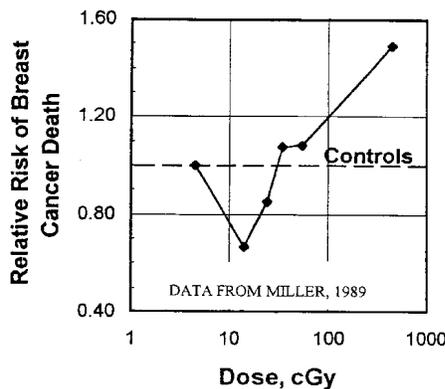
a. LNT Quote:

“The data were most consistent with a linear dose-response relation. ... The most appropriate form of dose-response relation is a simple linear one.” (Miller, 1989)

Hormesis Response:

Low dose irradiation reduced the breast cancer death rate. *Ibid.*

Fig. 11



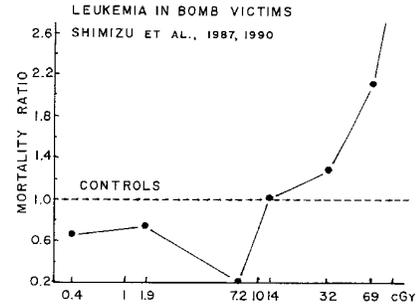
b. LNT Quote:

“The excess in leukemia mortality has continued to decline with time, but remains slightly and significantly elevated in 1981-1985 in Hiroshima.” (Shimizu, 1990)

Hormesis Response:

Strong evidence for radiation hormesis comes from leukemia data in the 86,000 Japanese bomb survivors.

Fig. 12



5. Data Omission

a. LNT Quote:

“There seems to be no way to evade the problem of curve fitting and extrapolation from high-dose estimates of excess risk” (Land, 1980)

Hormesis Response:

Leukemia incidence in Nagasaki survivors decreased between 2-50 cGy. Land ignored the zero incidence at 39 cGy.

7. Use median instead of mean - lifespan

a. LNT Quote:

“In laboratory animals exposed to whole body radiation, life expectancy decreases with increasing dose.” (BEIR V, 1990, p. 363)

Hormesis Response:

Most data refute the BEIR statement. Increased average lifespan from low dose irradiation has been reported in both animals and humans.

Table 7-1

INCREASED AVERAGE LIFESPAN IN MICE

<u>YEAR</u>	<u>AUTHOR</u>	<u>RADIATION</u>
1950	LORENZ	X RAY
1955	MAISIN	X RAY
1956	SACHER	X RAY
1957	CURTIS	X RAY
1958	LINDOP	X RAY
1960	GOWEN	X RAY
1960	LUNING	X RAY
1963	LANGENDORF	X RAY
1968	FRENCH	GAMMA RAY
1969	SPALDING	X RAY
1969	NISHIO	GAMMA RAY
1969	NISHIO	137-CESIUM
1970	GRAHN	GAMMA RAY

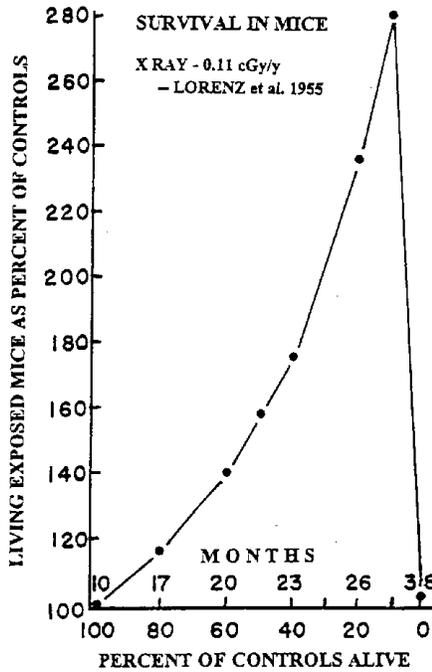
b. LNT Quote:

“In laboratory animals exposed to whole body radiation, life expectancy decreases with increasing dose.” (BEIR V, 1990, p. 363)

Hormesis Response:

The data show survival significantly increased by chronic low dose irradiation.

Fig. 13.



c. LNT Quote:

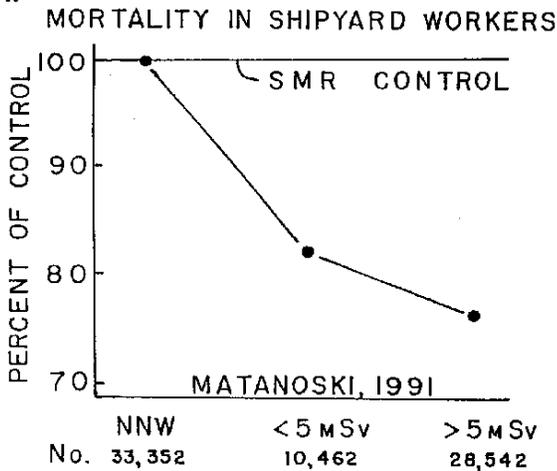
“In laboratory mammals exposed to whole body radiation life expectancy decreases with increasing dose.” (BEIR V, 1990, p.363)

“The bulk of the epidemiologic data appear to be consistent, therefore, with the data from laboratory animals.” *ibid* p.364

Hormesis Response:

Data from 72,000 nuclear workers shows that mortality decreased with increased exposure.

Fig 14.



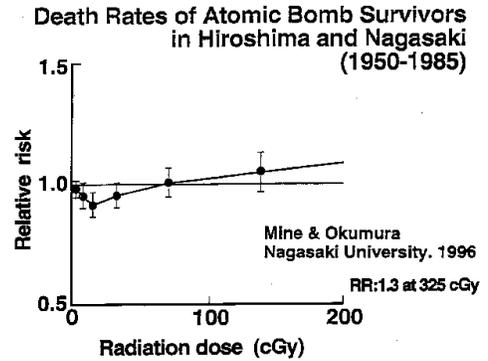
d. LNT Quote:

“...the life shortening increased as an exponential function of dose rate “ (NCRP 64, 1980)

Hormesis Response:

Data from Japanese bomb survivors confirm the radiation hormesis in life span consistently shown in animal experiments (Mine and Okumura, 1996)

Fig.15.



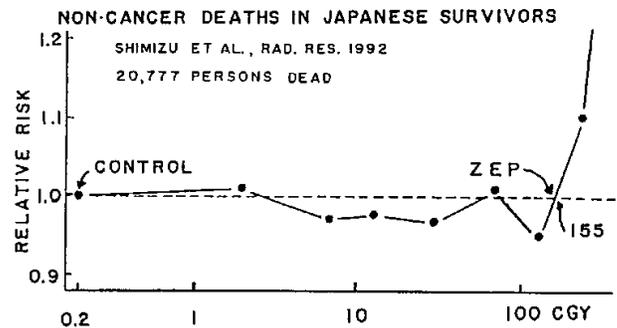
e. LNT Quote:

The life shortening increased as an exponential function of dose rate, (NCRP 64, 1980)

Hormesis Response:

The non-cancer life span of 20,777 Japanese bomb survivors show no shortening under 155 cGy.

Fig. 16.



8. Block publication

a. LNT Quote:

“Approximately 150 registrants from seven countries represented more than 30 laboratories and funding agencies.” (DOE, 1986, p. ix)

Hormesis Response:

“We did not have enough money to invite them...” paraphrased answer when asked why scientists with data on radiation hormesis in lifespan were not invited to a conference: Spalding (Los Alamos Nat Lab) and Bohnam, Donaldson and Hershberger (Wash. Univ.)

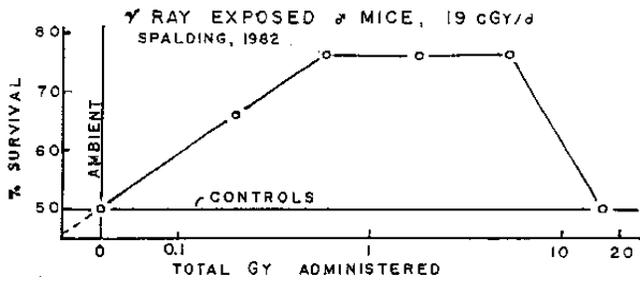
b. LNT Quote:

“There seems to be no way to evade extrapolation from high-dose estimates of excess risk.” (Land, 1980)

Hormesis Response:

When 50% of the controls were dead, 75% of the irradiated mice were alive. (Spalding, 1982) A study at Los Alamos with replicates of 4,000 mice that was not published in *Radiation Research*.

Fig. 17.



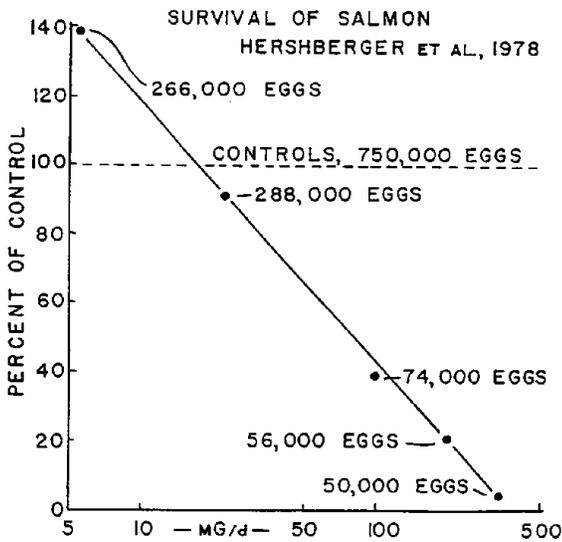
c. LNT Quote:

A sample of 100,000 may be needed for (to determine the effect of) a 100-rad exposure and about 10 million for 1 rad," (Land, 1980)

Hormesis Response:

A "mega-mouse experiment was suggested to show the effect of 1 rad". Ignored were these mega-fish data showing statistically significant increased survival of salmon released into the Pacific Ocean.

Fig. 18.



9. Interpolate to Background with LNT

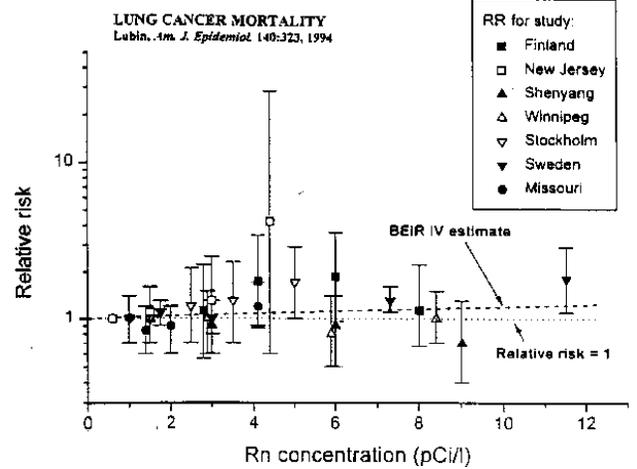
a. LNT Quote:

"The committee concluded that estimates of lung-cancer risks based on studies on miners can be used to estimate the potential lung-cancer risk associated with increased concentrations of radon..." (BEIR IV, 1988, p. 10)

Hormesis Response:

There is no correlation between radon levels and lung cancer mortality rates in miners. Radon in homes varies between 0.2 and 5 pCi/l.

Fig. 19.



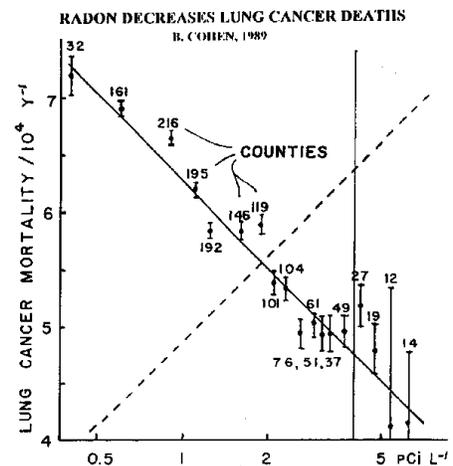
b. LNT Quote:

"The lung-cancer risk estimates for radon-daughter exposure derived by the committee in this report are based solely on epidemiological evidence." BEIR IV, p.6, 1988

Hormesis Response:

Reducing radon in homes increases lung cancer radon and progeny reduce lung cancer deaths. The EPA limit of 4 pCi/l has no reasonable basis. Extrapolation from animals & miners is fallacious.

Fig. 20.



c. LNT Quote:

"Health effects of exposure to radon daughters other than respiratory cancer are also of concern, but the data are sparse and associations are weak." (BEIR IV, 1988, p.9)

Hormesis Response:

Hospitals in Russia treat thousands of patients with radon for a variety of ills; success is judged by comparison with placebo controls.

Fig. 21.

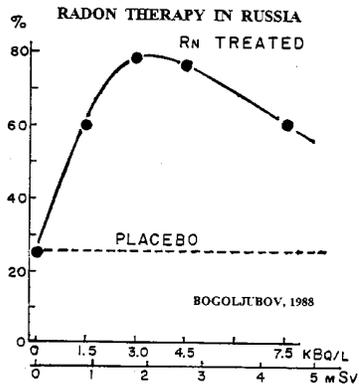
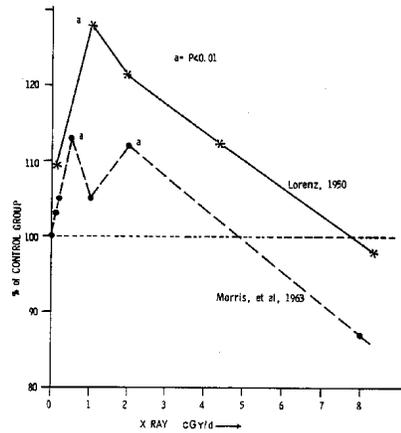


Fig. 22.



10. Extrapolate From Cells to Organisms

LNT Quote:

“Survival curves are so basic to an understanding of much of radiobiology that its worthwhile to go through the steps involved in a typical experiment using an established cell line in culture.” (Hall, 1978, p.18)

Hormesis Response:

“Cells in culture are laboratory artifacts which can not represent the complexities of integrated, whole organisms.” “... they cannot survive competition outside the laboratory.” (Luckey, 1991, p. 226)

b. LNT Quote:

“Plutonium is the most toxic substance known.”

“One pound of plutonium can kill all the people in the world.” POPULAR PRESS

Hormesis Response:

Plutonium is 10 billion times less toxic than the botulin toxins.

COMPARE Pu TOXICITY IN MICE

COMPOUND	Mg/Kg	LD 50 - IP (Luckey and Venugopal 1977)
NaCl	2600	
NIACIN	1860	
Pu CITRATE	1750	
ASPIRIN	495	
CAFFEINE	250	
HCN	3	
STRYCHNINE	1	
TETANUS T.	1.7x10 ⁻⁶	
BOTULINAL T.	3.2x10 ⁻⁷	

ITEM	CULTURED CELLS.	ANIMALS
HORMONES	RARE	NORMAL
CYTOCRINES	RARE	USUAL
SENSING SYSTEMS	POOR	GOOD
REACTIONS	POOR	GOOD
INTER-CELL EFFECTS	RARE	USUAL
DIFFERENTIATION	RARE	NORMAL
DEFENSE	LITTLE	GOOD
HOMEOSTASIS	LITTLE	GOOD
CHANGE	DEATH	ACTION
INFECTION	DEATH	RESPONSE
IMMUNITY	LITTLE	USUAL
REPRODUCE	RARE	USUAL
COMMUNICATION	LITTLE	GOOD
ENVIRONS	STRICT	VARIABLE
FOOD	STRICT	VARIABLE
DIGESTION	STRICT	VARIABLE

c. LNT Quote:

“One point is certain: it is simply absurd for anyone to suggest that plutonium may turn out *not* to cause human lung cancer, that is an impossibility,” (Gofman, 1981, p. 494)

Hormesis Response:

Russians with lifetime exposures less than 7 kBq have less lung cancer mortality than controls. *SIC TRANSIT, GOFMAN* Fig. 23.

11. Promulgate False Statements

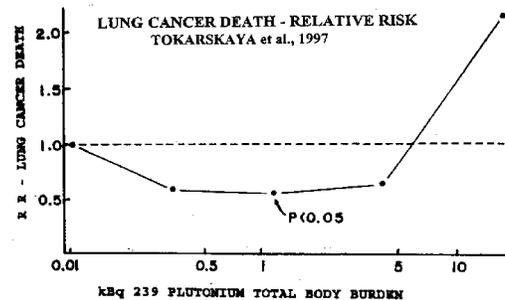
a. LNT Quote:

“... A sample of 100,000 may be needed for (to determine the effect of) a 100-rad exposure and about 10 million for 1 rad.” (Land, 1980)

Hormesis Response:

Statistically significant increased growth rates were obtained with 25 mice per group.

HORMESIS RESPONSE:



d. LNT Quote:

“...plutonium particulates have already committed approximately 950,000 persons worldwide to a lung-cancer death,”

Hormesis Response:

No cancer deaths in plutonium injected persons who survived up to 44 years.

e. LNT Quote::

“My own assessment of cancers in Europe from Chernobyl, plus cancers in the Soviet Union, is one million malignancies, ...” (Gofman, 1987)

Hormesis Response:

Chernobyl had 237 persons hospitalized with radiation sickness. In ten years, none of the 140 persons exposed to less than 2.1 Gy died of cancer or other disease. (NEA, 1995, p.57)

IN 1957 A RADIOACTIVE WASTE TANK EXPLOSION IN RUSSIA EXPOSED 10,000 PEOPLE. CANCER MORTALITY RATES ARE LOWER IN THE EXPOSED POPULATION:

AVG. cSv	CANCER DEATHS % OF CONTROL .	
4	27	(Kostyuchenko, 1994)
12	39	
49	28	

12. Radiation Harms Reproduction

a. LNT Quote:

“Until the early 1960’s, the genetic consequences were thought to be the most important delayed effect of radiation exposure.” (Eisenbud, 1997, p. 18)

Hormesis Response:

Both genotypic and phenotypic mutations were slightly decreased in children born to Japanese bomb survivors who were exposed to low doses.

b. LNT Quote:

“... other than cancer, developmental effects on the unborn child are of greatest concern.” (Hall, 1978, p. 446)

Hormesis Response:

Low dose irradiation decreases sterility. Kaplan found no mutations in the children or grandchildren. (Kaplan, 1959)

DECREASED STERILITY FOLLOWING X RAY

SPECIE	Gy	No.	%*	AUTHOR
HUMAN	0.9	644	54	KAPLAN
HUMAN	2	1000+	33	HBRG
MOUSE	2	4000	54	SPALDING
MOUSE**	2.8	124	25	LINING
TROUT***	0.5	11,000	75	NEWCOMB

* % OF CONTROL STERILITY

** mGy/y

*** SPERM

Also: Japanese children of one parent exposed to an atom bomb may have decreased mortality rates.

13. NO LOW DOSE CATEGORY

a. LNT Quote:

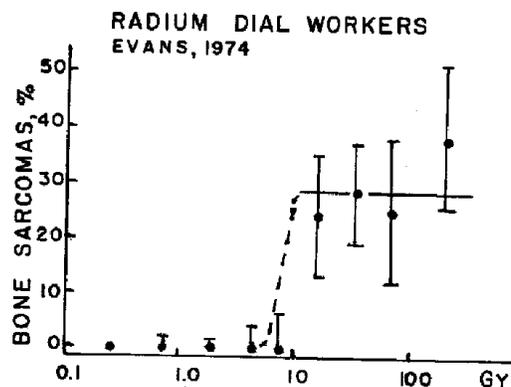
“The most definitive dose-response relationship for radiation-induced bone cancer come from studies of persons with elevated body burdens of the alpha-emitting radionuclides ... has been estimated to be about 2×10^{-2} person Gy.” (Mays, 1972)

Hormesis Response:

Risk, not health, is the only issue considered. BEIR and Mays ignore hundreds of dial painters exposed to below 10 Gy with no bone sarcomas. The study by Mays et al. has no low dose information. (Rowland, 1997)

Fig. 24.

HORMESIS RESPONSE:



b. LNT Quote:

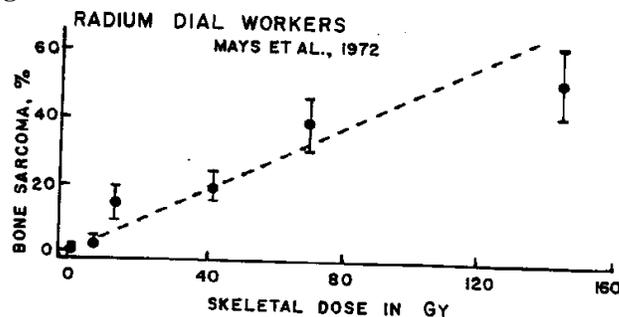
Their lifetime risk of bone cancer from internally deposited ^{224}Ra has been estimated to be about 2×10^{-2} /person Gy.” (BEIR V, 1990, p. 310)

“... as a working hypothesis, (radium) radiation is assumed to be carcinogenic even at the lowest dose levels, although there is no unequivocal evidence to support this hypothesis.” (BEIR IV, 1988, p. 176)

Hormesis Response:

British dial painters with less than 40 person years of work have cancer death rates below that of the control population, see below.

Fig. 25.



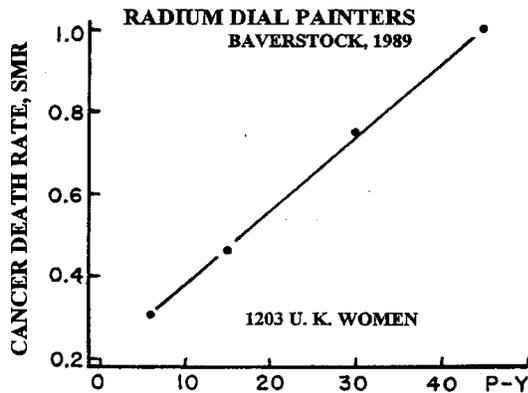
c. LNT Quote:

“... as a working hypothesis, (radium) radiation is assumed to be carcinogenic even at the lowest dose levels, although there is no unequivocal evidence to support this hypothesis.” (BEIR IV, 1988, p. 176)

Hormesis Response:

Dial painters in the United States show an inverse relationship between exposure to radiation and cancer mortality rate.

Fig. 26.



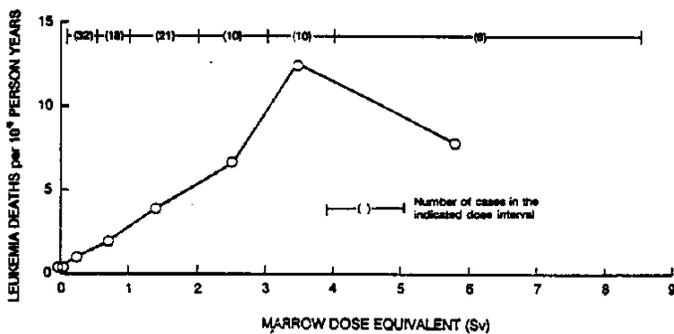
d. LNT Quote:

“The risk of acute leukemia and of chronic myeloid leukemia are increased by irradiation of the hemopoietic cells,...” (BEIR V, 1990, p. 252)

Hormesis Response:

The BEIR data of Japanese bomb survivors give no exposures greater than 10cGy which show radiation hormesis.

Fig. 27.



14. No or Poor controls

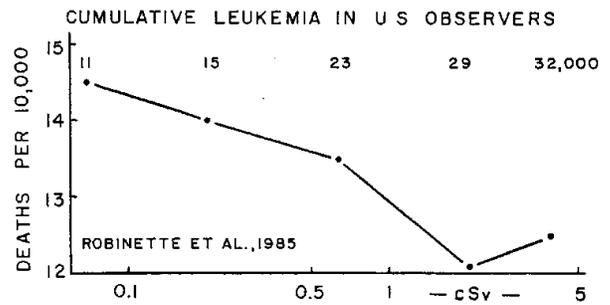
a. LNT Quote:

“Statistically significant increased frequency of occurrence and mortality was found only for leukemia.” re: SMOKY (Caldwell, 1983)

Hormesis Response:

Exposure to ionizing radiation decreased the rates for leukemia deaths in 32,000 observers of atom bomb explosions. There were no controls.

Fig. 28.



16. Use SPF Animals Without Challenge

a. LNT Quote:

“In laboratory animals exposed to whole body radiation, life expectancy decreases with increasing dose.” (BEIR V, 1990, p. 363)

Hormesis Response:

Chronically irradiated mice had significantly increased lifespan, see graph (Fig. 13, p. 5). When specific pathogen free animals (SPF animals do not have the usual bacterial infections) were used, Lorenz work was falsely discredited.

b. LNT Quote:

In each experiment, however, the survival of the non-irradiated controls was compromised by mortality from under-current infection. (BEIR V, 1990, p 364)

Hormesis Response:

Ionizing radiation increases immunity. Young guinea pigs and diphtheria bacillus control, dead in 28 hr; prior x-ray lived. (Schrader, 1896)

Rabbits injected by diphtheria toxin. Control: 95% died; 18 cGy by x-ray, all lived (Gerhartz, 1908)

Friend virus + 150 cGy to mice at 5 and 12 d alive 40 days: controls, 0; exposed, 100% (Shen et al, 1989)

3.9 Gy + V.S. virus to mice at 3 d pregnancy dams with living fetuses at 14 d: control 1/30; exposed, 17/30 (Mayr and Paulus, 1989)

20 reports show irradiation prior to virus or bacteria infection decreased deaths

18. IGNORE VITAL RESEARCH

a. LNT Quote:

“It is well known that absorption of ionizing radiation by tissues is connected with damage, however small the dose.” (Lorenz, 1950)

Hormesis Response:

The growth rate of protozoa is increased by adding radiation and is decreased by levels below ambient. (Luckey, 1986)

b. LNT Quote:

“It is well known that absorption of ionizing radiation by tissues is connected with damage, however small the dose.” (Lorenz, 1950)

Hormesis Response:

When compared with controls, organisms in subambient radiation levels were obviously efficient. ionizing radiation is essential.

19. DNA REPAIR vs IMMUNE COMPETENCE

a. LNT Quote:

“Of the various types of biomedical effects that may result from irradiation at low doses and low dose rates, alterations of genes and chromosomes remain the best documented.” (BEIR V, 1990, p. 4)

Hormesis Response:

Free radicals from oxidative metabolism are estimated to produce 10 million times more mutations each day than low dose irradiation. These few are removed by the immune response, apoptosis, induced differentiation and tissue necrosis.

RADIATION DEFICIENCY IN NON-VERTABRATES

<u>ORGANISM</u>	<u>EFFECT</u>	<u>WEEKS</u>	<u>%*</u>	<u>AUTHOR, YEAR</u>
ALGA	VIABILITY	10+	0	EUGASTER, 1954
ALGA	VIABILITY	1	72	PLANEL, 1979
BARLEY SEED	VIABILITY	10+	9	EUGASTER, 1954
PARAMECIA**	GROWTH	1	5	LUCKEY, 1978
PARAMECIA**	GROWTH	14	1	PLANEL, 1979
PARAMECIUM	GROWTH	1/2	56	LUCKEY, 1986
SHRIMP EGGS	VIABILITY	10+	0	EUGASTER, 1954
* PERCENT OF CONTROL		** BACTERIA PRESENT AS FOOD		

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