RSH Index Page

RSH > Documents > "Health Effects of Low-level Radiation" Review> Table of Contents > Chapter 2.3

RSH Data & Documents

"Health Effects of Low-level Radiation"

by Dr. Sohei Kondo

Table of Contents

Title Page: Front matter

Table of Contents

Terminology of radiation dose

2.3 Health effects of the fear of radiation accidents

After the accident at the Chernobyl nuclear reactor, many people in Byelorussia and the Ukraine reported that they were suffering from a variety of diseases; but many of those diseases may be the result, at least partly, of the fear of radiation. The news that radioactivity had been detected in soil, vegetables, meat and dairy products must have shocked the local inhabitants. They may have suffered from the illusion that the Earth was cursed by the devil radiation and that their food had been poisoned by that devil. Once obsessed with this illusion, they would have become habitual worriers, and the accumulation of stress would naturally have adverse effects on their health.

About 30 years ago, because of a shutter defect in an x-ray generator, I was accidentally exposed to a much higher dose of radiation than the estimated life-time doses received by residents of the 'hot' zones of the areas contaminated by radioactive nuclides in the fall-out from the Chernobyl accident. I was admitted to a hospital affiliated with the Tokyo University School of Medicine for about one week; but, since then, I have never worried about the effect that my exposure to radiation may have had on my health. Now, I am well acquainted with the various effects of radiation on humans, from the molecular to the whole-body level. This book partly describes those effects.

2.3.1 *Public panic about the radioactive fall-out from Chernobyl, and press reports*

Immediately after the Chernobyl accident on 26 April 1986, pregnant women living in Kiev, close to Chernobyl, began to panic. They were terrified that their exposure to 'lethal' radioactive fall-out from the reactor accident would cause malformations in their fetuses. Some of these women managed to persuade Hungarian students at Kiev University to marry them temporarily or they married previously so that they could go to Budapest to undergo medical examinations. High levels of radioactivity were detected around the thyroid glands of these women because of intake of radioiodine released in the accident. This exposure was called 'lethal fall-out' and given top coverage in the media.

Dr Andrew Czeizel, Department of Human Genetics and Teratology, National Institute of Public Health in Budapest, one of the most respected medical geneticists in the world, told the women that the amounts of radioiodine detected would scarcely harm their fetuses. His opinion was based on radiological knowledge of the threshold for induction of malformations in fetuses after irradiation (see Section 3.3) and of the fact that high levels of radioactivity are localized in the thyroid gland because of the selective uptake of radioiodine by the thyroid gland; fetuses would receive much lower levels of radioactivity. Most of the patients, however, appear to have disregarded Dr Czeizel's advice and wanted to undergo therapeutic abortions. However, the Abortion Committee

in Hungary did not allow it in the majority of the cases.

Dr Czeizel thought of telling the press that the doses of radiation received from radioiodine and other nuclides released in the Chernobyl accident were too low to induce malformations in fetuses and that therapeutic abortions were thus unnecessary. He did not disseminate this important information, however, because he feared that it would be misunderstood by readers and that they would probably interpret his report to mean the contrary. In fact, many Hungarians did panic shortly after the Chernobyl accident--unnecessarily, as is shown below.

As a consequence of the Contergan thalidomide catastrophe, a nation-wide registry of congenital malformations was established in Hungary in 1963. This system is one of the most reliable networks in the world. It provides monthly reports on a wide range of pregnancy outcomes, including induced abortions, fetal deaths, births of babies weighing less than 2500 g, isolated congenital anomalies, identified multiple congenital anomaly syndromes that include radiation syndromes, isolated congenital anomalies, and unidentified multiple congenital anomalies (Czeizel, 1991). Of these categories, only the number of newborns weighing less than 2500 g showed a significant increase in monthly incidence, rising from the normal level of under 10% to 10.7% in May and June 1986, the first two months after the accident (Table 2.5; Czeizel and Billege, 1988).

Since the excess dose of radiation accumulated during those two months was less than 0.05 rad (Feher, 1988), the observed increase in preterm births must have been due to some factor other than radiation (Czeizel, 1990). Czeizel and Billege (1988) proposed that the increase was the result of preterm labor caused by psychological anxiety. Psychological stress is known to cause preterm labor and consequently the birth of abnormally small babies (Newton et al., 1979).

Table 2.5 Monthly distribution of pregnancy outcomes in Hungary from 1986 to the first quarter of 1987 (from Czeizel and Billege, 1988)

Year Month	Induced abortion		Spontaneous abortion		Still-birth		Live birth	Live birth <2500 g		Congenital abnormality	
	nd	%	nd	%	nd	%	nd	nd	%	nd	%
1986											
Jan	248.8	38.1	53.0	13.1	2.6	0.7	349.8	34.1	9.7	13.6	3.85
Feb	261.8	39.1	50.9	12.5	2.4	0.7	355.1	32.8	9.2	13.6	3.80
Mar	216.7	34.6	50.7	12.3	2.3	0.6	357.5	36.0	10.1	12.5	3.46
Apr	246.6	37.6	49.5	12.1	2.8	0.8	356.6	35.8	10.0	10.3	2.86
May	225.1	36.4	50.6	12.9	2.6	0.8	340.2	36.3	10.7*	12.5	3.63
Jun	224.1	35.3	45.7	11.1	1.9	0.5	363.4	39.0	10.7*	11.5	3.14
Jul	236.1	35.2	53.4	12.3	2.3	0.6	379.8	37.3	9.8	11.3	2.95
Aug	199.3	32.5	47.5	11.5	2.4	0.7	364.1	35.9	9.9	10.6	2.90
Sep	239.8	36.9	49.5	12.1	2.3	0.6	358.4	32.7	9.1	11.0	3.05
Oct	211.1	35.3	50.4	13.1	1.8	0.5	333.6	29.5	8.8	10.1	3.00
Nov	201.3	35.1	47.5	12.8	1.9	0.6	322.9	30.9	9.6	10.1	3.11
Dec	227.3	37.0	51.1	13.2	2.0	0.6	333.8	34.1	10.2	9.4	2.80
1987											
Jan	243.5	38.4	47.6	12.2	2.3	0.6	340.8	33.5	9.8	-	-
Feb	251.1	39.1	49.6	12.7	2.2	0.6	338.9	33.0	9.7	-	-
Mar	226.1	35.2	48.8	12.5	2.2	0.6	344.9	33.0	9.6	-	-

nd = daily mean number
* p <0.01

In order to estimate the possible number of victims in Greece of fear of the radioactive fall-out from the Chernobyl reactor accident, Trichopoulos et al. (1987) surveyed temporal changes in the monthly numbers of live births before and after the accident. The observed and (in parentheses) expected figures for January, February and March 1987 were: 7032 (9103), 7255 (7645) and 8350 (8453), respectively, whereas in December 1986 there had been no reduction in the number of live births in comparison with the numbers in 1981 85 (Fig. 2.6). These results were interpreted as showing that, during the period of concern after the Chernobyl accident, i.e., May 1986, 23% ([9103 7032]/9103) of early pregnancies at perceived risk were artificially terminated and that, for the whole of 1986, about 2500 otherwise desired pregnancies were interrupted because of fear of radiation.

Kondo 93 Figure 2.6

Fig. 2.6 Observed (open circle) and expected numbers of live births in Greece during January 1987

Expected numbers were calculated on the basis of the 1981 86 linear trend of the number of live births during January of the corresponding year (filled circles) and the average monthly number of live births throughout the corresponding year (filled squares) (from Trichopoulos et al., 1987. Copyright British Medical Association, London. Reproduced with permission)

In Hungary, termination of pregnancy due to the Chernobyl fallout was not allowed, despite large proportion of legal abortions (Table 2.5), owing to the Abortion Law as the 'Abortion' Committee judged that excess doses by radioactive fallout from the Chernobyl accident were far below the lowest intervention dose of 10 rad to fetuses in the first 12 weeks (Czeizel, 1991). In fact, monthly distribution of induced abortions in the period of May of 1986 to April of 1987 did not significantly differ from that averaged over the period 1980-1989 excluding 1986 (Czeizel, 1991; see Table 2.6A for the cases of May and June of 1986). It is, however, noteworthy that monthly distribution of live births (% of the total live births per year) in February and March of 1987 was significantly lower than that averaged over the period 1980-1989 excluding 1987.

From the data of Czeizel (1991), we estimate that the decrements in the number of monthly live births in February and March of 1987 as compared with the corresponding number of monthly live births averaged over other years sum up to about 800 live births. This estimate is compatible with the annual excess of the decrement in the number of live births, [- deltaN_1], in 1987 over [- deltaN_1] in 1986 or 1988, as seen in Table

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Table 2.6 Pregnancy outcomes in Hungary, 1980-89

A. Monthly distribution of induced abortions and live births in the indicated month compared with that (with 95% confidence

intervals) averaged over 1980-1989

Month	Induced abortions (% of total/year)		Month	Live births (% of live births/year)	
	1986	1980-89 (except 1986)		1987	1980-89 (except 1987)
May	8.44	8.40+/-0.35	Feb	8.20	8.56+/-0.28
Jun	8.03	8.33+/-0.35	Jun	8.21	8.50+/-0.26

B. Distribution of pregnancy outcomes, 1985-1989

Year	Live births/year (N_1)	Difference (delta N_1)	All pregnancy outcome per year minus N_1 (N_t - N_1)	Difference delta(N_t - N_1)
1985	130,200		100,848	
1986	128,204	-1,996	102,708	1860
1987	125,840	-2,364	103,131	423
1988	124,296	-1,544	105,917	2786
1989	123,304	- 992	106,602	685

Constructed from the data of Czeizel, 1991

Czeizel (1991) interpreted these results as indicating that people were so frightened of 'lethal' radioactive fall-out from Chernobyl during the following two months that many of them practiced intensive birth control during that period, resulting in the decrease in live births 9 months later.

In many countries in western Europe, legal abortions increased for several months following the Chernobyl accident probably because of fear of the effects of the radioactive fall-out (see, e.g., Fig. 2.6); according to the IAEA, 100,000 to 200,000 excess abortions were performed throughout western Europe after the Chernobyl accident (Ketchum, 1987).

2.3.2 *Soviet citizens stubbornly continuing to live in highly contaminated areas and survivors of the atomic bombing in Nagasaki: people resisting despair*

In 1990, a large number of people were evacuated to radioactivity-free areas from their homes in Byelorussia, the Ukraine and Russia, where the levels of radioactivity from radioactive fall-out were so high that the estimated life-time dose would be over 35 rem (Int. Adv. Comm. IAEA, 1991).

Gomel' is one of these heavily contaminated areas (see Fig. 2.3). Recently, Professor Y. Satow, of the Hiroshima University School of Medicine, visited Gomel' (see Fig. 2.3); he subsequently made the following comments to a Japanese newspaper. *"I was very shocked to find that there were still many people living in dangerous zones with high radiation levels in spite of the governmental order to evacuate their homes and farms, although I sympathize*

with the farmers who love their farm lands so much that they want to remain on them. I understand their bitter feeling of possible loss and their fears of future uncertainty in new places. Nevertheless, I feel that evacuation from their homes and farm lands is the best way to prevent illness in the future due to the high levels of radioactivity." This opinion is probably shared by the majority of radiation protection experts, since the evacuation criterion of 35 rem established by the NCRP of the USSR was supported by radiation experts from the international organizations for radiation protection--the IAEA, the World Health Organization and the United Nations Scientific Committee on the Effects of Atomic Radiation (Gonzalez, 1990).

As a scientist who majored first in radiation physics and later in radiobiology in a medical school, I support the intuitive decision of residents to stay in their homes in spite of the considerable contamination of their homes and land with radioactive fall-out. Furthermore, I would not be surprised if those who stayed in houses contaminated by radioactive fall-out lived longer than those who moved away. There are many lines of evidence for me to believe so. The first is described below and the others in the following chapters.

The first line of evidence is based on the results of an epidemiological study of deaths among survivors of the atomic bomb in Nagasaki, published by Mine *et al*. (1981) after surveying 7,782 deaths occurring in 1970-76. As indicated in Figure 2.7, the age-specific mortality rates among the bomb survivors over the age of 60 were significantly lower than among control citizens.

Kondo 93 Figure 2.7

Fig. 2.7 Comparison of age-dependent rates of mortality (1970-76) for atomic bomb survivors (solid line) and controls (broken line) in Nagasaki

Mortality rates are averages for 1970-76 at five-year intervals; e.g., the rate at age 30 is the average for ages 30-34 years (constructed from data of Mine et al., 1981)

In the comparison of Mine *et al*., atomic bomb survivors are defined as people who were given an **'Atomic Bomb Survivor Health Handbook'** (*hibakusha techo* in Japanese) by the Japanese Government via the Nagasaki City Office after they had been confirmed as authentic atomic survivors, whereas unexposed groups are defined as people living in Nagasaki City but without a health handbook. The health handbook holders receive free medical care and subsidies for diseases for which a possible causal relation with the atomic bombing is presumed, and, when they die, funeral subsidies are given to their relatives by the Ministry of Health and Welfare of Japan. According to a survey, health handbook holders undergo more frequent health examinations than people who do not have the handbook. Slight changes in the life style of atomic bomb survivors, who are more concerned with their health than other people, may also have a favorable effect on their longevity, despite the exposure to radiation.

Experts in epidemiology and other branches of life sciences criticized the study of Mine et al. (1981) and argued that the atomic bomb survivors must have suffered from worry and anxiety during the long period since they were exposed to the bomb; most of them may have had to live more stoically, in fear of potential diseases, than unexposed citizens. Therefore, it is possible that changes

in life style, rather than radiation, reduced the mortality of atomic bomb survivors compared with unexposed citizens. I, too, would regard this paper as of little value if I were still in the ivory tower of the National Osaka University School of Medicine, because the comparison of the two groups described in the paper lacks scientific rigidity. Now, however, I greatly appreciate the value of this paper because of its view of the real world. The real data on survivors of the atomic bomb in Nagasaki might be very valuable to those residents of the ex-USSR who have decided to continue living in their highly contaminated homes, opposing the governmental order to evacuate them.

Human beings cannot be studied like experimental animals, and data on humans are almost always considered to be incomplete from the academic point of view. The available factual data on humans exposed to low-level radiation are, however, invaluable, and I propose now that we exercise rationality in handling these incomplete but important data. This change in my view of the evaluation of scientific data has come about gradually, since April 1986, when I retired from the National Osaka University and took a research job at Kinki University, a private establishment. This was also at the time of the Chernobyl accident. I was thus forced to face public opinion, because I met more people in private enterprises than I did Government officials.

I considered that it might be worthwhile to test the possibility that the atomic bomb survivors overcame the harmful effects of radiation and lived longer than unexposed people, not because of a 'healthy survivor effect', but because of a beneficial effect of low-dose radiation. To exclude the 'healthy survivor effect', mortality rates were compared between two subgroups of health handbook holders: an exposed group made up of people exposed to more than 1 rad and an 'unexposed' group made of people exposed to less than 0.5 rad. As can be seen from the preliminary data given in Table 2.7, the mortality rates of people exposed to more than 1 rad of radiation are lower than those of the people exposed to less than 0.5 rad. This finding was true for both men and women, except for women aged over 80 and men aged 30 39 years. The data I show here can be readily understood by ordinary people. I shall not bother my readers with the statistical analysis, which will be published elsewhere.

Table 2.7 Annual mortality rates (per 100,000), 1970-76, in Nagasaki

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Sex	Age	Bomb survivors[a]		Controls[b]
		>1 rad	<0.5 rad	
	(years)			
Male				
	30-39	205	201	188
	40-49	375	489	417
	50-59	1,036	1,201	957
	60-69	2,119	2,485	2,640
	70-79	6,342	6,856	8,856
	80	15,758	16,319	32,673
Female				
	30-39	78	87	103
	40-49	218	224	223
	50-59	428	569	510
	60-69	833	1,303	1,516
	70-79	3,242	4,161	5,305
	80	13,158	12,626	19,634

Personal communication from M. Mine and Y. Okumura
[a] Holders of the Atomic Bomb Survivor Health Handbook (see text)
[b] Citizens without the health handbook

However, cautious readers may raise the possibility that the decrease in mortality in every age group above 30 is simply because the less healthy 10-20% of the exposed population have already died as the result of the bomb explosion. This possibility is discussed in the next chapter, using data on mortality in 1950-1985 among bomb survivors in Hiroshima as well as Nagasaki.

References

To:

Chapter 3. Results of Health Surveys of Atomic Bomb Survivors Exposed to Low Doses of Radiation

- Up to: Kondo: "Table of Contents"

RSH > **Documents** > **"Health Effects of Low-level Radiation"** **Review>** **Table of Contents** > **Chapter 2.3**

For more information please contact mailto:cnts@cnts.wpi.edu.
You may also contact the Center's Co-Directors:
Mr. J. Muckerheide jmuckerheide@cnts.wpi.edu
Prof. J. A. Mayer jamayer@wpi.edu

For website problems please contact the mailto:jmuckerheide@cnts.wpi.edu

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