Physical Conditions of the Environment and the Resident Population of the Semipalatinsk Area

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Foreword

Thanks to perestroika, Dr. Boris Gusev, Director of the Semipalatinsk Institute of Medical Radiology and Ecology in the Republic of Kazakhstan, and others, came to Japan at the invitation of "The Organization to Invite Physicians from Semipalatinsk to Hiroshima" (with the support of contributions from citizens). During their visit from November 12-23 1990, information on nuclear testing in Kazakhstan began reaching Japan.

While in Hiroshima the visitors reviewed studies and saw clinic facilities. They visited administrative offices, saw atomic bomb survivors (promoting friendship with them), and went back home. During their stay in Hiroshima, the visitors requested that since the Semipalatinsk area is unique in that a great number of people have been externally and internally exposed to radiation for a long duration, they hoped that materials would be collected, preserved and publicized for the entire world. At this time, I would like to document the catastrophic conditions which were described orally by Dr. Gusev in Hiroshima at an official occasion and faithfully recorded in writing.

Information on the Semipalatinsk Nuclear Test Disaster

The first nuclear test was detonated 38 kilometers above ground and 70 kilometers away from Dorony Village on August 29, 1949. This was a 40-kiloton hydrogen bomb (note: the explosive force from the atomic bomb in Hiroshima is said to have been equivalent to 13 kilotons of TNT; the atomic bomb in Nagasaki was equivalent to 22 kilotons) and fallout equivalent to 200 rads fell for an hour on the village where 50,000 people lived. Later, fallout of 60 rads fell during the day and night, then 130 rads for a week; a week after that, fallout of 160 rads fell for a month. After the first test, residual radiation remained for two years and 10 months. Dr. Gusev states that the route of contamination was 20% from fallout (external exposure) and 80% from internal exposure. Investigation regarding internal exposure has not progressed yet. The radiation consisted mainly of alpha rays, beta rays (from tritium), and gamma rays. Alpha rays and beta rays are related to internal exposure and absorbed into the body through water and food. According to Dr. Gusev, exposure to 150 to

600 rads causes disorders in the thyroid grand, 120 to 150 rads affects the digestive system, and 100 to 150 rads affects the bones.

After this first test, approximately 200 tests were conducted in the atmosphere and on the surface for 16 years from 1949 to 1965. Another 370 tests were conducted underground for 24 years between 1965 and 1989. The underground tests were conducted with the nuclear weapon set in the ground by boring 400 to 700 meters below the ground surface. Radioactive gases such as krypton (^{36}Kr), radon (^{86}Rn), etc. blew above the ground in 10 to 20 of the underground tests.

A large-scale test, which was approximately 38 times more powerful than the Hiroshima atomic bomb, was conducted on August 12, 1985. In some areas, fallout amounting to 70,000 rads fell, and fallout of 150 to 200 rads per hour was recorded in a village. The villagers were evacuated from the village, but they returned to their village in three weeks. The test site was approximately 18,000 km^2 (twice the area of Hiroshima Prefecture), but the hypocenter varied depending on where the test was conducted. However, 500,000 people who resided in the area, 70 to 550 km away from the test site, were exposed to radiation. Of this population, 300,000 people moved from the area or died, while 200,000 still live in the same area. As of 1990, the second (F_1) and the third generations (F_2) of approximately 250,000 survivors who were originally exposed to radiation also live there, but they cannot be regarded as "pure descendents of the survivors" because they have been exposed to radioactive materials internally and from fallout for many years since their birth. That is, they are F_1 or F_2 and also directly exposed people. They are thought to have been exposed to between a minimum of one rad and a maximum of 160 rads or over. Dr. Gusev conducted a health survey of 20,000 survivors exposed from a short distance along with another 20,000 people from a long distance as a control group. Both groups were compared and surveyed, and the following was observed in the group exposed from a short distance:

1. A high rate (39 to 40%) of malignant tumors was observed.
2. Esophageal cancers rates increased by seven times, while liver and lung cancer rates tripled. (Esophageal cancer occurred four times as often even among those who were not exposed to radiation compared to those from other areas, so it is surmised that the occurrence increased by 7/4 =1.75 due to radiation exposure).
3. When cholesterol levels, pulse, and other physical characteristics were used as indexes, aging appeared 10 to 15 years earlier.
4. The death rate of children was 1.5 to 2 times higher due to congenital anomalies and immunodeficiencies.
5. Leukemia rates rose by 70%, six to ten years after beginning the experiment, with no difference from the control group for 11 to 23 years; the second peak appeared with a 50% increase 23 years later.
6. Chromosome abnormalities were observed among 20% of the control group and 60% of the highly exposed group.

7. In Kainal Village, 60 km away from the hypocenter, between 1980 and 1990, among the village's 2500 residents, there were 165 cases of malignant tumors (6.6%), 16 cases of leukemia (0.64%), 26 incidents of mental retardation (1.04%), and 11 suicides (0.44%), and other maladies.

Where do the great amount of gases go during the underground nuclear tests? Does the radiation leak outside? Is the underground water contaminated? It has become clear, at least, that radiation has leaked to the outside, but the movement of radiation in the natural world is not known. There is a mutual understanding that we need to exchange information on the disasters which occurred in Semipalatinsk and Hiroshima. The scale of the disaster, the amount of radiation released, the number of tests, and the type of radiation released should be studied so that a clearer understanding of radiation's effects on humans can be gained. Since the first exchange, we have been interacting with public and private organizations from Japan to exchange investigation information and to support a visit to the site in Semipalatinsk. Three guest researchers from the site in Semipalatinsk visited the Hiroshima University Research Institute for Radiation Biology and Medicine, each staying for a year.

Medical Conditions in Kazakhstan

The medical system in Kazakhstan is very different from Japan's. The biggest difference is that Kazakhs can receive medical treatment without charge. Wherever people live in Kazakhstan, there is supposed to be a medical facility, or they should be able to receive high-level treatment in a big city if necessary. However, in reality, this system is not working. There is still a state where there is an asylum for patients with Hansen's disease. Kazakhstan used to supply medical materials, which were manufactured in the Baltic States, for distribution in the former Soviet Union. PAS (an anti-tuberculosis medicine), for example, had been produced at low prices. However, due to the lack of foreign currency following the collapse of the Soviet Union, there have been shortages. Doctors lack anti-cancer drugs, antibiotics, CTs and MRIs. At clinical sites there are shortages in medical supplies including bandages, test tubes, oxygen cylinders, suture materials and so on.

Cancer, in the nation as a whole, has been observed in the lungs, stomach, skin, esophagus, and breasts in this order. This tendency occurred in 1989 and 1990. Cancer, collectively, occurs in the northeast area of Kazakhstan, and the occurrence of skin cancer in eastern Kazakhstan is particularly high with a rate of 43.9/100,000. It is difficult to make an international comparison since these statistics have not been adjusted according to age, race, residence history, radiation exposure history, career, etc. However the statistics strongly suggest that something serious is occurring in the northeastern part of Kazakhstan.

Fieldwork

In May 1993, I had an opportunity to accompany NHK reporters to visit the Semipalatinsk Nuclear Test Site for three weeks in order to study the delayed effects of radiation exposure. It took ten hours from Narita Airport to Moscow, another four hours by air from Moscow to Alma-Ata and then two more hours by air going back eastward to Semipalatinsk. Several hours of jeeping through a wide expanse of steppe finally brought us to Kainal Village, which suffered greatly due to the nuclear testing. (Fig. 1) While we were in Alma-Ata, we paid a courtesy call to President Nazarbaev and received his consent to conduct our investigation since the country had gone through perestroika only a short while before. (Fig. 2)

Fig. 1. The author had an opportunity to visit Semipalatinsk in order to study the late effect of radiation exposure in 1993.

Fig. 2. We paid a courtesy call to President Nazarbaev and received his consent to our investigation.

In addition, we also met Dr. Balmukhanov of the Republic of Kazakhstan, who had been conducting independent studies on the harm caused by radiation. He shared with us some incidents that demonstrated how difficult it was to conduct research and investigate freely under the very strict controls of the government in those days.

At the test site, we saw Mount Degelen. On the mountainside, they had dug a 500-meter-long tunnel complex, where they conducted nuclear tests in 1953, 1970, 1973 and 1974. Should this be called an underground test site or a surface test site? Blast wind and radioactive debris shot through the tunnel complex, partly destroying the mountain itself, turning the green mountain into a heap of rubble. (Fig. 3)

We met a number of children with congenital anomalies. Among them were those with microcephaly or retardation in mental development supposedly induced by exposure in utero, as was the case with several dozen people in Hiroshima.

Fig. 3. The Degelen Mountain where nuclear tests were conducted in 1953, 1970, 1973 and 1974. The green mountain turned into a heap of rubble.

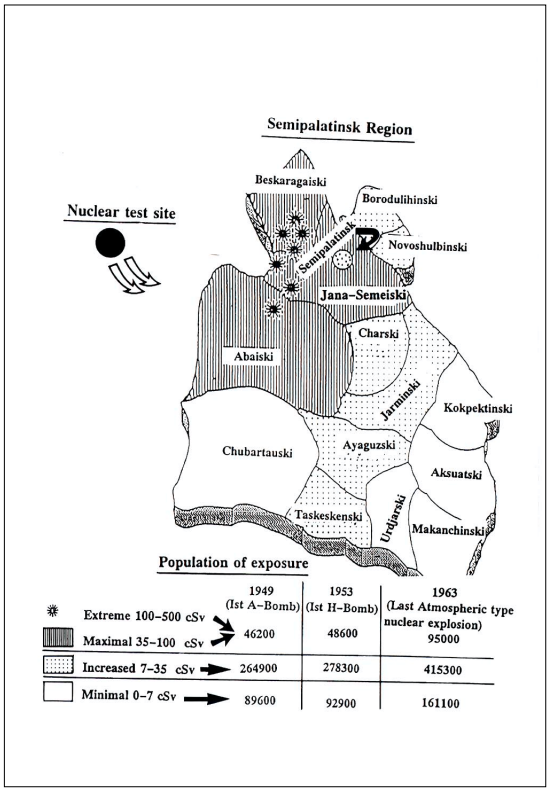
We visited Kainal Village located about 60km from the test site to see Mr. Malgariev Eleogas (60 years old at that time), a resident of the village. He was working at the post office in the village when a nuclear test was conducted in June 1953. Even after other villagers had been evacuated, he was told by the military he should stay because his job was so important. As a result he was exposed about 18 km from the test site. Half a year later, he experienced some health problems including bleeding from the skin. Now he suffers from scleroma. Out of his 41 colleagues who were working there on that day, four died of leukemia after six to ten years, 36 died of gastric cancer, etc. and one killed himself, leaving him as the only survivor. He led us to the graves of his former colleagues. In the case of another family, the father, who was 66 years old in 1913, kept on living in the village but saw four of his seven children suffer from severe mental retardation. According to Dr. Gusev, who was their family doctor, there were many children with similar symptoms in Dorony Village. We were surprised to learn that there were so many cases of similar disorders.

I would like to introduce some of the findings from the study we conducted there.

1) In the Semipalatinsk Region, various groups are using different dosimetric methods to study the radiation levels of the contaminated soil. There are 95,000 people who were exposed to large doses of 35 ~ 100 cSv, 415,300 people who were exposed to intermediate level doses of 7 ~ 35 cSv, and 161,100 people who were exposed to low doses of 0 ~ 7 cSv. The total number of exposed people, approximately 670,000, accounts for nearly 80% of the whole population of Semipalatinsk, which is some 830,000. (Fig. 4)
2) Regarding the life spans of the residents in the Semipalatinsk Region, among those who were exposed to 8 ~ 200 cSv of radiation, the average life span was 59 for women and 58 for men. This was considerably shorter compared with the average for Kazakhstan as a whole, which is 73 for women and 65 for men. The gaps between the figures in Semipalatinsk and those

for the United Kingdom, the United States and Japan are even more notable. (Fig. 5)

3) Infectious diseases are the top cause of death by underlying cause, followed by diseases of the circulatory system, malignancy, diseases of the digestive system and congenital abnormalities. Especially high incidences of malignant tumors have been observed among people exposed to high doses of radiation, while higher incidences of infectious diseases and circulatory disorders among the control group exposed to lower levels of radiation suggest a greater role for environmental factors other than radioactivity. (Fig. 6)
4) The death rate from leukemia, as of 1984, 30 ~ 37 years after nuclear tests began, was 4.8 in a population of 100,000 for those exposed to radiation, and 2.0 for the control group. In Japan, the figure for 1984 was 3.7 for men and 2.8 for women. (Fig. 7)
5) The incidence of congenital abnormalities among newborn babies in Semipalatinsk between 1985 ~ 1988 was 12.9 % in the group exposed to a high dose of 195 cSv. This is 7.5 times greater than Japan's rate of 1.7% in 1985. (Fig. 8)



① Exposed to high doses (35-100 cSv (=rem)): 95,000 in 1963

② Exposed to medium doses (7-35 cSv): 415,300

③ Exposed to low doses (Control)(0-7 cSv): 161,100

① and ② combined: over 510,000

Fig. 4. Outline of exposure and number of people exposed due to nuclear tests in Semipalatinsk.

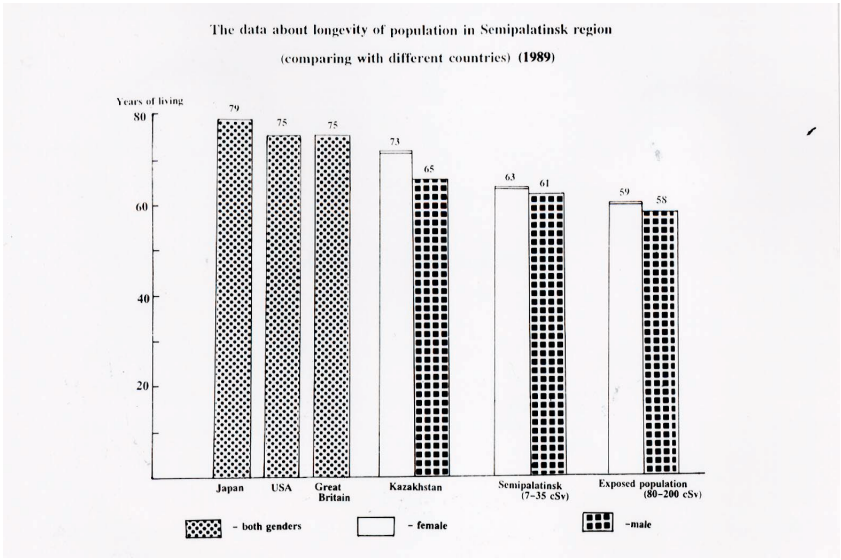


Fig. 5. Life span comparison between Semipalatinsk residents and other countries. Life span of those exposed to high doses of 8-200cSv: as short as 59 for women and 58 for men as compared to 73 for women and 65 for men in the entire Republic of Kazakhstan.

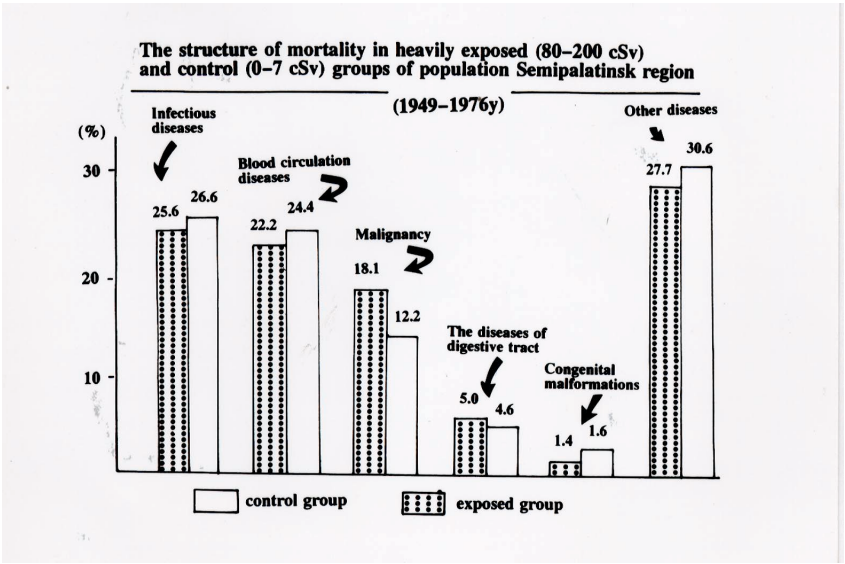


Fig. 6. Death rate from various diseases among Semipalatinsk residents (1949-1976), with cases of infectious and contagious diseases characteristically high.

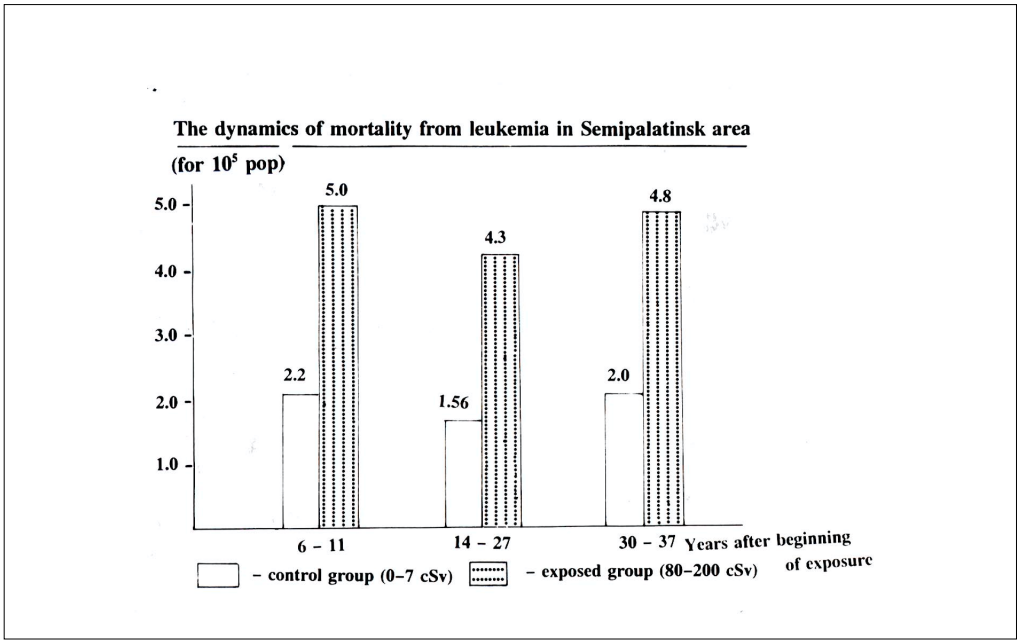


Fig. 7. Death rate from leukemia among Semipalatinsk residents per 100,000: 4.8 among the exposed versus 2.0 among the control group in 1984 (30 to 37 years after the tests started), with the rate of leukemia in Japan at 3.7 for men and 2.8 for women in 1984.

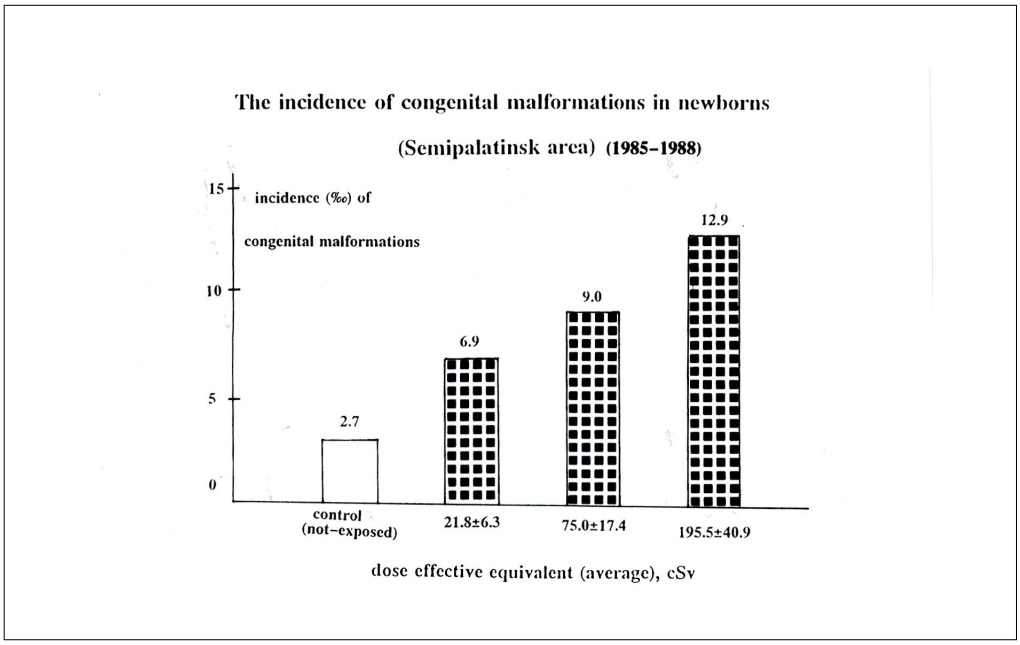


Fig. 8. Frequency of congenital anomalies among newborns in Semipalatinsk (1985-1988). The frequency in areas with exposure to high doses of 195 cSv is 12.9%, which is 7.5 times higher than the Japanese frequency of 1.7% in 1985.

Conclusion

There are still many unclear points regarding how much radiation residents in Semipalatinsk were exposed to and the details of health disorders caused by exposure to radiation because the nuclear tests were a subject classified by the military. The former Soviet government and military have kept the data on doses and diseases for the past 40 years, but much of it is missing now. Since the nuclear tests were conducted over a long period of time, 40 years, many of those who were exposed to radiation are dead or have moved, making it difficult to collect and record materials. The testimony that I introduced at the beginning of this paper is based on the memories of Dr. Gusev, who worked for a military survey organization at the site from the beginning to the end of the nuclear tests, and on the results of the survey they conducted themselves after the start of perestroika.

On the other hand, some local scientists felt that military announcements underestimated the effects from nuclear tests and radiation exposure and conducted their own survey between 1952 and 1960. The survey results could not evade government and military censorship, but the contents are similar to Dr. Gusev's report. There were too many cases of cancer, deformities, and other diseases to list when we went to the site to conduct our survey. As far as these indications show, the site does not look like a normal picture of society. It is very difficult to produce statistics to prove radiation damage and the relationship between diseases and dose dependency. This is what I feel in surveying radiation's aftereffects in Hiroshima, Chernobyl, or Semipalatinsk as well, even if there are some differences in degree. In the cases of external and internal radiation exposure in Semipalatinsk and Chernobyl, which ranged over a very long time, radioactivity should be considered as an important environmental factor, taking other environmental factors into consideration such as interactions with chemical contamination, smoking, alcohol, nutrition, and mental stress. Considering the fact that most cases of cancer, deformations, and geriatric diseases are multi-factorial abnormalities caused by genes and the comprehensive effects of a variety of environmental factors, it will be possible to understand the viewpoint of these disasters. The process of long-term disasters such as nuclear disasters cannot be separated from where the disaster has occurred, and what the politics and economy of the area are like. We should not only think of the relationship between disease and radioactivity, we need to respond to it from the wider viewpoint of environmental sociology and pathology.

I am happy to hear that Prof. S. Yamashita, from Nagasaki University and Professor M. Hoshi, are working in this field in Semipalatinsk and we are looking forward to seeing the results of their work.

Acknowledgements

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