An Attempt to Develop a Database for Epidemiological Research in Semipalatinsk

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The present paper reports progress and problems in our development of a database for comprehensive epidemiological research in Semipalatinsk whose ultimate aim is to examine the effects of low dose radiation exposure on the human body. The database was constructed and set up at the Scientific Research Institute of Radiation Medicine Ecology in 2003, and the number of data entries into the database reached 110,000 on 31 January 2005. However, we face some problems concerning size, accuracy and reliability of data which hinder full epidemiological analysis. Firstly we need fuller bias free data. The second task is to establish a committee for a discussion of the analysis, which should be composed of statisticians and epidemiologists, to conduct a research project from a long-term perspective, and carry out the collection of data effectively, along the lines of the project. Due to the insufficiency of data collected so far, our analysis is limited to showing the trends in mortality rates in the high and low dose areas.

INTRODUCTION

In the Republic of Kazakhstan, which is located in Central Asia, many nuclear tests were conducted by the former Soviet Union in many places such as the regions of East Kazakhstan and West Kazakhstan. Especially, at the Semipalatinsk Nuclear Test Site in the region of East Kazakhstan (the former region of Semipalatinsk), approximately 458 nuclear tests (between 456 to 470 according to different sources) were conducted from 1949 to 1989. From 1949 to 1962, the nuclear tests were conducted both on the ground and above ground. For example, from the ground test on 28 August 1949, a plutonium bomb, whose output power was 20kt, exploded up to 38 meters above ground, and raised dust containing radioactive substances, which became clouds. As a result, the residents in the Beskaragaisky area, who were down wind, were exposed to radiation. On 12 August 1953, the former Soviet Union conducted the first test of a hydrogen bomb (with 470kt output power) at 30 meters above ground. The residents of the villages on which the radioactive substances were expected to fall, were evacuated for three days, but those who were late in fleeing were exposed to radiation because the speed of the wind was higher than had been expected. It is clear from the evidence of A-bomb victims collected by Kawano et al.1) that there was neither a unified evacuation nor an official announcement in the case of both tests.

It is estimated that there are about 500,000 A-bomb victims around Semipalatinsk City because of such nuclear tests, but the exact number of them has not been determined yet. In 1957, the Ministry of Health of the former Soviet Union established the Fourth Clinic in order to carry out research into the effects of radiation exposure on the residents around nuclear test sites, and collected the information as to the condition of residents in the region of Semipalatinsk. After the Republic of Kazakhstan achieved independence from the Soviet Union in 1991, this Fourth Clinic was reorganized as the Scientific Research Institute of Radiation Medicine and Ecology (Hereafter abbreviated as SRIRME), which took over its affairs. Germany, the United States, Switzerland, and Belgium began research concerning A-bomb victims around 1995. In Japan, Hiroshima University began the examination of radiation exposure dose in 1995, and Nagasaki University began collaborative research with the Semipalatinsk Medical Academy in 1997. In addition, JICA has given medical aid, and the Ministry of Education,
Culture, Sports, Science and Technology (former Science and Technology Agency) has carried out the preliminary survey of the health conditions of radiation victims since 1999. There are exchanges of staff and aid for installation of medical equipment by Hiroshima International Council for Health Care of the Radiation-Exposed (HICARE) and Nagasaki Association for Hibakushas’ Medical Care (NASHIM).

With regard to epidemiological research, it is a serious problem that there has not been enough data for comprehensive research into the effects of low dose radiation exposure, in spite of the attempts by some institutes and organizations. For example, Gusev has collected the mortality data from a subject group of 20,000 persons selected from both atom-bombed and non-atom-bombed areas. This subject group was used for research conducted in Germany and the United States, however, it was impossible to select a new subject group from this for new research because they had not collected the basic information of all the residents in the atom-bombed areas, such as the history of residence and family since 1949. Only a portion of the residents have been treated among the cases of medical aid by JICA and the health examination conducted by the Ministry of Education and Science. Therefore, it is a very important task to collect enough information in order to conduct more reliable epidemiological research.

In this context, the Republic of Kazakhstan has been exerting considerable efforts toward the medical treatment and protection of the A-bomb victims. It enacted laws such as “The Social Protection for the Citizens Exposed to Radiation” (1992) and “A Project for the Return of A-bomb Victims to Medical Treatment” (1997). As mandated by these laws, SRIRME has continued the survey of the residents exposed to radiation, which it took over from the Fourth Clinic, and been accredited as an institution issuing proof of radiation exposure to be submitted to the Soviet certifying committee, which certifies the A-bomb victims. In the region of East Kazakhstan, the regional health office and research institution took the initiative in drawing up “A Project of Medical Support for the Residents in the Region of East Kazakhstan, the Victims of Nuclear Tests at the Semipalatinsk Nuclear Test Site,” and began the comprehensive registration and clinical examination of the radiation exposed residents, including a survey of their eating habits. In order to carry out this project, Apsalikov, Director of SRIRME, asked Katayama, the main author of the present paper, to be in charge of developing a database in 2002, and we immediately began the preparation for construction of the database, aiming for its operation within a year. Cooperation from Hoshi et al. was obtained for the training of computer technicians. The database server was installed at SRIRME, and the input of data necessary for epidemiological research was begun in August 2003, as had been scheduled.

\[\text{MATERIAL AND METHOD}\]

\section*{Study Population}

The aim of the present study is to conduct comprehensive epidemiological research, specifically to examine the effects of low dose radiation exposure on the human body. In order to accomplish this object, we constructed a database covering all the residents in all the areas around Semipalatinsk City, the region of East Kazakhstan, inputting the data necessary for the epidemiological research. Based on this accumulated data, we will consequently be able to estimate the radiation dose to which each subject was exposed, enabling us to design a risk assessment of low dose radiation exposure.

When our subject group was decided, the date for the beginning of our analysis was fixed for 12 August 1949, when the first nuclear test was done at the former Semipalatinsk nuclear test site. When the basic information of the subject group was initially put into the database, the basic data and death information of the subject group of 20,000 people owned by SRIRME were automatically transferred to the database because they were already computerized. Additional information was collected by SRIRME according to the schedule of the medical examination of the residents, which was carried out in cooperation with JICA. In 2003, the survey was done first in the area of Beskaragaisky, which is said to be the highest dose area, and then in the areas of Abaisky and Jana-Semeisky. In 2004, the survey was begun in June and done in the areas of Charsky, Jaminsky, and Borodulinskiy.

The basic information includes subject’s name, sex, birth date, history of residence, history of occupation, history of marriage, and the full family background covering two generations. For the collection of this basic information, ZAGS (the birth and death certificates) was used, and doctors in each region gained additional information such as family information firsthand by visiting each subject.

On 21 July 2003, we installed the OS and database engine in the database server set at SRIRME, and set up the client PCs. On 25 July 2003, the data entry was begun. The data entry went smoothly, and the number of data entered into the database reached 49,000 subjects on 30 September 2003, and 110,000 on 31 January 2005.

\section*{Radiation Dose}

With regard to the radiation dose of external and internal exposure, Takada et al.\cite{1,2} brought about 200 kg exposed materials such as bricks to Japan, and measured their radiation levels. The study so far shows that 99 cGy of radiation was detected from the bricks gathered from Dolon in the Beskaragaisky Region, which confirms the assumption that this village with a population of 3,000 was the “high-dose area.” In addition to this, 40 cGy of radiation was detected...
in the samples gathered in Semipalatinsk with a population of 350,000, and it is possible that many people living in the city were exposed to radiation. The examination of the thyroid gland by ultrasonic waves, and the examination of hormones by biopsy showed a high rate of abnormalities. Yamamoto\(^4\) and Sakaguchi\(^5\) measured the amount of uranium, plutonium, and strontium in human bones, and confirmed that there are cases with high values of plutonium and uranium. Imanaka et al.\(^6\) quite precisely calculated the radiation dose of the external exposure in Dolon using a VB Excel program, FPCOMP.xls. This program was developed to measure temporal changes of FP Composition after nuclear explosions, using the JNDC FP Data Library collated by JAERI containing fission data for 1,227 FP nuclides. The researchers also drew conclusions about the width and center-axis location of the radioactive plume that passed over Doron and nearby villages.

However, the radiation doses of the internal and external exposure in this area were calculated by Russia, Kazakhstan, and the U.S. using their own calculation formula, and there was no unified assessment. In September 2002, an international workshop on the assessment of the radiation exposure was held in Semipalatinsk, and it was decided that a unified assessment of the radiation exposure would be carried out through the collaborative research by the U.S., Germany, Russia, Kazakhstan, and Japan. Then on 9-11 March 2005, an international workshop (The 3rd Dosimetry Workshop on the Semipalatinsk Nuclear Test Site) was held in Hiroshima. The discussion at this workshop centered on the radiation exposure levels in Doron, and it was decided that the different estimated doses obtained by different methods should be unified. Therefore, though there are some problems to be solved concerning each research study, it was decided that the radiation dose for each survivor be calculated based on the information accumulated in the database, and that the analysis be made on the effects of the exposure to low dose radiation on the human body.

**Causes of Death**

The causes of death recorded on ZAGS (the certificates of birth and death) were encoded according to the 9th edition of the International Classification of Diseases (ICD). The 9th edition defines leukemia as 204–207, and other cancers (all cancers except leukemia) as 140–203.

According to Dr. Gusev, Assistant Director of SRIRME, there is a problem concerning the accuracy of the name of diseases, because it is possible that 30% of cancers were recorded as other diseases for concealment until 1989. Under the medical system of the former Soviet Union, those who were diagnosed with cancer at the medical center were...
then introduced to the cancer center. Therefore, it is better to check the ZAGS records with the records of medical examination at the State Cancer Center in Semipalatinsk in order to get mortality information more accurately, however, this was not possible because the State Cancer Center lost most of its records in a fire in 1980.

**Database and Application Program**

Hardware used for the database is as follows: the CPU is Pentium 1.4GHz, 1GB RAM, the HD for the main part is 36GB, and for the data part 108GB (36GB*3) RAID. Software chosen for the OS is Red Hat Linux 8.1, and for the database engine Sybase 11.0.3.3. for Linux. The main reason for choosing Sybase 11.0.3.3 for Linux is that no charge is incurred for use as is the case for the OS.

Two databases were constructed, one of which was set up as a back up. The data are transferred from the main one to the back up database every night in order to guard against an unexpected accident. All the equipment is placed in the 19-inch rack, which is locked. The room in which the database server is placed is also locked all the time, and carefully protected.

**The Structure of the Database Tables**

The database contains not only the above basic information, but also mortality statistics, as well as the results of hematological and biochemical examinations from the group checkups. These data were obtained from different sources, and all the data are connected by the unique numbers called “sysid.” The whole structure of the database tables is shown in Fig. 1.

The application programs, which are used for the data entry on client PCs, were written using the PowerBuilder software. It was developed in a Japanese environment, but ultimately translated into Russian, made into a run-time version, and sent to the Institute as a file attached to an e-mail. Then a trained programmer copied the program to the prescribed place so that it could be used on each client PC. These programs are very complicated because they contain the function for identifying a person.

### Table 1. Number of registrations and deaths classified by year and area.

|               | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 |
|---------------|------|------|------|------|------|------|------|------|------|------|
| **Number of Registrations** |      |      |      |      |      |      |      |      |      |      |
| Abaisky       | 5,862| 5,715| 5,784| 5,355| 4,821| 4,100| 3,386| 2,550| 1,806| 1,102|
| Ayagozsky     | 4    | 5    | 5    | 5    | 5    | 5    | 5    | 4    | 4    | 4    |
| Kokpektinsky  | 3,517| 3,153| 2,647| 1,924| 1,137| 227  | 0    | 0    | 0    | 0    |
| Jarminsky     | 11,764| 11,145| 10,141| 9,182| 7,952| 6,537| 6,494| 5,745| 4,545| 2,075|
| Charsky       | 3,079| 2,852| 2,611| 2,175| 1,782| 1,405| 1,304| 1,205| 863  | 370  |
| Jana-Semeisky | 3,458| 3,482| 3,461| 3,535| 3,323| 2,943| 2,583| 2,070| 1,485| 653  |
| Beskaragaisky | 19,124| 21,151| 22,406| 21,846| 21,105| 20,001| 18,801| 17,374| 15,597| 13,461|
| Borodulihinsky| 8,055| 8,681| 9,356| 9,712| 9,997| 10,195| 9,200| 7,768| 6,168| 4,285|
| Unknown       | 4,467| 4,240| 3,925| 3,755| 3,284| 2,924| 2,066| 1,604| 1,157| 713  |
| **Total**     | 59,330| 60,423| 60,336| 57,489| 53,046| 47,479| 43,377| 37,873| 31,181| 22,232|

|               | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 |
|---------------|------|------|------|------|------|------|------|------|------|------|
| **Number of Deaths** |      |      |      |      |      |      |      |      |      |      |
| Abaisky       | 90   | 62   | 125  | 148  | 212  | 241  | 210  | 195  | 169  | 227  |
| Ayagozsky     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| Kokpektinsky  | 172  | 214  | 209  | 167  | 198  | 216  | 0    | 0    | 0    | 0    |
| Jarminsky     | 381  | 523  | 441  | 385  | 346  | 129  | 0    | 523  | 501  | 610  |
| Charsky       | 150  | 93   | 106  | 90   | 16   | 115  | 0    | 106  | 80   | 2    |
| Jana-Semeisky | 65   | 53   | 4    | 18   | 111  | 83   | 116  | 124  | 147  | 197  |
| Beskaragaisky | 273  | 265  | 214  | 299  | 267  | 276  | 348  | 289  | 365  | 365  |
| Borodulihinsky| 4    | 3    | 5    | 0    | 4    | 21   | 317  | 216  | 366  | 370  |
| Unknown       | 170  | 176  | 48   | 80   | 214  | 223  | 120  | 127  | 58   | 92   |
| **Total**     | 1,305| 1,389| 1,152| 1,187| 1,368| 1,304| 1,112| 1,580| 1,686| 1,863|
RESULTS OF THE COLLECTION OF DATA

The number of the registered persons and fatalities classified by year and area

Table 1, made from data in the database, shows the number of registered persons and fatalities by year (every five years) and geographical area. We excluded 26 cases in which the dates of entry to and leaving an area were reversed, and 2 cases in which the sex is unknown.

There are quite a number of names registered from 1950 to 1975. This is because they put into the database the results of epidemiological research conducted by Gusev et al. and the newly collected data by the new research of SRIRME. Data have been collected mainly from the areas of Abaisky and Beskaragaisky, but the number of input data from these areas had decreased after 1975. This indicates the possibility that there are some problems concerning the method of collecting information, or that they have intentionally put an emphasis on collecting data until 1980.

Compared with the registration, consistently steady numbers of mortality data are entered into the database. However, there are periods that suggest that data were not adequately collected. For example, there are the periods when no data was entered with regard to the areas of Kokpektinsky and Jarminsky, and there is a marked decrease in the number of input data over some years with regard to such areas as Jana-Semeisky and Borodulihinsky.

The number of the registered persons and deaths in the high and low dose areas

The registered areas are divided into two categories: the high dose area (Abaisky, Beskaragaisky, and Jana-Semeisky) and the low dose area (other areas). Table 2 shows the number of registered persons and the mortality rates in these two categories by sex and year (every five years). Compared with the number of registrations by area (Table 1), steady numbers of persons were registered in the high dose area until 1975, but the number of registrations has gradually decreased after that. In the low dose area, the number of registration markedly decreased because the survey has not been conducted as thoroughly compared with the high dose area.

There is not a big difference in the number of fatalities between the high and low dose areas. This leads us to suppose that the mortality data have been collected with the intention of making a comparison with those of the high dose area. Besides, if a comparison is made between the change in the number of registrations and the number of fatalities, it is clear that the registration of residents and that of fatalities have been done separately, and these data have been put into the database.

Table 2. Number of registrations and deaths by sex and year in High and Low dose area

|        | 1950  | 1955  | 1960  | 1965  | 1970  | 1975  | 1980  | 1985  | 1990  | 1995  |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| **Number of Registrations** |       |       |       |       |       |       |       |       |       |       |
| Male   |       |       |       |       |       |       |       |       |       |       |
| High   | 14,133| 15,245| 16,007| 15,548| 14,744| 13,572| 12,265| 10,723| 9,101 | 7,143 |
| Low    | 16,084| 15,906| 15,364| 14,384| 12,782| 10,849| 9,821 | 8,343 | 6,516 | 3,742 |
| Female |       |       |       |       |       |       |       |       |       |       |
| High   | 14,311| 15,103| 15,644| 15,188| 14,505| 13,472| 12,505| 11,271| 9,787 | 8,073 |
| Low    | 14,802| 14,169| 13,321| 12,369| 11,015| 9,586 | 8,786 | 7,536 | 5,777 | 3,274 |
| Total  | 28,444| 30,348| 31,651| 30,736| 29,249| 24,770| 21,994| 18,888| 15,216|       |
| Low    | 30,886| 30,075| 28,685| 26,753| 23,797| 20,435| 18,607| 15,879| 12,293| 7,016 |
| **Number of Deaths**       |       |       |       |       |       |       |       |       |       |       |
| Male   |       |       |       |       |       |       |       |       |       |       |
| High   | 200   | 190   | 198   | 262   | 324   | 324   | 387   | 321   | 347   | 433   |
| Low    | 454   | 527   | 459   | 406   | 442   | 389   | 320   | 521   | 538   | 587   |
| Female |       |       |       |       |       |       |       |       |       |       |
| High   | 228   | 190   | 145   | 203   | 266   | 276   | 287   | 287   | 334   | 356   |
| Low    | 423   | 482   | 350   | 316   | 336   | 315   | 208   | 451   | 467   | 487   |
| Total  | 428   | 380   | 343   | 465   | 590   | 600   | 674   | 608   | 681   | 789   |
| Low    | 877   | 1,009 | 809   | 722   | 778   | 704   | 438   | 972   | 1,055 | 1,074 |

High: Abaisky, Beskaragaisky and Jana-Semeisky
Low: Other areas
Mortality rates classified by kinds of cancers

Figure 2 shows annual mortality rates of the most common cancers (cancers of the esophagus, the stomach, the large intestines, the liver, respiratory organs, the female breast, the uterus, and non-solid cancers). With regard to cancers of the female breast, the uterus, and non-solid cancers such as leukemia, there are too few cases to discern a clear pattern or trend.

The mortality rates given here were obtained by dividing the number of fatalities by those of registered persons, and the adjusted mortality rates by age were not calculated. Therefore, the graph does not show the strict comparison of the mortality rates between the high and low dose areas, but rather the trends in mortality rates in these areas. We have limited ourselves to showing just the trends because the registration into the database does not reflect the accurate population composition, and there is also a bias as to the data on death in some areas and periods.

**DISCUSSION**

Based on the data registered in the database so far, we have shown the total number of registered persons and fatalities by year and area, the number of registered persons and mortality rates in the high and low dose areas, and mortality rates by kinds of cancers. However, it is premature to conclude that there is an effect of the difference in radiation dose on mortality rates because, though the number of registered fatalities, varying in areas, is increasing in the high dose area, the number of registered persons is decreasing in every area, (as seen from the number of registered persons and fatalities by year, shown in Table 2).

Table 3, used by Rosenson et al., shows the changes in the population of the former Semipalatinsk Region. The same table was used by Gusev et al., and it seems that they obtained the data from the same source. However, the source of the data is not specified, and the sum total of population of some years is incorrect, for example, the years of 1954. Therefore, it can be assumed that they had compiled data from different sources.

In 2005, Apsalikov, Director of SRIRME, offered to us the data on population statistics compiled by an international project, INCO-COPERNICUS, in 2001. The data show the population (classified by age and sex) of some areas of the former Semipalatinsk Region (Abaisky, Jana-Smeisky, Beskaragaisky, Jarminsky, Charsky, Borodulihinsky), where the radiation dose was relatively high, from 1949 to 1975. Detailed population statistics were not compiled after 1975. A survey on population was conducted by the government of Kazakhstan in 1989 and 1999, and based on these sur-
veys, population statistics were compiled and classified by age, sex and area.

Thus, the data on population composition, which is a basis for research, are not complete. However, we consider the population statistics compiled by INCO-COPERNICUS to be official data, and compare it with the number of registered persons in our database in Table 5.

According to Director Apsalikov, the survey in the area of Beskaragaisky is almost over, and therefore it can be considered that the registration of this area is also almost over.

It is problematic that the number of registrations into our database is gradually decreasing every year. Though the census conducted in 1989 counted 32,958 residents in this area, the number of registrations into the database is only 13,500. The number of registrations is decreasing in spite of an increase in population. With regard to other areas, the number of registrations is considerably less than the population given by INCO-COPERNICUS. It is an urgent task to explore how the number of registrations can be approximated with the population data given by INCO-COPERNICUS, and why the number of registrations in Beskaragaisky is larger than the population from 1949 to 1965, but smaller after 1966.

The mortality statistics for the database were obtained mainly from ZAGS (the birth and death certificates). In Table 3, with regard to the number of fatalities in Beskaragaisky, the same figures are given in the database and in INCO-COPERNICUS, and therefore it is assumed that the number of deaths given by INCO-COPERNICUS is also based on ZAGS. However, the registration has not been done consistently every year. Table 4 shows the number of fatalities in the area of Jana-Semeisky from 1955 to 1970, which has been registered in the database. During this period, very few cases of death were registered, compared with other periods although the number of registrations was stable in every year.

With regard to mortality rates from various kinds of cancers, mortality rates of esophagus and stomach cancers reached a peak in the high dose area in 1960 and 1965, a phenomenon which has been pointed out by Gusev et al.7) An increase is observed both in the number of fatalities and mortality rates in the area of Beskaragaisky, but it is impossible to decide on the precise cause: whether it is due to the effect of radiation exposure, or a relative increase in the proportion of senior citizens to the total population because of the migration of young people to cities, or possibly due to

Table 3. Number in population (given by Rosenson, etc.)

|          | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Abaisky  | 7.2  | 7.1  | 7.4  | 8.5  | 8.8  | 9.7  | 13.0 | 12.8 | 13.3 | 13.6 | 14.1 | 14.6 | 15.3 | 24.1 | 23.5 |
| Ayagozsky| 38.9 | 41.4 | 41.8 | 44.0 | 45.5 | 18.9 | 21.8 | 25.3 | 24.7 | 20.3 | 22.4 | 25.1 | 25.6 | 45.0 | 43.4 |
| Kokpekinsky| 21.9 | 23.5 | 24.1 | 23.0 | 24.4 | 25.5 | 28.6 | 27.9 | –    | 26.2 | 29.5 | 31.0 | 32.9 | 35.9 | 57.5 |
| Jarminsky| 39.5 | 39.6 | 37.7 | 36.0 | 35.6 | 28.5 | 25.5 | 23.5 | –    | 26.9 | 26.5 | 27.5 | 30.9 | 43.3 | 45.0 |
| Charsky  | 16.1 | 16.2 | 17.1 | 18.0 | 19.4 | 8.6  | 9.6  | 9.8  | –    | 16.4 | 17.0 | 18.0 | 19.1 | –    | 20.3 |
| Jana-Semeisky| 16.7 | 18.4 | 16.7 | 16.1 | 16.4 | 17.8 | 20.5 | 21.0 | –    | 22.3 | 23.6 | 24.5 | 24.9 | 25.6 | 26.3 |
| Beskaragaisky| 16.7 | 17.1 | 18.1 | 18.3 | 18.4 | 18.4 | 19.0 | 19.1 | 19.8 | 32.4 | 34.3 | 35.5 | 37.3 | 47.3 | 45.2 |
| Borodulihinsky| 16.4 | 16.6 | 15.1 | 14.2 | 14.3 | 15.3 | 16.4 | 15.8 | 17.6 | 17.6 | 18.5 | 19.6 | 20.2 | 69.6 | 67.0 |

Table 4. Number of registrations and deaths from 1955 to 1970 in Jana-Semeisky.

|          | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Number of Registrations | | | | | | | | | | | | | | | |
| Male     | 1,860| 1,857| 1,849| 1,830| 1,855| 1,870| 1,885| 1,894| 1,902| 1,912| 1,920| 1,927| 1,899| 1,869| 1,837| 1,803 |
| Female   | 1,622| 1,612| 1,596| 1,578| 1,583| 1,591| 1,599| 1,599| 1,602| 1,606| 1,615| 1,612| 1,598| 1,566| 1,550| 1,520 |
| Total    | 3,482| 3,469| 3,445| 3,408| 3,438| 3,461| 3,484| 3,493| 3,504| 3,518| 3,535| 3,539| 3,497| 3,435| 3,387| 3,323 |
| Number of Deaths | | | | | | | | | | | | | | | |
| Male     | 30   | 27   | 33   | 0    | 0    | 2    | 6    | 7    | 2    | 4    | 9    | 40   | 39   | 43   | 49   | 64   |
| Female   | 23   | 25   | 23   | 0    | 1    | 2    | 3    | 1    | 5    | 3    | 9    | 22   | 42   | 26   | 35   | 47   |
| Total    | 53   | 52   | 56   | 0    | 1    | 4    | 9    | 8    | 7    | 7    | 18   | 62   | 81   | 69   | 84   | 111  |
problems concerning registration, that is, the possibility that the registration of fatalities was done correctly while that of residents was not. Because there is a big difference between the statistics compiled from the database and those given by INCO-COPERNICUS, at the present time, there is no way to confirm that data has been collected without bias concerning the registered persons. The number of fatalities due to cancers of the respiratory organs has been increasing though the total number of registered persons and the number of registered fatalities are irregular. This fact indicates that there may be some additional factors behind the increase in the number of fatalities. However, we have to wait until we can obtain enough registrations for an analysis before we can draw any conclusions. At the very least, an apparent increase in mortality rates is due to the fact that the number of registrations in the database is too small, compared with the data of INCO-COPERNICUS, which is an indicator for the collection of data for the database.

CONCLUSION

As we have stated so far, the registration into the database has been going smoothly, but a careful analysis of the content of data reveals that the collection of data varies by year and area, and that there is not enough data for epidemiological research. In order to achieve our principal aim to conduct comprehensive epidemiological research, specifically to examine the effects of low dose radiation exposure on the human body, there are two urgent tasks to be done immediately. The first is to make up the gap between the number of registrations in the database and the number of data of INCO-COPERNICUS by comparing them and collecting as much data as possible without bias. Otherwise, it is difficult to prove the accuracy and reliability of data for a study population in epidemiological research. The second task is to establish as soon as possible a committee for a discussion of the analysis, which should be composed of statisticians and epidemiologists, to conduct a research project from a long-term perspective, and carry out the collection of data effectively, along the lines of the project.

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