13 Summary

The following table summarizes the results concerning disease incidence yielded by studies related to atomic bomb radiation (primarily involving the Hiroshima explosion).

The lists below indicate the diseases in which an increase in incidence related to exposure to atomic radiation has been observed and those in which an increase has not been seen. Since these are based on the information available at the present day, it must be noted that it is possible that they may change on the basis of future research.

Increase observed

- Malignant tumors
  - Leukemia
  - Thyroid cancer
  - Breast cancer
  - Lung cancer
  - Gastric cancer
  - Colon cancer
  - Ovarian cancer
  - Multiple myeloma *
  - Esophageal cancer *
  - Salivary gland cancer *
  - Urinary tract cancer *
  - Malignant lymphoma *
  - Skin cancer *
- Cataracts
- Chromosomal aberrations (lymphocytes and myeloid cells)
- Somatic cell mutations
- Mental retardation among prenatally exposed survivors (microcephaly)
- Growth and development retardation following infantile exposure
- Abnormalities in organ function (parathyroid glands)
- Non-cancer mortality rates *
- Changes in specific humoral immunocompetence and cell-mediated immunocompetence

* Asterisks indicate suggested increases

No increase observed

- Malignant tumors
  - Chronic lymphocytic leukemia
  - Osteosarcoma
- Accelerated aging
- Infertility
- Solid tumors, leukemia, congenital abnormalities, mortality rates, chromosomal aberrations and protein variants in the children of atomic bomb survivors

Absorbed dose

▶ The absorbed dose is the amount of energy (in Joules) imparted to a unit mass of matter (kg) by the action of radiation on a substance or living body. Formerly described in rad, the SI units currently adopted are Gray (Gy). [1 Gy = 100 rad].

Dose (DS86 and T65D)

▶ For many years the T65D system of dosimetry ("tentative 1965 dosimetry") was used as the most accurate method of estimating the doses received by individual survivors, although this has now been replaced by the DS86 system ("Dosimetry System 1986"). The T65D dose estimation system was based on experimental data obtained for Nagasaki-type atomic bombs in Nevada, USA, and was devised in 1965 as a formula that incorporated various parameters such as distance from the hypocenter, and transmission factors for shielding materials, etc.. In order to permit more detailed calculations, the DS86 system was devised in 1986 based on elementary physical processes, and enabled computer coding of the different processes involved from the time of emission until arrival at various human organs.

DS86

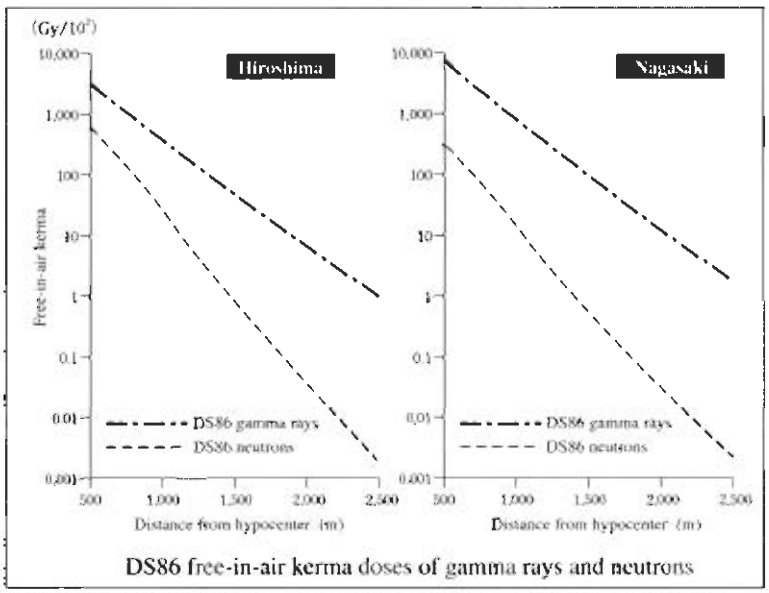
▶ See "Dose"

Equivalent dose

▶ This describes the effect of radiation on a living body, and is obtained by multiplying the absorbed dose by a radiation weighting factor (factoring in the relative biological effectiveness). The concept is basically the same as that of the dose equivalent defined in the 1977 advisory of the International Committee of Radiation Protection (ICRP), but differs in that a radiation weighting factor is employed instead of a radiation quality factor. Formerly described in rem, the SI units currently adopted are Sievert (Sv). [1 Sv = 100 rem].

Exposed dose

▶ The exposed dose describes the ability of X-rays or gamma rays to ionize a fixed volume of air at a given point. Formerly described in roentgen (R), the SI units currently adopted are Coulomb per kilogram (C/kg).



DS86 free-in-air kerma doses of gamma rays and neutrons

Adapted from Roesch WC. US—Japan joint reassessment of atomic bomb radiation dosimetry in Hiroshima and Nagasaki, final report, Vol 1. Hiroshima: Radiation Effects Research Foundation; 1987.

Glossary

Hematopoeitic disease

▶ Disease of the blood-forming organs.

Hiroshima Atomic Bomb Casualty Council

▶ Established in 1953 and incorporated as a non-profit foundation in April 1956, at which time its Japanese name was revised to the current name (*Hiroshima Genbaku Shogai Taisaku Kyogikai*). With the aim of promoting research into the effects of the atomic bomb and consideration of treatment policies, the Council has conducted various activities, such as health management and guidance of atomic bomb survivors, research into therapy for survivors suffering as a result of exposure, surveys of the actual conditions of living survivors, and welfare support etc.. The Council was relocated to the Hiroshima Comprehensive Health Center in September 1989; with its state-of-the-art diagnostic and therapeutic equipment and advanced technological and information functions, it is one of the nation's leading health facilities. In addition to its previous activities, and with a view to future evolution in a wide range of fields, the institution will strive hard in areas such as health management, the promotion of community health, and health education for all residents of Hiroshima, including atomic bomb survivors.

Hiroshima International Council for Medical Care of the Radiation-exposed

▶ Established in order to contribute to the effective medical care of radiation-exposed individuals throughout the world by utilizing Hiroshima's accumulation of results regarding the medical treatment of atomic bomb survivors and research into atomic bomb injuries, the Council was inaugurated in April 1991 when various local bodies (and the city and prefectural governments of Hiroshima in particular) worked together to contribute to world society and international co-operation. Activities pursued by the Hiroshima International Council for Medical Care of the Radiation-exposed include acceptance of visiting medical personnel for training, dispatch of medical specialists, compilation of manuals on the medical care of exposed individuals, worldwide dissemination of educational material concerning the treatment of exposed individuals, and implementation of research programs.

Hypocenter

▶ The location on the ground vertically below the point of detonation of the atomic bomb.

Immune function

▶ This is a system for not only eliminating pathological microorganisms (e.g. bacteria and viruses etc.) and foreign bodies, but also for eliminating cancer cells, virally infected cells, mutants, and dead cells etc.; it is a general term describing the function of a system which acts as a mechanism for maintaining a state of equilibrium within a living body. Lymphocytes are the most important cells in the immune system, and are broadly divided into T lymphocytes (T cells) and B lymphocytes (B cells). T cells become activated upon coming into contact with antigens (foreign bodies or damaged cells), at which time they produce humoral factors that cause activation and proliferation of various immune system cells. Some of the humoral factors cause differentiation of B cells and produce proteins (antibodies) which combine with antigens. Some humoral factors derived from T cells produce differentiation and proliferation of cells that kill the bacteria, viruses and other harmful cells which caused the activation of the T cells themselves.

Leukemia

▶A malignancy of hematopoietic ("blood-forming") cells, and classified by cellular morphology into acute non-lymphocytic leukemia, acute lymphocytic leukemia, chronic myelocytic leukemia, and chronic lymphocytic leukemia.

P:

▶The value of P (probability) gives an indication of degree of significance; the lower the value of p, the greater the significance.

Prenatally exposed survivors

▶Defined at the Radiation Effects Research Foundation as those individuals born alive after the dropping of the atomic bomb but before May 31st 1946, and who were exposed to the bomb while in the womb. Approximately 1,100 people are believed to have been prenatally exposed within 2 km of the hypocenter.

Radiation Effects Research Foundation (RERF)

▶The successor to the Atomic Bomb Casualty Commission, ABCC, which was established in 1947 (with participation of the Japan National Institute of Health of the Ministry of Health and Welfare from 1948). In accordance with an inter-governmental agreement between the United States and Japan, it was inaugurated as a non-profit foundation under Japanese domestic law in April 1975. With peaceful objectives, the foundation has conducted studies on the medical effects of radiation on the human body and the resultant diseases, and contributed to the maintenance of health and welfare of atomic bomb survivors. In addition, in order to improve health standards the foundation has conducted numerous research programs, including the epidemiological studies such as Life Span Study, the Adult Health Study, and studies on pathological aspects, prenatal exposure, genetics, immunocompetence, mutations, cancer and radiosensitivity etc..

Research Institute for Nuclear Medicine and Biology, Hiroshima University

▶Established in 1961 with the aim of conducting research on the late medical and biological effects of the atomic bombing, and devising fundamental policies concerning the medical treatment of atomic bomb survivors. The institute consists of ten departments i.e. the Departments of Radiation Biology, Pathology, Hematology, Geneticopathology, Biochemistry and Biophysics, Epidemiology and Social Medicine, Biometrics, Cancer Research, Internal Medicine, and Surgery. The clinical departments also have clinical sections in the hospital affiliated to the School of Medicine and conducts therapy on both in- and out-patients. The institute possesses a number of facilities such as a radiation studies laboratory (in which various radiation sources can be utilized), a radioisotope laboratory, a tritium laboratory, a facility for animal irradiation experiments, and the Data and Specimens Center of the Atomic Bomb Disaster.

Residual radiation

▶This is distinguished from the initial radiation which was released by the atomic bomb at the moment of detonation. Residual radiation was produced when the radioactive materials constituting the bomb were dispersed as radioactive fallout, and when neutrons emitted by the explosion collided with atomic nuclei in the soil and building materials to produce new radioactive materials (induced radioactivity).

T65D

▶See "Dose"