Reference 4

Epidemiologic Survey of Radiation Health Effects
― Survey of Health Effects of Atomic Bomb Radiation ―

Radiation Effects Research Foundation
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Survey of Health Effects of Atomic Bomb Radiation

(1945) (1947) (1948) (1975) (2012)

Atomic Bomb Casualty Commission (ABCC)

Branch of the Japanese National Institute of Health

Hiroshima: August 6

Nagasaki: August 9

Radiation Effects Research Foundation

Epidemiologic Survey of Radiation Health Effects

Denominator

- **Establishment of survey population**
- **Estimation of individuals' radiation exposure doses**

Numerator

- **Acquisition of health information, cause of death, etc.**

Survey of Health Effects of Atomic Bomb Radiation

— Survey Population —

1. **Atomic bomb survivors: 120,000**

   Life Span Study (LSS): 120,000
   Adult Health Study (AHS): 20,000

2. **Atomic bomb survivors exposed *in utero*: 3,600**

3. **Children of atomic bomb survivors: 77,000**

Adult Health Study Population

Selected from among the 120,000 atomic bomb survivors covered by the lifespan study, based on the following conditions:

A. **Approx. 5,000 people who were within 2,000m of the hypocenter of the bombing and presented acute radiation symptoms**

B. **Approx. 5,000 people who were within 2,000m of the hypocenter of the bombing but did not present acute radiation symptoms, selected to balance with group A by matching gender, age and the city they live in**

C. **Approx. 5,000 people who were 3,000m or farther from the hypocenter of the bombing, selected to balance with group A by matching gender, age and the city they live in (Hiroshima: 3,000-3,500m; Nagasaki: 3,000-4,000m)**

D. **Approx. 5,000 people (residents of Hiroshima and Nagasaki) who were not in the cities at the times of the bombing, selected to balance with group A by matching gender, age and the city they live in**

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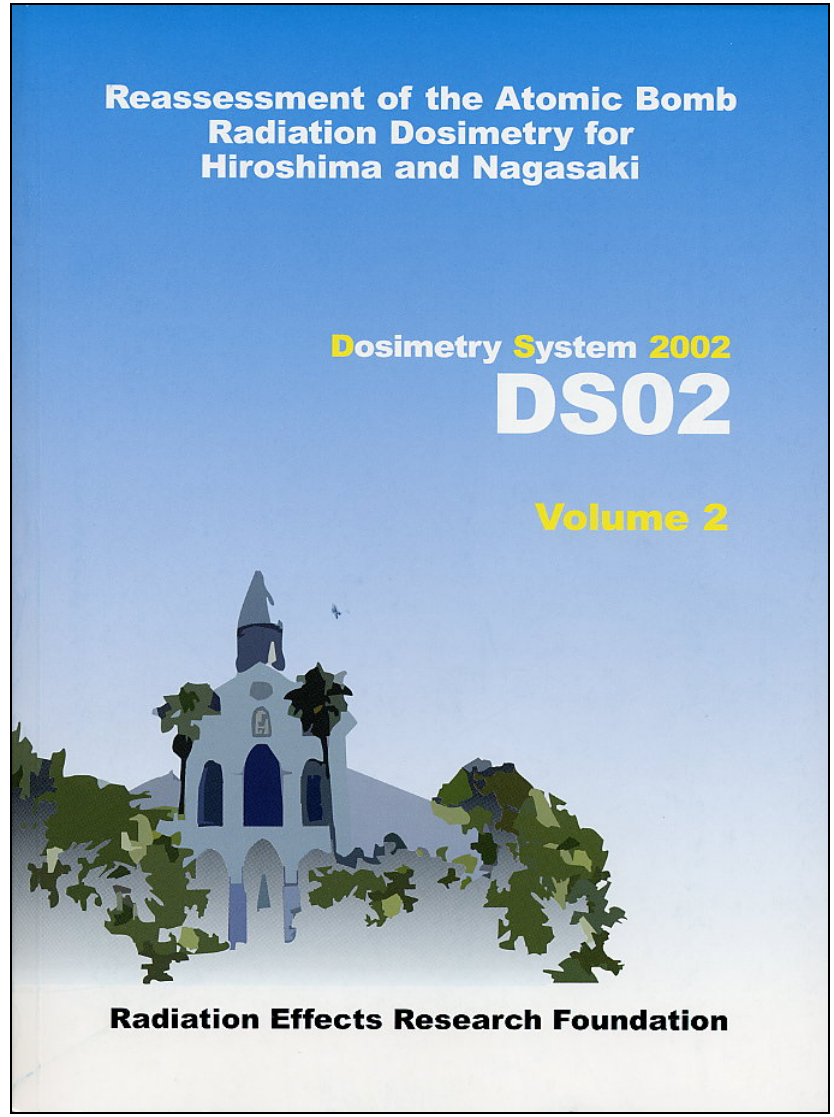
Survey of Health Effects of Atomic Bomb Radiation
－ Estimation of exposure doses －

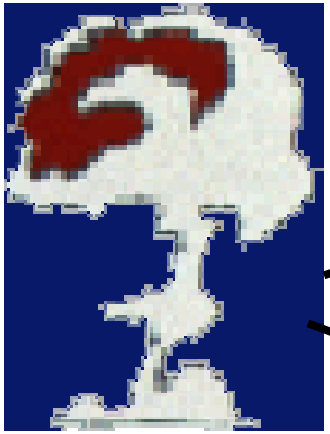
1. Physical dose estimates
   - Dosimetry System 2002
2. Biological dose estimates
   - Lymphocytic chromosome aberration
   - ESR in tooth enamel

Dosimetry System 2002 (DS02)

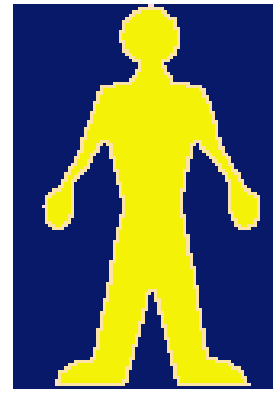


Calculation of Atomic Bomb Radiation Doses

Discharged radiation
(Quality and quantity)



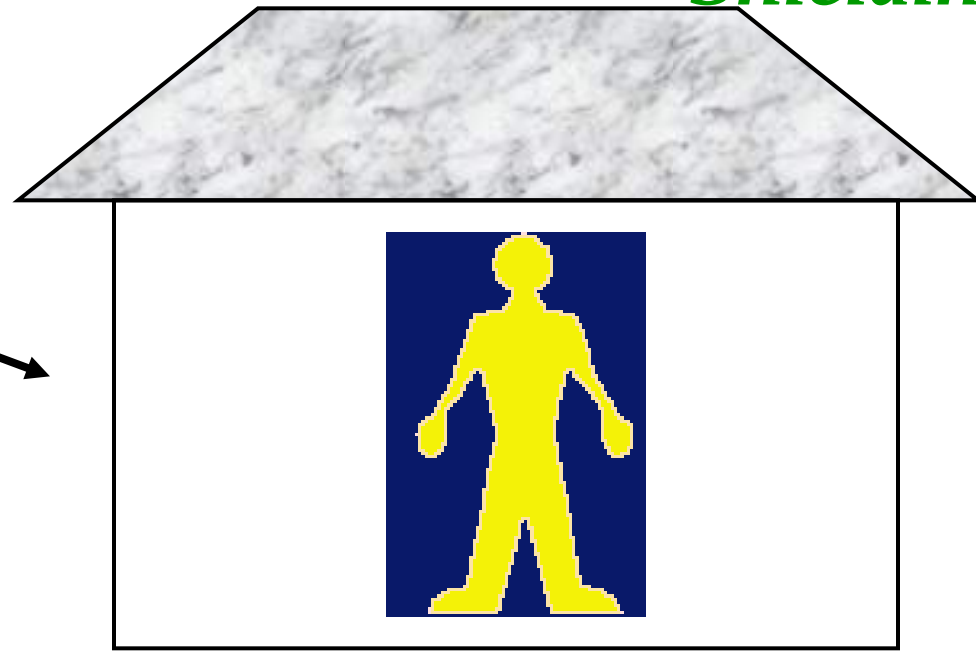
Radiation (n, γ)



Distance

Shielding

Radiation (n, γ)



Epidemiologic Survey of Radiation Health Effects

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Survey of Health Effects of Atomic Bomb Radiation

― Means to acquire health information, cause of death, etc. ―

1. Death survey (survey of causes of death) [LSS]
   - Causes of death
2. Cancer incidence survey [LSS]
   - Cancer registry information
   - Pathological findings
3. Clinical survey [AHS]
   - Information on health checkups
   - Stored biological samples (serum, lymphocytes, etc.)
4. Mail survey [LSS/AHS]
   - Mail
   - Mail and Telephone

Survey of Health Effects of Atomic Bomb Radiation

― Advantage and disadvantages of death survey (survey of causes of death) ―

Advantage

- **Relatively easy to obtain data**

Disadvantages

- **Variation in the accuracy of diagnosis**
- **Difficulty in ascertaining non-fatal cancer cases**
- **Lack of health information other than causes of death**
- **Uncertainty of time of onset**

Survey of Health Effects of Atomic Bomb Radiation

－ Advantages and disadvantage of cancer incidence survey －

Advantages

- **Accurate cancer incidence data**
- **Ability to ascertain non-fatal cancer cases**

Disadvantage

- **Lack of national data**

Survey of Health Effects of Atomic Bomb Radiation

－ Advantages and disadvantages of clinical survey －

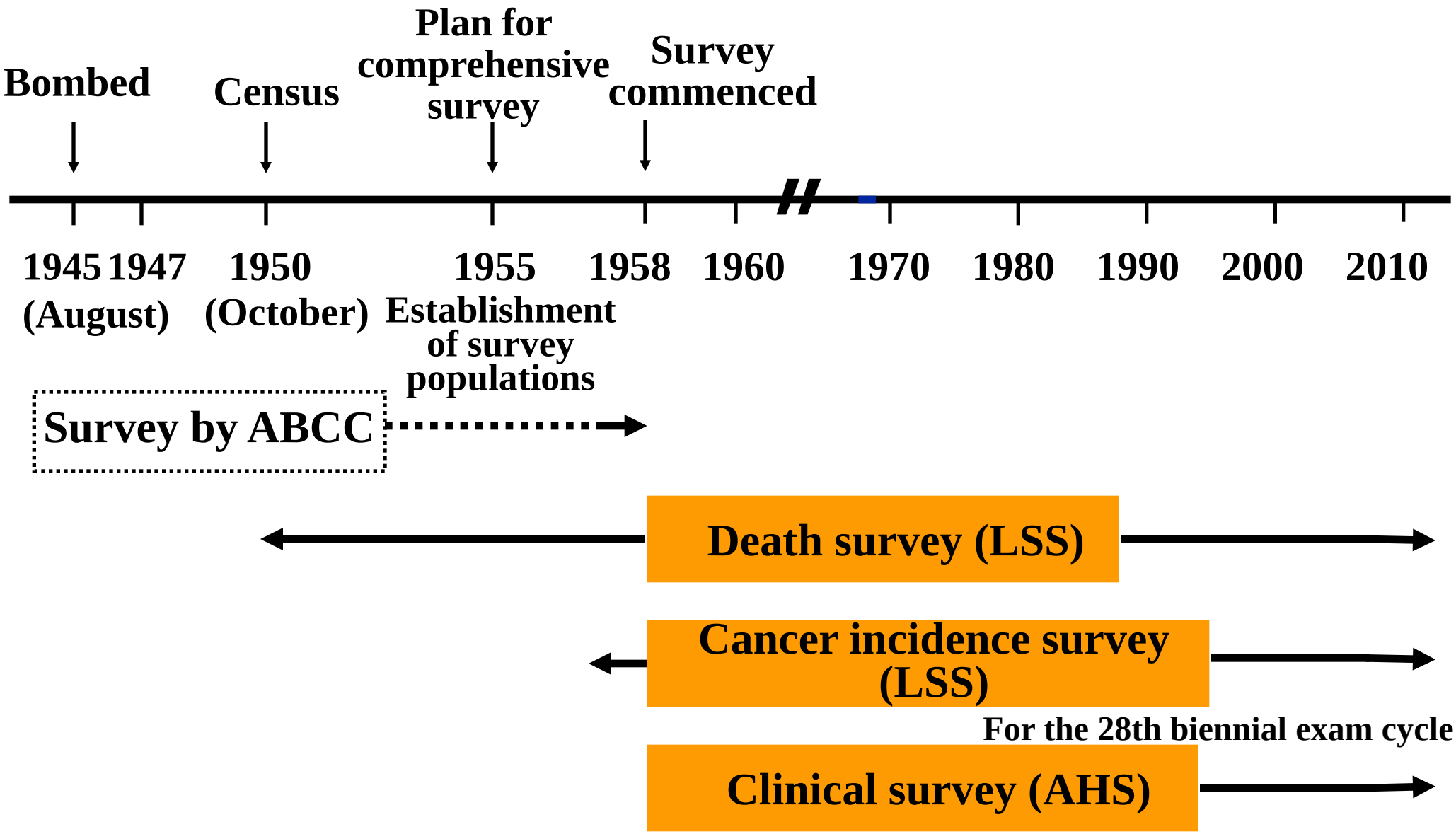
Advantages

- Ability to obtain data on diseases other than cancer
- Ability to ascertain non-fatal cancer cases
- Health information other than diseases
  Measured values and laboratory test results, etc.
- Information on exposure to factors other than radiation
- Storage of biological samples
- Feedback of survey results (early detection, health guidance)

Disadvantages

- Expenses (personnel costs, test fees, etc.)
- Lack of information between surveys (once every 2 years)
- Bias caused by people who receive health checkups
- Bias caused by people who do not receive health checkups

Survey of Health Effects of Atomic Bomb Radiation



Clinical Survey by the Radiation Effects Research Foundation (AHS)

[Health checkups once every two years]

- **Medical interview (history of diseases and details of treatment)**
- **Physical measurements (height, weight, abdominal girth)**
- **Physiological tests (blood pressure, electrocardiogram)**
- **Clinical tests (peripheral blood cell count, biochemical tests, urine test, fecal occult blood test, etc.)**
- **Imaging tests (chest X-ray, abdominal ultrasonography)**
- **Questionnaire (daily habits such as smoking and drinking)**
- **Medical examination (physical examination)**

[Special survey]

- **Thyroid examination, cardiovascular disease examination, autoimmune disease examination, ophthalmic examination, etc.**

List of Clinical Tests

Test item	Details
Urine test	Protein, sugar, occult blood, bacteria, urinary sediment
Stool test	Occult blood in feces (one-day test)
Physiological tests	Blood pressure at rest, resting electrocardiogram (12-lead electrocardiogram)
Blood test	Red blood cell count, white blood cell count, platelet count, hemoglobin, hematocrit, leukocyte classification, etc.
Biochemical tests	Liver function [GOT(AST), GPT(ALT), γ-GTP, cholinesterase, etc.]
	Kidney function [urea nitrogen, creatinine, uric acid, electrolytes (Na, K, Cl, Ca, P)]
	Lipid metabolism (total cholesterol, triglyceride, LDL cholesterol, HDL cholesterol)
Glucose metabolism tests	Blood glucose, hemoglobin A1c
Inflammation tests	CRP, rheumatoid factor
Hepatitis screening (only screening)	HBs antigen/antibody, HBc antibody, HCV antibody (when positive: HCV-RNA)
Tumor marker test (Male over 50 yeas old)	PSA
Chest X-ray test	Direct radiography
Sputum test (only applicants)	Sputum cytology
Ultrasound scanning	Abdominal ultrasonography, thyroid gland ultrasonography
Osteoporosis test	X-ray bone density test
Gynecological examination (only applicants)	Cervical cytology

Survey of Health Effects of Atomic Bomb Radiation

— Quality control of the accuracy of the clinical survey —

Elimination of bias

- **Maintenance of high participation rate**
- **Others**

Quality control of the accuracy of diagnosis and laboratory test results

- **Training of examiners**
- **Unification of standards for diagnosis**
- **Standardization of tests (external quality control)**
- **Others**

Survey of Health Effects of Atomic Bomb Radiation

－ Storage of biological samples －

Ultra low temperature freezers

Liquid nitrogen tanks

Survey of Health Effects of Atomic Bomb Radiation

－ Preservation and management of clinical survey data －

1) Preservation of records of health checkups

- Medical examination records
- Medical interview records
- Others

2) Data entry into the resource database

- Encoding and input of diagnosis
- Automatic input of clinical test results
- Digital images (X-ray photography, etc.)
- Others

3) Conversion to the research database