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DEPARTAMENTO DE ENERGIA NUCLEAR
PROGRAMA DE PÓS-GRADUAÇÃO EM TECNOLOGIAS ENERGÉTICAS E NUCLEARES

EXAME DE PROFICIÊNCIA EM LÍNGUA INGLESA

NOME COMPLETO: ____ DATA:_______

Text 1

Japanese Legacy Cohorts: The Life Span Study Atomic Bomb Survivor Cohort and Survivors' Offspring[1]

In August 1945, two atomic bombs were exploded over the cities of Hiroshima and Nagasaki and generated shock waves, thermal energy, and ionizing radiation. People suffered from physical injuries and acute radiation syndromes, and late health effects continue to this day. Local governments reported that approximately 140,000 people in Hiroshima and 74,000 in Nagasaki died before the end of 1945. Medical aspects of physical injuries and acute radiation syndrome have been investigated in the survivors since shortly after the bombings. Studies of possible genetic effects in the offspring, including birth defects, still birth, neonatal death, and the sex ratio of newborns, were initiated in the late 1940s to early 1960s.

In the earliest period after the bombings, the medical conditions of the survivors and the environmental radioactive levels were intensively investigated by scientists from Japanese universities, the United States (US)-Japan Joint Commission, and others. In 1947, the Atomic Bomb Casualty Commission (ABCC) was established in Hiroshima by the US National Academy of Sciences and the National Research Council, and another laboratory of ABCC was opened in Nagasaki in 1948. (...)

The National Census of Japan in 1950 included a supplementary survey for atomic bomb survivors that identified approximately 284,000 survivors throughout Japan. Among them, about 195,000 survivors were residing in Hiroshima or Nagasaki at the time of the census. ABCC personnel contacted more than 99% of them to collect basic information about survivors' situation at the time of the bombings (eg, location and simple shielding information). Indeed, such information was already collected from a considerable proportion of the target population in previous surveys since the late 1940s. The Life Span Study (LSS) cohort included four groups: (1) all survivors who were located within 2 km of either hypocenter at the time of the bombings ("inner proximal"), (2) all survivors at 2 to <2.5 km ("outer proximal"), (3) survivors at 2.5 to <10 km who were sex- and age-matched to the inner proximal survivors ("distal"), and (4) people who were not in either city (ie, >10 km of the hypocenters) at the time of the bombings and sex- and age-matched to the inner proximal survivors ("not-in-city"). (…)

Radiation from atomic bomb explosions is classified into initial radiation and residual radiation. Initial radiation was emitted directly from nuclear fission and fission products in fireballs, resulting in exposures to gamma rays and neutrons on the ground. Residual radiation was released from neutron-induced radioactive materials in the environment and fission products contained in fallout. Such fallout often fell down with rain just after the bombings, as fission products cooled as they rose to high atmospheric layers. The rain often contained dust and soot from the remains of the cities (Figure 1).

The first systematic estimation of atomic bomb radiation doses was developed in the 1950s and designated T57D ("T" represents "tentative" and the number indicates the year of development), but it was not officially used in ABCC studies. The T65D system was officially used for individual dose estimates of survivors. DS86 was the first comprehensive dosimetry system developed in collaboration by US and

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[1] Extrato do artigo de "Ozasa K, Grant EJ, Kodama K. Japanese Legacy Cohorts: The Life Span Study Atomic Bomb Survivor Cohort and Survivors' Offspring. J Epidemiol. 2018 Apr 5;28(4):162-169. doi: 10.2188/jea.JE20170321."

Japanese scientists. DS02 was developed to correct remaining inconsistencies in DS86. Since DS86, individual doses of initial radiation have been estimated based on (1) amount of radiation emitted from the bombs, (2) transfer from fireball to persons, and (3) shielding conditions of persons. The factors (1) and (2) were estimated using nuclear physics, demonstration experiments at nuclear test fields in the US, and measurements of elements in metal and concrete exposed to atomic bomb radiation in Hiroshima and Nagasaki. Detailed shielding conditions of about 20,000 proximal survivors in the LSS were investigated using interview surveys in which location at the time of the bombing was identified on a map and surrounding buildings were drawn to evaluate shielding; in addition, if the survivor was inside a house, the house layout was drawn and location and posture of the survivor was identified. Based on this information, individual neutron and gamma doses for 15 organs were estimated. (...)

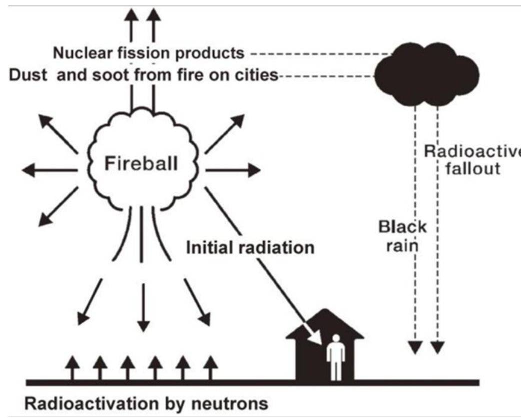

*Figure 1 - **Scheme of radiation released from atomic bombs. Atomic bomb radiation consisted of initial radiation and residual radiation. Initial radiation was emitted directly from the fireball. Gamma rays and neutrons reached people on the ground. Residual radiation was released from activated materials by neutrons and fission products. Fission products went up to high atmospheric layers with rising air from the fireball, then cooled and condensed. Some fallout fell down with rain just after the bombings. The rain often contained dust and soot from the fires in the cities and so was called "black rain".***

Unshielded weighted radiation dose was estimated to be about 7 Gy and 10 Gy at 1 km from the hypocenters in Hiroshima and Nagasaki, respectively, but only 13 mGy and 23 mGy, respectively, at 2.5 km. (…) The total number of LSS cohort members who were exposed to initial radiation doses of 1 Gy or higher according to DS02R1 was about 2,200, whereas almost half were exposed to around 5 mGy or less. Most subjects with unknown dose were located in large concrete buildings or bomb shelters in proximal areas. Due to these complex shielding conditions their individual doses could not be estimated. The spatial distribution of subjects within dose categories is shown in Figure 2. Those who were exposed to 1 Gy or higher were within a relatively narrow distance range from the hypocenters (between concentric circles at about 0.7 and 1.5 km) and are, therefore, assumed to be relatively homogenous in socioeconomic and lifestyle factors, with no selection factors for exposure. Therefore, there should be virtually no potential for bias or confounding by other major risk factors of cancer and other lifestyle-related diseases.

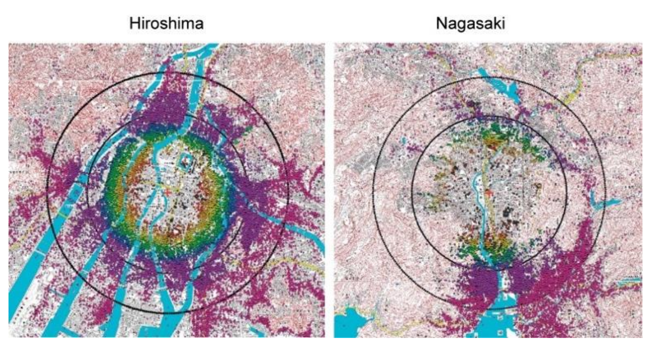

*Figure 2. **Spatial distribution of LSS subjects with grouped radiation dose estimates. The points on the maps indicate the locations at exposure to atomic bomb explosion of LSS subjects. Color key starting with bottom layer: pink, <5 mGy weighted colon dose; purple, 5 to 100; blue, 100 to 200; green, 200 to 500; yellow, 500 to 1,000; orange, 1,000 to 2,000; red, >2,000; dark gray, unknown dose. Black circles at 2 and 3 km from the hypocenter.***

Late health effects are assumed to develop based on subclinical injuries of cells; for example, DNA injuries that might induce a later cancer may not necessarily indicate immediate clinical manifestations. The dose of atomic bomb radiation to bone marrow at which half of exposed people should die within 60 days (ie “$LD_{50/60}$”) is estimated to be 2.9 to 3.3 Gy in DS02. The observed radiation dose-response using an excess relative risk model was usually linear for solid cancers in the LSS (described later), which is consistent with the expectation that one additional injury to a tumor suppressor gene could induce a loss of heterogeneity.

Therefore, survival between 1945 and 1950, when the Japanese national census occurred (and was the basis for constructing the LSS cohort), should not cause a large selection bias at radiation exposures less than about 4 Gy of shielded kerma (roughly equivalent to bone marrow dose of 2.7 Gy in the LSS). All these points taken together indicate that the strong radiation risks observed at 1 Gy or higher are thought to be causal. In contrast, distal survivors were distributed across wide areas, so risk factors for cancer and other diseases might be related to residential districts, which may also correlate with distance from the hypocenters, and hence, individual radiation dose. Therefore, caution must be used when interpreting radiation effects at low dose levels due to their vulnerability to possible confounding by lifestyle-related risk factors. (…)

1. **From the first paragraph, it is NOT correct to say that, according to the author that:**
    a. Shock waves, intense heat and ionizing radiation was released from the atomic bombs.
    b. Between august and the end of December 1945, approximately 140,000 people in Hiroshima and 74,000 in Nagasaki died.
    c. Genetic effects in the offspring, including birth defects was initiated shortly after the bombings up to 1960s.
    d. Approximately 140,000 people in Hiroshima and 74,000 in Nagasaki died from acute radiation syndrome, birth defects, still birth and neonatal death.
    e. None of the above.

2. **Which of the following is according to the text:**
    a. The objective of the ABCC was to investigate the cause of death of the approximately 140,000 people in Hiroshima and 74,000 in Nagasaki that died between August 1945 and the end of 1945.
    b. All residents within 2 km of either hypocenter (Hiroshima or Nagasaki) at the time of the bombings (“inner proximal”) died by the end of 1945.
    c. The Atomic Bomb Casualty Commission (ABCC) was established by the United States (US).
    d. 284,000 survivors were within 10 km of the epicenter.
    e. None of the above.

3. **From lines 27 to 39, it is NOT correct to say that, according to the author:**
    a. All radiation exposure to the survivors was delivered at the moment of the bombings (from the fireballs).
    b. The rain that fell after the bombings contained radioactive elements and fission products.
    c. T57D, T65D DS86, DS02 are studies that contained doses to individual survivors.
    d. Of the T57D, T65D DS86, DS02 systems, the DS02 is the most recent of them.
    e. None of the above.

4. **From lines 34 to 56 the author states that, regarding the individual doses of the initial radiation, calculated in the DS86 system:**
    a. The location of individuals behind walls and other materials were taken into account.
    b. Photons, neutrons, radioactivation and fallout were used to estimate individual doses.
    c. Only unshielded weighted radiation dose was used to estimate doses.
    d. Shielding conditions of the 284,000 survivors were carefully calculated from interviews.

5. Some fallout fell down with rain just after the bombings. Nuclear Fallout is NOT:

a. Residual radioactive material propelled into the upper atmosphere following a nuclear blast.
b. Dust and ash created from the remains of the city after an explosion.
c. A black rain (rain darkened by soot and other particulates) containing radioactive materials.
d. A kind of shock wave.
e. None of the above.

6. Mark as True or False. With respect to the difference between initial radiation and residual radiation, it is CORRECT (TRUE) or INCORRECT (FALSE) to state that:

( ) Radiation emitted directly from nuclear fission and fission products in fireballs, resulting in exposures to gamma rays and neutrons on the ground, is a kind of *initial radiation*.
( ) Fission products that went up to high atmospheric layers with rising air from the fireball, then cooled and condensed is classified as *initial radiation*.
( ) Radioactivation from neutrons of buildings and other materials found within the city is an *initial radiation*.
( ) Fallout is the only residual radiation discussed in the text.

T F F F

7. Mark as True or False. From lines 59 to 80, the authors state that:

( ) Doses of 7 to 10 Gy were estimated within a circle of radius 1 km around the hypocenter and around 1/4 of these values occurred at 2.5 km.
( ) The total number of exposed individuals in the LSS cohort with doses of 1Gy or higher were located inside large concrete buildings or bomb shelters.
( ) Individuals exposed to 1 Gy or higher were assumed to have similar socioeconomic and lifestyle factors so that risk factors have no bias due to the lifestyle of the survivors.
( ) There were no low doses (< 5 mGy) included in any of the cohorts.

F F T F

8. Mark as True or False. From lines 82-85:

( ) "Late health effects" are non-cancer effects that appear years after the explosion.
( ) "Late health effects" are effects to a somatic cell that is clinically visible after a few days.
( ) "Late health effects" is a kind of damage to the bone marrow where patients die within 60 days.
( ) "Late health effects" are DNA injuries that may lead to cancer.

F F F T

9. From lines 86-97, the observed radiation dose-response using an excess relative risk model:

a. Showed a linear response to dose for most of the solid cancers.
b. is consistent with the expectation that one injury to a DNA will cause one observed cancer.
c. is only linear in the range 2.9 to 3.3 Gy.
d. Is always linear for any cancer.

10. From lines 90-99, authors state that:

a. radiation risks is only observed at 1 Gy or higher.
b. The closer to the hypocenter, the higher the dose.
c. Lifestyle-related factors have no correlation to cancer risk.
d. Radiation effects at low dose levels do not include cancer.
e. None of the above.