Assessment actions and communication of solid cancer development risk in scenarios rdd

V. M., Bulhosa[1], E. R., Andrade[2], Z. R., de Lima[1]
e-mail: valquiriambrj@gmail.com,
fisica.dna@gmail.com , zrlima@ien.gov.br

[1] *PPGIEN, IEN*
[2] *IME*

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Radiological dispersal devices (RDDs) are artifacts containing explosives and an industrial or medical radiological source for the purpose of dispersing radioactive material in an urban area, impacting public health and safety by spreading radioactive material into the environment. This work intends to analyze the relative risk of developing solid cancer in a population exposed to an RDD event. For the simulation of the radiological scenario, the HotSpot health Physics Code software was used to estimate the doses received by exposed individuals and the contamination at the event site. The estimated dose values on the HotSpot platform were used in the biostatistical model Radiation Effects Research Foundation (RERF), developed from the Japanese survivors of the atomic bomb, to estimate the risks of detriment due to solid cancer in general. The radioactive material associated with RDD was cesium 137 because it is soluble in water and metabolically similar to potassium, which for the human organism this mimicry can be a serious metabolic problem.

In the first stage, the Hotspot software was used to estimate the total effective dose equivalent received in exposed individuals. The blast mode was used with 55.1 lb of TNT (equivalent to 25 kg) and a source of cesium-137, whose half-life is 30 years, with an activity of 3,7E14 Bq. The chosen terrain was a city, the chosen atmospheric stability was the class F, moderately stable, and this class provides the solar insolation factor and the speed of the wind near the ground.

The estimated dose values were used as input data for the solid cancer induction equation of the biostatistical model BEIR V. For solid tumors the relative risk model at each solid tumor site is as follows:

$$\mathrm{RR} = [1 + \alpha_s Dexp\left(\beta(e - 25)\right)]$$

where, α_{Sv} is the linear risk excess over the specific age by Sv being equal to 0.45 for men and 0.77 for women, D is the dose, e is the age at exposure in the year and β (-0.026) represents the coefficient accounting the effect of age during exposure being sex-independent [1].

The boundary conditions for the internal, medium and external isodoses curves represent a dose of 10, 5 and 1 mSv, respectively. According to the emergency intervention limits established by regulation 3.01 / 006: 2011, derived from CNEN standard 3.01, it is recommended that the dose is greater than 10 mSv in a maximum period of 2 days and evacuation when in a maximum period of 1 weeks the effective dose exceeds the value of 50 mSv. Using the statistical model RERF for solid tumors it was possible to estimate the relative risk for the incidence of solid cancer, the results are presented in the graph cancer rate versus distance, by age and sex, per 100 thousand inhabitants, Figure 1:

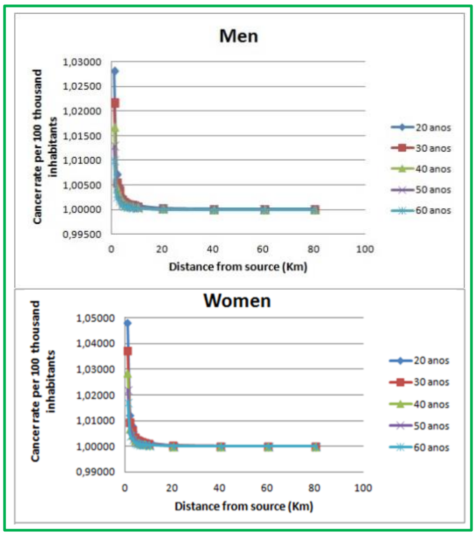

Figure 1. Risk relative to every 100 thousand inhabitants.

In this work, we can conclude that the relative risk is higher in the first two kilometers, where the 3.01 / 006: 2011 regulatory position, provided for in norm 3.01 of CNEN determines the shelter to levels of 10 mSv Dose to be avoided. If this measure is taken in a situation of risk as projected in this work the dose received for the public located in these two kilometers will be smaller than projected, so the relative risk of obtaining cancer will be lower as well.

Reference

[1] INTERNATIONAL ATOMIC ENERGY AGENCY. **Methods for Estimating the Probability of Cancer from Occupacional Radiation Exposure**. Vienna: IAEA, 1996. 56p.