Critical Body Systems in Individuals and Population Mortality under Low Level Chronic Irradiation

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A mathematical model is developed which describes the dynamics of radiation-induced mortality in a mammalian population. The model relates statistical biometric functions (mortality rate, life span probability density, and life span probability) with statistical characteristics and dynamics of a critical body system in individuals composing the population. In the framework of the model the effects of low and very low dose rates of chronic irradiation on the population of mammals (mice) are simulated, the thrombocytopoietic and granulocytopoietic systems, respectively, being considered as the critical ones. To calculate the dynamics of these systems, nonlinear dynamical models are developed. The mortality model reproduces, in a quantitative level, both increased and decreased values of the mortality rate in populations of LAF1 mice under, respectively, low and very low level chronic irradiation in comparison with those for unexposed specimens. Accordingly, the values of an average lifespan for mice chronically irradiated at low and very low dose rates are, respectively, smaller and greater than those for unexposed animals. The similar nonlinear effects of low dose rate chronic exposures were revealed in epidemiological studies of humans residing in areas with elevated level of ambient ionizing radiation. These experimental facts show that the principal concepts of the developed model are also applicable to humans. All this makes it feasible to employ the model as the basis for assessment of real hazards for the population residing in regions with elevated radiation background. In this case the model coefficients have to be determined by making use of the available data for humans. Scenarios for the dose

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accumulation dynamics should also be taken into account.