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Letter to the Editor

Consequences of the Fukushima nuclear accident with special reference to the perinatal mortality and abortion rate

Sir,

A tendency to exaggerate health risks from low-dose low-rate exposures to ionizing radiation has been discussed previously [1-7]. In the author's opinion, some scientists, exaggerating medical and ecological consequences of the anthropogenic increase in the radiation background, potentially contribute to the strangulation of the development of atomic energy, which would agree with the interests of fossil fuel producers [7,8]. Nuclear power has returned to the agenda because of the concerns about increasing global energy demand and climate changes. Health burdens were reported to be greatest for power stations based on lignite, coal, and oil. The health burdens are smaller for natural gas and still lower for nuclear power. This same ranking also applies for greenhouse gas emissions, and thus, potentially to the climate change [9].

Consequences of the Fukushima nuclear accident in Japan (2011) have been discussed [1] with reference to the paper [10], describing the increase in the perinatal mortality in contaminated areas as a possible consequence of the radiation exposure. A series of reports by the same and other researchers, arguing for a cause-effect relationship between radioactive contamination after the Chernobyl accident, nuclear testing, etc., and the shift of the gender ratio at birth toward males, was commented previously; the conclusion was that the cause-effect relationships have not been proven [1,2]. In the Authors' reply, it has been argued: "The doubling of the background radiation level, say, from 1 to 2 mSv/a, represents a doubling of an important physical environmental parameter relevant for the development of life on earth, and cannot as such be considered a 'low dose' and of no effect" [11]. Note that after a local increase from 1 to 2 mSv/a the doses would remain under the global average, which is 2.4 mSv/a. Given the evolutionary prerequisite of the best fitness, living organisms are probably adapted by natural selection to the background level of ionizing radiation existing today or to some average from the past [12]. It was further commented in the Authors' reply: "The dose (Gray or Sievert) in the radiation sciences is a surprisingly old and crude concept developed long before the discovery of the molecular structure of the DNA" [11]. Without discussing the "molecular structure of the DNA" it should be commented that the dose units are apparently suitable for the following dose comparisons. Estimated average effective doses to adults, 10-year-old children, and 1-year-old infants over the 1st year after NPP accident in Japan (2011) in the most contaminated Fukushima prefecture were 1.0-4.3, 1.2-5.9, and 2.0-7.5 mSv [13]. Worldwide annual exposures to natural radiation sources are generally expected to be in the range of 1-10 mSv [14]. Some national averages exceed 10 mSv [15]. In the USA, the average annual individual exposure from the natural radiation background (NRB) is 3.10, in Japan - 1.5 mSv/a; medical exposures add in the USA - 3.0, in Japan - 2.3 mSv/a [16]. In Europe, average annual doses from the NRB are above 5-6 mSv in several countries [17]. Additional doses to the residents of the most contaminated Fukushima prefecture have thus remained during the 1st year after the accident within the limits of the NRB. According to the concept discussed previously [3,4], with the dose rates tending to the background level, radiation-related risks would tend to zero, and can even fall below zero in accordance with hormesis. The DNA damage and repair are in dynamic equilibrium. Living organisms have probably adapted to the NRB in the same way as they did to other environmental factors: Various chemical substances, products of radiolysis of water, visible and ultraviolet light, etc. Natural selection is a slow process; therefore, an evolutionary adaptation to a changing factor would probably correspond to some average from the past. The NRB has been decreasing during the time of life existence on earth [18]. The character of the dose-response relationship at the dose levels close to the NRB can be predicted theoretically. There are many carcinogenic factors. The lower would be the level of environmental radioactivity, the less would be the contribution of the radioactive contamination compared to the NRB, and the less would by the role of radiation in total compared to other carcinogens and spontaneous carcinogenesis. Considering the above, the dose-effect curve would progressively deviate from the linearity with a decreasing dose; the dependence can even become inverse within some dose range in accordance with hormesis. Although some animal experiments have not confirmed hormesis, the experimental evidence in favor of hormesis is considerable [19-22]. The following, for example, illustrates the dose range associated with hormesis: In mice irradiated with the dose rate 70-140 mGy/a, a significant increase in life expectancy was observed [23]. Doses up to 100 mGy reduced the incidence of certain malignancies in cancer-prone mice [24]. In small animals, acute exposures associated with tumorigenesis are generally in the range of thousands or hundreds of mGy [14,25-28]. Note that an acute exposure to low linear energy transfer radiation is more effective than protracted one [3]. This means that experimental data are partly at variance with ecological and epidemiological studies [10,29-34]. It should be commented that epidemiological studies of the low-dose radiation effects may be associated with the dose-dependent selection, self-selection or recall bias [35-38]. In case-control studies, the participation of cases (cancer patients) has been higher than that of controls [37-39]. A better recollection by cases of facts related to the radiation exposure (recall bias) may be conductive to the overestimation of doses in the cases.

Unlike many other papers, the study [35] reasonably concluded: "The results are not consistent with any simple causal interpretation," in spite of the found association between mortality from noncancer causes of death and external exposure to ionizing radiation in the cohort of employees in the nuclear industry [35]. In fact, the dose-effect relationships between low-dose low-rate exposures and nonneoplastic diseases call in question such relationships for cancer found in epidemiological studies [3]. The selection or self-selection bias is a potentially serious problem of the epidemiological research. It is known, e.g., from studies of the low-frequency magnetic fields (electromagnetic waves), where, similarly to low-dose low-rate ionizing radiation, there is some epidemiological association with cancer but neither supporting laboratory evidence nor biophysical plausibility [40-42]. In populations exposed to ionizing radiation, the self-selection bias must be stronger than that in people exposed to low-frequency electromagnetic waves because carcinogenicity of the former is generally known. People knowing their higher doses would probably come to medical institutions more frequently being given averagely more attention. The same mechanism can cause in future an increase in the registered cancer incidence in the areas with a high NRB (Guarapari, Brazil; Kerala, India; Ramsar, Iran; Yangjiang, China and others), where no cancer increase has been demonstrated so far [43-49], although singular reports on enhanced cancer risk have already appeared [44,50]. It may be predicted that reports on increased incidence of cancer and other diseases in the areas with a high NRB will appear in future because of the increasing awareness of residents, physicians and researchers, above-average medical surveillance and self-reporting. However, considering the above argumentation, such studies would hardly prove any cause-effect relationships.

It is not surprising that catastrophes with evacuation of people, causing stress, disturbances of the healthcare, of diets and lifestyles, are accompanied by an increase in the morbidity and mortality [51]. Another factor potentially contributing to some reported dose-effect relationships is an ideological bias aimed at the strangulation of nuclear energy [7,8]. Misrepresentation of some data cannot be excluded [1-7]. Epidemiological studies based on the best fitting of functional forms do not necessarily prove a cause-effect relationship. Exposures to stress after a nuclear accident may have detrimental effects on the pregnancy [52,53]. Expectant mothers with anxiety and post-traumatic stress disorders were reported to be at a higher risk of preterm birth [54]. Exaggeration of risks from low-dose low-rate radiation exposures by some scientific papers, resonated by mass media and gossip, may cause anxiety in pregnant women. A presumed risk of fetal abnormalities may be a reason moving some families toward the decision to make abortion. There was an increase in the induced abortion rate after the Chernobyl accident [55-58]. It was reasonably assumed that "the public debate and anxiety among the pregnant women and their husbands "caused" more fetal deaths… than the accident" [59]. Biased information "repeatedly created a situation of panic, like a posttraumatic stress disorder" [60]. After the Chernobyl accident, "conflicting information and false rumors spread considerable alarm among the public in general and among pregnant women in particular" [61]. Certain publications in professional journals may prevent physicians from giving adequate advice to pregnant women inquiring about a possible abortion. Radiation phobia with psychosomatic manifestations developed in many exposed people [62], being probably more prevalent in more contaminated areas thus contributing to dose-effect correlations.

The induced abortion rate per 100 pregnancies in contaminated areas after the Fukushima accident increased from 17.61 to over 18.5 (i.e., approximately by 5.1%), which has been deemed insignificant [63]. The increase in the perinatal mortality in the Eastern part of Germany after 1986, discussed in [30,64-66] in support of the role of ionizing radiation after the Chernobyl accident (GDR plus West Berlin: 1986 - 2,183; 1987 - 2,281 [64], i.e., increased by 4.9%), was of a comparable scale. This increase might have been caused by social factors or emigration of some doctors from the former GDR to the West. In general, oscillations of the perinatal mortality in Central and Eastern Europe after the Chernobyl accident [30,67] could have been explained by sociopolitical perturbations of that time.

Reiterations of the perinatal mortality "jump" [10,68] after the Fukushima accident without consideration of doses from the NRB, diagnostic radiography, and other factors potentially influencing the perinatal mortality, can contribute to anxiety in pregnant women and to an increase in the abortion rate. According to this mechanism, wanted pregnancies were interrupted after the Chernobyl accident [60]. Moreover, it cannot be excluded that radiophobia contributed also to illegal abortions during the last trimester of pregnancy possibly influencing perinatal mortality figures. Considering that a certain percentage of abortions induced after a prenatal ultrasonic gender testing may be gender-selective due to the son preference, the enhanced abortion rate may also contribute to an increase in the male to female ratio at birth [2].

In conclusion, the papers [10,29-34,64-68] do not prove dose-effect relationships. In particular, the article [10] creates an exaggerated impression about the consequences of the Fukushima accident. According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), no discernible increased incidence of radiation-related health effects is expected among exposed members of the public or their descendants after the Fukushima accident [13]. It is known that radiation exposure of the developing embryo or fetus can cause damage. However, based on animal studies and observations following high-dose exposures of pregnant women, the UNSCEAR considered that there is a threshold for these effects at about 100 mGy [69], i.e., much higher than the doses discussed above. Dose-response relationships at low radiation doses can be further studied in large-scale animal experiments with different mammal species, comparable doses and dose rates, shielded from biases and conflicts of interest.

Sergei V. Jargin

Department of Public Health, Peoples' Friendship University of Russia, Moscow, Russia

Address for correspondence:

Sergei V. Jargin, Department of Public Health, Peoples' Friendship University of Russia, Clementovski Per 6-82, Moscow, Russia.
E-mail: sjargin@mail.ru

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