Letter to the editor regarding The Impact of Prenatal Exposure to Chernobyl Fallout in Finland

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We read with interest the recent paper by Sipiläinen (1) describing an analysis of the association between Cs-137 deposition from the Chernobyl nuclear power plant accident in 1986 and school performance, more specifically matriculation examination, but also highest degree of education and income level. We would like to draw attention to several sources of uncertainty that may affect the validity of the conclusions.

Importantly, the doses are several orders of magnitude below those known to affect the development of the nervous system. Among those exposed to radiation in utero in Hiroshima and Nagasaki, during the sensitive fetal period of organogenesis, effects on cognitive development were shown only for doses exceeding 0.3 Gy (300 mGy), that is three orders of magnitude higher than that from Chernobyl fallout in Finland (2). This substantially reduces the plausibility of the reported findings being attributable to radiation effects.

Effects of radiation are determined by the dose, which is the indicator of the amount of exposure relevant for any biological effect. Unfortunately, Sipiläinen in his paper does not have data on radiation doses but relies only on deposition of Cs-137 as exposure indicator. This can be misleading for several reasons.

First, radiation doses received by the Finnish population from the Chernobyl fallout were very low compared with all other sources of radiation exposure. In terms of effective dose, Finns receive on average 6 mSv annually, of which 1.1 mSv natural background radiation excluding radon and 0.8 from medical exposures, mainly diagnostic radiology (3). The additional dose from Chernobyl fallout was on average 0.2 mSv in 1986, ranging from 0.1 to 0.5 mSv during the first year when the Finnish population is divided into quintiles (4).

Second, differences in exposure from the Chernobyl fallout are so small that they can easily be masked by variation in doses from other sources. Exposure level (more specifically, dose rate) from natural background gamma radiation varies substantially within Finland: the annual doses can range from approximately 0.4 to 1.6 mSv and ignoring this source of variation will lead to misclassification, i.e., inaccuracies and potential bias in exposure classification. Furthermore, the analysis ignores doses from internal radiation, i.e., ingested radionuclides. Their distribution was more even across Finland due to consumption of food produced elsewhere. This also dilutes the differences between areas.

Third, Sipiläinen assumed that the exposure was instantaneous, occurring only on April 28, 1986, while in fact it decreased gradually over time. The dose from Chernobyl fallout was on average 0.2 mSv in 1986 and 1987, 0.15 mSv in 1988 and so forth. This makes comparison between the in-utero cohort (born in August-November 1986) and children born subsequently problematic, as it does not represent a comparison of exposed and non-exposed children as assumed.

These issues are not properly taken into account in the interpretation of the findings, though we believe they render any causal interpretation of radiation effects highly uncertain.

(1) *Sipiläinen M. The impact of prenatal exposure to Chernobyl fallout in Finland. JFEA 2022 (1):40-52*
(2) *Otake M, Schull WJ. Radiation-related brain damage and growth retardation among the prenatally exposed atomic bomb survivors Int J Radiat Biol 1998;74:159-171*
(3) *Suomalaisten keskimääräinen efektiivinen annos vuonna 2018. STUK A263. Säteilyturvakeskus 2020.*
(4) *Auvinen A, Seppä K, Pasanen K et al. Chernobyl fallout and cancer incidence in Finland. Int J Cancer 2014;134:2253-63*