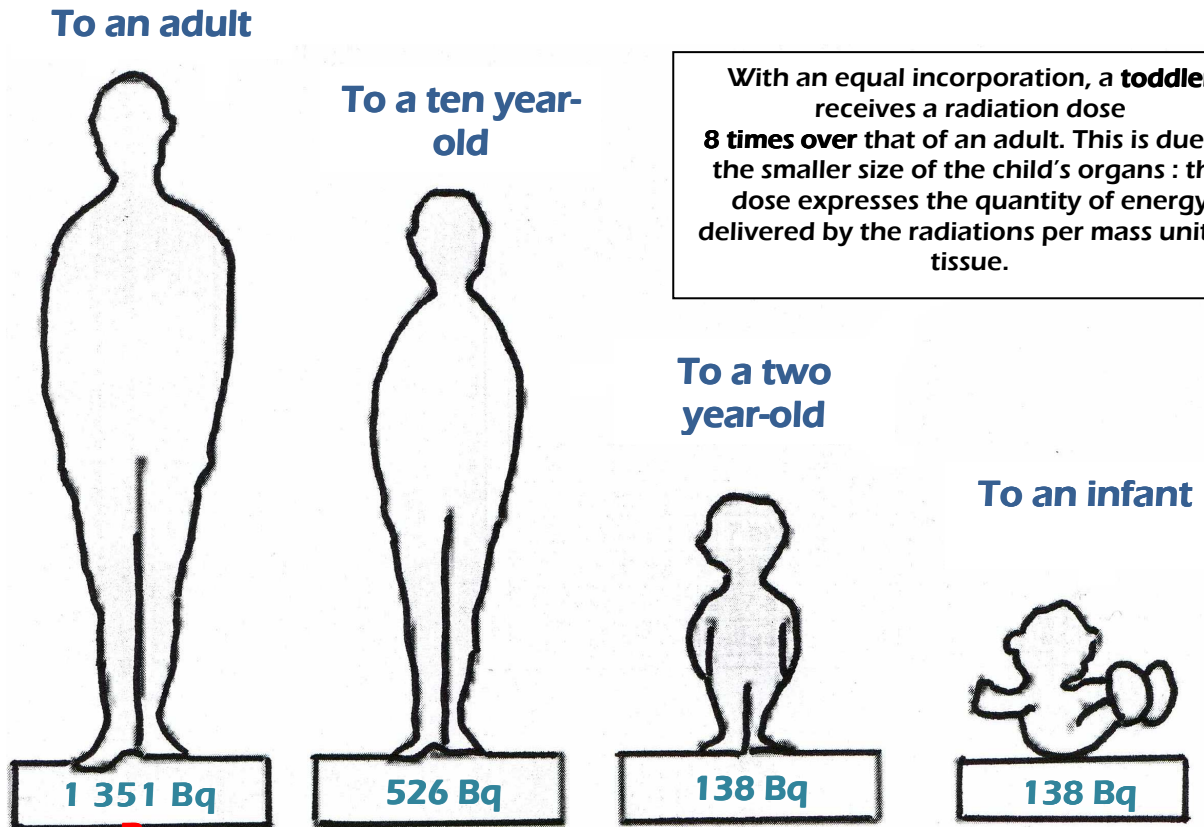


INCORPORATION of IODINE 131 by INHALATION

Quantity of iodine 131 delivering and effectual dose of 10 μSv
(threshold under which authorities consider the risk as trivial)



- The becquerel (noted as Bq) is the legal unit to measure the activity (or radioactivity).
1 Bq = 1 disintegration per second
- The dose of iodine 131 depends on atmospheric activity, respiratory debit and duration of exposure

If we refer to the impact in France of the radioactive releases from the Fukushima Daiichi nuclear power plant, we can suppose an iodine 131 activity in the air of **20 mBq/m³** and a permanent exposition to this level of contamination during **40 days** (from 22nd March 2011 to 30 April 2011). Based on these hypotheses, we obtain, depending on the considered ages, incorporations comprised **between 4 and 23 Bq of iodine 131**. The differences are explained by the respiratory debit disparities : the adult lungs are more developed and therefore inspire larger air volumes than those of children.

NB : The 20 mBq/m³ value retained for the computation is a just a little higher than values measured in France ; hypothesis of a persisting contamination of 40 days is shielding (the air contamination has strongly declined after April 15th).

In proceeding with very pessimistic calculations, with an iodine 131 concentration of **100 mBq/m³**, thus a value 10 times superior, and in considering that it carries on at this level for 70 days (thus a permanent exposition at 100 mBq/m³ from 22 March through 31 May), the incorporated iodine 131 activities would reach, depending on the age span **between 30 to 200 Bq**.

- **The radiation dose received depends on the the quantity of iodine131 inhaled and the age of a given person.**

Doses associated to the incorporation by inhalation of an activity of iodine 131 vary depending on the age of the person. Effectual dose coefficients by age range have been delimited on international and European levels and have been integrated in the French¹ regulations since 2001. They are expressed in Sieverts per becquerel (Sv.Bq⁻¹). For a better understanding, they are listed in the table below and are expressed in $\mu\text{Sv}.\text{Bq}^{-1}$.

Age range	Sv/Bq	$\mu\text{Sv/Bq}$
Under one year	7,20E-05	0,072
1 to 2 years	7,20E-05	0,072
2 to 7 yeas	3,70E-05	0,037
7 to 12 years	1,90E-05	0,019
12 to 18 years	1,10E-05	0,011
Over 17 years	7,40E-06	0,0074

Knowing, for each age range, the iodine 131 activity that will be inhaled and the associated dose coefficient, enables us to compute the effective dose and, by deduction, its induced risk level.

- For incorporations comprised between **4 and 23 Bq**, effectual doses do not reach **0,4 μSv** , hence a few percents (<4%) of the threshold limit of **10 $\mu\text{Sv/yr}$** from which the European regulations admit that the risk levels are no longer inconsequential and that methods to reduce expositions must be designed . Of course, this dose represents an ever lower fraction 0,001% of the limit standard of 1 mSv/an.
- With such pessimistic hypotheses (a nonstop exposition for **70 days** to a volumic activity of **100 mBq/m³** causing, depending on the age range, incorporations comprised **between 30 and 200 Bq** of iodine 131) the doses extend **from 2 to 3 μSv** , which is lower than the threshold limit of 10 $\mu\text{Sv/yr}$ (all the more so to the maximum dose limit of 1 mSv/annum).

Caution : the exactness of the above figures must not be misleading. The calculations involve significant uncertainties: very simplified biological models, radiation and organs gross weight factors, dose evaluation in a physicist standpoint rather than of a biologist angle (absorbed energy averaged down to tissue-scale and not to cell-scale). However, considering the contamination levels measured in France, these reservations do not challenge the conclusions on the very low inhalation-related risk level.

¹ Decree n°2002-460 of 4 April 2002 related to the general public protection measures against ionized radiations, codified in the public health policy and bylaw of 1st September 2003 delimiting the calculation standards of effectual and equivalent doses resulting from the exposition of persons to ionizing radiations.