

## 특별강연II

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### Ryugo Hayano

Professor of Physics,  
Emeritus,  
The University of  
Tokyo, Tokyo, Japan

## Radiological consequences of the Fukushima Nuclear Power Accident: myths and facts

In March 2011, immediately after the Fukushima Daiichi Nuclear Power Plant accident, transportation system, communication network and energy infrastructure were all severely disrupted by the earthquake and tsunami, which caused a lot of confusion both at the accident site and within the government. Among other things, the radiation measurements were inadequately carried out. In these eight years, however, a lot of data have been accumulated, such as soil contamination, food contamination, external as well as internal exposure doses of residents, and so on.

On the other hand, the paper published in PNAS (1), for which I am one of the co-authors, estimated the soil contamination level throughout Japan using an atmospheric diffusion model, when there were no wide-area radiation monitoring data, and the "source term" (timeline of radioactivity emission from Fukushima Dai-ichi) was poorly known. As noted above, a large number of actual measurement data have been accumulated in these eight years. The measurements show that the PNAS paper much over-estimated the contamination, particularly at large distances. I am quite embarrassed therefore to hear that some people are still using our PNAS paper to claim that the whole of Japan is significantly contaminated. I would like to urge everybody to use actual data for such discussions.

I have been an "antimatter" research team leader at the CERN laboratory in Geneva since 1997. As such, I had no experience in radiological protection nor risk communication. However, after the Fukushima accident, it so happened that my tweets got the attention of many people (the number of followers exceeded 150,000). I started to collaborate with medical doctors in Fukushima to measure internal/external radiation doses of Fukushima residents and to communicate the results to general public. Luckily, all my Fukushima-related activities, including this trip to Korea, have been funded by the donations from my twitter followers.

In the following, let me discuss the results of two papers to which I contributed.

In the first paper (2), we measured the internal radiation doses of approximately 30,000 Fukushima people using whole body counters throughout 2012, and found that the committed effective doses did not exceed 1 mSv. The average dose was less than in early 1960's when the food contamination level was high due to atmospheric A-bomb and H-bomb tests. Our data (and all subsequent measurements) confirm that the radioactive contamination level of food consumed by Fukushima residents is extremely low.

In the second paper (3), co-authored by some 200 people, mostly high school students, the external radiation doses (including natural radiation) of high school students were compared in Fukushima, France, Poland, and in Belarus, using electronic personal dosimeter called the "D-Shuttle". We found that the external doses of Fukushima high school students were not much higher than those of other parts of the world.

In Fukushima prefecture, as of spring 2019, areas still remain where the evacuation order have not yet been lifted. However, it is worth noting that nearly 2 million people live safely in Fukushima Prefecture. For many, psychosocial and economical issues may be more important than the radiation issues.

Let me close by showing some important numbers, i.e., the number of deaths in Fukushima Prefecture and in Miyagi Prefecture (north of Fukushima). The number of direct deaths (+ missing) due to the earthquake and tsunami: Miyagi-10761, Fukushima-1810. The number of disaster-related death (death during and after the evacuation): Miyagi-928, Fukushima-2268. These show the huge death toll by tsunami (in Miyagi), as well as the difficulties caused by the evacuation (in Fukushima). Of course, no death due to radiation has been reported in these two Prefectures or elsewhere in Japan since the accident.

- 1) T.J. Yasunari et al., "Cesium-137 deposition and contamination of Japanese soils due to the Fukushima nuclear accident", PNAS 108 19530-19534 (2011); <https://doi.org/10.1073/pnas.1112058108>
- 2) R.S. Hayano et al., "Internal radiocesium contamination of adults and children in Fukushima 7 to 20 months after the Fukushima NPP accident as measured by extensive whole-body-counter surveys", Proceedings of the Japan Academy, B89, 157-163 (2013); <https://doi.org/10.2183/pjab.89.157>
- 3) N. Adachi et al., "Measurement and comparison of individual external doses of high-school students living in Japan, France, Poland and Belarus—the 'D-shuttle' project—", Journal of Radiological Protection, 36, 49-66 (2016); <http://doi.org/10.1088/0952-4746/36/1/49>