Fukushima nuclear power plant and your health

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(5) Radiation and radioactive materials released from the nuclear power plant
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There are only two episodes in human history:

Hundreds of thousands of people exposed biologically significant dose (= meaningful amount) of radiation

1. Hiroshima & Nagasaki, atomic bomb in 1945
2. Chernobyl, nuclear plant accident in 1986

To tell the conclusion first,
‘Fukushima’ unlikely becomes the third episode.
How people are exposed to radiation?

**External exposure**

- Radioactive materials
- Irradiation from outside

**Internal exposure**

- Contaminated air, water and foods
- Intake
- Irradiation from inside

- Air
- Milk
- Contaminated vegetables
How radiation harms your health

*Discriminate* these two clearly

**Immediate damage within weeks**

- Very high dose (=amount) by mainly external exposure
  - Serious damage
    - Brain
    - Intestine/Colon
    - Blood-producing system
  - (It will *never* happen to you)

**Cancer may develop years later**

- Relatively low dose by external & internal exposure
  - Breast
  - Lung
  - Thyroid gland
  - Air
  - (It *might* concern you)
External exposure
(Irradiation from outside)

Hiroshima & Nagasaki

Atomic bomb

Airburst

600m from the ground

γ-ray

Neutron-ray

Hundreds of thousands of citizens

>100 mSv (Many many > 1 Sv)

Died ~140,000 within 1 month

Leukemia ↑

Other cancers ↑

Chernobyl

Groundburst

Nuclear Power Plant

Thousands of workers and firemen

>100 mSv (Hundreds > 1 Sv)

Died ~30

Seriously injured ~200

No significant increase of cancer, so far
Internal exposure (Irradiation from inside)

Chernobyl Groundburst

Wind

Air

Fallout

Hundreds of thousands of citizens

Died within 1 month

0

>100 mSv

~4000 thyroid cancer, mainly children

Other cancers did not increase significantly
Why thyroid cancer?

Chernobyl

Wind

Air

Fallout

Xenon-133 ($^{133}\text{Xe}$)

Cecium-137 ($^{137}\text{Ce}$)

Iodine-131 ($^{131}\text{I}$)

(Probably) No problem

$^{133}\text{Xe}$ Can’t enter body

$^{137}\text{Ce}$ Distributes in whole body, and diluted

$^{131}\text{I}$ Concentrated in thyroid gland

↓

Irradiates thyroid gland

↓

Thyroid cancer

$^{131}\text{I}$
What’s going on in Fukushima
Fukushima : External exposure

**Chernobyl**
- Thousands of workers and firemen
- Release of radioactive materials
- Died ~30
- Seriously injured ~200
- >100 mSv (Hundreds >1 Sv)

**Groundburst**

**Fukushima**
- ~30 workers
- Release of radioactive materials
- Died 0
- Seriously injured 0
- 100 ~250 mSv

No significant increase of cancer, so far
No significant increase of cancer, most likely
Fukushima: To avoid external exposure, what you should do?

Stay 20 km away from the nuclear plant, and you are absolutely safe.

Do not try to enter the nuclear plant.
Fukushima : Internal exposure

**Chernobyl**
- Wind → Air → Fallout
- Hundreds of thousands of citizens
- Died: 0
- Seriously injured: 0
- Thyroid cancer: ~4000
- No significant increase of other cancer, so far
- Probably >100 mSv

**Fukushima**
- Wind → Air → Fallout → Sea
- 0, so far
- Died: 0
- Seriously injured: 0
- No significant increase of cancer, most likely
- >10 mSv
Contamination levels are very low even at maximum levels. Contamination levels are improving.

If you take in these contaminated water more than 1Kg for 1 year, you may get slightly increased risk for cancer....
2. Inhalation of contaminated air (by breathing)

Once air in this area was contaminated with radioactive materials at very low levels.

Currently radioactivity of air in Tokyo is less than half of that in Moscow.
3. Tapwater

Once tapwater in this area was contaminated with radioactive materials at very low levels.

At that time, if you drink >10 L of tapwater every day for years, you might get slight increase of cancer risk.
4. Food

Vegetable, milk, and fish in this area might be contaminated with radioactive materials at very low levels.

If you have such food more than 1 Kg every day for years, you might get a slight increase of cancer risk.

Contaminated food won’t be shipped to market.
Q: I have heard that Fukushima is now rated ‘Level 7’, the same as Chernobyl. If there is a big difference between Fukushima and Chernobyl, why the same level?

A: Many experts in United Nations, USA, France, Russia, and other countries think that this rating system is not good for evaluating big accident. I expect that the rating system will be changed in the future to avoid confusion. I think that if Fukushima is ‘7’, Chernobyl should be ‘8’ or even ‘9’. Many experts will agree.
Do not worry too much

External exposure: you are absolutely safe as long as you stay 20 Km away from the plant.

Internal exposure: Air, tapwater, vegetable, milk, and fish near the nuclear power plant are once contaminated with radioactive materials at very low levels. Overall, radioactivity is decreasing to normal levels.

If you take in (maximum) contaminated water/food more than 1 Kg every day for 1 year, you might get slightly increased cancer risk.

Research Institute for Radiation Biology & Medicine will inform you immediately if the situation worsens.