

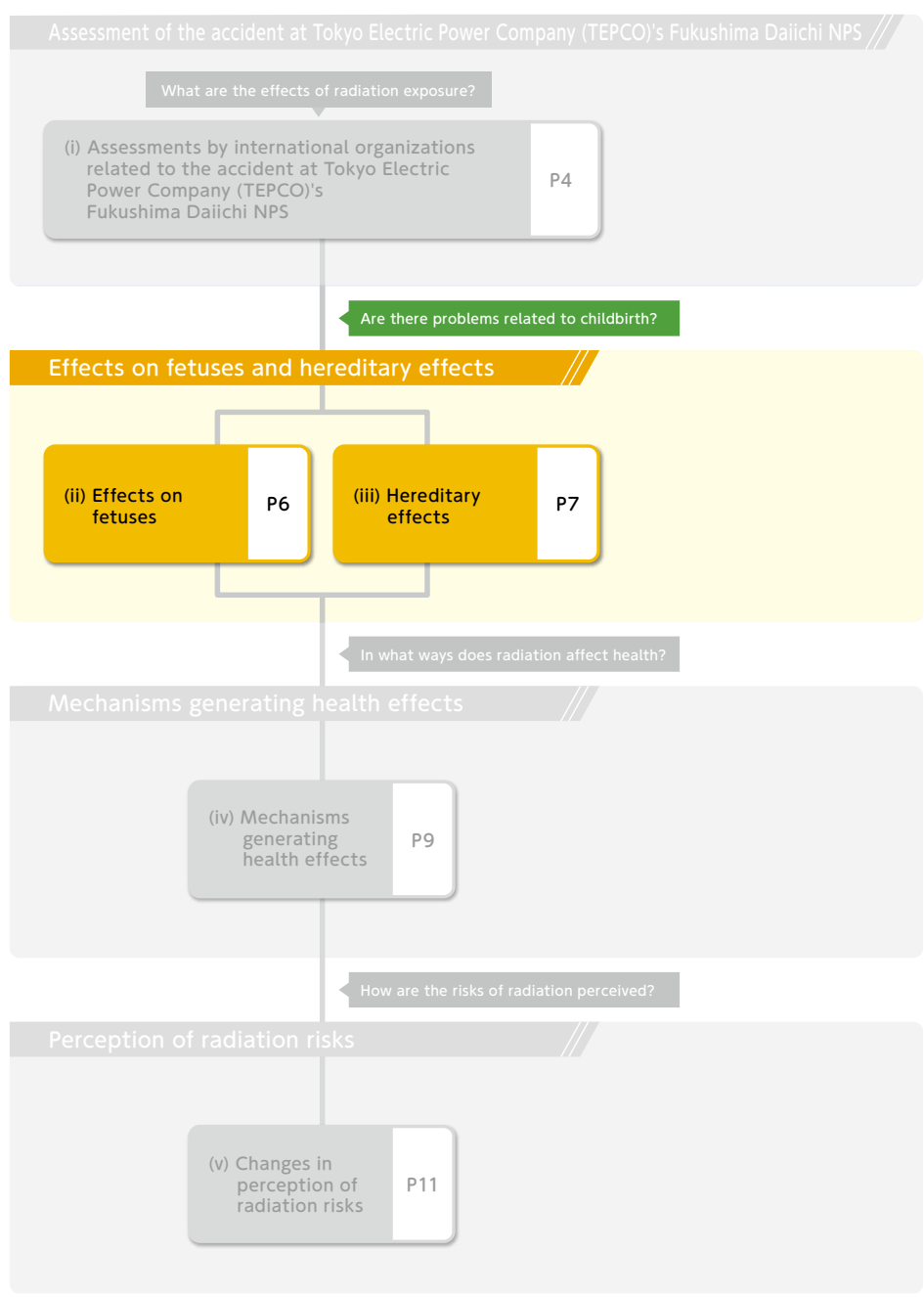


Health Effects of Radiation: 5 Themes

Effects on Fetuses and Hereditary Effects

# Theme: Effects on fetuses and hereditary effects

This section considers the effects of radiation on fetuses when pregnant mothers are exposed and the hereditary effects on the next generation. Survey results from the Chernobyl accident are also included as a reference.





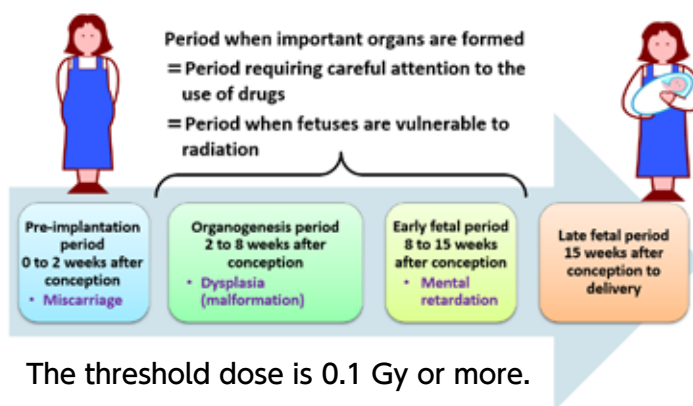
## (ii) Effects on fetuses

There are two types of health effects radiation can cause related to pregnancy problems. The first is effects on the fetus at the time of exposure during pregnancy and the second is hereditary effects on children born in the future. Research has been carried out regarding these effects since even before the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. First of all, let's look at effects on fetuses.

### ● Deterministic effects and differences depending on the timing of exposure

When a pregnant woman is exposed to radiation and radiation passes through her womb or radioactive materials migrate into her womb, the fetus may also be exposed to radiation.

It is known that fetuses are highly sensitive to radiation and the incidence of effects varies depending on the timing of exposure (time specificity).



• Exposure to radiation exceeding 100 mSv\* at one time is thought to be sufficient to cause the effects above on fetuses.

In addition, UNSCEAR has evaluated the maximum exposure dose from the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS as 13 mSv.

\* Exposure to radiation exceeding 100 mSv at one time is equivalent to 0.1 Gy of  $\gamma$ -ray or X-ray exposure.

For more information about deterministic effects and differences caused by exposure time periods, see page 104 of Vol. 1, FY2022 edition.

### ● Results of surveys related to the Chernobyl accident

Surveys of the effects on fetuses in the surrounding area continued to be conducted even after the Chernobyl accident.

European Surveillance of Congenital Anomalies (EUROCAT): 18 regions in 9 countries:	No change in incidence of malformations before and after the accident
Finland, Norway, Sweden:	No change in incidence of malformations before and after the accident
Belarus:	Although there was an increase in the registration of malformations of aborted fetuses regardless of whether from the contaminated areas or not, this could be caused by reporting bias*1
Ukraine: participated in EUROCAT in this century	Although there was an increase in neural tube defects in an isolated Polish community in the Rivne province, the influence of factors such as folate deprivation, alcoholism, consanguineous marriage must also be evaluated in addition to radiation*2

Source: \*1: Stem Cells 15 (supple 1): 255, 1997 \*2: Pediatrics 125:e836, 2010  
For more information about reports, see page 107 of Vol. 1, FY2022 edition.

### ● Survey on children born from mothers who were pregnant at the time of the Chernobyl accident

It is considered that radiation exposure during pregnancy does not directly affect intelligence quotients of fetuses and children after growth.

For more information about survey results, see page 106 of Vol. 1, FY2022 edition.



## (iii) Hereditary effects

Next, let's take a look at the results of hereditary effects research.

There has been no evidence to prove that parents' radiation exposure increases hereditary diseases in their offspring in the case of human beings.

### ● Results of the next-generation health effect studies of the children of atomic bomb survivors

Surveys of health effects on children of atomic bomb survivors examine incidence rates of serious congenital disorders, gene mutations, chromosome aberrations, and cancer, as well as mortality rates from cancer or other diseases. However, no significant differences were found between the survey targets and the individuals with no exposure with the same classification for attributes such as gender, age, and residence area (control group) for any of these categories.



For more information about the results of surveys of health effects on children of atomic bomb survivors, see page 109 of Vol. 1, FY2022 edition.

### ● Other epidemiological surveys of the children of atomic bomb survivors

#### ● Deaths due to malignant tumors developing by age 20

The follow-up survey of 41,066 subjects revealed no correlation between parents' gonadal doses (0.435 Sv on average) and their children's deaths.

(Source: Y. Yoshimoto et al.: Am J Hum Genet 46: 1041-1052, 1990.)

#### ● Cancer prevalence (1958 - 1997)

As a result of the follow-up survey of 40,487 subjects, development of solid tumors and blood tumors was found in 575 cases and 68 cases, respectively, but no correlation with parents' doses was observed (the survey is still underway).

(Source: S. Izumi et al.: Br J Cancer 89: 1709-13, 2003.)

#### ● Deaths due to cancer

During the observation period of 1946 to 2009, a long-term survey of 75,327 people found 1,246 deaths due to cancer, with no correlation with radiation doses received by parents.

(Source: E. Grant et al.: Lancet Oncol 16: 1316-23, 2015.)

#### ● Incidence rates of lifestyle-related diseases (2002 - 2006)

The clinical cross-sectional survey of approx. 12,000 subjects revealed no correlation between parents' doses and their children's incidence rates of lifestyle-related diseases (the survey is still underway).

(Source: S Fujiwara et al.: Radiat Res 170: 451-7, 2008.)

For more information about survey results, see page 112 of Vol. 1, FY2022 edition.