

[Review]

## The Japan Environment and Children's Study (JECS) in Fukushima Prefecture—A progress report on the enrollment stage

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### Abstract

The Japan Environment and Children's Study is an ongoing nationwide birth cohort study that is being conducted at 15 regional centers throughout Japan. The recruitment of subjects in the study area within Fukushima Prefecture, which includes Fukushima City, Minami Soma City and Futaba County, was begun on January 31, 2011 with the cooperation of the obstetrics and gynecology departments of local medical institutions. On March 11, soon after the start of recruitment, the Tohoku region was hit by an unprecedented disaster in the shape of the Great East Japan Earthquake, which was closely followed by the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant accident. As a result of the disaster, the study area in Fukushima Prefecture was expanded on October 1, 2012 to include 59 municipalities across Fukushima Prefecture. Three points are seen as particularly important: 1) Radiation risk communication, 2) The motto is "Be attentive. Be supportive.", and 3) Establishing cooperating partnerships. With the cooperation of all concerned, the recruitment period ended on March 31, 2014. The tentative total number of the participants enrolled at the Fukushima Regional Center was 34,666 (13,134 pregnant mothers, 8,695 fathers and 12,837 children born before November 30, 2014 as of June 2016).

**Key words :** JECS, birth cohort, Fukushima, Great East Japan Earthquake, enrollment stage

### Introduction

A child's development, including the fetal stage and early infancy, involves the maturation of various organic structures and functions, and varies with each child. The physical features and behavioral characteristics of children result in specific exposure routes for toxic substances in the environment (environmental pollutants). The pharmacokinetics of these chemicals are also known to differ between adults and children, with children being more vulnerable to such exposure. The World Health Organization published a report in 2006 in which approximately 40% of all children's deaths were attributed

to the environment<sup>1)</sup>. The vulnerability of children to certain environmental pollutants has since been clarified; however, there is little information available on the effects of most of these environmental pollutants<sup>2)</sup>.

In recent years, there has been grave concern over the increased environmental risks for children and much attention has been paid, both domestically and internationally, to the vulnerability of children to toxic substances in the environment. In 1997, the G8 Environment Ministers' Meeting delivered a declaration on "Children's Environmental Health" (the Miami Declaration); thereafter, large-scale epidemiological studies (with study populations of

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around 100,000) focusing on children began in Denmark<sup>3)</sup>, Norway<sup>4)</sup>, and the United States<sup>5)</sup>. Here in Japan, the Ministry of the Environment developed and announced a plan for the “Japan Environment and Children’s Study (JECS)”<sup>2)</sup>.

The JECS is a birth cohort study that focuses on environmental factors, particularly chemicals, surrounding children, with the following central hypothesis : exposure to chemical substances in the fetal stage to early childhood has a significant effect on children’s health. The final goal of the study is to investigate the long-term effects of exposure to chemical substances in the environment on the growth, development, incidence of disease, and change in health conditions of children. The study also aims to clarify the associations between environmental factors and health to formulate appropriate risk management steps that can benefit children and future generations. The JECS seeks to investigate a wide range of items including the outcomes of exposure to chemical substances in relation to pregnancy and reproduction, congenital anomalies, mental development, immunology and allergies, metabolism, and the endocrine systems, as well as genetic, social, and lifestyle factors. These items are

related to children’s health and various modifying and confounding factors.

### Methods and subjects

The JECS was designed as a birth cohort study<sup>2)</sup>. Under the plan established by the Ministry of the Environment, the all-inclusive management of the study lies with the National Institute for Environmental Studies as the National Center supported by specialists from the National Center for Child Health and Development in the form of the Medical Support Center. Fifteen regional centers (Hokkaido, Miyagi, Fukushima, Chiba, Kanagawa, Koshin, Toyama, Aichi, Kyoto, Osaka, Hyogo, Tottori, Kochi, Fukuoka, and south Kyushu/Okinawa) were selected (Figure 1). Each regional center acts as a hub for establishing close cooperation with medical facilities and local government agencies for the participant enrollment and their follow-up within the area. The participants are 100,000 pairs of pregnant women and children (fetuses), but the fathers’ participation is not essential. The enrollment period ran from January 31, 2011 through to March 31, 2014. The follow-up is to be continued until the children

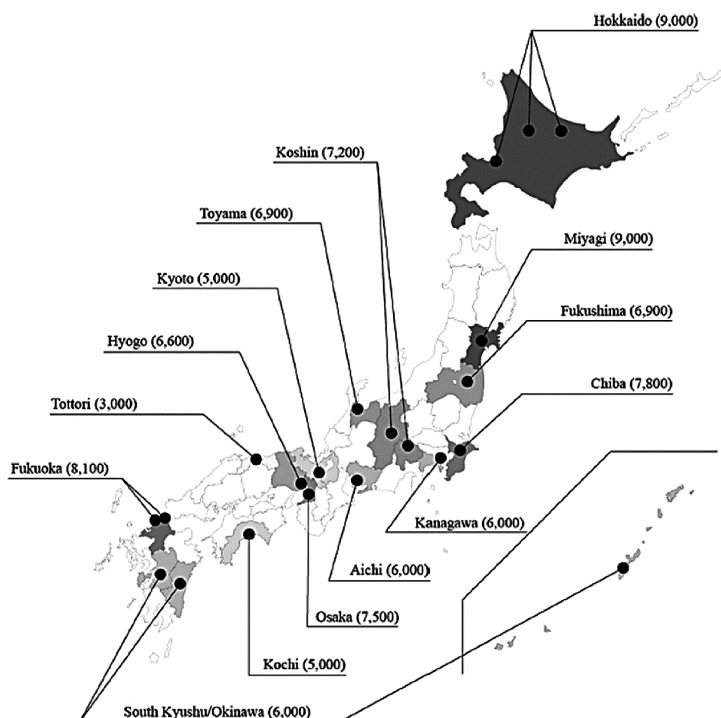


Fig. 1. Study areas and targeted sampling sizes of the JECS as of January, 2011.

Fifteen regional centers were selected in a competitive process in which universities and other research institutions were invited to submit proposals for the covered areas, population, recruitment methods, organization structures, regional liaison, and resources. The JECS aims to cover half of all the births in the area. Selected regional centers were required to recruit 3,000 to 9,000 pregnant women over a period of 3 years, totaling 100,000 participants in 15 regional centers. This figure is cited in “Reference 1” and is partially modified.

Table 1. Participant eligibility and exclusion criteria

Eligibility criteria	
(1)	Pregnant women whose babies are due between August 1, 2011 and the end of the registration period.
(2)	Pregnant women who live in the areas designated by the regional center and who are expected to live within Japan in the future.
(3)	Pregnant women who visit the cooperating medical facilities or claimed their maternity handbook at the local municipal offices.
Exclusion criteria	
(1)	Pregnant women and fathers of children who do not consent to participate in this study.
(2)	Pregnant women or fathers who have difficulties filling in the questionnaire forms.
(3)	Pregnant women who are expected to give birth outside the target area and are thus unable to provide an umbilical cord blood samples.

reach 13 years of age. The criteria for eligibility and exclusion of the pregnant women are shown in Table 1. Written informed consent to participate in this study was obtained as follows. At obstetrics and gynecology departments in the cooperating medical institutions, research coordinators provided an oral explanation, using a briefing paper outlining the study, to eligible pregnant women and expectant fathers. Pregnant women, fetuses, and fathers were then registered as participants after signing an agreement to participate in the study. Consent on behalf of the fetuses was obtained from the mothers by proxy. Trained and certified research coordinators obtained the informed consent.

Soon after the start of recruitment, the Tohoku region was hit by an unprecedented disaster in the shape of the Great East Japan Earthquake, which was closely followed by the Tokyo Electric Power Company (TEPCO) Fukushima Daiichi Nuclear Power Plant (NPP) accident. The Fukushima Regional Center received requests from pregnant women and medical personnel in Fukushima Prefecture to conduct the JECS throughout the prefecture. In order to ease public concerns, the overall research plan of the study was revised based on the concept that it is important to collect as much data as possible on the effects of radiation on health to monitor and prevent unexpected effects of radiation. On October 1, 2012, radiation exposure was added to the study as an environmental factor in all 15 regions, and the study area in Fukushima was also expanded to cover all areas within the prefecture.

#### The Enrollment in Fukushima Regional Center

In Fukushima, the regional center for the JECS was established at Fukushima Medical Universi-

ty. In addition, Fukushima City, Minami Soma City and Futaba County (Hirono Town, Naraha Town, Tomioka Town, Kawauchi Village, Okuma Town, Futaba Town, Namie Town, and Katsurao Village) were designated for research (Figure 2). The recruitment of subjects began at 19 medical institutions with obstetrics and gynecology departments on January 31, 2011. Unexpectedly, Japan has suffered from severe damage caused by the earthquake and the NPP accident soon after the start of recruitment. The JECS in Fukushima was relaunched to cover all areas within the prefecture, including 59 local municipalities (13 Cities, 31 Towns, and 15 Villages) with 51 medical institutions in Fukushima Prefecture and 1 institution in Daigo Town in Ibaraki Prefecture on October 1, 2012. The initial target for the number of participants recruited was 6,900; however, the target was increased to 15,900 when the study area was expanded to cover all areas of Fukushima Prefecture (Figure 2, Table 2). The coverage rate of the JECS was calculated as the number of pregnant women divided by the total number of live births from the month when the recruitment began through to the end of the recruitment period on March 31, 2014.

As the study area was expanded in the wake of the Great East Japan Earthquake, the registration of participants rose from 150 per month to 500–600 per month (Figure 3). The tentative total numbers of the participants enrolled at the Fukushima Regional Center were 13,134 pregnant mothers, 8,695 fathers, and 12,837 children who were born before November 30, 2014, as of June 2016. The participation rate among eligible pregnant mothers was 78.6%, and the coverage rate for Fukushima Prefecture as a whole was 48.5%; however, excluding both Minami Soma City and Futaba County, where recruitment was suspended due to the disaster, the

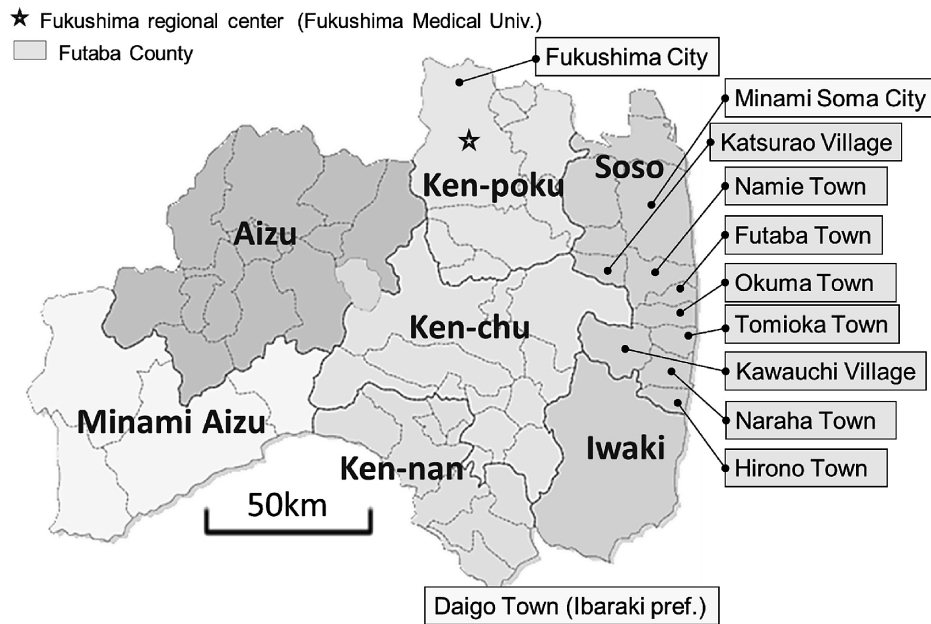


Fig. 2. Fukushima Prefecture

Fukushima Prefecture consists of 7 districts : Aizu, Minami-Aizu, Ken-poku, Ken-chu, Ken-nan, Soso, and Iwaki. Minami Soma City and Futaba County are part of the Soso district.

Table 2. Overview of the study area expansion to cover all areas in Fukushima Prefecture

	Initial plan	Plan from October 2012 after expansion of the study area
Study areas	10 local municipalities (2 Cities, 6 Towns, 2 Villages)	59 local municipalities (13 Cities, 31 Towns, 15 Villages)
Cooperating medical institutions	19 institutions	52 institutions (incl.1 in Ibaraki)*
Target number of participants	6,900	15,900 (increased by 9,000)
Recruitment period	January, 2011 to March, 2014 (3 years)	October, 2012 to March, 2014 (18 months)

\* Out of about 60 medical institutions with obstetrics and gynecology department within Fukushima Prefecture, 51 took part in the JECS. A portion of the pregnant women who live in the Ken-nan district visited the cooperating medical institution in Ibaraki.

coverage rate was 54.0%. The coverage rates for each regional Public Health Center in the prefecture were as follows : 62.6% in Ken-poku ; 57.2% in Ken-chu ; 47.7% in Ken-nan ; 48.0% in Aizu ; 55.7% in Minami Aizu ; 44.3% in Koriyama City ; 48.4% in Iwaki City ; and 11.2% in Soso (Table 3).

This study was approved by the Ethics Committee of Fukushima Medical University (#1165), as well as the directors and chairmen of the cooperating medical institutions.

### Discussion

In Fukushima, the JECS was relaunched to cover the expanded study areas following the Great East Japan Earthquake and the TEPCO Fukushima

Daiichi NPP accident. Immediately after the disasters, we received requests from pregnant women and medical institutions located outside the study areas appealing for the research to be conducted across the entire prefecture. Most of these requests were made based on concerns about the effects of radiation. As the JECS focuses on the effects of chemical substances and not those of radiation, we initially felt that it may be difficult to meet such requests. However, participation in the JECS makes it possible to closely monitor children's health in the long-term through answering questionnaires every 6 months regarding the children's growth and their living environment. Through this monitoring, parents would be able to take action immediately if any symptoms of illness

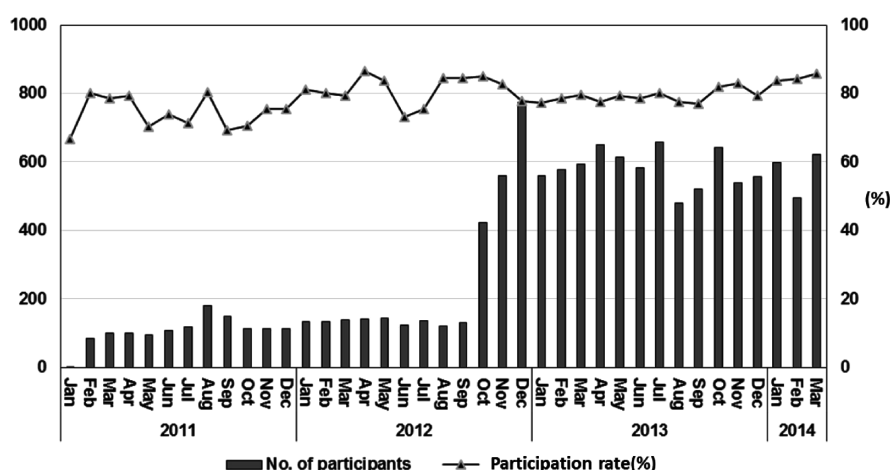


Fig. 3. Registration of pregnant women in Fukushima Prefecture for the J ECS

The number of participants (right vertical axis) indicates the number of pregnant women registered each month for the J ECS. The recruitment of subjects began on January 31, 2011. Soon after the start of recruitment, the Tohoku Region was hit by the Great East Japan Earthquake, followed by the TEPCO Fukushima Daiichi NPP accident. On October 1, 2012, the study area was expanded from 10 to 59 local municipalities covering the entire Fukushima Prefecture. Participation rate (left vertical axis) is the number of participating pregnant women divided by the total number of pregnant women who were provided with an oral explanation of this study.

Table 3. The number of participants and coverage rate

Public health center	Number of children born <sup>c)</sup>	Number of pregnant women participating <sup>a)</sup>	Coverage rate <sup>b)</sup>
Ken-poku	9,119	5,711	62.6%
Ken-chu	2,173	1,243	57.2%
Ken-nan	1,767	843	47.7%
Aizu	2,665	1,279	48.0%
Minami Aizu	230	128	55.7%
Koriyama City	3,936	1,743	44.3%
Iwaki City	3,699	1,790	48.4%
Soso <sup>d)</sup>	3,486	390	11.2%
Other		7 <sup>e)</sup>	
Total	27,075	13,134	48.5% <sup>f)</sup>

- The number of pregnant participants is tentative and has not been confirmed yet.
- Coverage rate is the number of participating pregnant women divided by the number of children born from the beginning of the recruitment period to the end of the recruitment period on March 31, 2014.
- The number of children born is based on the population statistics for Fukushima Prefecture.
- Minami Soma City and Futaba County are part of Soso district. The recruitment was suspended at the medical institutions in Minami Soma City and Futaba County after the TEPCO Fukushima Daiichi NPP accident in March, 2011.
- Pregnant women who lived in the study areas of other regional centers and were enrolled at the cooperating medical facilities in Fukushima Prefecture.
- The coverage rate was 54% in the areas excluding Soso district where recruitment was suspended.

are observed; thus, future concerns would be minimized.

This long-term study requires close communication with the participants and the local communities. In Fukushima, the following three points are seen as particularly important:

#### 1) Radiation risk communication

Concern about radiation is common not only to the participants (pregnant women and their families) but also to staff of medical institutions and Fukushima Regional Center. In a situation where even medical personnel were confused regarding information

about radiation, it was difficult for us to convey accurate information on this topic to the general public. While various initiatives were being conducted in Fukushima Prefecture, we held lectures with experts for the participating pregnant women, their families, medical practitioners, and the staff conducting the study. In order to answer the questions from the participants, a contact center was also set up within the National Center.

2) *The motto of the JECS in Fukushima, "Be attentive. Be supportive."*

Since the start of the recruitment period, we have been providing as detailed explanations as possible to the participants. Especially after the Great East Japan Earthquake and the TEPCO Fukushima Daiichi NPP accident, we have carried out this study with the motto of "Be attentive. Be supportive." through face to face communication.

3) *Establishing cooperating partnerships*

In order to carry out this study across Fukushima Prefecture with proper understanding of the participants, it is important not only to treat the participants with care, but also to share information with all parties engaged in the JECS. In this study, research coordinators began their work after training and certification. In order to deepen the understanding of the study, we recommended that workers not only in the regional centers but also in the cooperating medical institutions and the local governments receive the same training. As a result, around 700 people are now certified as research coordinators. In addition, in order to broaden the understanding of the study, 5 local conferences have been set up within the prefecture by various groups consisting of medical, educational and local government agencies, and currently approximately 170 people are members of the local conferences.

In Fukushima prefecture, the Fukushima Health Management Survey (FHMS) has been conducted to assist in the long-term health management of residents, to promote the future well-being of residents, and to determine whether long-term low-dose radiation exposure has any effect of their health following the TEPCO Fukushima Daiichi NPP accident<sup>6)</sup>. The FHMS consists of the Basic Survey, Thyroid Ultrasound Examination, Comprehensive Health Checks, Mental Health and Lifestyle Survey, and Pregnancy and Birth Survey. Thus, part of the FHMS study population overlaps with the JECS population. Both the JECS and the FHMS will disseminate valuable information on the conse-

quences of pregnancy and the health condition of children in Fukushima Prefecture. Therefore, these surveys are very important projects for residents of Fukushima Prefecture.

It is possible that there are differences across the regions regarding the degree of public awareness and understanding of this study. However, the coverage rate of close to 50% in Fukushima Prefecture demonstrates that 1 out of 2 women who were pregnant during the registration period participated. This coverage rate indicates that the families in Fukushima Prefecture have great interest in the outcome of this study. The standout factor of the Fukushima Regional Center is that the JECS is carried out across Fukushima Prefecture, while other regional centers conduct the JECS in selected area of each prefecture. Therefore, not only can we compare the Fukushima Regional Center with other regional centers, but we can also analyze the situation in Fukushima independently, which can lead to be more attentive and supportive for the Fukushima participants. On the other hand, an important task going forward is minimizing the number of families who will drop out of the study.

Our regional center is responsible for the preparation of answers to the questions that will be asked in the future; how we raised children in Fukushima Prefecture, and what the environmental effects were on those children. With regard to the most important aim of this study, providing support for the families in Fukushima Prefecture in the raising of their children, we hope to disseminate the knowledge gained from this research to future generations and families.

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#### *The cooperating medical institutions*

(Ken-poku district)

Fukushima Red Cross Hospital, Meiji Hospital, Ichikawa Clinic, Sasaya Obstetrics and Gynecology Clinic, Niitsuma Obstetrics and Gynecology Clinic, Honda Obstetrics and Gynecology Clinic, Saiseikai Fukushima General Hospital, Ohara General Hospital, Fukushima Medical University Hospital, Okawa Lady's Clinic, Kanno Obstetrics and Gynecology Clinic, Saint Clinic, Nihonmatsu Hospital, Watanabe Clinic, Tani Hospital

(Ken-chu district)

Tanaka Lady's Clinic, Okazaki Obstetrics and Gynecology Clinic, Jusendo General Hospital, Tsukahara Obstetrics, Gynecology, Internal medicine, and Surgery Clinic, Total Health Clinic, Furukawa Obstetrics and Gynecology Clinic, Ohta Nishinouchi Hospital, Southern Tohoku General Hospital, Fukushima National Hospital, Komoriyama Obstetrics and Gynecology Clinic, Hoshi General Hospital (Ken-nan district)

Katakura Obstetrics and Gynecology Clinic, Shirakawa Kosei General Hospital, Hanawa Kosei Hospital, Iwasa Clinic (Aizu district)

Funada Clinic, Takeda General Hospital, Aidu Chuo Hospital, Bange Kosei General Hospital (Soso district)

Araki Obstetrics and Gynecology Clinic, Nishijun Maternity Clinic, Lady's Clinic Haramachi, Ohmachi Hospital, Haramachi-chyuo Obstetrics and Gynecology Clinic (Minamisoma-chyuo Clinic), Futaba Kosei Hospital, Minamisoma City General Hospital (Iwaki district)

Muraoka Obstetrics and Gynecology Clinic, Watanabe Obstetrics and Gynecology Clinic, Katabayose Obstetrics and Gynecology Clinic, Iwaki Kyoritsu Hospital, Morita Urology, Obstetrics and Gynecology Clinic, Tsukudamachi Obstetrics and Gynecology Clinic, Tsukikawa Lady's Clinic, Sato Maternity Clinic

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#### Conflicts of interest

The authors have no conflict of interest to disclose with respect to this manuscript.

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