Elective cesarean delivery at term and its effects on respiratory distress at birth in Japan: The Japan Environment and Children's Study

Sayaka Horiuchi1 | Ryoji Shinohara1 | Sanae Otawa1 | Megumi Kushima1 | Yuka Akiyama2 | Tadao Ooka2 | Reiji Kojima2 | Hiroshi Yokomichi2 | Kunio Miyake2 | Zentaro Yamagata2 | The Japan Environment and Children's Study Group

1Center for Birth Cohort Studies, University of Yamanashi, Chuo-shi, Japan
2Department of Health Sciences, School of Medicine, University of Yamanashi, Chuo-shi, Japan

Correspondence
Sayaka Horiuchi, Center for Birth Cohort Studies, University of Yamanashi, Chuo-shi, Yamanashi, Japan.
Email: sayakahoriuchi@gmail.com

Funding information
Ministry of the Environment, Japan

Abstract

Background and Aims: Early-term birth between 37 and 38 weeks of gestation increases the risk of mortality and morbidity. This study investigated the status and impact of early-term birth among neonates born by cesarean section in Japan.

Methods: All singleton live births that had data of gestational age at birth available in the Japan Environment and Children's Study (JECS), a nationwide birth cohort study launched in 2011, were eligible for this study. Neonates born by cesarean delivery at term without indications for early delivery were included to examine the association between early-term birth and respiratory distress at birth. The gestational age at birth was categorized as 37 weeks 0 day to 38 weeks 6 days (early-term), 39 weeks 0 day to 40 weeks 6 day (full-term), and 41 weeks 0 day to 41 weeks 6 days (late-term). Respiratory distress at birth included respiratory distress syndrome, transient tachypnea, and difficulty in breathing after birth. Univariable and multivariable analyses were performed using logistic regression models with a two-tailed significance level of 5%. All statistical analyses were performed using SAS, version 9.4, for Windows (SAS Institute, Cary, NC).

Results: In total, 32 078 of 100 011 (32.1%) neonates had early-term birth. At 37 gestational weeks, 49.7% of the deliveries were via cesarean section, and half of the cesarean deliveries were due to a previous cesarean section. Among the 10 051 neonates born by elective cesarean delivery at term, neonates with early-term births were more likely to have respiratory distress at birth (adjusted odds ratio: 4.19; 95% confidence interval, 1.70, 10.34) than those born at full term.

Conclusions: Early-term birth is associated with a high risk of respiratory distress in births involving cesarean delivery without indication for early delivery. There is a need for guidelines for early delivery considering adverse effects of early-term births.
1 | BACKGROUND

Worldwide, more than 1 in 10 children born in 2014 (approximately 15 million children) were preterm. Preterm birth is associated with high mortality and morbidity rates. Globally, it is one of the leading causes of death among neonates and the second leading cause of death among children younger than 5 years of age.

Although preterm birth is defined as birth before 37 weeks of gestation, birth between 37 and 38 weeks of gestation (early-term birth) is considered suboptimal. Early-term birth may increase the risk of mortality and short-term and long-term morbidities, including respiratory, allergic, neurologic, and metabolic disorders. Risk factors of early-term deliveries were reported as socioeconomic factors, environmental factors, pregnancy-related complications, or medical indications; however, some of these deliveries were not medically indicated.

As the number of elective deliveries that are not medically indicated contributes to the growing proportion of early-term births in the United States, measures to reduce these deliveries have been undertaken in the country. Recent studies have reported a declining trend in early-term birth rates. The avoidance of unnecessary early births has led to lower perinatal mortality rates between 2006 and 2014 in North America and Europe.

Among high-income countries, Japan had the highest prevalence of early-term births (30.8%) in 2010. The guideline on obstetric care to the opinion of the American College of Obstetricians and Gynecologists (ACOG) for selecting indications for early delivery. We decided to remove multiple births and obstetric complications such as hypertensive disorder, placenta previa, non-reassuring fetal status, delayed/orchidectomy, prematurity rupture of membranes, intrauterine infection, or other complications. Also excluded were neonates with congenital malformations of the head (eg, anencephaly, encephalocele, microcephaly, hydrocephalus), eye (eg, eyelid coloboma, microphthalmia), or ear; orofacial anomalies; anomalies in the upper limb, chest (eg, congenital diaphragmatic hernia, pulmonary sequestration), abdomen (eg, umbilical hernia, gastrochisis, esophageal atresia), urogenital apparatus (eg, hydronephrosis, cystic renal anomalies, renal agenesis), lower limb, skin, or skeleton/muscle (eg, thanatophoric dysplasia, achondrogenesis, achondroplasia); myelomeningocele (eg, spina bifida); and chromosomal anomalies (eg, Down's syndrome, Trisomy 18, Trisomy 13). Post-term births (42 weeks of gestation and beyond) were excluded due to the limited number of cases.

The JECS is an ongoing, nationwide, prospective birth cohort study that was launched in January 2011 under the initiative of the JECS Working Group to investigate the effects of environmental factors on child health and development. The JECS included pregnant women who resided in the study areas with due dates between August 2011 and mid-2014 and had no difficulty understanding Japanese or completing the self-administered questionnaires. Women were recruited in the early stages of pregnancy, and the participants and their partners and offspring were followed up at 15 regional centers in Japan. The representativeness of the study population to the Japanese general population was verified at baseline and 1 year after the study inception.

2 | METHODS

2.1 | Cohort

All babies who had live births and had data of gestational age at birth available in the Japan Environment and Children’s Study (JECS) were eligible for this study to investigate the prevalence of early-term birth (Figure 1). Further, singleton live births by cesarean delivery at term without indications for early delivery were included to examine the association between early-term birth and respiratory distress at birth. As there is no clear indication for early delivery in Japan, we referred to the opinion of the American College of Obstetricians and Gynecologists (ACOG) for selecting indications for early delivery.

2.2 | Exposure

The present study explored the effects of early-term birth on the occurrence of respiratory distress at birth among neonates born by cesarean section in Japan. Data of the gestational age at birth were extracted from the medical record transcripts from the co-operating healthcare providers at which the study participants were born. The gestational age at birth was categorized as 37 weeks 0 day to 38 weeks 6 days (early-term birth) and 39 weeks 0 day to 41 weeks 6 days (full-term birth) 41 weeks 0 day to 41 weeks 6 days (late-term birth).

2.3 | Outcomes

The outcome of the present study was respiratory distress at birth, including respiratory distress syndrome, transient tachypnea, and
difficulty breathing after birth. Neonatal complications were reported by co-operating healthcare providers based on medical records.

Socioeconomic factors (including maternal occupation at conception and maternal educational status), child characteristics (such as sex), maternal behaviors, maternal medical history, and complications related to the pregnancy were considered potential confounders. Maternal age at study enrolment (during early pregnancy), mode of conception (including fertility treatments such as assisted reproductive technology), maternal anxiety (Kessler Psychological Distress Scale [K6 score] ≥ 529,30), maternal alcohol consumption, maternal smoking, maternal comorbidities during pregnancy, and maternal parity were considered maternal factors that affect gestational age and
neonatal health outcomes based on previous studies. Maternal comorbidities included hypertension, thyroid disease, diabetes, autoimmune disease, heart disease, kidney disease, hepatitis, cerebral infarction, cerebral hemorrhage, epilepsy, hematologic disease, malignant tumor, mental disease, neurological disorder, and thrombosis. Data of the sex of the child, gestational age at birth, maternal comorbidities during pregnancy, and mode of conception were extracted from the medical record transcripts. Data of all other factors were collected from the mothers using questionnaires at the time of enrolment (during early pregnancy) and during mid- to late pregnancy.

2.4 Statistical analyses

The distributions and frequencies of early-term births by mode of delivery and reason for delivery were examined, and the distributions and frequencies of exposure, outcomes, and covariates among the restricted study participants were analyzed and summarized as percentages or means, as appropriate. Univariable analyses were performed to assess the relationship between early-term birth and respiratory distress at birth using logistic regression models. Multivariable analyses were performed with all covariates using logistic regression models. A two-tailed significance level of 5% was used for all statistical tests. All statistical analyses were performed using SAS, version 9.4, for Windows (SAS Institute, Cary, North Carolina).

2.5 Ethics approval

This study was conducted according to the principles of the World Medical Association Declaration of Helsinki and Ethical Guidelines for Medical and Health Research Involving Human Subjects promulgated by the Ministry of Health, Labour, and Welfare of Japan. The JECS protocol was approved by the Ministry of the Environment’s Institutional Review Board on Epidemiological Studies (no. 100406001) and the ethics committees of all participating institutions. Written informed consent was obtained from all participants.

### RESULTS

The dataset of jecs-ta-20190930 was used for the analyses. The patient selection flowchart is shown in Figure 1. Among 104 062 registered, there were 3758 (3.5%) abortions and stillbirths and 293 (0.3%) neonates whose gestational age was not recorded. A total of 100 011 neonates were included in the present study, including 1231 (1.2%) born before 34 weeks of gestation, 4353 (4.4%) neonates born between 34 and 36 weeks of gestation, 32 078 (32.1%) neonates born between 37 and 38 weeks of gestation, 53 313 (53.3%) neonates born at 39 and 40 weeks of gestation, 8809 (8.8%) neonates born at 41 weeks of gestation, and 227 (0.2%) neonates born at 42 weeks or later. The mean gestational age at birth was 38.8 weeks (SD, 1.7) (Table 1). Planned or emergency cesarean sections were the most common delivery mode at 37 weeks (49.7%), 34 to 36 weeks (46.6%), and ≤33 weeks (75.3%) of gestational age (Table 1). At 38 weeks of gestation, the most common delivery mode was spontaneous (48.3%), followed by cesarean section (34.6%).

Repeated cesarean delivery was the most common reason for cesarean deliveries at 38 (60.3%) and 37 (51.5%) weeks of gestation (Table 2). In contrast, at 37 or 38 weeks of gestation, 23.9% of cesarean deliveries were due to complications such as gestational hypertensive disorder of pregnancy, placenta previa, non-reassuring fetal status, delayed/obstructed labor, premature rupture of membranes, intrauterine infection, and other complications. Complications were the most common reason for cesarean deliveries at 34 to 36 and ≤33 weeks of gestation.

The univariable and multivariable analyses included 10 051 neonates who were born by cesarean delivery at term without a clear indication for early delivery to investigate the effects of early-term birth on respiratory distress. Table 3 summarizes the characteristics of the neonates included in the univariable and multivariable analyses. Among the neonates delivered by cesarean section with no indications for early delivery, 87.4% were born at 37 or 38 weeks of gestation. Half of the neonates were male (49.5%), and the mean maternal age at enrolment was 32.1 years (SD, 4.9 years). More than half of the mothers were employed (57.7%), and only 6.8% underwent assisted

### Table 1: Delivery mode according to gestational age at birth (N = 100 011)

| Gestational age at birth (weeks) | Total        | Spontaneous delivery | Induced delivery | Vacuum extraction | Forceps delivery | Planned/emergent cesarean delivery |
|---------------------------------|--------------|----------------------|-----------------|-------------------|-----------------|-----------------------------------|
| >41                             | 227          | 32 (14.2)            | 104 (46.0)      | 10 (4.4)          | 0 (0.0)         | 80 (35.4)                         |
| 41                              | 8809         | 3586 (40.8)          | 3314 (37.7)     | 639 (7.3)         | 26 (0.3)        | 1221 (13.9)                       |
| 40                              | 25 849       | 16 975 (65.8)        | 5219 (20.2)     | 1867 (7.2)        | 94 (0.4)        | 1627 (6.3)                        |
| 39                              | 27 464       | 19 806 (72.3)        | 4261 (15.6)     | 1663 (6.1)        | 57 (0.2)        | 1618 (5.9)                        |
| 38                              | 22 053       | 10 629 (48.3)        | 2876 (13.1)     | 841 (3.8)         | 26 (0.1)        | 7617 (34.6)                       |
| 37                              | 10 025       | 3478 (34.8)          | 1238 (12.4)     | 307 (3.1)         | 7 (0.1)         | 4968 (49.7)                       |
| 34-36                           | 4353         | 1768 (40.7)          | 425 (9.8)       | 125 (2.9)         | 3 (0.1)         | 2021 (46.6)                       |
| ≤33                             | 1231         | 257 (21.1)           | 38 (3.1)        | 7 (0.6)           | 0 (0.0)         | 918 (75.3)                        |
| Total                           | 100 011      | 56 531 (56.7)        | 17 475 (17.5)   | 5459 (5.5)        | 213 (0.2)       | 20 070 (20.1)                     |

Note: Data are presented as numbers (percentages). Some data regarding the mode of delivery are missing (n = 263).
reproductive technology treatments. Comorbidities were present in 14.9% of mothers during pregnancy.

The overall incidence of respiratory distress was 2.5% (250/10051) (Table 4). The incidence was highest at 37 weeks (3.5%) and decreased each week after 37 weeks.

Early-term birth was found to increase the risk of respiratory distress at birth compared with full-term birth (adjusted OR, 4.19; 95% CI 1.70, 10.34) (Table 5, Figure 2).

4 | COMMENT

4.1 | Principle findings

Among the live births between 2011 and 2014, 32.1% were early term. Nearly half of the early-term births were due to cesarean delivery; half of the early-term births via cesarean deliveries were indicated because of a history of cesarean delivery regardless of the existence of maternal complications during the current pregnancy. Among neonates born by cesarean delivery, early-term birth was associated with an increased risk of respiratory distress at birth compared with full-term birth.

4.2 | Strengths of the study

This was a large nationwide cohort study that represents the Japanese population well. The modes of delivery and reasons for performing cesarean deliveries in the present study reflect actual obstetric care in Japan.

4.3 | Limitations of the data

This study is not without limitations. Detailed information that was necessary to evaluate the risk of uterine rupture such as type of previous cesarean section, conditions of wound and myometrium after previous cesarean section, and history of uterine rupture was not available; therefore, the assessment of the appropriateness of the early initiation of cesarean delivery was challenging.

4.4 | Interpretation

In this study, 32.1% of live births were early term, suggesting a stable or slight increase in the prevalence of early-term births since 2010 (early-term birth rate: 30.8%). This study also identified a lower proportion of spontaneous deliveries at early term in Japan (44.0%) compared with that in the United States (53.6%). Although it is not well documented, elective early-term births might be widely performed without recognition of its potential negative impact on children in Japan. The Guideline for Obstetrics in Japan (2020 edition) provides guidance for the elective induction of labor at 37 to 41 weeks of gestation without any indications for early-term birth. This may partly explain the higher proportion of early-term births and lower proportion of spontaneous deliveries at early term in Japan compared with the United States.

Approximately half of the early-term births in this study were cesarean deliveries, and half of these were indicated due to a history of cesarean delivery with no maternal complications in the current pregnancy. Cesarean deliveries for fetal malpresentation, which is not an indication for early delivery according to ACOG, were performed...
It was reported that the frequency of early-term births decreased in the United States between 2006 and 2014 in relation to significant reduction in clinician-initiated delivery. \(^{16}\) The authors discussed that the reduction in clinician-initiated deliveries reflected successful implementation of quality initiatives that aimed to reduce elective deliveries before 39 weeks of gestation. A similar effort will be necessary for Japan to address early deliveries that are not medically indicated.

**TABLE 3** Characteristics of the children included in the multiple regression analyses (N = 10 051)

| Characteristic                                           | Mean [SD] | Number (%) |
|----------------------------------------------------------|-----------|------------|
| Gestational age at birth (weeks)                         | 37.9 [0.9]|            |
| 41                                                       | 318 (3.2) |            |
| 40                                                       | 373 (3.7) |            |
| 39                                                       | 573 (5.7) |            |
| 38                                                       | 5853 (58.2)|           |
| 37                                                       | 2934 (29.2)|           |
| Sex of the child                                         |           |            |
| Male                                                     | 4971 (49.5)|           |
| Female and unclassified                                  | 5080 (50.5)|           |
| Maternal age at study entry (years)                      | 32.1 [4.9]|            |
| Parity                                                   |           |            |
| 0                                                        | 2181 (21.7)|           |
| 1                                                        | 5240 (52.1)|           |
| 2                                                        | 2082 (20.7)|           |
| ≥3                                                       | 485 (4.8) |            |
| Missing data                                             | 63 (0.6)  |            |
| Mode of conception                                       |           |            |
| Spontaneous                                              | 9296 (92.5)|           |
| Ovulation induction/AIH                                   | 295 (2.9) |            |
| Assisted reproductive technology                          | 389 (3.9) |            |
| Missing data                                             | 71 (0.7)  |            |
| Maternal comorbidities during pregnancy                  |           |            |
| No                                                       | 8314 (82.7)|           |
| Yes                                                      | 1499 (14.9)|           |
| Missing data                                             | 238 (2.4) |            |
| Maternal job type at conception                           |           |            |
| Employed                                                 | 5801 (57.7)|           |
| Homemaker/student, unemployed, or other                  | 3822 (38.0)|           |
| Missing data                                             | 428 (4.3) |            |
| Maternal educational status                              |           |            |
| Secondary/high school                                    | 3591 (35.7)|           |
| Vocational school/junior college                          | 4242 (42.2)|           |
| University and higher education                           | 1978 (19.7)|           |
| Missing data                                             | 240 (2.4) |            |
| Maternal anxiety during pregnancy                         |           |            |
| No                                                       | 2743 (27.3)|           |
| Yes                                                      | 7090 (70.5)|           |
| Missing data                                             | 218 (2.2) |            |
| Maternal alcohol consumption during pregnancy             |           |            |
| No                                                       | 3310 (32.9)|           |
| Quit                                                     | 6180 (61.5)|           |
| Continued                                                | 301 (3.0) |            |
| Missing data                                             | 260 (2.6) |            |

**Abbreviations:** AIH, artificial insemination with husband’s semen; SD, standard deviation.

**Note:** Data are presented as numbers (percentages) or mean [SD].

**TABLE 4** Incidence of respiratory distress at birth according to gestational week (N = 10 051)

| Number of patients with respiratory distress/number at risk | Incidence (%) |
|------------------------------------------------------------|---------------|
| Overall 250/10051                                           | 2.5           |
| Gestational age at birth (weeks)                            |               |
| 41                                                         | 3/318 (0.9)   |
| 40                                                         | 0/373 (0.0)   |
| 39                                                         | 5/573 (0.9)   |
| 38                                                         | 139/5853 (2.4)| |
| 37                                                         | 103/2934 (3.5)| |

**TABLE 5** Crude and adjusted odds ratios of respiratory distress at birth in relation to early-term birth (N = 10 051)

| Gestational age (95% CI) | Crude OR (95% CI) | Adjusted OR (95% CI) |
|--------------------------|-------------------|----------------------|
| 39 weeks 0 day to 40 weeks 6 days | 1.00 (1.00) | 1.00 (1.00) |
| 41 weeks 0 day to 41 weeks 6 days | 1.79 (0.43-7.54) | 2.06 (0.48-8.75) |
| 37 weeks 0 day to 38 weeks 6 days | 5.33 (2.19-12.95) | 4.19 (1.70-10.34) |

**Abbreviations:** CI: confidence interval; OR: odds ratio.

*Adjusted for child sex, maternal age at study entry, maternal comorbidities during pregnancy, maternal job at conception, maternal educational status, maternal parity, mode of conception, maternal anxiety during pregnancy, maternal alcohol consumption during pregnancy, and maternal smoking during pregnancy.

It was reported that the frequency of early-term births decreased in the United States between 2006 and 2014 in relation to significant reduction in clinician-initiated delivery. \(^{16}\) The authors discussed that the reduction in clinician-initiated deliveries reflected successful implementation of quality initiatives that aimed to reduce elective deliveries before 39 weeks of gestation. A similar effort will be necessary for Japan to address early deliveries that are not medically indicated.
This study also showed that early-term birth was associated with an increased risk of respiratory distress among neonates delivered via cesarean delivery at term with no indications for early delivery. This result is consistent with previous studies that showed the effects of early-term birth on neonatal respiratory morbidity\textsuperscript{34,35} and highlights the significance of the increasing frequency of early-term births on neonatal health.

Early-term births may be beneficial to maternal and child health when signs of uterine rupture or severe complications are present and earlier termination of pregnancy is considered optimal.\textsuperscript{12} Nonetheless, this study showed that a history of cesarean delivery was the most common reason for early-term birth. The results of this study suggest that healthcare providers may plan early-term deliveries to avoid the need for an emergency obstetric response when a woman with a history of a cesarean delivery presents with contractions, regardless of the existence of complications. The number of hospitals in Japan that can provide obstetric care decreased from 2459 to 1313 facilities between 1990 and 2017.\textsuperscript{36} These reduced resources have made it difficult to respond to obstetric emergencies, especially in rural areas and during shifts with reduced staff.\textsuperscript{37} Early-term elective deliveries that are not medically indicated may be scheduled due to limited facilities and medical resources for trials of labor after cesarean deliveries or perinatal care during obstetric emergencies. Early-term elective deliveries may be appropriate in some patients with previous cesarean deliveries to avoid uterine rupture. However, this study did not include sufficient data to determine if the medical indications for cesarean deliveries were appropriate. Further research at the facility level is needed to investigate the causes of early-term births in Japan and what measures can be taken to prevent them.

Regardless of the high prevalence of early-term births and the accumulated evidence of the adverse effects of early-term birth on children’s health, little efforts to reduce early-term births have been made in Japan. Guidelines regarding the appropriate timing of delivery should be discussed by considering situations in health facilities and feasibilities. Additionally, the occurrence of early-term birth should be continuously monitored to provide timely feedback to medical professionals.\textsuperscript{38} The long-term impact of early-term birth in Japan also needs to be investigated to understand the significance of early-term births among the Japanese population.

5 | CONCLUSIONS

This study showed a slight increase in the prevalence of early-term births in Japan. The results suggest that early-term birth is associated with an increased risk of respiratory distress in neonates born by cesarean delivery without an indication for early delivery. Early-term births are often elective and may not be medically indicated. The adverse effects of early-term births should be considered, and guidelines regarding the appropriate timing of delivery should be discussed. Facility-level research is needed to elucidate the reasons for early-term births and to determine what actions can be taken to decrease their prevalence. Investigations regarding the long-term impact of early-term birth on children’s health and development in Japan are also necessary.

ACKNOWLEDGEMENTS

Members of the JECS Group as of 2021: Michihiro Kamijima (principal investigator, Nagoya City University, Nagoya, Japan), Shin Yamazaki (National Institute for Environmental Studies, Tsukuba, Japan), Yukihiro Ohya (National Center for Child Health and Development, Tokyo, Japan), Reiko Kishi (Hokkaido University, Sapporo, Japan), Nobuo Yaegashi (Tohoku University, Sendai, Japan), Koichi Hashimoto (Fukushima Medical University, Fukushima, Japan), Chisato Mori (Chiba University, Chiba, Japan), Shuichi Ito (Yokohama City University, Yokohama, Japan), Zentaro Yamagata (University of Yamanashi, Japan).
Chuo, Japan), Hidekuni Inadera (University of Toyama, Toyama, Japan), Takeo Nakayama (Kyoto University, Kyoto, Japan), Hiroyasu Iso (Osaka University, Suita, Japan), Masayuki Shima (Hyogo College of Medicine, Nishinomiya, Japan), Youichi Kurozawa (Tottori University, Yonago, Japan), Nanfumi Suganuma (Kochi University, Nankoku, Japan), Koichi Kusuhara (University of Occupational and Environmental Health, Kitakyushu, Japan), and Takahiko Katoh (Kumamoto University, Kumamoto, Japan). The authors are grateful to all participants of the JECS.

FUNDING
The Japan Environment and Children’s Study was funded by the Ministry of the Environment, Japan.

CONFLICT OF INTEREST
None declared.

AUTHOR CONTRIBUTION
Conceptualization: Sayaka Horiuchi.
Formal Analysis: Sayaka Horiuchi.
Funding Acquisition: Sanae Otawa, Megumi Kushima.
Project Administration: Sanae Otawa, Megumi Kushima.
Supervision: Ryoji Shinohara.
Writing—Original Draft Preparation: Sayaka Horiuchi.
Writing—Review and Editing: Ryoji Shinohara, Sanae Otawa, Megumi Kushima, Yuka Akiyama, Tadao Ooka, Reiji Kojima, Hiroshi Yokomichi, Kunio Miyake, Zentaro Yamagata.

All authors have read and approved the final version of the manuscript.

Sayaka Horiuchi had full access to all data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

TRANSPARENCY STATEMENT
Sayaka Horiuchi affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

DATA AVAILABILITY STATEMENT
Data are unavailable for public deposition due to ethical restrictions and the legal framework of Japan. It is prohibited by the Act on the Protection of Personal Information (Act No. 57 of May 30, 2003; amendment on September 9, 2015) to publicly deposit data containing personal information. Ethical Guidelines for Medical and Health Research Involving Human Subjects enforced by the Japan Ministry of Education, Culture, Sports, Science, and Technology and the Ministry of Health, Labour, and Welfare also restrict the open sharing of epidemiologic data. All inquiries regarding access to data should be sent to Dr Shoji F. Nakayama, JECS Programme Office, National Institute for Environmental Studies at jecs-en@nies.go.jp.

ORCID
Sayaka Horiuchi https://orcid.org/0000-0001-5050-8732

REFERENCES
1. Chawanaipboon S, Vogel JP, Moller AB, et al. Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. Lancet Glob Health. 2019;7:e37–e46.
2. March of Dimes, PMNCH, Save the Children, WHO. In: Howson CP, Kinney MV, Lawn JE, eds. Born Too Soon: the Global Action Report on Preterm Birth. Geneva: World Health Organization; 2012.
3. Crump C, Sundquist K, Winkleby MA, Sundquist J. Early-term birth (37-38 weeks) and mortality in young adulthood. Epidemiology. 2013;24:270-276.
4. Edwards MO, Kotecha SJ, Lowe J, Richards L, Watkins WJ, Kotecha S. Early-term birth is a risk factor for wheezing in childhood: a cross-sectional population study. J Allergy Clin Immunol. 2015;136(3):581-587.e2.
5. Sengupta S, Carrion V, Shelton J, et al. Adverse neonatal outcomes associated with early-term birth. JAMA Pediatr. 2013;167(11):1053-1059.
6. Parikh LI, Reddy UM, Männistö T, et al. Neonatal outcomes in early term birth. Am J Obstet Gynecol. 2014;211(3):265.e1-265.e11.
7. Korhonen P, Haataja P, Ojala R, et al. Asthma and atopic dermatitis after early-, late-, and post-term birth. Pediatr Pulmonol. 2018;53(3):269-277.
8. MacKay DF, Smith GCS, Dobbie R, Pell JP. Gestational age at delivery and special educational need: retrospective cohort study of 407,503 schoolchildren. PLoS Med. 2010;7(6):e1000289.
9. Kumar C, Sharma D, Pandita A. Late preterm and early-term neonates: a new group of high risk newborn in neonatology with varied complications. J Neonatol Biol. 2014;3:1006E-112.
10. Ananth CV, Vintzileos AM. Epidemiology of preterm birth and its clinical subtypes. J Matern Neonatal Med. 2006;19(12):773-782.
11. Chang YK, Tseng YT, Chen KT. The epidemiologic characteristics and associated risk factors of preterm birth from 2004 to 2013 in Taiwan. BMC Pregnancy Childbirth. 2020;20(1):201.
12. Spong CY, Mercer BM, D’Alton M, Kilpatrick S, Blackwell S, Saade G. Timing of indicated late-preterm and early-term birth. Obstet Gynecol. 2011;118(2):323-333.
13. American college of obstetricians and gynecologists committee opinion No. 765: avoidance of nonmedically indicated early-term deliveries and associated neonatal morbidities. Obstet Gynecol 2019;133(2):e156-e163.
14. Ananth CV, Friedman AM, Goldberg RL, Wright JD, Vintzileos AM. Association between temporal changes in neonatal mortality and spontaneous and clinician-initiated deliveries in the United States, 2006-2013. JAMA Pediatr. 2018;172(10):949-957.
15. Ananth CV, Goldberg RL, Friedman AM, Vintzileos AM. Association of temporal changes in gestational age with perinatal mortality in the United States, 2007-2015. JAMA Pediatr. 2018;172(7):627-634.
16. Richards JL, Kramer MS, Deb-Rinker P, et al. Temporal trends in late preterm and early term birthrates in 6 high-income countries in North America and Europe and association with clinician-initiated obstetric interventions. JAMA. 2016;316(4):410-419.
17. Delnord M, Zeitlin J. Epidemiology of late preterm and early term births - an international perspective. Semin Fetal Neonatal Med. 2019; 24:3-10.
18. Japan Society of Obstetrics and Gynecology, Japan Association of Obstetricians and Gynecologists. Guideline for obstetrics in Japan (2020 edition). Japan Society of Obstetrics and GynecologyTokyo, 2020. http://www.jsog.or.jp/activity/pdf/gl_sanka_2020.pdf
19. Yorifuji T, Naruse H, Kashima S, et al. Trends of preterm birth and low birth weight in Japan: a one hospital-based study. BMC Pregnancy Childbirth. 2012;12(1):162.
20. Ohmi H, Hirooka K, Hata A, Mochizuki Y. Recent trend of increase in proportion of low birthweight infants in Japan. Int J Epidemiol. 2001;30:1269-1271.
21. Takemoto Y, Ota E, Yoneoka D, Mori R, Takeda S. Japanese secular trends in birthweight and the prevalence of low birthweight infants during the last three decades: a population-based study. Sci Rep. 2016;6:31396.
22. American College of Obstetricians and Gynecologists Committee. Medically indicated late-preterm and early-term deliveries. Obstet Gynecol. 2021;138(1):166-169. doi:10.1097/AOG.0000000000005444
23. Kawamoto T, Nitta H, Murata K, et al. Rationale and study design of the Japan environment and children’s study (JECS). BMC Public Health. 2014;14(1):25.
24. Nakayama SF, Michikawa T, Sekiyama M, Kobayashi Y, Nishihama Y. Japan environment and children’s study (JECS): Concept, protocol and current status. Encyclopedia of Environmental Health. Amsterdam, The Netherlands: Elsevier B.V; 2019:720-728.
25. Iwai-Shimada M, Nakayama SF, Isobe T, et al. Questionnaire results on exposure characteristics of pregnant women participating in the Japan environment and children study (JECS). Environ Health Prev Med. 2018;23(1):45.
26. Michikawa T, Nitta H, Nakayama SF, et al. The Japan environment and Children’s study (JECS): a preliminary report on selected characteristics of approximately 10 000 pregnant women recruited during the first year of the study. J Epidemiol. 2015;25(6):452-458.
27. Michikawa T, Nitta H, Nakayama SF, et al. Baseline profile of participants in the Japan Environment and Children’s Study (JECS). J Epidemiol. 2018;28(2):99-104.
28. Sunderam S, Kissin DM, Zhang Y, et al. Assisted reproductive technology surveillance - United States, 2016. MMWR Surveill Summ. 2019;68(4):1-23.
29. Furukawa TA, Kawakami N, Saitoh M, et al. The performance of the Japanese version of the K6 and K10 in the world mental health survey Japan. Int J Methods Psychiatr Res. 2008;17(3):152-158.
30. Prochaska JJ, Sung H-Y, Max W, Shi Y, Ong M. Validity study of the K6 scale as a measure of moderate mental distress based on mental health treatment need and utilization. Int J Methods Psychiatr Res. 2012;21(2):88-97.
31. Stewart DL, Barfield WD. Updates on an at-risk population: late-preterm and early-term infants. Pediatrics. 2019;144(5):e20192760.
32. Sakata S, Konishi S, Ng CFS, Watanabe C. Preterm birth rates in Japan from 1979 to 2014: analysis of national vital statistics. J Obstet Gynaecol Res. 2018;44(3):390-396.
33. Ozkan H, Cetinkaya M, Koksal N, et al. Neonatal outcomes of pregnancy complicated by idiopathic thrombocytopenic purpura. J Perinatol. 2010;30(1):38-44.
34. Thomas J, Olukade TO, Naz A, et al. The neonatal respiratory morbidity associated with early term caesarean section - an emerging pandemic. J Perinat Med. 2021;49:767-772. doi:10.1515/JPM-2020-0402
35. Tefera M, Assefa N, Mengistie B, Abrah A, Teji K, Worku T. Elective cesarean section on term pregnancies has a high risk for neonatal respiratory morbidity in developed countries: a systematic review and meta-analysis. Front Pediatr. 2020;8:286.
36. Ministry of Health, Labour and Welfare. Survey of Medical Institutions, Tokyo. http://www.mhlw.go.jp/toukei/list/79-1.html. Accessed May 26, 2020.
37. Unno N. The perinatal care system in Japan. J Japan Med Assoc. 2011;54(4):234-240.
38. Martin JA, Hamilton BE, Osterman MJK. Births in the United States, 2018. NCHS Data Brief. 2019;346:1-8.

How to cite this article: Horiuchi S, Shinohara R, Otawa S, et al. Elective cesarean delivery at term and its effects on respiratory distress at birth in Japan: The Japan Environment and Children’s Study. Health Sci Rep. 2021;4:e421. doi: 10.1002/hsr2.421