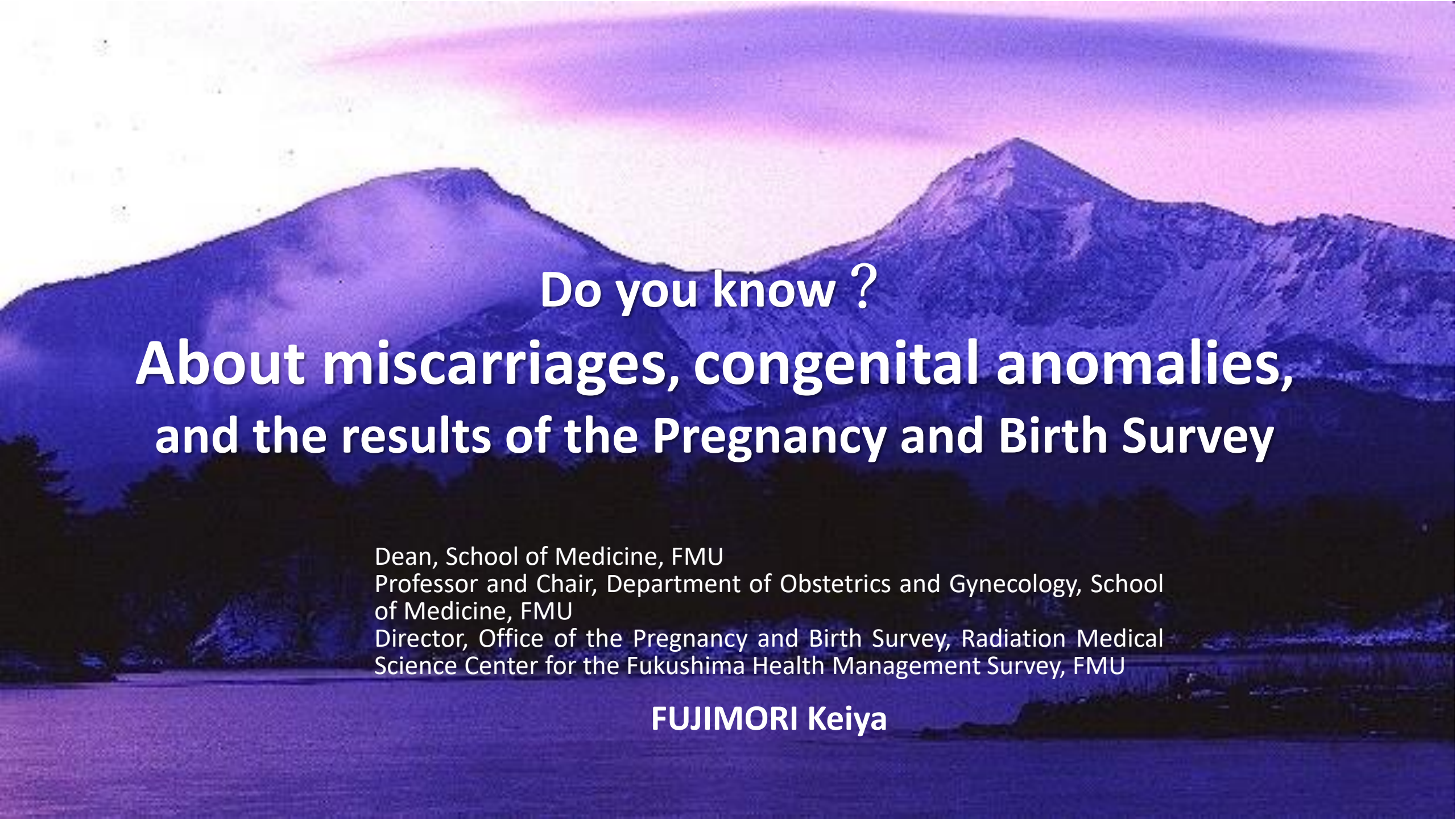


Do you know ?
About miscarriages, congenital anomalies, and the results of the Pregnancy and Birth Survey

Dean, School of Medicine, FMU
Professor and Chair, Department of Obstetrics and Gynecology, School of Medicine, FMU
Director, Office of the Pregnancy and Birth Survey, Radiation Medical Science Center for the Fukushima Health Management Survey, FMU

FUJIMORI Keiya

Do you know？

How often do you think miscarriages occur?

(average for mothers of any age)

① 0.1～0.5%

② 0.5～1.0%

③ 1～5%

④ 10～15%

⑤ 20～30%

Do you know？

Which do you think is the most common cause of miscarriages?

①Chromosomal abnormalities in fertilized eggs

②Endocrine disorders (glucose intolerance, thyroid dysfunction, etc.)

③Autoimmune disorders (antiphospholipid syndrome, etc.)

④Intrauterine infection

⑤External factors such as drug use and exposure to radiation

Do you know？

How often do you think of congenital anomalies occur?

(average for mothers of any age)

① 0.1～0.5%

② 1～2%

③ 2～3%

④ 5～10%

⑤ 10～20%

Do you know？

What do you think is the most common cause of congenital anomalies ?

① Chromosomal abnormalities in the fetus

② Single-gene disorders

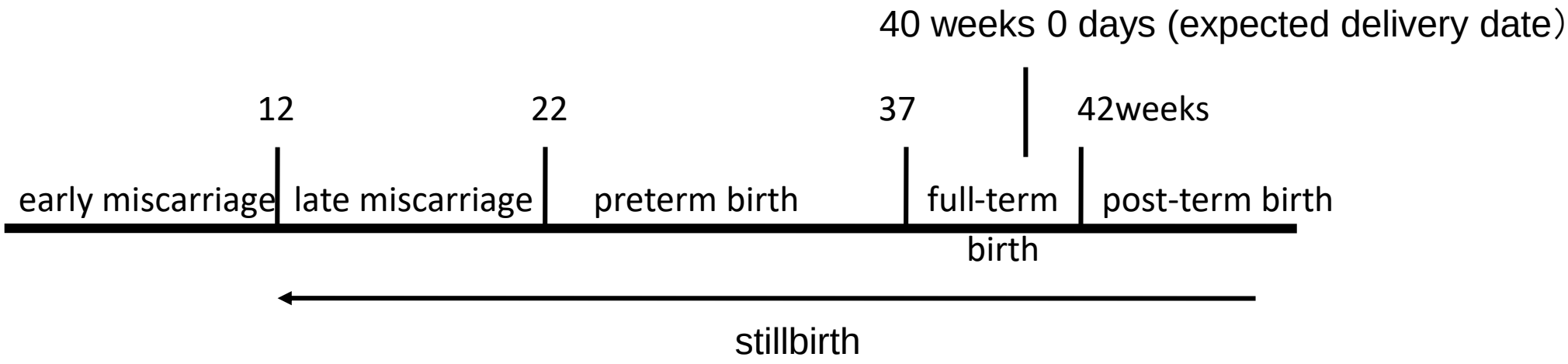
③ Multifactorial genetic disorders

④ Drugs

⑤ Environmental factors (radiation exposure, etc)

Definition of abortion

- In Japan, termination of pregnancy before 22 weeks
  - –Induced (artificial) abortion
  - –Spontaneous abortion



About the spontaneous abortion rate

- Occurs in 10-15% of clinically confirmed pregnancies
- Two or more miscarriages occur in 1-2% of women who get pregnant
- Three or more miscarriages occur in less than 1% of women who get pregnant

Hironobu Hyodo, Prenatal Genetic Counseling:
Workbook in Perinatal and neonatal Medicine, 3rd Edition, p6-9, 2024

- 15% of clinically confirmed pregnancies end in miscarriage
- 38% of pregnant women experience miscarriage(s)

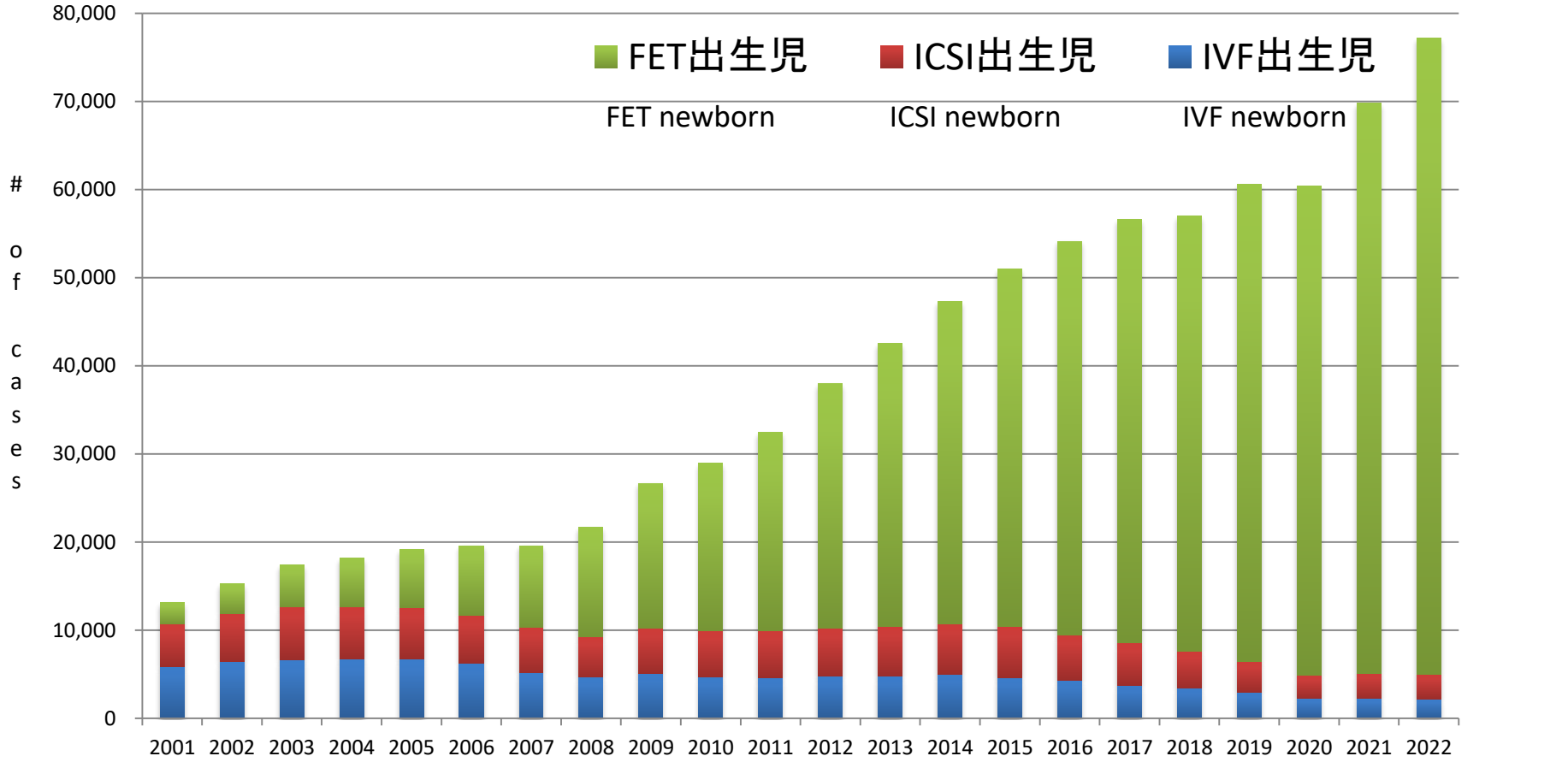
Guidelines for Obstetrical Practice, 2023 edition

- The frequency of miscarriage is greatly dependent on the mother's age
  15% or less for those aged 30 or younger, ～20% for those aged 35,
  ～40% for those aged 40, and ～80% for those aged 45

Essential knowledge for obstetrician-gynecologist specialist, 2022 edition

Number of babies born per year from advanced ART (2001-2022)

2022
IVF cycle 2,183
ICSI cycle 2,822
Frozen embryo cycle 72,201

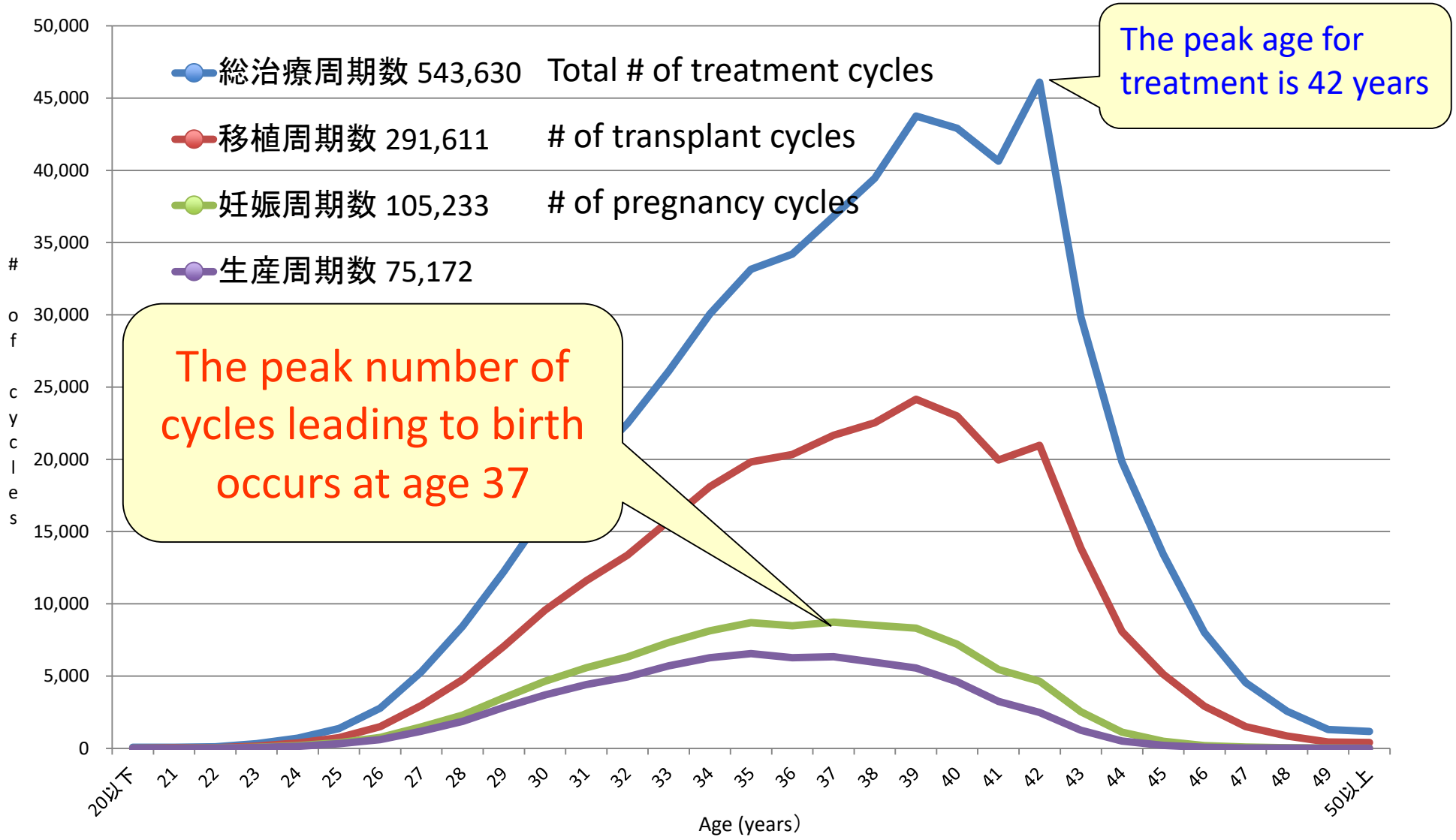


In 2022, the number of births in Japan from ART was 76,706. Total number of births: 770,759. Thus, 1 in 10.0 births.

(ART: Assisted Reproductive Technology, FET: Frozen Embryo Transfer, ICSI: Intracytoplasmic Sperm Injection, IVF: In Vitro Fertilization and Embryo Transfer)

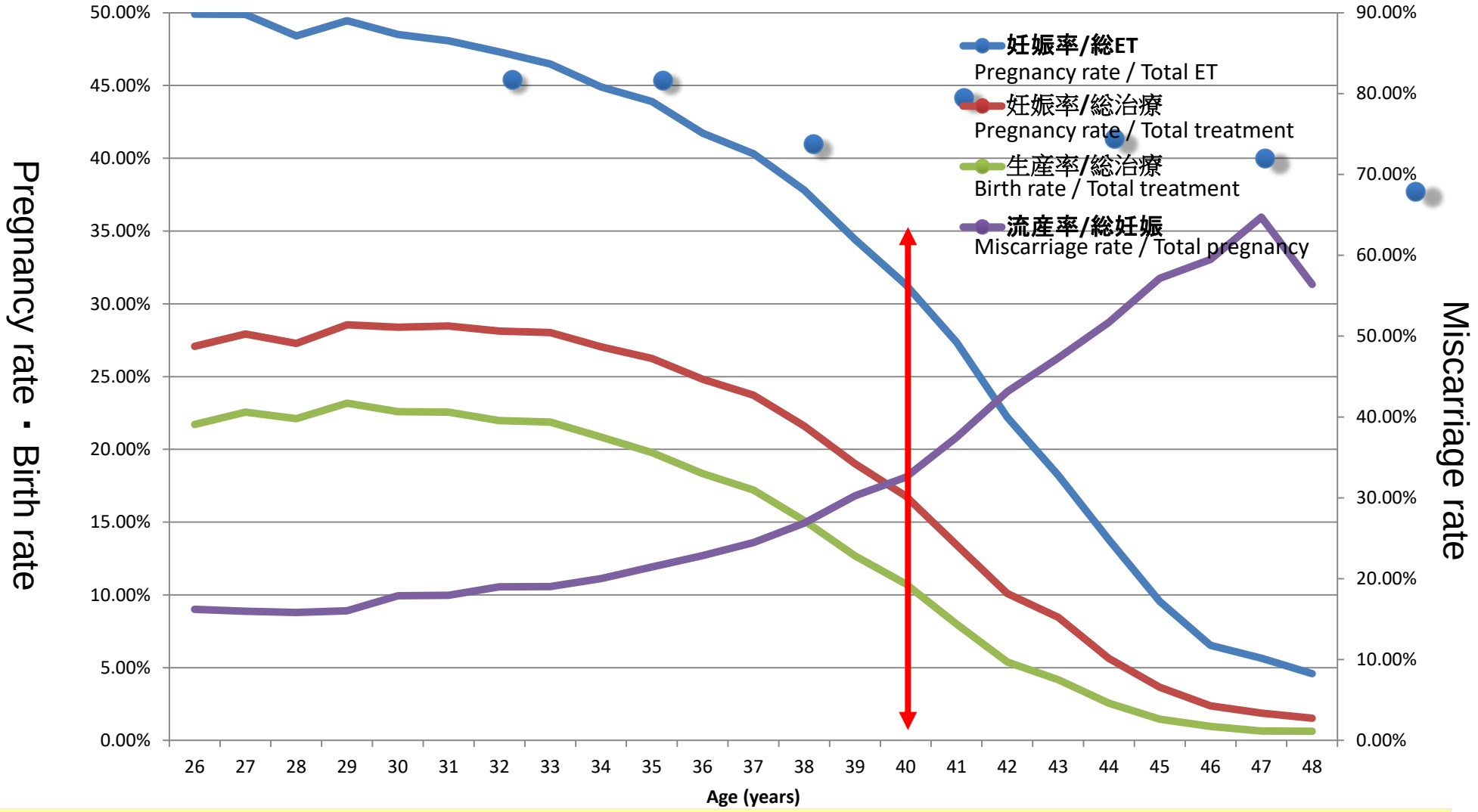
From the website of the Japan Society of Obstetrics and Gynecology

Number of treatment cycles in advanced ART in 2022



From the website of the Japan Society of Obstetrics and Gynecology

Advanced ART: pregnancy, birth, and miscarriage rates in 2022



With age, the pregnancy rate decreases while the miscarriage rate increases.

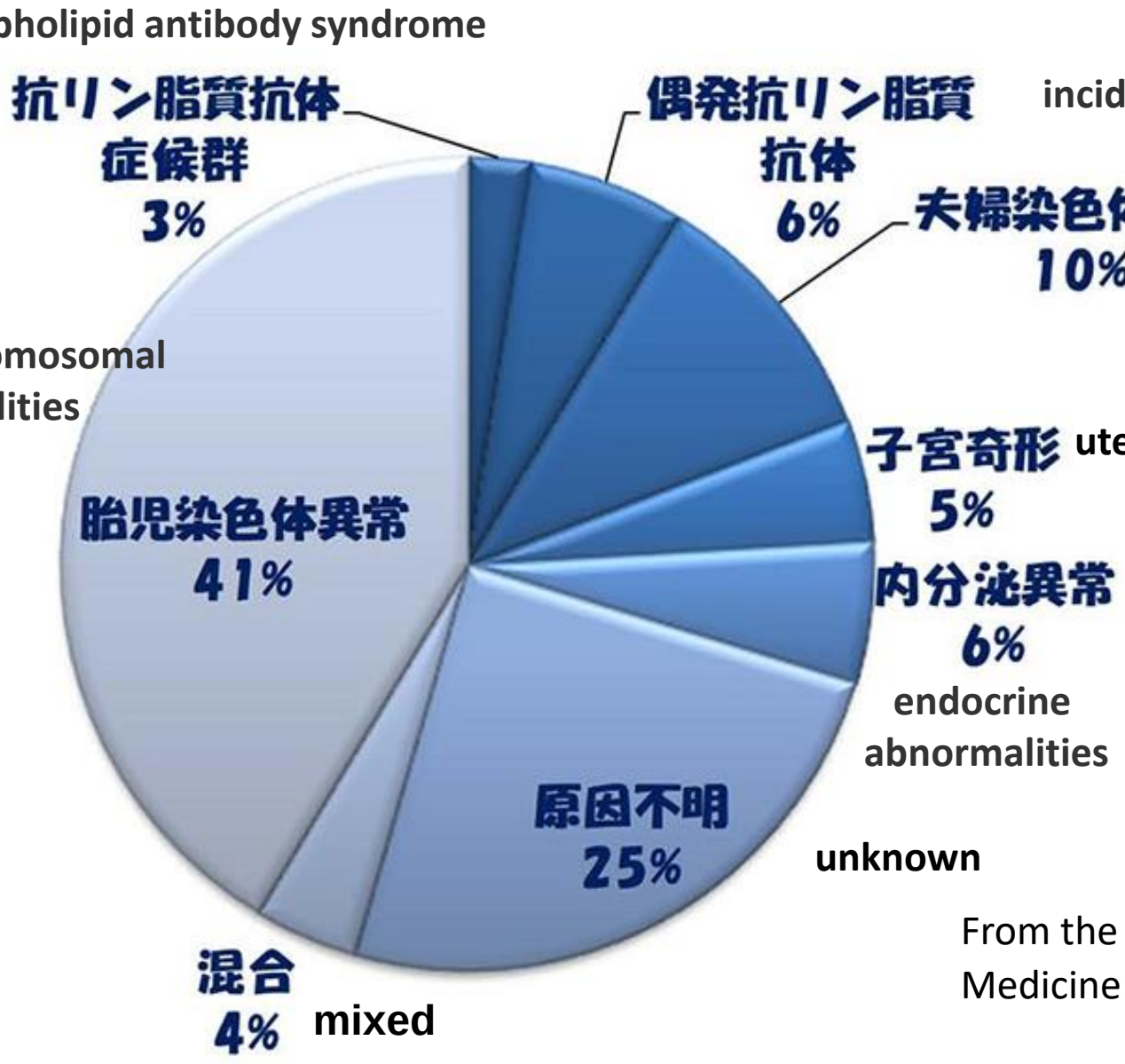
From the website of the Japan Society of Obstetrics and Gynecology

Causes of miscarriage

Cause classification	Details of causes
Fetal side	Abnormalities in fertilized egg (mainly chromosomal abnormalities) Abnormalities in fetal structure Abnormalities in placenta, amniotic membrane, umbilical cord Multiple pregnancy
Maternal side	Abnormalities in uterus (uterine malformation, uterine fibroid, adenomyosis) Incompetence cervix Infections (intrauterine infection, systemic maternal infection) Endocrine disorders (glucose intolerance, thyroid dysfunction) Autoimmune disorders (antiphospholipid antibody syndrome, etc.) Chromosomal abnormalities (balanced translocations carriers, etc.) Trauma, drugs, exposure to radiation

Modified from "Essential knowledge for obstetrician-gynecologist specialist 2022 edition"

Frequency of causes of recurrent pregnancy loss



What is recurrent pregnancy loss？

It is a medical condition in which a couple of reproductive age desires to conceive, but when they do, they experience repeated miscarriages or premature births, ultimately failing to achieve a live birth.

From the website of the Japan Society of Reproductive Medicine: www.jsrm.or.jp/public/funinsho_qa19.html

Miscarriages and chromosomal abnormalities

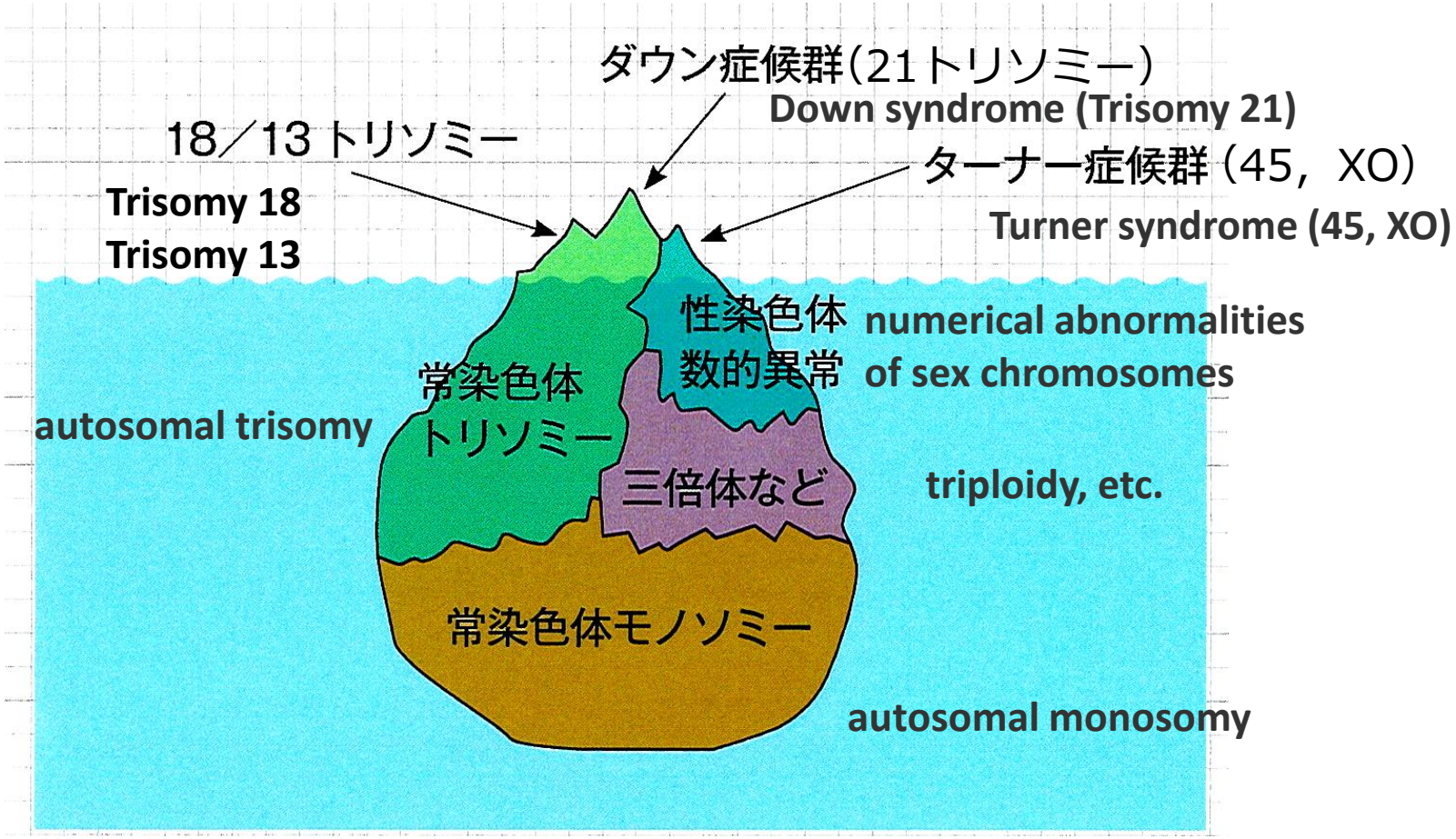
TABLE 1–7. RELATIVE FREQUENCY OF ABERRATIONS IN CHROMOSOMALLY ABNORMAL ABORTUSES

TYPE	INCIDENCE (%)
Trisomy	52
14	3.7
15	4.2
16	16.4
18	3.0
21	4.7
22	5.7
Other	14.3
45,X	18
Triploid	17
Tetraploid	6
Unbalanced translocation	3
Other	4
Total	100

Data from Carr DH, Gedeon M: Population cytogenetics of human abortuses. *In* Hook EB, Porter IH (eds): Population Cytogenetics: Studies in Humans. New York, Academic Press, 1977. Reprinted from Thompson MW: Thompson and Thompson's Genetics in Medicine. 4th ed. Philadelphia, WB Saunders, 1986.

chromosomal abnormalities in 50-60% of miscarriages

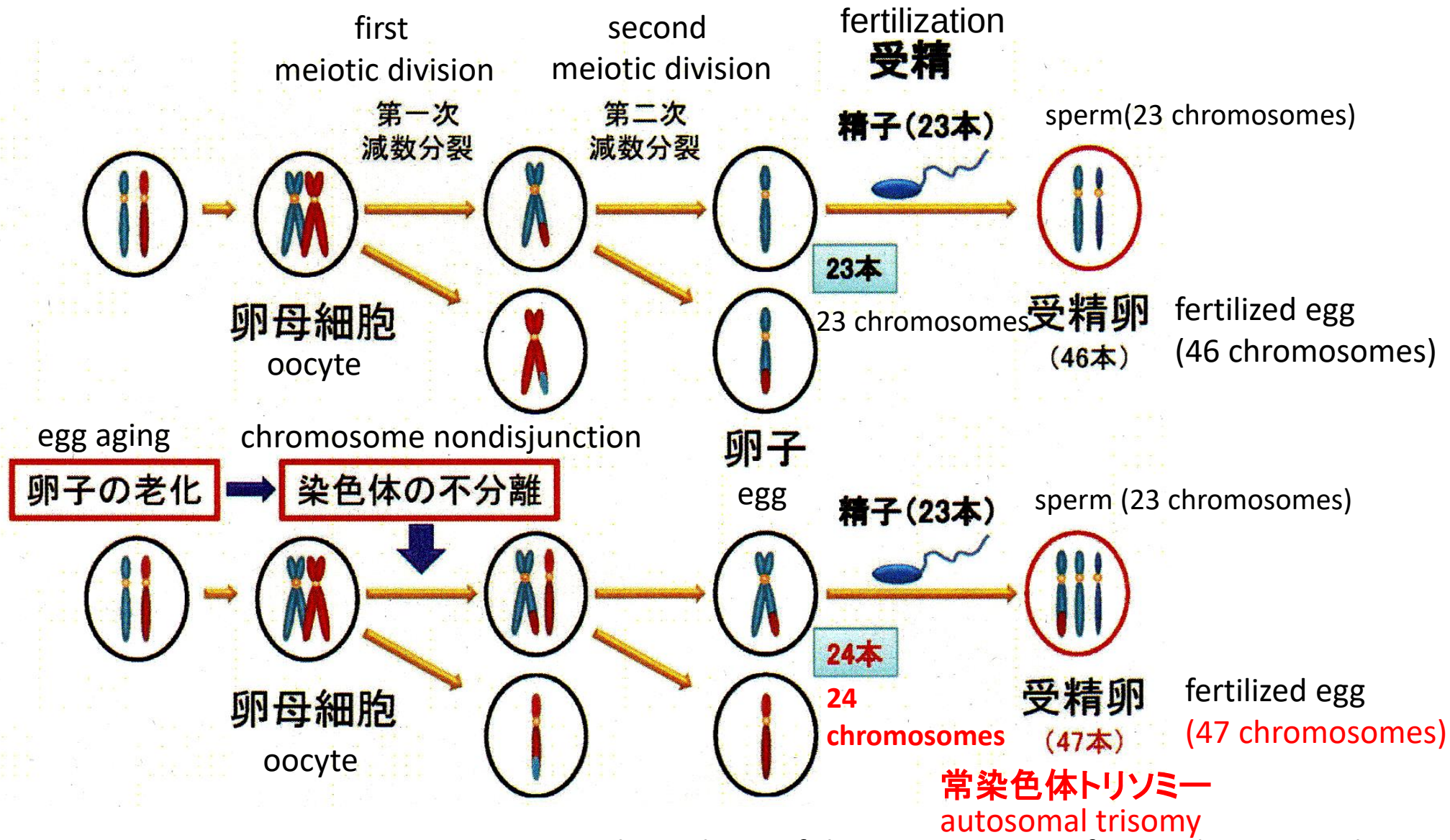
Births of children with chromosomal disorders



The majority of pregnancies with chromosomal disorders result in miscarriage, and only a small fraction are born alive.

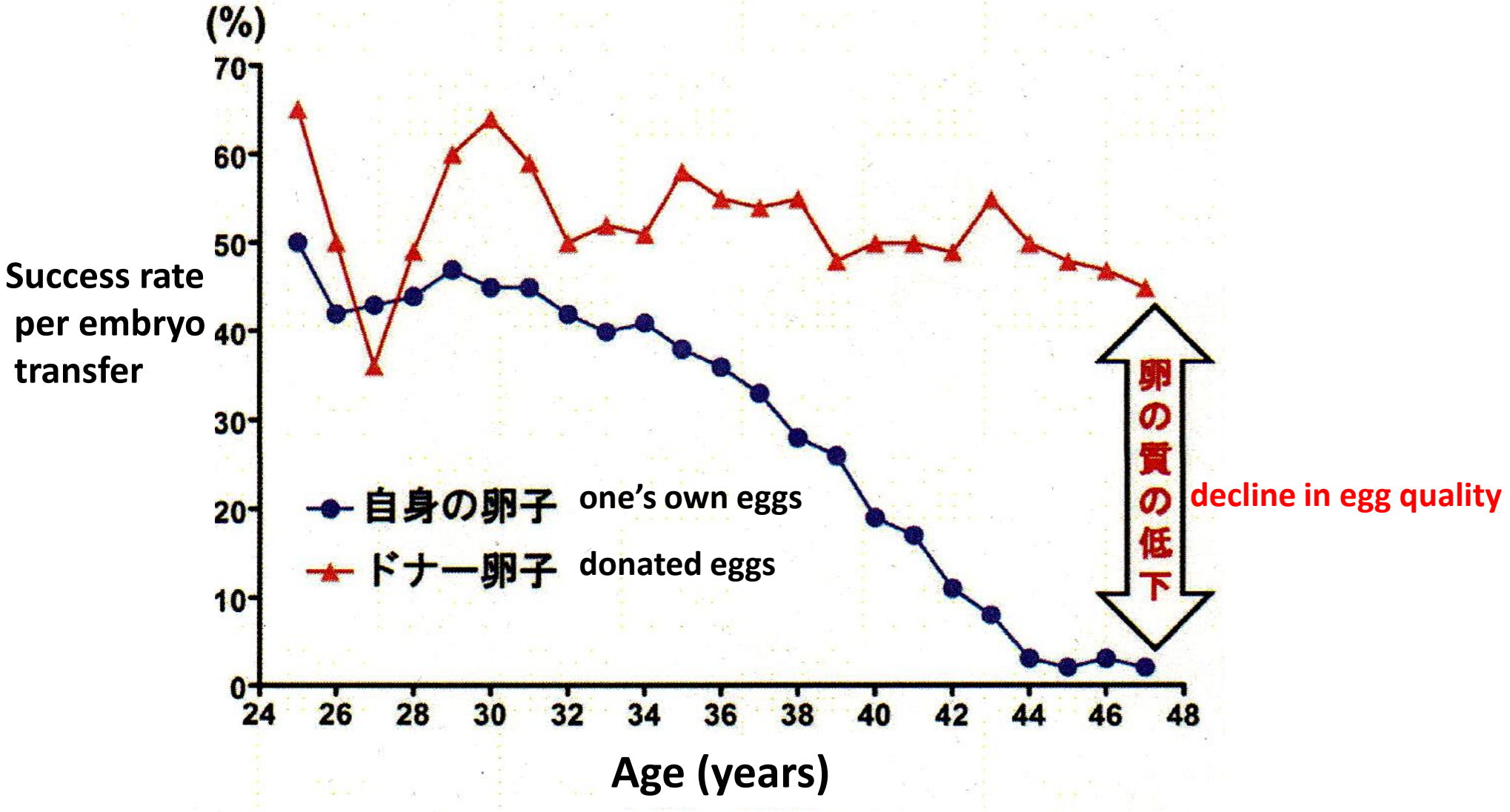
Gardner RJM: Chromosome Abnormalities and Genetic Counseling, 4th Edition. New York, Oxford University Press, 2011.

Chromosomal abnormalities in oocytes caused by nondisjunction



From the website of the Japan Society of Reproductive Medicine

Treatment outcomes from assisted reproductive technology with donated eggs and one's own eggs



From the website of the Japan Society of Reproductive Medicine

What are congenital anomalies?

Congenital disorders are diseases or disabilities that a person is born with, and are classified into two types: “morphological abnormalities,” which affect the shape of the body (e.g., internal organs, external limbs) and “functional abnormalities.”

From the website of NIPT Japan:
https://niptjapan.com/column/congenital-disorder/

Morphological abnormalities

- Conditions that affect the body's structure or shape, including defects and malformations.

[Examples of morphological abnormalities]

- Ventricular septal defect (congenital heart disease)
- Cleft lip/palate
- Limb abnormalities
- Hydrocephalus
- Spina bifida (neural tube defect)

From the website of NIPT Japan:
https://niptjapan.com/column/congenital-disorder/

Functional abnormalities

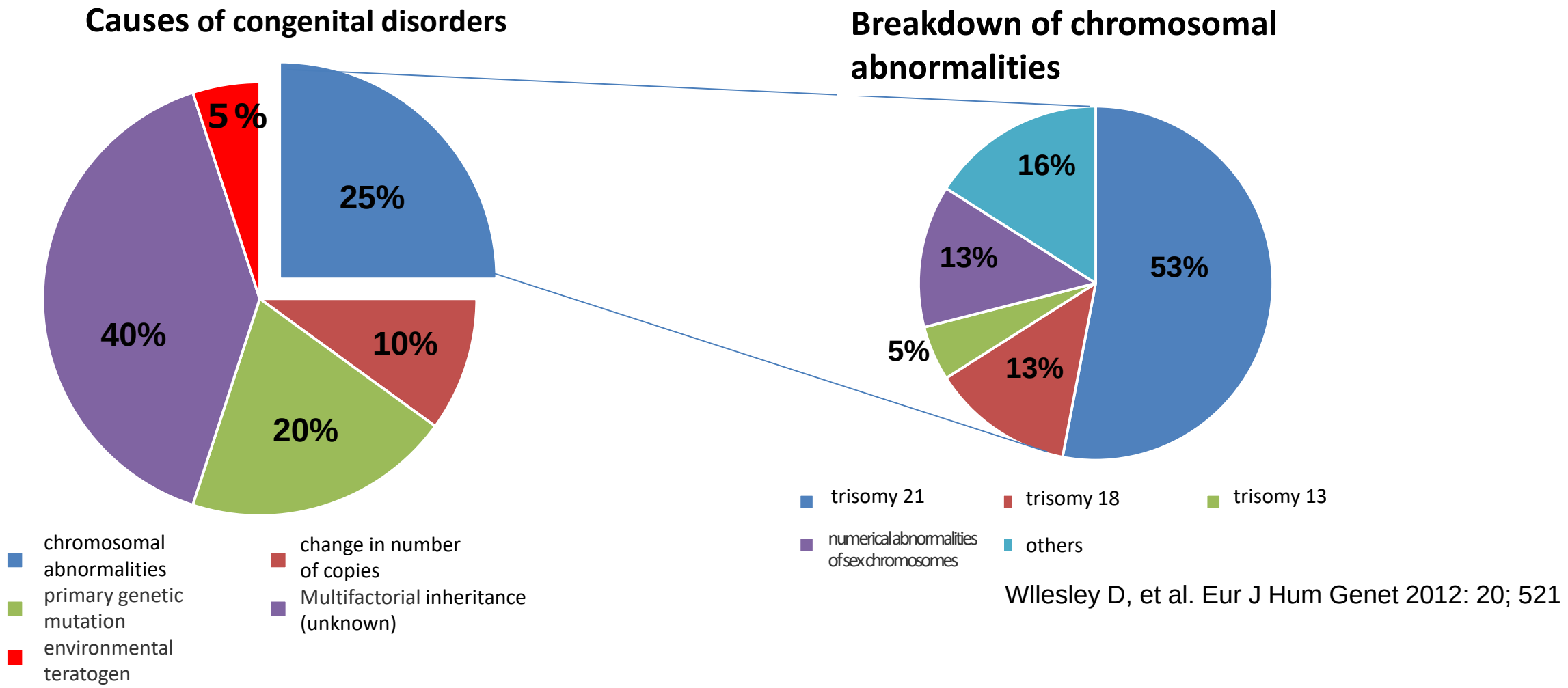
Conditions where, even though a person may appear healthy, there are effects on bodily systems and functions due to levels of specific hormones or enzymes, or impairment of metabolic processes.

[Examples of functional abnormalities]

- Phenylketonuria
- Maple syrup urine disease
- Cretinism (congenital hypothyroidism)
- Galactosemia
- Congenital adrenal hyperplasia

From the website of NIPT Japan:
https://niptjapan.com/column/congenital-disorder/

Causes of congenital disorders and breakdown of chromosomal abnormalities



Wllesley D, et al. Eur J Hum Genet 2012: 20; 521

Nussbaum R, et al. Thompson & Thompson Genetics in Medicine, 8th ed, 2016, p285

Multifactorial genetic disorders

Disorders that develop from interactions between multiple genetic abnormalities and environmental factors.

[Examples of multifactorial disorders]

- Neural tube defect
- Congenital heart disease
- Hereditary hydrocephalus
- Cleft lip/palate
- Congenital bowel obstructions

From the website of NIPT Japan:
https://niptjapan.com/column/congenital-disorder/

Examples of environmental and teratogenic factors that can cause congenital disorders

【 Environmental teratogens 】

- Tabacco
- Alcohol
- Air pollution
- Water pollution
- Pesticides
- Radiation
- Maternal infection (e.g., TORCH syndrome)
- Drugs

【Examples of disorders】

- Limb abnormalities (polydactyly, syndactyly, brachydactyly, etc.)
- Developmental disorders
- Hydrocephalus
- Malformations

From the website of NIPT Japan:
https://niptjapan.com/column/congenital-disorder/改変

Miscarriage and congenital anomalies

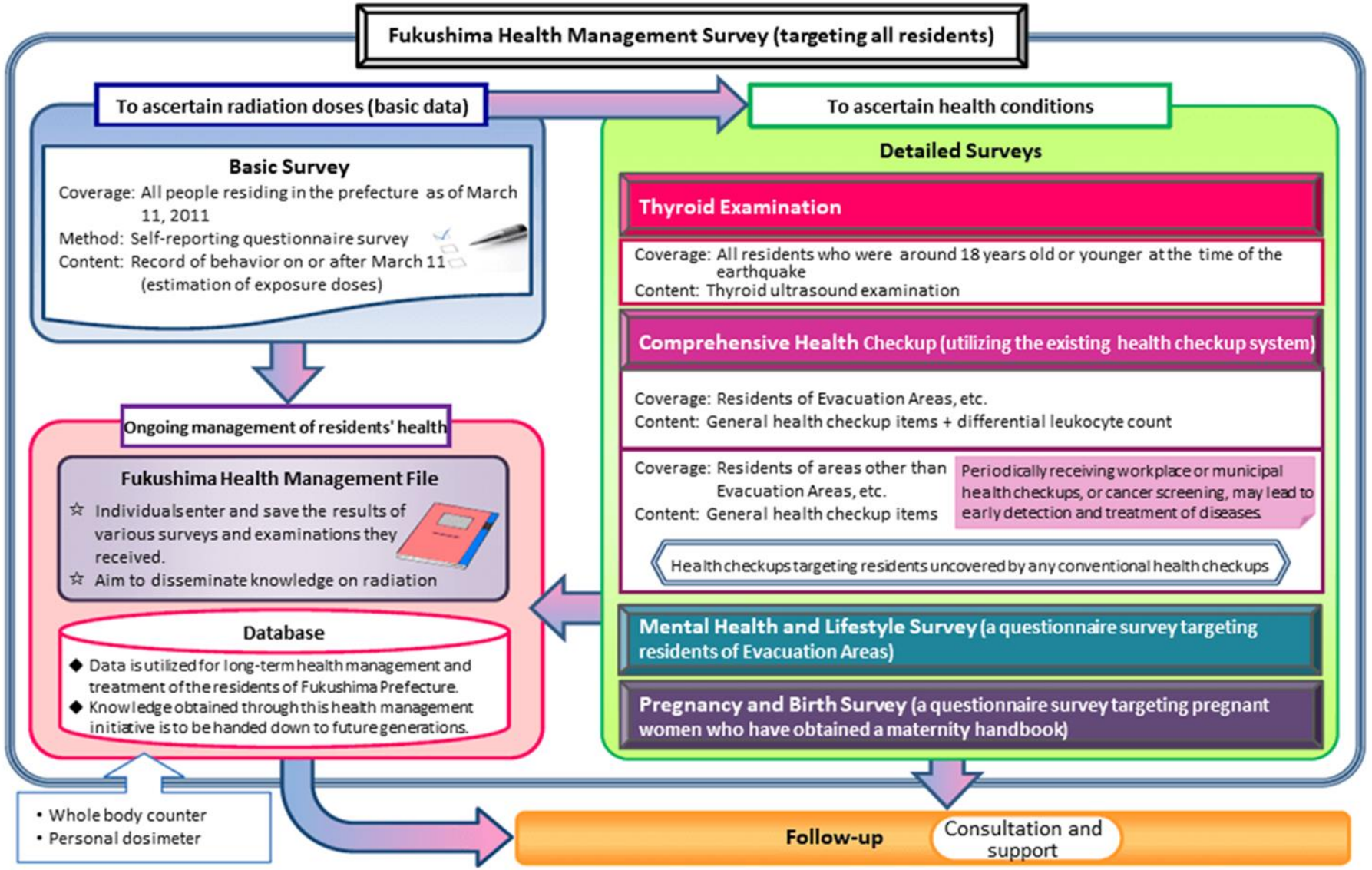
- Miscarriages occur

- at a frequency of between 10 and 15%
- strongly related to the mother's age
- Chromosomal abnormalities in the fertilized egg are the most common cause

- Congenital anomalies are

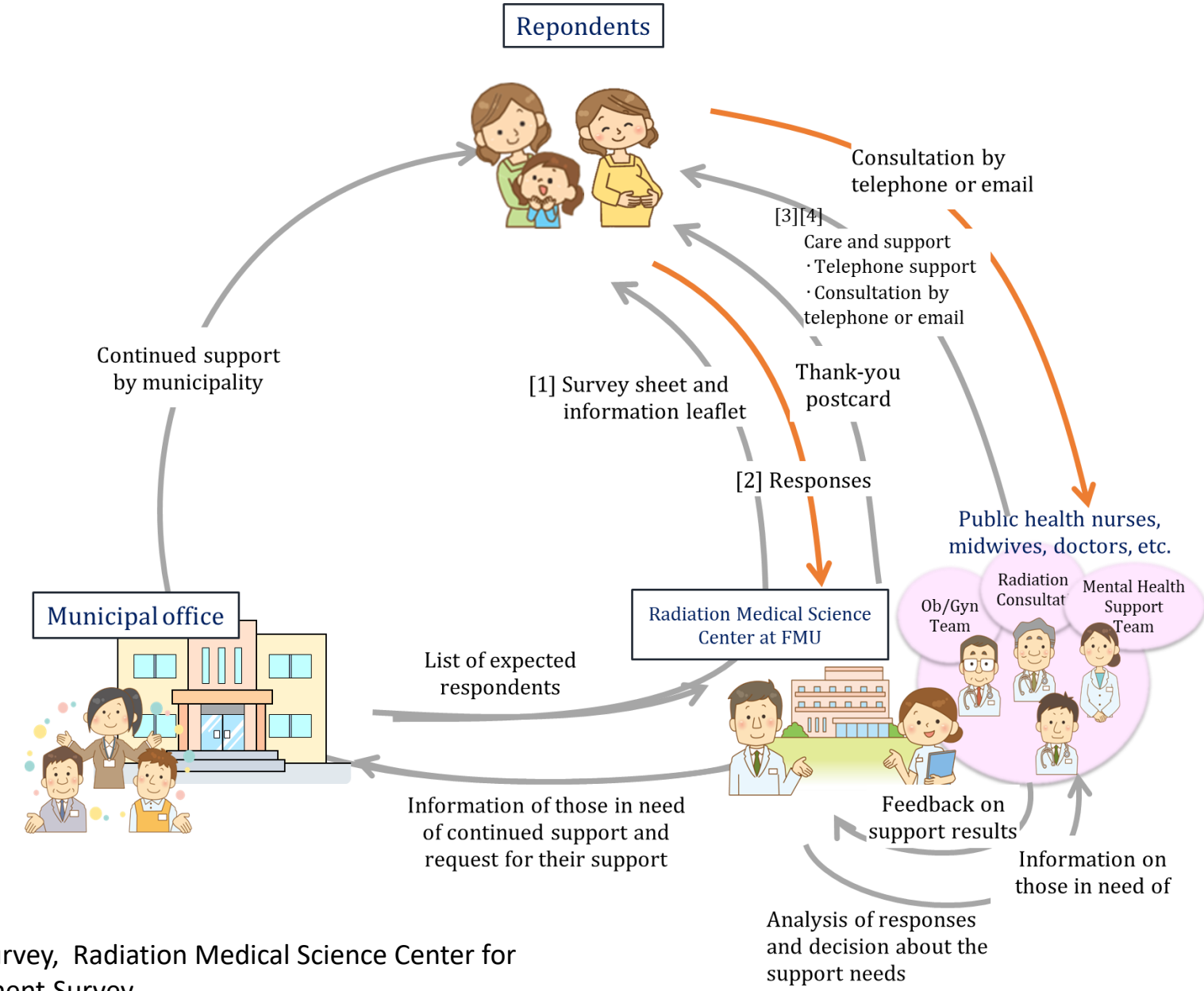
- found in 2-3% of newborns
- multifactorial genetic disorders are the most common
- rarely caused by radiation or environmental factors

Overviews of the Fukushima Health Management Survey



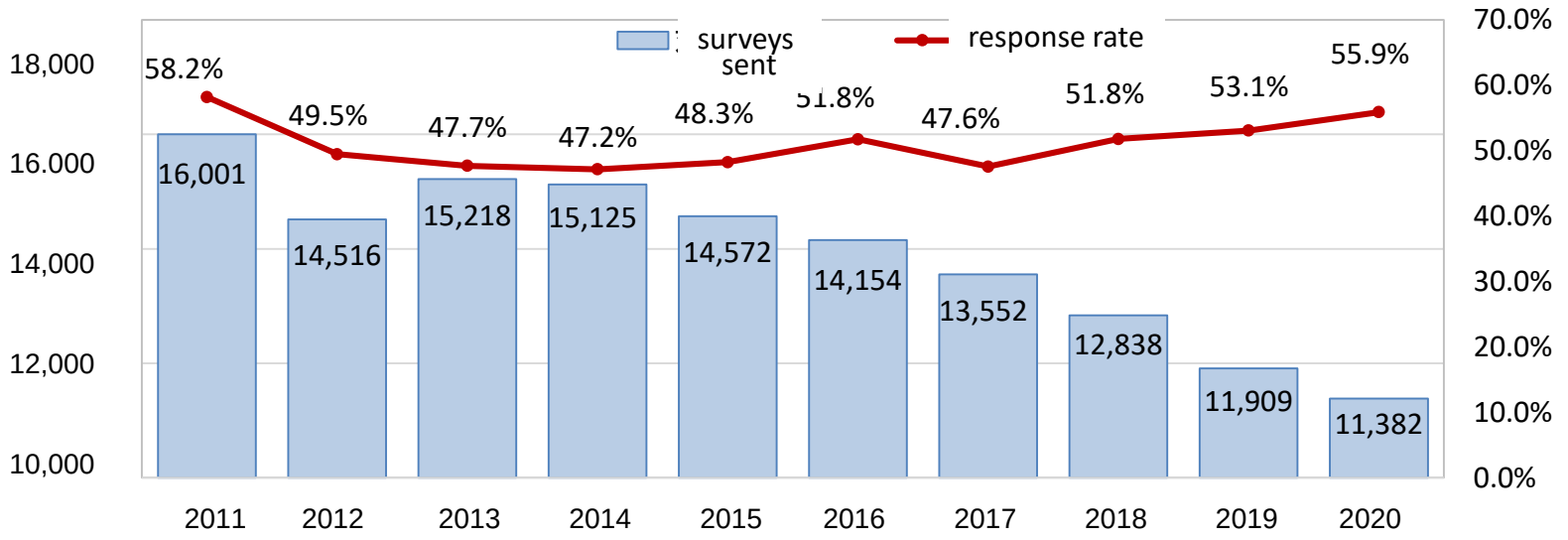
Prepared based on the outline of the "Fukushima Health Management Survey," Fukushima Prefecture

Radiation Medical Science Center for the Fukushima Health Management
Support and research for pregnant and nursing mothers by the Office of Pregnancy and Birth Survey

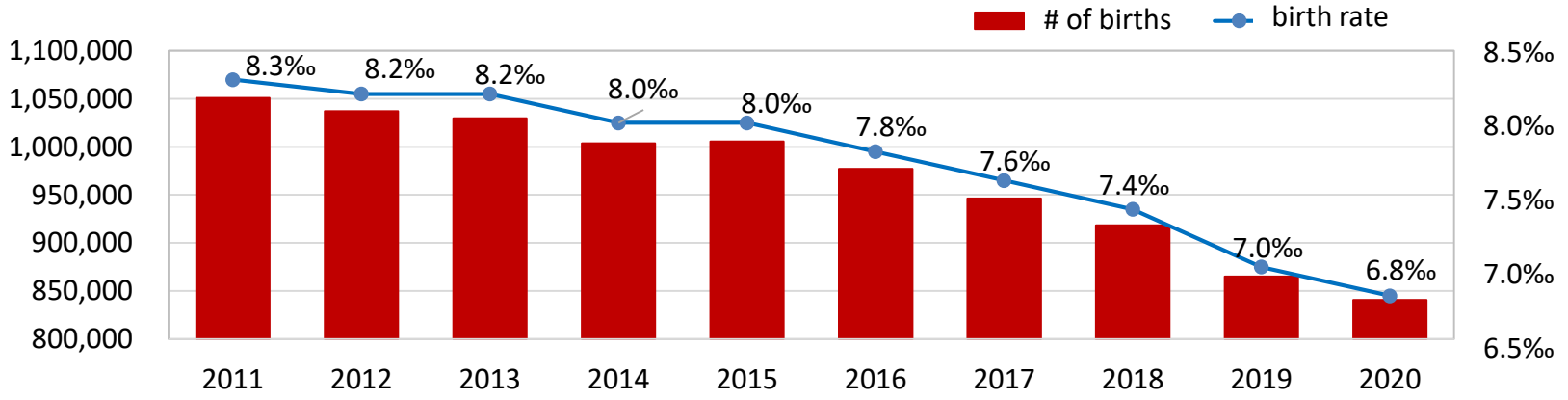


Office of Pregnancy and Birth Survey, Radiation Medical Science Center for the Fukushima Health Management Survey

(persons) **The survey population, responses, and response rates (Main Survey)**



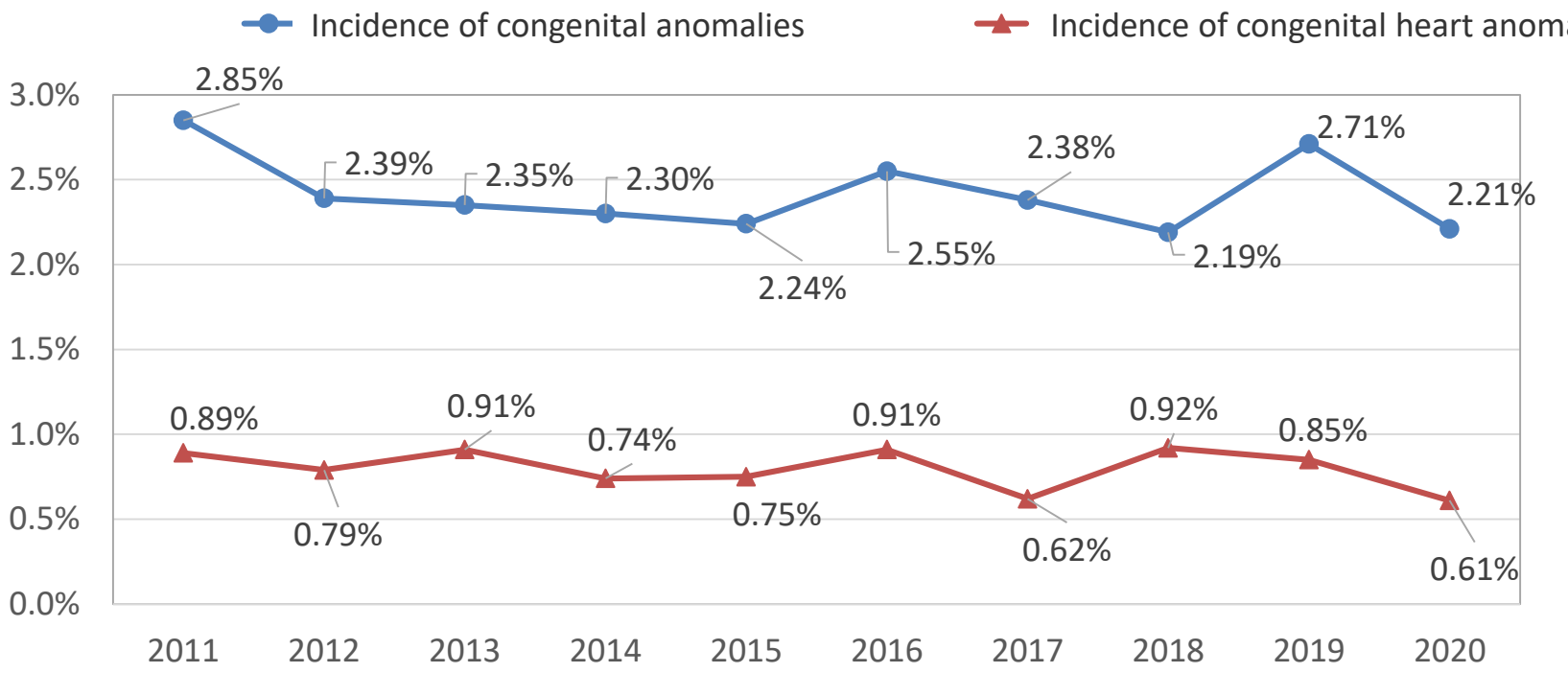
(For reference) **Ministry of Health, Labour and Welfare Statistics, List on vital statistics**



※ birth rate: in thousands in population

Fujimori K, et al. Fukushima J Med Sci 60: 75-81, 2014
Fujimori K, et al. Fukushima J Med Sci 71: 75-81, 2025

Incidence of congenital anomalies (singleton pregnancies)



※ The frequency of morphological abnormalities (fetal anomalies) that can be confirmed at the time of birth is said to be 2-3%.

（Guidelines for Obstetrical Practice 2023 edition）

Characteristics of 6,875 pregnant women (2011) and external radiation exposure doses (Basic Survey)

		external radiation dose(mSv)					
		Total	missing dose value	<1 mSv	1-2 mSv	≥2 mSv	
	N	6,875 (100.0)	3,575 (52.0)	2,267 (33.0)	979 (14.2)	54 (0.8)	*P value*
Maternal age	6,875	30.9 (5.0)	30.3 (5.2)	31.5 (4.6)	31.6 (4.7)	30.5 (5.4)	0.238
Birth height (cm)	6,783	49.1 (2.2)	49.1 (2.3)	49.1 (2.2)	49.2 (2.2)	49.1 (2.1)	0.397
Birth weight (g)	6,815	3,029 (403)	3,026 (412)	3,036 (395)	3,028 (391)	3,006 (382)	0.763
Low birth weight（<2500g）(%)	6,815	7.6	7.8	7.3	7.3	9.3	0.861
SGA（<10%）(%)	6,270	8.9	8.5	8.8	10.7	4.4	0.144
Percentage of congenital anomalies (%)	6,600	2.9	3.1	2.9	2.0	0.0	0.163
Percentage of stillbirth(%)	6,875	0.2	0.3	0.2	0.1	0.0	0.847
Percentage of preterm birth (<37 weeks of pregnancy) (%)	6,348	4.1	4.5	3.6	3.5	4.3	0.942
Percentage of cases forced to change health facilities (%)	6,809	32.4	32.3	45.6	23.7	20.4	<0.001

One-way analysis of variance was used for continuous variables, and the χ^2 test was used for categorical variables (excluding missing dose values)

Yasuda S, Fujimori K, et al. Journal of Epidemiology, 2022; 32: S104

External radiation doses and congenital anomalies (2011)

	Total n = 6,600	<1mSv 2,188	1-2mSv 944	≥2 mSv 0	(Missing) 3,414
Total *	189 (2.86)	64	19	0	106
Cataract	1 (0.02)	0	1	0	0
Neural tube defect	3 (0.05)	1	2	0	0
Microcephaly	0 (0.00)	0	0	0	0
Heart anomaly	57 (0.86)	20	4	0	33
Renal and urinary tract malformation	19 (0.29)	5	3	0	11
Hydrocephalus	1 (0.02)	1	0	0	0
Cleft lip/palate	12 (0.18)	1	3	0	8
Gastrointestinal atresia/stenosis	5 (0.08)	3	0	0	2
Anorectal atresia	4 (0.06)	1	0	0	3
Polydactyly/syndactyly	18 (0.27)	7	1	0	10
Others	83 (1.26)	28	6	0	49

* Multiple answers possible

Yasuda S, Fujimori K, et al. Journal of Epidemiology, 2022; 32: S104

July 20, 2013 Fukushima Minyu

新生児「原発事故影響ない」

福島医大調査結果

原発事故に伴う県民健康管理調査のうち、県と福島医大が県内の妊婦や出産後の母親約1万6千人を対象に行った2011(平成23)年度の妊産婦調査で、同大は19日、福島市で開いた市町村の担当者向け結果報告会で、回答者のうち、早産だった人や低出生体重児が占める割合は、全国のデータとほぼ変わらない結果だったと報告した。同調査の回答者は9316人で、回答率は58・2%だった。

先天奇形・異常がある県内の赤ちゃんの割合は2・7%で、産科医で一般的とされる異常の発見率(3~5%)と同様の水準となった。同大放射線医学県民健康管理センター妊産婦調査部門長の藤森敬也教授は「現時点では全国とほぼ変わらない傾向で、原発事故の影響はないとみられる」との見解を示した。

同大によると、県内で早産だった人は412人(回答者に占める割合4・8%)、低出生体重児は772人(同8・9%)で、人口動態統計を基にした全国の早産者(同5・7%)と低出生体重児(同9・6%)とほぼ変わらなかった。

藤森教授は今後の調査について「客観的なデータを継続して示していくことで県内の妊産婦の安全、安心につなげたい」と語った。

うつ傾向の妊産婦 県全体で27・1%

一方、調査では「気分が沈んだり、憂鬱な気持ちになる」「物事に興味がわかない」と答え、うつ傾向にある妊産婦の割合が県全体で27・1%に達し、国が震災前の10年に実施した別の調査結果の10%を上回った。

相双地区が32・9%と特に高く、県北地区が29・6%、県中地区が26・7%と続いた。医大は、うつ傾向の妊産婦に対し、電話で相談に応じるなど支援に取り組んでいるが、相双地区の妊産婦を中心に心のケア対策の充実が求められている状況が浮き彫りになった。

July 20, 2013 Fukushima Minpo

新生児 原発事故影響見られず

福島医大が調査結果発表

福島医大は十九日、東京電力福島第一原発事故後の県内での妊娠と出産について、放射線の影響は見られないとする調査結果を発表した。県内の新生児に何らかの異常があった割合は2・7%で、一般的な発見率である3~5%と同程度としている。

県民健康管理調査の一環。平成二十二年八月~二十三年七月に市町村から母子健康手帳を交付され、主に二十三年度に出産した一万六千一人を調査対象とし、九千三百十六人(58・2%)から回答を得た。

新生児に異常があったかどうかについて、回答した八千五百三十八人のうち、「あり」は二百三十四人(2・7%)、「なし」は七千九百七十六人(93・4%)だった。

出産まで要した期間についての質問に答えた八千七百人のうち、早産者は四百十二人(4・8%)で、平成二十三年の国の人口動態統計の早産割合の5・7%とほぼ同程度だった。妊娠結果について回答した八千八百十二人のうち、流産が六十八人(0・8%)、死産が二十二人(0・2%)、中絶が五人(0・1%)だった。

一方、気分が沈んだり、物事に興味が湧かなかったりするうつ傾向は回答者八千八百十二人のうち、二千三百九十二人(27・1%)に見られた。平成二十二年度の厚生労働省の妊婦を対象とした全国調査の10%程度と比べ高い結果となった。

県民健康管理調査の妊産婦調査部門長で福島医大産科婦人科学講座の藤森敬也教授は「妊婦や新生児に放射線の影響はないと考えられる。ただ、客観的に安全を示すため調査を継続したい」と話している。

十九日に福島市の県青少年会館で開いた県民健康管理調査の妊産婦に関する調査の結果報告会で示した。

July 26, 2014　Asahi Shimbun

先天異常率「全国と同じ」

厚労省研究班　福島の赤ちゃん調査

東京電力福島第一原発の事故後に福島県内で生まれた赤ちゃんは、全国の赤ちゃんと比べて先天異常の発症率がほぼ同じ傾向だったとする報告を、厚生労働省研究班がまとめた。27日に開かれる日本先天異常学会学術集会で発表する。

研究班は、日本産婦人科医会が毎年実施している全国調査のデータと、2011年の原発事故以降、福島県内の全分娩施設を対象に実施した調査データを比較。全国調査は1997～2010年に生まれた赤ちゃんのうち回答のあった約122万人、福島県内は11～13年の約1万7800人について解析、1万人あたりの発症率を比べた。福島県では年間約1万5千人の赤ちゃんが誕生している。

解析の結果、妊娠22週～生後1カ月の間にわかった心室中隔欠損やダウン症、口唇口蓋裂、多指症などすべての先天異常の発症率が全国調査と福島調査の間に統計的に意味のある差はなかったという。（岡崎明子）

January 9, 2015　Yomiuri Shimbun

先天異常新生児 全国と同等

原発事故後 福島県が2万人調査

東京電力福島第一原発の事故後に福島県内で生まれた新生児約2万人を調べたところ、先天異常の発生率は全国の発生率と差がなかったことが、同県の調査で分かった。低線量の放射線が妊娠時期に与える影響は科学的に分からない点が多く、県外に避難している若い世代が今も帰還をためらう一因になっている。調査にあたった福島県立医科大の藤森敬也教授（周産期学）は「今後も継続して客観的なデータを積み重ね、福島で安心して産み育てる環境を取り戻したい」としている。

県は、2010年8月以降に福島県内で母子手帳をもらったり、里帰り出産したりした全妊婦約4万5000人を対象に、郵送で出産事例を集め、詳しく分析している（回答率52％、14年10月末現在）。

その結果、妊娠12週から生後1か月までに心臓奇形や二分脊椎、ダウン症などの先天異常が見つかった赤ちゃんは、11年度は821人中234人、12年度は6829人中1631人、13年度（中間集計）は686人中161人。発生率はそれぞれ2・85％、2・39％、2・35％だった。

先天異常の一般的な発生率は3％程度といわれる。日本産婦人科医会がまとめた12年の全国の発生率は2・34％で、福島の率は、これとほぼ変わらなかった。また、早産や低出生体重児の割合も、全国的な傾向と変化が見られなかった。

藤森教授によると、原発事故から2年を過ぎた13年以降は放射線の不安を口にする妊産婦が減ったという。福島県内の出産数も回復傾向にある。震災前は年1万8000人を超えていたが、震災があった11年は17％減少。翌年も微減したが、13年は1万5000人と増加に転じた。「福島で暮らし、出産を選択する妊婦は、落ち着きを取り戻しつつある」と藤森教授はみている。

Changes in the spontaneous and induced abortion proportions in Fukushima Prefecture (January 2011 - December 2016)

- **Comprehensive survey of all gynecological medical facilities in Fukushima Prefecture**

  •Less than 22 weeks of pregnancy (number of spontaneous and induced abortions)

  Monthly breakdown

  Less than 8 weeks of pregnancy, 8 to less than 12 weeks of pregnancy, 12 to less than 22 weeks of pregnancy (response rate: 100%)

- **Vital Statistics Birth Certificate**

  After 22 weeks of pregnancy (number of births, number of stillbirths)

  As it is an individual record, it is possible to ascertain the duration of pregnancy (weeks and days) and the outcome date (year, month, day).

Inoue Y, Fujimori K, et al. JOGR 2023; 49: 812-827.

Analysis method

- **Event-based analysis (cross-sectional method)**

  Events (miscarriages, stillbirths, births) examined by month

★ A pregnant woman's choice "to have an abortion now" is reflected

- **Analysis based on the month of pregnancy (longitudinal method)**

  By calculating backwards from the gestational week of pregnancy when the event occurred, estimate the month of pregnancy and consider it prospectively from the time of conception.

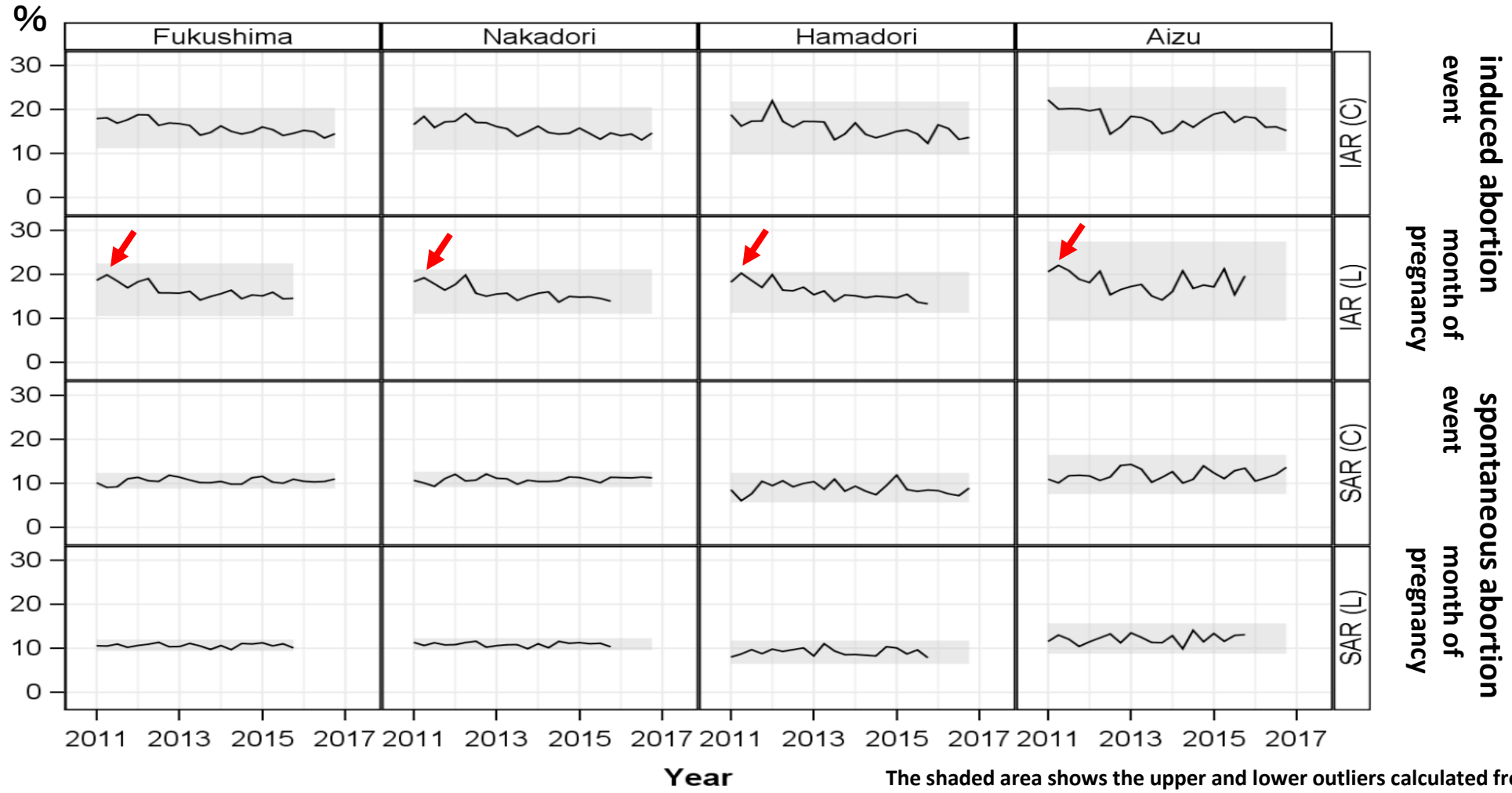
★It is possible to adjust the time axis of the denominator and numerator

★The relationship between the week of pregnancy and the day when the disaster occurred is reflected

★A pregnant woman's choice "to become pregnant now" is reflected

Number of events can be collected on a monthly basis.
This survey analyzed data on a quarterly basis (January to March, April to June, July to September, October to December)

Summary of spontaneous and induced abortion proportions



The shaded area shows the upper and lower outliers calculated from the quartiles.

- There were no significant increases in the proportions of spontaneous or induced abortions after the disaster.
- While there were increases in induced abortions immediately after the disaster, they did not indicate a specific trend.
- Based on cyclical patterns, the temporary increases in abortions after the disaster may have coincided with natural cyclical variations.

Inoue Y, Fujimori K, et al. JOGR 2023; 49: 812-827.

Results of the “Pregnancy and Birth Survey”

- **The incidence of congenital anomalies in Fukushima Prefecture was at the same level as that reported generally.**
- **Maternal external radiation doses obtained by the "Basic Survey" were not associated with the incidence of congenital anomalies.**
- **There were no significant changes in the proportions of spontaneous and induced abortions since the disaster.**

Future issues concerning pregnant and nursing mothers in Fukushima Prefecture after the disaster

- Regarding low-dose radiation exposure, simply stating that it is "safe" from a scientific perspective does not necessarily lead to "peace of mind."
- In order to create an environment where people can live in "safety" and "peace of mind," it is important to actively disclose **objective scientific data** to demonstrate "safety" while supporting the residents of Fukushima Prefecture.