INTRODUCTION

Since the first baby in Japan conceived as a result of in vitro fertilization (IVF) was born in 1983, the number of assisted reproductive technology (ART) cycles has dramatically increased each year. According to the latest report from the International Committee Monitoring Assisted Reproductive Technologies (ICMART), Japan has been one of the largest users of ART worldwide in terms of annual number of treatment cycles performed.1

As it is essential to monitor the trend and situation of ART treatments implemented in the country, the Japan Society of Obstetrics and Gynecology (JSOG) began an ART registry system in 1986

Abstract

Purpose: The Japan Society of Obstetrics and Gynecology (JSOG) has collected cycle-based assisted reproductive technology (ART) data in an online registry since 2007. Herein, we present the characteristics and treatment outcomes of ART cycles registered during 2017.

Methods: We collected cycle-specific information for all ART cycles implemented at participating facilities and performed descriptive analysis.

Results: In total, 448,210 treatment cycles and 56,617 neonates (1 in 16.7 neonates born in Japan) were reported in 2017, increased from 2016; the number of initiated fresh cycles decreased for the first time ever. The mean patient age was 38.0 years (standard deviation 4.6). A total 110,641 of 245,205 egg retrieval cycles (45.1%) were freeze-all cycles; fresh embryo transfer (ET) was performed in 55,720 cycles. A total 194,415 frozen-thawed ET cycles were reported, resulting in 66,881 pregnancies and 47,807 neonates born. Single ET (SET) was performed in 81.8% of fresh transfers and 83.4% of frozen cycles, with singleton pregnancy/live birth rates of 97.5%/97.3% and 96.7%/96.6%, respectively.

Conclusions: Total ART cycles and subsequent live births increased continuously in 2017, whereas the number of initiated fresh cycles decreased. SET was performed in over 80% of cases, and ET shifted from using fresh embryos to frozen ones.

KEYWORDS
ART registry, freeze-all strategy, in vitro fertilization, intracytoplasmic sperm injection, Japan Society of Obstetrics and Gynecology
TABLE 1  Trends in the number of registered initiated cycles, egg retrievals, pregnancies, and neonates according to IVF, ICSI, and frozen-thawed ET cycles in Japan, 1985-2017

| Year | Fresh cycles | ICSIb | FET cyclesc |
|------|--------------|-------|-------------|
|      | No. of registered initiated cycles | No. of egg retrieval | No. of freeze-all cycles | No. of cycles with pregnancy | No. of ET cycles | No. of cycles with pregnancy | No. of neonates | No. of registered initiated cycles | No. of ET cycles | No. of cycles with pregnancy | No. of neonates |
| 1985 | 1,195 | 1,195 | 862 | 64 | 27 |
| 1986 | 752 | 752 | 556 | 56 | 16 |
| 1987 | 1,503 | 1,503 | 1,070 | 135 | 54 |
| 1988 | 1,702 | 1,702 | 1,665 | 257 | 114 |
| 1989 | 4,218 | 3,890 | 2,968 | 580 | 446 |
| 1990 | 7,405 | 6,892 | 5,361 | 1,178 | 1,031 | 160 | 153 | 17 | 17 |
| 1991 | 11,177 | 10,581 | 8,473 | 2,015 | 1,661 |
| 1992 | 17,404 | 16,381 | 12,250 | 2,702 | 2,525 | 963 | 936 | 414 | 35 | 184 | 92 | 7 | 3 |
| 1993 | 21,287 | 20,345 | 15,565 | 3,734 | 3,334 | 2,608 | 2,447 | 1,271 | 176 | 149 |
| 1994 | 25,157 | 24,033 | 18,690 | 4,069 | 3,734 | 5,510 | 5,339 | 4,114 | 759 | 698 |
| 1995 | 26,648 | 24,694 | 18,905 | 4,246 | 3,810 | 9,820 | 9,054 | 7,722 | 1,732 | 1,579 |
| 1996 | 27,338 | 26,385 | 21,492 | 4,818 | 4,436 | 13,438 | 13,044 | 11,269 | 2,799 | 2,588 |
| 1997 | 32,247 | 30,733 | 24,768 | 5,730 | 5,060 | 16,573 | 16,376 | 14,275 | 3,495 | 3,249 |
| 1998 | 34,929 | 33,670 | 27,436 | 6,255 | 5,851 | 18,657 | 18,266 | 15,505 | 3,701 | 681 | 597 | 86 | 71 |
| 1999 | 36,085 | 34,290 | 27,455 | 6,812 | 5,870 | 22,984 | 22,350 | 18,592 | 4,198 | 1,576 |
| 2000 | 31,334 | 29,907 | 24,447 | 6,328 | 5,447 | 26,712 | 25,794 | 21,067 | 4,582 | 1,163 | 10,719 | 2,660 | 2,245 |
| 2001 | 32,676 | 31,051 | 25,143 | 6,749 | 5,829 | 30,369 | 29,309 | 23,058 | 4,862 | 13,034 | 11,888 | 3,080 | 2,467 |
| 2002 | 34,953 | 33,849 | 26,854 | 7,767 | 6,443 | 34,824 | 33,823 | 25,866 | 7,775 | 5,486 | 15,887 | 14,759 | 4,094 | 3,299 |
| 2003 | 38,575 | 36,480 | 28,214 | 8,336 | 6,608 | 38,871 | 36,663 | 27,895 | 7,506 | 5,994 | 24,459 | 19,641 | 6,205 | 4,798 |
| 2004 | 41,619 | 39,656 | 29,090 | 8,542 | 6,709 | 44,698 | 43,628 | 29,946 | 7,768 | 5,921 | 30,287 | 24,422 | 7,606 | 5,538 |
| 2005 | 42,822 | 40,471 | 29,337 | 8,893 | 6,706 | 47,579 | 45,388 | 30,983 | 8,019 | 5,864 | 35,069 | 28,743 | 9,396 | 6,542 |
| 2006 | 44,778 | 42,248 | 29,940 | 8,509 | 6,256 | 52,539 | 49,854 | 32,509 | 7,904 | 5,401 | 42,171 | 35,804 | 11,798 | 7,930 |
| 2007 | 53,873 | 52,165 | 7,626 | 28,228 | 7,416 | 5,144 | 61,813 | 60,294 | 11,541 | 34,032 | 7,784 | 5,194 | 45,478 | 43,589 | 13,965 | 9,257 |
| 2008 | 59,149 | 57,217 | 10,139 | 29,124 | 6,497 | 4,664 | 71,350 | 69,864 | 15,390 | 34,425 | 7,017 | 4,615 | 60,115 | 57,846 | 18,597 | 12,425 |
| 2009 | 63,083 | 60,754 | 11,190 | 28,559 | 6,891 | 5,046 | 76,790 | 75,340 | 19,046 | 35,167 | 7,330 | 5,180 | 73,927 | 71,367 | 23,216 | 16,454 |
| 2010 | 67,714 | 64,966 | 13,843 | 27,905 | 6,556 | 4,657 | 90,677 | 88,822 | 24,379 | 37,172 | 7,699 | 5,277 | 83,770 | 81,300 | 27,382 | 19,011 |
| 2011 | 71,422 | 68,651 | 16,202 | 27,284 | 6,341 | 4,546 | 102,473 | 100,518 | 30,773 | 38,098 | 7,601 | 5,415 | 95,764 | 92,782 | 31,721 | 22,465 |
| 2012 | 82,108 | 79,434 | 20,627 | 29,693 | 6,703 | 4,740 | 125,229 | 122,962 | 41,943 | 40,829 | 7,947 | 5,498 | 119,089 | 116,176 | 39,106 | 27,715 |

(Continues)
and launched an online registration system in 2007. Since then, cycle-specific information for all ART treatment cycles performed in ART facilities has been collected. The aim of the present report was to describe the characteristics and treatment outcomes of registered ART cycles during 2017 in comparison with previous year.²

2 | MATERIALS AND METHODS

Since 2007, the JSOG has requested all participating ART clinics and hospitals to register cycle-specific information for all ART treatment cycles. The information includes patient characteristics, information on ART treatment, and pregnancy and obstetric outcomes. Detailed information collected in the registry has been reported previously.³ For ART cycles performed between January 1 and December 31, 2017, the JSOG requested registration of the information via an online registry system by the end of November 2018.

Using the registry data for 2017, we performed a descriptive analysis to investigate the characteristics and treatment outcomes of registered cycles. The number of registered cycles for the initiation of treatment, egg retrievals, fresh embryo transfer (ET) cycles, frozen-thawed embryo transfer (FET) cycles, freeze-all embryos/oocytes cycles, pregnancies, and neonates were compared with those in previous years. The characteristics of registered cycles and treatment outcomes were described for fresh ET and FET cycles. Treatment outcomes included pregnancy, miscarriage and live birth rates, multiple pregnancies, pregnancy outcomes for ectopic pregnancy, intrauterine pregnancy coexisting with an ectopic pregnancy, artificial abortion, stillbirth, and fetal reduction. Furthermore, the treatment outcomes of pregnancy, live birth, miscarriage, and multiple pregnancy rates were analyzed according to patient age. We also described treatment outcomes for cycles using frozen-thawed oocytes based on medical indications.

3 | RESULTS

In Japan, there were 607 registered ART facilities in 2017, of which 606 participated in the ART registration system. A total 586 facilities actually implemented ART treatment in 2017; 19 registered facilities did not implement ART cycles. Trends in the number of registered cycles, egg retrievals, pregnancies, and neonates born as a result of IVF, intracytoplasmic sperm injection (ICSI), and FET cycles from 1985 to 2017 are shown in Table 1. In 2017, 448,210 cycles were registered, and 56,617 neonates were recorded, accounting for 1 in 16.7 neonates born in Japan (the total number of neonates born in Japan was 946,065 in 2017). The total number of registered cycles and neonates born as a result of ART demonstrated an increasing trend from 1985 to 2017. In 2017, for the first time ever, the number of registered cycles for fresh IVF and ICSI decreased from the previous year; registered IVF and ICSI cycles decreased by 3.2% and 2.2%, respectively, from the previous year. The number of FET cycles increased continuously; the number in 2017 was 198,985 (a 3.7%
increase from 2016), resulting in 67,255 pregnancies and 48,060 neonates in 2017. Among registered fresh cycles, 63.3% were ICSI. In terms of FET cycles, 188,388 FETs were performed, resulting in 62,749 pregnancies and 44,678 neonates born in 2016. The distributions of patient age in registered cycles and different subgroups of cycles with ET, pregnancy, and live birth are shown in Figure 1. The mean patient age for registered cycles was 38.0 years (standard deviation [SD] = 4.6); the mean age for pregnancy and live birth cycles was 36.0 years (SD = 4.1) and 35.5 years (SD = 4.0), respectively.

The characteristics and treatment outcomes of registered fresh cycles are shown in Table 2. There were 87,445 registered IVF cycles, 26,485 split-ICSI cycles, 128,643 ICSI cycles using ejaculated sperm, 2,581 ICSI cycles using testicular sperm extraction (TESE), 25 gamete intrafallopian transfer (GIFT) cycles, 537 cycles with oocyte freezing based on medical indications, and 3,509 other cycles. Of the 245,205 cycles with oocyte retrieval, 110,641 (45.1%) were freeze-all cycles. The pregnancy rate per ET was 23.0% for IVF and 19.2% for ICSI using ejaculated sperm. Single ET was performed at a rate of 81.8%, with a pregnancy rate of 21.7%. Live birth rates per ET were 16.2% for IVF, 13.2% for ICSI using ejaculated sperm, and 10.2% for ICSI with TESE. The singleton pregnancy rate and live birth rate were 97.5% and 97.3%, respectively.

The characteristics and treatment outcomes of FET cycles are shown in Table 3. There were 197,593 registered cycles, among which FET was performed in 194,415 cycles leading to 66,881 pregnancies (pregnancy rate per FET = 34.4%). The miscarriage rate per pregnancy was 14.3%, resulting in a 19.8% live birth rate per ET. The treatment outcomes of cycles using frozen-thawed oocytes based on medical indications are shown in Table 5. There were a total of 91 cycles using frozen oocytes, among which 21 cycles resulted in pregnancy (pregnancy rate per FET = 23.1%). The miscarriage rate per pregnancy was 14.3%, resulting in a 19.8% live birth rate per ET.

4 | DISCUSSION

Using the current Japanese ART registry system, we demonstrated that there were a total 448,210 registered ART cycles and 56,617 resultant live births, accounting for 1 in 16.7 neonates born in Japan during 2017, the most since the registry began. However, in 2017, the total number of initiated fresh cycles (both IVF and ICSI) decreased from the previous year for the first time. Freeze-all cycles predominated, accounting for nearly 45% of total initiated cycles, resulting in frozen cycles accounting for most embryo transfers. The single ET rate was 81.8% for fresh transfers and 83.4% for frozen cycles, which also showed an increasing trend since 2007, reaching a singleton live birth rate of nearly 97% in total. These results represent the latest clinical practice of ART in Japan.

The characteristic that more than 45% of fresh cycles were freeze-all is unique in Japan. Freeze-all is beneficial for avoiding complications related to ovarian stimulation, such as ovarian hyperstimulation syndrome (OHSS), especially in high-risk patients such as those with polycystic ovary syndrome (PCOS) or high ovarian reserve. However, it remains under discussion whether the freeze-all strategy is beneficial for the entire IVF population. A recently published meta-analysis including 11 randomized controlled trials (RCTs) with 5,379 patients reported that freeze-all and subsequent elective FET demonstrated significantly higher live birth rates than those with fresh ET (risk ratio [RR] = 1.12, 95% confidence interval [CI], 1.01 to 1.24) in the entire population. Interestingly, neither the live birth rate (RR = 1.03, 95% CI, 0.91 to 1.17) in the subgroup of...
normo-responders nor the cumulative live birth rate in the entire population (RR = 1.04, 95% CI, 0.97 to 1.11) was significantly different between groups. However, a more recent multicenter RCT investigating the effect of blastocyst ET after freeze-all or fresh ET cycles among 825 ovulatory women from China demonstrated that a freeze-all strategy with subsequent elective FET achieved

### TABLE 2 Characteristics and treatment outcomes of registered fresh cycles in assisted reproductive technology in Japan, 2017

| Variables                                      | IVF-ET | Split | ICSI | Frozen oocyte | Others | Total  |
|------------------------------------------------|--------|-------|------|---------------|--------|--------|
| No. of registered initiated cycles            | 87,445 | 26,485| 128,643 | 2,581 | 25 | 3,509 | 249,225 |
| No. of egg retrieval                          | 85,541 | 26,185| 126,996 | 2,577 | 25 | 3,351 | 245,205 |
| No. of fresh ET cycles                        | 21,939 | 5,691 | 26,931 | 675   | 25 | 2 | 457 | 55,720 |
| No. of freeze-all cycles                      | 34,930 | 17,320| 55,585 | 1,295 | 0   | 457 | 1,054 | 110,641 |
| No. of cycles with pregnancy                  | 5,047  | 1,475 | 5,174 | 108   | 7 | 0 | 128 | 11,939 |
| Pregnancy rate per ET                         | 23.0%  | 25.9% | 19.2% | 16.0% | 28.0% | 0 | 28.0% | 21.4% |
| Pregnancy rate per egg retrieval              | 5.9%   | 5.6% | 4.1% | 4.2% | 28.0% | - | 3.8% | 4.9% |
| Pregnancy rate per egg retrieval excluding freeze-all cycles | 10.0% | 16.6% | 7.2% | 8.4% | 28.0% | - | 5.6% | 8.9% |
| SET cycles                                    | 18,428 | 4,913 | 21,502 | 412   | 3 | - | 300 | 45,559 |
| Pregnancy following SET cycles                | 4,234  | 1,312 | 4,179 | 72    | 0 | - | 86 | 9,883 |
| Rate of SET cycles                            | 84.0%  | 86.3% | 79.8% | 61.0% | 12.0% | - | 65.6% | 81.8% |
| Pregnancy rate following SET cycles           | 23.0%  | 26.7% | 19.4% | 17.5% | 0.0% | - | 28.7% | 21.7% |
| Miscarriages                                  | 1,227  | 327   | 1,380 | 36    | 3 | - | 31 | 3,004 |
| Miscarriage rate per pregnancy                | 24.3%  | 22.2% | 26.7% | 33.3% | 42.9% | - | 24.2% | 25.2% |
| Singleton pregnancies                         | 4,755  | 1,417 | 4,881 | 98    | 7 | - | 121 | 11,279 |
| Multiple pregnancies                          | 114    | 35    | 136  | 4     | 0 | - | 3 | 292 |
| Twin pregnancies                              | 113    | 33    | 134  | 3     | 0 | - | 3 | 286 |
| Triplet pregnancies                           | 1      | 2     | 2    | 1     | 0 | - | 0 | 6 |
| Quadruplet pregnancies                        | 0      | 0     | 0    | 0     | 0 | - | 0 | 0 |
| Multiple pregnancy rate                       | 2.3%   | 2.4% | 2.7% | 3.9% | 0.0% | - | 2.4% | 2.5% |
| Live births                                   | 3,555  | 1,085 | 3,552 | 69    | 4 | - | 90 | 8,355 |
| Live birth rate per ET                        | 16.2%  | 19.1% | 13.2% | 10.2% | 16.0% | - | 19.7% | 15.0% |
| Total number of neonates                      | 3,635  | 1,103 | 3,653 | 70    | 4 | - | 92 | 8,557 |
| Singleton live births                         | 3,464  | 1,066 | 3,439 | 66    | 4 | - | 88 | 8,127 |
| Twin live births                              | 84     | 17    | 107  | 2     | 0 | - | 2 | 212 |
| Triplet live births                           | 1      | 1     | 0    | 0     | 0 | - | 0 | 2 |
| Quadruplet live births                        | 0      | 0     | 0    | 0     | 0 | - | 0 | 0 |
| Pregnancy outcomes                            |        |       |      |       |    |    |    |      |
| Ectopic pregnancies                           | 58     | 12    | 63   | 0     | 0 | - | 3 | 136 |
| Intrauterine pregnancies coexisting with ectopic pregnancy | 1     | 0     | 1    | 0     | 0 | - | 0 | 2 |
| Artificial abortions                          | 18     | 5     | 25   | 0     | 0 | - | 0 | 48 |
| Stillbirths                                   | 14     | 3     | 14   | 0     | 0 | - | 1 | 32 |
| Fetal reductions                              | 1      | 0     | 0    | 1     | 0 | - | 0 | 2 |
| Unknown cycles for pregnancy outcomes         | 102    | 32    | 111  | 2     | 0 | - | 2 | 249 |

Abbreviations: ET, embryo transfer; IVF-ET, in vitro fertilization-embryo transfer; ICSI, intracytoplasmic sperm injection; GIFT, gamete intrafallopian transfer; TESE, testicular sperm extraction; SET, single embryo transfer.

<sup>a</sup>Others include zygote intrafallopian transfer (ZIFT).

<sup>b</sup>Singleton, twin, triplet, and quadruplet pregnancies were defined according to the number of gestational sacs in utero.
a significantly higher live birth rate than did fresh blastocyst ET (RR = 1.26, 95% CI, 1.14 to 1.41). Thus, evidence for the use of a freeze-all strategy in the entire IVF population remains limited.

FET might increase specific complications during pregnancy. Previous analysis using the Japanese ART registry has demonstrated that FET is associated with significantly higher risk for hypertensive disorders of pregnancy (HDP) and placenta accreta than fresh ET. In particular, higher risk of HDP in FET is noted in several RCTs. Recently, it was reported that methods of endometrium preparation, especially hormone replacement cycles for FET, might be associated with these complications. Therefore, caution should be exerted with respect to the risks of specific pregnancy complications, although frozen ET is reported to be beneficial in avoiding OHSS and reducing the risk of low birth weight and preterm delivery, as compared with fresh cycles.

ICSI cycles accounted for 63% of registered fresh cycles in 2017. An increasing trend in ICSI use is seen worldwide. The latest report from ICMART indicates that ICSI was used at a rate of 66.5% in 2011 among 65 countries and 2,560 ART clinics. That report also highlighted that large disparities exist for ICSI; the ICSI rate varies from 97% in Middle Eastern countries to 55% in Asia, 69% in Europe, and 73% in North America. Importantly, despite its increased use, there is no rigorous evidence that ICSI improves reproductive outcomes, especially for non-male factor infertility such as unexplained infertility, low ovarian reserve, or advanced maternal age. Based on this insufficient evidence, practice committees of the American

| Variables                                      | FET   | Others<sup>a</sup> | Total |
|------------------------------------------------|-------|--------------------|-------|
| No. of registered initiated cycles             | 197,593 | 1,199              | 198,792|
| No. of FET                                     | 194,415 | 1,053              | 195,468|
| No. of cycles with pregnancy                   | 66,881  | 353                | 67,234 |
| Pregnancy rate per FET                         | 34.4%  | 33.5%              | 34.4% |
| SET cycles                                     | 162,343 | 746                | 163,089|
| Pregnancy following SET cycles                 | 57,167  | 241                | 57,408 |
| Rate of SET cycles                             | 83.5%  | 70.8%              | 83.4% |
| Pregnancy rate following SET cycles            | 35.2%  | 32.3%              | 35.2% |
| Miscarriages                                   | 17,343  | 81                 | 17,424 |
| Miscarriage rate per pregnancy                 | 25.9%  | 22.9%              | 25.9% |
| Singleton pregnancies<sup>b</sup>              | 63,391  | 324                | 63,715 |
| Multiple pregnancies<sup>b</sup>               | 2,168   | 22                 | 2,190 |
| Twin pregnancies<sup>b</sup>                   | 2,126   | 22                 | 2,148 |
| Triplet pregnancies<sup>b</sup>                | 42      | 0                  | 42    |
| Quadruplet pregnancies<sup>b</sup>             | 0       | 0                  | 0     |
| Multiple pregnancy rate<sup>b</sup>            | 3.3%    | 6.4%               | 3.3%  |
| Live births                                    | 46,396  | 228                | 46,624|
| Live birth rate per FET                        | 23.9%  | 21.7%              | 23.9% |
| Total number of neonates                       | 47,807  | 235                | 48,042|
| Singleton live births                          | 44,820  | 213                | 45,033|
| Twin live births                               | 1,471   | 11                 | 1,482 |
| Triplet live births                            | 15      | 0                  | 15    |
| Quadruplet live births                         | 0       | 0                  | 0     |
| Pregnancy outcomes                             |         |                    |       |
| Ectopic pregnancies                            | 354     | 2                  | 356   |
| Intrauterine pregnancies coexisting with ectopic pregnancy | 3 | 0 | 3 |
| Artificial abortions                           | 286     | 3                  | 289   |
| Stillbirths                                     | 180     | 1                  | 181   |
| Fetal reduction                                | 15      | 0                  | 15    |
| Unknown cycles for pregnancy outcomes          | 1,901   | 33                 | 1,934 |

Abbreviations: FET, frozen-thawed embryo transfer; SET, single embryo transfer.

<sup>a</sup>Including cycles using frozen-thawed oocytes.

<sup>b</sup>Singleton, twin, triplet, and quadruplet pregnancies were defined according to the number of gestational sacs in utero.
### TABLE 4  Treatment outcomes of registered cycles, according to patient age in Japan, 2017

| Age (years) | No. of registered initiated cycles | No. of ET cycles | Pregnancy | Multiple pregnancies\(^a\) | Miscarriage | Live birth | Pregnancy rate per ET | Pregnancy rate per registered cycles | Live birth rate per registered cycles | Miscarriage rate per pregnancy | Multiple pregnancy rate\(^b\) |
|-------------|-----------------------------------|-----------------|-----------|-----------------------------|-------------|-----------|----------------------|----------------------------------|----------------------------------|-------------------------------|-----------------------------|
| Under 20s   | 39                                | 10              | 3         | 0                           | 1           | 2         | 30.0%                | 7.7%                             | 5.1%                             | 33.3%                        | 0.0%                         |
| 21          | 33                                | 12              | 5         | 0                           | 1           | 4         | 41.7%                | 15.2%                            | 12.1%                            | 20.0%                        | 0.0%                         |
| 22          | 79                                | 37              | 25        | 2                           | 5           | 19        | 67.6%                | 31.6%                            | 24.1%                            | 20.0%                        | 8.0%                         |
| 23          | 149                               | 86              | 34        | 1                           | 7           | 24        | 39.5%                | 22.8%                            | 16.1%                            | 20.6%                        | 2.9%                         |
| 24          | 364                               | 199             | 91        | 0                           | 10          | 77        | 45.7%                | 25.0%                            | 21.2%                            | 11.0%                        | 0.0%                         |
| 25          | 788                               | 468             | 213       | 11                          | 46          | 157       | 45.5%                | 27.0%                            | 19.9%                            | 21.6%                        | 5.2%                         |
| 26          | 1,569                             | 918             | 425       | 15                          | 65          | 339       | 46.3%                | 27.1%                            | 21.6%                            | 15.3%                        | 3.6%                         |
| 27          | 2,895                             | 1,762           | 806       | 22                          | 134         | 623       | 45.7%                | 27.8%                            | 21.5%                            | 16.6%                        | 2.8%                         |
| 28          | 4,965                             | 3,026           | 1,396     | 41                          | 242         | 1,070     | 46.1%                | 28.1%                            | 21.6%                            | 17.3%                        | 3.0%                         |
| 29          | 7,731                             | 4,792           | 2,147     | 55                          | 371         | 1,671     | 44.8%                | 27.8%                            | 21.6%                            | 17.3%                        | 2.6%                         |
| 30          | 10,721                            | 6,754           | 2,990     | 79                          | 498         | 2,352     | 44.3%                | 27.9%                            | 21.9%                            | 16.7%                        | 2.7%                         |
| 31          | 13,829                            | 8,843           | 3,911     | 119                         | 673         | 3,065     | 44.2%                | 28.3%                            | 22.2%                            | 17.2%                        | 3.1%                         |
| 32          | 16,744                            | 10,678          | 4,620     | 143                         | 787         | 3,596     | 43.3%                | 27.6%                            | 21.5%                            | 17.0%                        | 3.2%                         |
| 33          | 19,951                            | 12,671          | 5,259     | 130                         | 1,019       | 3,988     | 41.5%                | 26.4%                            | 20.0%                            | 19.4%                        | 2.5%                         |
| 34          | 23,392                            | 14,806          | 6,055     | 175                         | 1,172       | 4,611     | 40.9%                | 25.9%                            | 19.7%                            | 19.4%                        | 2.9%                         |
| 35          | 25,809                            | 16,210          | 6,492     | 247                         | 1,321       | 4,869     | 40.0%                | 25.2%                            | 18.9%                            | 20.3%                        | 3.9%                         |
| 36          | 27,594                            | 17,184          | 6,583     | 249                         | 1,424       | 4,867     | 38.3%                | 23.9%                            | 17.6%                            | 21.6%                        | 3.9%                         |
| 37          | 31,095                            | 19,156          | 6,940     | 255                         | 1,612       | 5,000     | 36.2%                | 22.3%                            | 16.1%                            | 23.2%                        | 3.8%                         |
| 38          | 34,081                            | 20,484          | 6,867     | 224                         | 1,762       | 4,778     | 33.5%                | 20.1%                            | 14.0%                            | 25.7%                        | 3.3%                         |
| 39          | 38,618                            | 22,400          | 6,894     | 238                         | 2,111       | 4,440     | 30.8%                | 17.9%                            | 11.5%                            | 30.6%                        | 3.5%                         |
| 40          | 38,698                            | 21,604          | 5,872     | 184                         | 1,973       | 3,603     | 27.2%                | 15.2%                            | 9.3%                             | 33.6%                        | 3.2%                         |
| 41          | 37,365                            | 19,672          | 4,645     | 146                         | 1,819       | 2,626     | 23.6%                | 12.4%                            | 7.0%                             | 39.2%                        | 3.2%                         |
| 42          | 36,600                            | 17,946          | 3,394     | 82                          | 1,466       | 1,763     | 18.9%                | 9.3%                             | 4.8%                             | 43.2%                        | 2.5%                         |
| 43          | 28,253                            | 13,138          | 1,932     | 43                          | 952         | 881       | 14.7%                | 6.8%                             | 3.1%                             | 49.3%                        | 2.3%                         |
| 44          | 20,255                            | 8,667           | 965       | 17                          | 555         | 371       | 11.1%                | 4.8%                             | 1.8%                             | 57.5%                        | 1.8%                         |
| 45          | 12,836                            | 4,956           | 393       | 4                           | 246         | 130       | 7.9%                 | 3.1%                             | 1.0%                             | 62.6%                        | 1.0%                         |
| 46          | 7,147                             | 2,634           | 165       | 0                           | 107         | 54        | 6.3%                 | 2.3%                             | 0.8%                             | 64.8%                        | 0.0%                         |
| 47          | 3,275                             | 1,093           | 39        | 0                           | 30          | 8         | 3.6%                 | 1.2%                             | 0.2%                             | 76.9%                        | 0.0%                         |
| 48          | 1,799                             | 556             | 15        | 1                           | 9           | 5         | 2.7%                 | 0.8%                             | 0.3%                             | 60.0%                        | 7.1%                         |
| 49          | 973                               | 317             | 14        | 0                           | 10          | 3         | 4.4%                 | 1.4%                             | 0.3%                             | 71.4%                        | 0.0%                         |
| Over 50s    | 563                               | 200             | 4         | 0                           | 3           | 1         | 2.0%                 | 0.7%                             | 0.2%                             | 75.0%                        | 0.0%                         |

Abbreviation: ET, embryo transfer.

\(^a\)Multiple pregnancies were defined according to the number of gestational sacs in utero.
FIGURE 2  Pregnancy, live birth, and miscarriage rates, according to patient age, among all registered cycles in 2017. Adapted from the Japan Society of Obstetrics and Gynecology ART Databook 2017 (http://plaza.umin.ac.jp/~jsog-art/2017data_20191015.pdf). ET, embryo transfer

TABLE 5  Treatment outcomes of cycles using frozen-thawed oocytes based on medical indications in assisted reproductive technology, Japan, 2017

| Variables                                      | Embryo transfer using frozen-thawed oocyte |
|------------------------------------------------|------------------------------------------|
| No. of registered cycles                       | 193                                      |
| No. of ET                                       | 91                                       |
| No. of cycles with pregnancy                   | 21                                       |
| Pregnancy rate per ET                          | 23.1%                                    |
| SET cycles                                     | 69                                       |
| Pregnancy following SET cycles                 | 18                                       |
| Rate of SET cycles                             | 75.8%                                    |
| Pregnancy rate following SET cycles            | 26.1%                                    |
| Miscarriages                                   | 3                                        |
| Miscarriage rate per pregnancy                 | 14.3%                                    |
| Singleton pregnancies^a                        | 20                                       |
| Multiple pregnancies^a                         | 1                                        |
| Twin pregnancies^a                             | 1                                        |
| Triplet pregnancies^a                          | 0                                        |
| Quadruplet pregnancies^a                       | 0                                        |
| Multiple pregnancy rate^a                      | 4.8%                                     |
| Live births                                    | 18                                       |
| Live birth rate per ET                         | 19.8%                                    |
| Total number of neonates                       | 18                                       |
| Singleton live births                          | 18                                       |
| Twin live births                               | 0                                        |
| Triplet live births                            | 0                                        |
| Quadruplet live births                         | 0                                        |
| Pregnancy outcomes                             |                                          |
| Ectopic pregnancies                            | 0                                        |
| Intrauterine pregnancies coexisting with ectopic pregnancy | 0                                         |
| Artificial abortions                           | 0                                        |
| Stillbirths                                    | 0                                        |
| Fetal reduction                               | 0                                        |
| Unknown cycles for pregnancy outcomes          | 0                                        |

Abbreviations: ET, embryo transfer; SET, single embryo transfer.
^aSingleton, twin, triplet, and quadruplet pregnancies were defined according to the number of gestational sacs in utero.
CONFLICT OF INTEREST

There is no conflict of interest regarding the publication of this study.

HUMAN RIGHTS STATEMENT AND INFORMED CONSENT

All procedures were performed in accordance with the ethical standards of the relevant committees on human experimentation (institutional and national) and the Helsinki Declaration of 1964 and its later amendments. Informed consent was obtained from all patients included in the study.

ANIMAL RIGHTS

This report does not contain any studies performed by any of the authors that included animal participants.

APPROVAL BY ETHICS COMMITTEE

Not applicable.

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