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SPECIAL REPORT

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Assisted reproductive technology in Japan: A summary report for 2016 by the Ethics Committee of the Japan Society of Obstetrics and Gynecology

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Abstract

Purpose: The Japan Society of Obstetrics and Gynecology started an online cycle-based assisted reproductive technology (ART) registry system in 2007. This report presents the characteristics and treatment outcomes of ART registered for the cycles practiced during 2016.

Methods: Cycle-specific information for all ART cycles implemented in participating ART facilities were collected. A descriptive analysis was conducted for the registry database of 2016.

Results: In total, 447 790 treatment cycles and 54 110 neonates (one in 18.1 neonates born in Japan) were reported in 2016. The mean patients' age was 38.1 years (SD = 4.5). Among the egg retrieval cycles, 104 575 of 251 399 (41.6%) were freeze-all cycles without fresh embryo transfers (ET), while fresh ET was performed in 64 497 cycles (58.4%). A total of 187 132 frozen-thawed ET cycles were reported, resulting in 62 432 pregnancies and 44 484 neonates born. Single ET was selected for 81.0% of fresh transfers and 82.7% of frozen cycles, resulting in singleton pregnancy/live birth rates of 97.0%/96.4% and 96.7%/96.4%, respectively.

Conclusion: The total ART cycles and subsequent live births continued to increase in 2016. Single ET was performed more than 80%, and ET has shifted from using fresh embryos to frozen ones.

KEYWORDS

ART registry, freeze-all, in vitro fertilization, Japan Society of Obstetrics and Gynecology, single embryo transfer

1 | INTRODUCTION

In Japan, the first in vitro fertilization (IVF) baby was born in 1983, and thereafter, the annual number of assisted reproductive technology (ART) cycles has dramatically increased year by year. Japan has become one of the largest users of ART worldwide in terms of the annual number of treatment cycles done.[1]

Records of the characteristics and clinical outcomes of ART are crucial to monitor trends and situations of ART treatment implemented in a country. The Japan Society of Obstetrics and Gynecology

TABLE 1 Trends in numbers of registered cycles, egg retrieval, pregnancy, and neonates according to IVF, ICSI, and frozen-thawed embryo transfer cycles, Japan, 1985-2016

	Fresh cycles												FET cycles[c]			
	IVF[a]						ICSI[b]									
Year	No. of registered cycles	No. of egg retrieval	No. of freeze-all cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of egg retrieval	No. of freeze-all cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates
1985	1195	1195		862	64	27										
1986	752	752		556	56	16										
1987	1503	1503		1070	135	54										
1988	1702	1702		1665	257	114										
1989	4218	3890		2968	580	446							184	92	7	3
1990	7405	6892		5361	1178	1031							160	153	17	17
1991	11 177	10 581		8473	2015	1661							369	352	57	39
1992	17 404	16 381		12 250	2702	2525	963	936		524	42	35	553	530	79	66
1993	21 287	20 345		15 565	3730	3334	2608	2447		1271	176	149	681	597	86	71
1994	25 157	24 033		18 690	4069	3734	5510	5339		4114	759	698	1303	1112	179	144
1995	26 648	24 694		18 905	4246	3810	9820	9054		7722	1732	1579	1682	1426	323	298
1996	27 338	26 385		21 492	4818	4436	13 438	13 044		11 269	2799	2588	2900	2676	449	386
1997	32 247	30 733		24 768	5730	5060	16 573	16 376		14 275	3495	3249	5208	4958	1086	902
1998	34 929	33 670		27 436	6255	5851	18 657	18 266		15 505	3952	3701	8132	7643	1748	1567
1999	36 085	34 290		27 455	6812	5870	22 984	22 350		18 592	4702	4247	9950	9093	2198	1812
2000	31 334	29 907		24 447	6328	5447	26 712	25 794		21 067	5240	4582	11 653	10 719	2660	2245
2001	32 676	31 051		25 143	6749	5829	30 369	29 309		23 058	5924	4862	13 034	11 888	3080	2467
2002	34 953	33 849		26 854	7767	6443	34 824	33 823		25 866	6775	5486	15 887	14 759	4094	3299
2003	38 575	36 480		28 214	8336	6608	38 871	36 663		27 895	7506	5994	24 459	19 641	6205	4798
2004	41 619	39 656		29 090	8542	6709	44 698	43 628		29 946	7768	5921	30 287	24 422	7606	5538
2005	42 822	40 471		29 337	8893	6706	47 579	45 388		30 983	8019	5864	35 069	28 743	9396	6542
2006	44 778	42 248		29 440	8509	6256	52 539	49 854		32 509	7904	5401	42 171	35 804	11 798	7930
2007	53 873	52 165	7626	28 228	7416	5144	61 813	60 294	11 541	34 032	7784	5194	45 478	43 589	13 965	9257
2008	59 148	57 217	10 139	29 124	6897	4664	71 350	69 864	15 390	34 425	7017	4615	60 115	57 846	18 597	12 425
2009	63 083	60 754	11 800	28 559	6891	5046	76 790	75 340	19 046	35 167	7330	5180	73 927	71 367	23 216	16 454
2010	67 714	64 966	13 843	27 905	6556	4657	90 677	88 822	24 379	37 172	7699	5277	83 770	81 300	27 382	19 011
2011	71 422	68 651	16 202	27 284	6341	4546	102 473	100 518	30 773	38 098	7601	5415	95 764	92 782	31 721	22 465

(*Continues*)

TABLE 1 (Continued)

Year	Fresh cycles: IVF[a] No. of registered cycles	No. of egg retrieval	No. of freeze-all cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates	ICSI[b] No. of registered cycles	No. of egg retrieval	No. of freeze-all cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates	FET cycles[c] No. of registered cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates
2012	82 108	79 434	20 627	29 693	6703	4740	125 229	122 962	41 943	40 829	7947	5498	119 089	116 176	39 106	27 715
2013	89 950	87 104	25 085	30 164	6817	4776	134 871	134 871	49 316	41 150	8027	5630	141 335	138 249	45 392	32 148
2014	92 269	89 397	27 624	30 414	6970	5025	144 247	141 888	55 851	41 437	8122	5702	157 229	153 977	51 458	36 595
2015	93 614	91 079	30 498	28 858	6478	4629	155 797	153 639	63 660	41 396	8169	5761	174 740	171 495	56 888	40 611
2016	94 566	92 185	34 188	26 182	5903	4266	161 262	159 214	70 387	38 315	7324	5166	191 962	188 338	62 749	44 678

ET, embryo transfer; FET, frozen-thawed embryo transfer; ICSI, intracytoplasmic sperm injection; IVF, in vitro fertilization.
[a]Including gamete intrafallopian transfer.
[b]Including Split-ICSI cycles.
[c]Including cycles using frozen-thawed oocyte.

(JSOG) started an ART registry system in 1986. In 2007, the JSOG launched an online registration system and collected cycle-specific information for all ART treatment cycles implemented in ART facilities. The aim of this study was to report the characteristics and treatment outcomes of ART cycles registered during 2016 following the previous report.[2]

2 | MATERIALS AND METHODS

Since 2007, the JSOG has requested all participating ART clinics and hospitals to register cycle-specific information for all treatment cycles. The information includes patient characteristics, information on ART treatment, and pregnancy and obstetric outcomes. Details on the information collected in the registry have been reported previously.[3] For ART cycles conducted between January 1 and December 31, 2016, JSOG requested registration of the information via an online registry system by the end of November 2017. This study was approved by the Institutional Review Board at the Saitama Medical University and ethics committee at the JSOG.

Using the database registered for 2016, a descriptive analysis was performed to investigate the characteristics and treatment outcomes of registered fresh and frozen-thawed embryo transfer (FET) cycles. The number of registered cycles, egg retrievals, fresh embryo transfer (ET) cycles, freeze-all embryos/oocytes cycles, pregnancies, and neonates were compared with that in previous years. The characteristics of the registered cycles and treatment outcomes were described for fresh and FET cycles. Treatment outcomes included the 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. Treatment outcomes for cycles using frozen-thawed oocytes were also reported.

3 | RESULTS

There were 604 registered ART facilities in 2016, of which 603 participated in the ART registration system. The number of facilities that actually implemented ART treatment in 2016 was 587; 16 registered facilities did not implement ART cycles. The trends in the number of registered cycles, egg retrievals, pregnancies, and neonates for IVF, intracytoplasmic sperm injection (ICSI), and FET cycles from 1985 to 2016 are shown in Table 1. In 2016, 447 790 cycles were registered and 54 110 neonates were recorded, accounting for one in 18.1 neonates born in Japan (total number of neonates was 976 979 in 2016). The total number of registered cycles demonstrated an increasing trend from 1985 to 2016 for both fresh ET and FET cycles. In 2016, the numbers of cycles registered

for fresh IVF, fresh ICSI, and FET cycles were 94 566, 161 262, and 191 962, respectively. The total number of freeze-all embryos/oocytes cycles showed an increasing trend both for IVF and ICSI cycles, and 34 188/92 185 IVF (37.1%) and 70 387/159 214 ICSI (44.2%) cycles used freeze-all embryos/oocytes in 2016, resulting in fewer fresh ET cycles in 2016 than in 2015. In terms of FET cycles, 188 388 FETs were performed resulting in 62 749 pregnancies and 44 678 neonates in 2016.

Distributions of patients' age in registered cycles, different subgroup of cycles with ET, pregnancy and live birth are shown in Figure 1. The patients' mean age for the registered cycles was 38.1 years (SD = 4.5), while the mean age for pregnancy and live birth cycles was 36.2 years (SD = 4.1) and 35.6 years (SD = 4.0), respectively.

The characteristics and treatment outcomes of the registered fresh cycles are shown in Table 2. There were 89 857 registered IVF cycles, 24 754 split-ICSI cycles, 133 709 ICSI cycles using ejaculated sperm, 2799 ICSI cycles using testicular sperm extraction (TESE), 27 gamete intrafallopian transfer cycles, 462 cycles with oocyte freezing based on medical indications, and 4220 other cycles. Of the 251 399 cycles with oocyte retrieval, 104 575 (41.6%) were freeze-all cycles. The pregnancy rate per ET was 22.7% for IVF and 18.2% for ICSI using ejaculated sperm. Single ET was performed at a rate of 81.0% with a pregnancy rate of 20.8%. The miscarriage rate per pregnancy was 25.9% for IVF, 28.5% for ICSI using ejaculated sperm, and 27.6% for ICSI with TESE, resulting in respective live birth rates per ET of 15.9%, 12.3%, and 10.3%. Singleton pregnancy rate and live birth rate were 97.0% and 96.4%, respectively.

The characteristics and treatment outcomes of the FET cycles are shown in Table 3. There were 190 541 registered cycles, of which FET was performed in 187 132 cycles leading to 62 434 pregnancies (pregnancy rate per FET = 33.4%). The miscarriage rate per pregnancy was 26.5%, resulting in a 23.0% live birth rate per ET. Single ET was performed at a rate of 82.7%, and the singleton pregnancy and live birth rate was 96.7% and 96.4%, respectively.

The treatment outcomes of registered cycles including pregnancy, miscarriage, live birth, and multiple pregnancy rates according to patients' age are shown in Table 4. Similarly, the distribution of the pregnancy, live birth, and miscarriage rates according to patients' age is shown in Figure 2. The pregnancy rate per ET exceeded 40% up to 33 years of age, gradually fell below 30% after 39 years of age and below 10% after 44 years of age. The miscarriage rate per pregnancy was 17% for those under 32 years of age and gradually increased with an increase in patient age. The miscarriage rate was below 20% under 35 years of age but gradually increased to 34.3% and 52.6% for those of 40 and 43 years of age, respectively. The live birth rate per registered cycle was around 20% up to 33 years of age and decreased to 9.0% and 2.8% at 40 and 43 years of age, respectively. Multiple pregnancy rates varied between 2% and 3% across most of the age groups.

The treatment outcomes for FET using frozen-thawed oocytes based on medical indications are shown in Table 5. The total number of FET using frozen oocytes was 106 cycles, of which 23 cycles resulted in a pregnancy (pregnancy rate per FET = 21.1%). The miscarriage rate per pregnancy was 17.4%, resulting in a 15.1% live birth rate per ET.

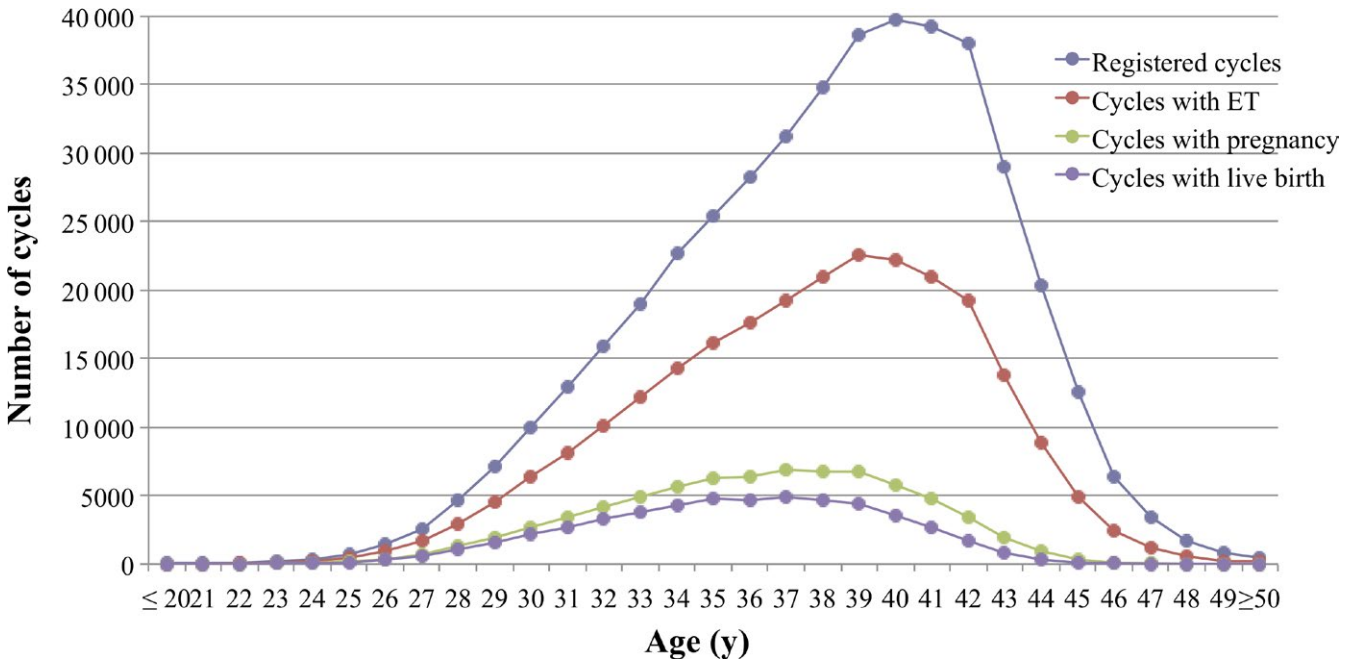

FIGURE 1 Age distributions of registered cycles, different subgroup of cycles with ET, pregnancy, and live birth. Adapted from the Japan Society of Obstetrics and Gynecology assisted reproductive technology Databook 2016 (http://plaza.umin.ac.jp/~jsog-art/2016data_20180930.pdf). ET, embryo transfer

TABLE 2 Characteristics and treatment outcomes of registered fresh cycles in assisted reproductive technology, Japan, 2016

Variables	IVF-ET	Split	ICSI		GIFT	Frozen oocyte	Others[a]	Total
			Ejaculated sperm	TESE				
No. of registered cycles	89 857	24 754	133 709	2799	27	462	4220	255 828
No. of egg retrieval	87 656	24 545	131 873	2796	27	454	4048	251 399
No. of fresh ET cycles	25 649	6499	30 917	899	27	-	506	64 497
No. of freeze-all cycles	32 379	15 090	54 036	1261	0	395	1414	104 575
No. of cycles with pregnancy	5817	1555	5635	134	1	-	85	13 227
Pregnancy rate per ET (%)	22.7	23.9	18.2	14.9	3.7	-	16.8	20.5
Pregnancy rate per egg retrieval (%)	6.6	6.3	4.3	4.8	3.7	-	2.1	5.3
Pregnancy rate per egg retrieval excluding freeze-all cycles(%)	10.5	16.4	7.2	8.7	3.7	-	3.2	9.0
SET cycles	21 199	5606	24 517	548	3	-	365	52 238
Pregnancy following SET cycles	4825	1372	4484	94	0	-	65	10 840
Rate of SET cycles	82.7%	86.3%	79.3%	61.0%	11.1%	-	72.1%	81.0%
Pregnancy rate following SET cycles	22.8%	24.5%	18.3%	17.2%	0.0%	-	17.8%	20.8%
Miscarriages	1508	357	1605	37	0	-	24	3531
Miscarriage rate per pregnancy	25.9%	23.0%	28.5%	27.6%	0.0%	-	28.2%	26.7%
Singleton pregnancies[b]	5518	1496	5318	121	1	-	82	12 536
Multiple pregnancies[b]	181	31	170	3	0	-	1	386
Twin pregnancies[b]	180	31	168	3	0	-	1	383
Triplet pregnancies[b]	1	0	2	0	0	-	0	3
Quadruplet pregnancies[b]	0	0	0	0	0	-	0	0
Multiple pregnancy rate (%)[b]	3.2	2.0	3.1	2.4	0.0	-	1.2	3.0
Live births	4078	1123	3806	93	1	-	58	9159
Live birth rate per ET (%)	15.9	17.3	12.3	10.3	3.7	-	11.5	14.2
Total number of neonates	4206	1155	3916	95	1	-	59	9432
Singleton live births	3930	1090	3666	89	1	-	57	8833
Twin live births	135	31	122	3	0	-	1	292
Triplet live births	2	1	2	0	0	-	0	5
Quadruplet live births	0	0	0	0	0	-	0	0
Pregnancy outcomes								
Ectopic pregnancies	68	26	77	1	0	-	2	174
Intrauterine pregnancies coexisting with ectopic pregnancy	1	0	1	0	0	-	0	2
Artificial abortions	23	6	28	0	0	-	1	58
Stillbirths	22	5	19	0	0	-	0	46
Fetal reductions	0	0	1	0	0	-	0	1
Unknown cycles for pregnancy outcomes	105	35	95	3	0	-	0	238

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

[a]Others include ZIFT.

[b]Singleton, twin, triplet, and quadruplet pregnancies were defined according to the number of gestational sacs in utero.

4 | DISCUSSION

Using the current Japanese ART registry system, this study demonstrated that the total number of registered ART cycles was 447 790, and resultant live births were 54 110, accounting for one in 18.1 neonates born in Japan in 2016. These figures are the largest since the registry started. Single ET was performed at rates of more than 80% for both fresh and frozen cycles, resulting in a

TABLE 3 Characteristics and treatment outcomes of frozen cycles in assisted reproductive technology, Japan, 2016

Variables	FET	Others[a]	Total
No. of registered cycles	190 541	1222	191 763
No. of FET	187 132	1100	188 232
No. of cycles with pregnancy	62 432	294	62 726
Pregnancy rate per FET (%)	33.4	26.7	33.3
SET cycles	154 801	849	155 650
Pregnancy following SET cycles	53 130	230	53 360
Rate of SET cycles (%)	82.7	77.2	82.7
Pregnancy rate following SET cycles (%)	34.3	27.1	34.3
Miscarriages	16 552	84	16 636
Miscarriage rate per pregnancy (%)	26.5	28.6	26.5
Singleton pregnancies[b]	59 472	257	59 729
Multiple pregnancies[b]	2020	12	2032
Twin pregnancies[b]	1979	11	1990
Triplet pregnancies[b]	38	1	39
Quadruplet pregnancies[b]	3	0	3
Multiple pregnancy rate (%)[b]	3.3	4.5	3.3
Live births	43 153	176	43 329
Live birth rate per FET (%)	23.1	16.0	23.0
Total number of neonates	44 484	178	44 662
Singleton live births	41 615	170	41 785
Twin live births	1412	4	1416
Triplet live births	15	0	15
Quadruplet live births	0	0	0
Pregnancy outcomes			
Ectopic pregnancies	357	2	359
Intrauterine pregnancies coexisting with ectopic pregnancy	1	0	1
Artificial abortions	277	1	278
Stillbirths	175	2	177
Fetal reduction	23	1	24
Unknown cycles for pregnancy outcomes	1702	11	1713

FET, frozen-thawed embryo transfer; SET, single embryo transfer.
[a]Including cycles using frozen-thawed oocyte.
[b]Singleton, twin, triplet and quadruplet pregnancies were defined according to the number of gestational sacs in utero.

singleton live birth rate of 96% in total. The number of freeze-all cycles increased, resulting in a reduction in the number of fresh ET cycles. These results represent the latest clinical practice of ART in Japan.

One potential reason for the rising number of ART cycles is the advancing age of patients receiving ART. In the registered cycles, the mean age of registered cycles was 38.1 years (SD = 4.5), which was much higher than the mean age for cycles with live births (35.6 years, SD = 4.0). This age gap between patients receiving ART and patients who gave live birth after ART warrants further investigation. Patients' age is the most important factor determining the probability of a live birth after ART. Since the pregnancy and live birth rates decreased as patients' age increased (Table 4), the number of ET cycles resulting in a live birth would theoretically exceed that in patients of a younger age. Thus, substantial education of patients regarding the association between age and probabilities for pregnancy in ART is essential.

Single ET was performed at a rate of more than 80% both for fresh and frozen cycles, which is the highest rate in the world.[1] Single ET is one effective way to prevent adverse perinatal outcomes related to multiple births while maintaining a cumulative live birth rate.[4] In 2008, JSOG recommended restricting the number of ETs to one in order to prevent multiple pregnancies, although double ET was allowed for women over 35 years of age or for women who

TABLE 4 Treatment outcomes of registered cycles according to patients' age, Japan, 2016

Age (y)	No. of registered cycles	No. of ET cycles	Pregnancy	Live birth	Miscarriage	Pregnancy rate per ET (%)	Pregnancy rate per registered cycles (%)	Live birth rate per registered cycles (%)	Miscarriage rate per pregnancy (%)	Multiple pregnancy rate (%)[a]
Under 20s	39	3	1	1	0	33.3	2.6	2.6	0.0	0.0
21	29	13	6	4	2	46.2	20.7	13.8	33.3	0.0
22	71	37	11	9	2	29.7	15.5	12.7	18.2	0.0
23	160	86	37	32	4	43.0	23.1	20.0	10.8	0.0
24	364	211	98	77	15	46.4	26.9	21.2	15.3	7.3
25	748	440	189	143	37	43.0	25.3	19.1	19.6	3.8
26	1463	903	386	294	73	42.7	26.4	20.1	18.9	3.4
27	2581	1631	737	568	130	45.2	28.6	22.0	17.6	3.4
28	4658	2898	1310	1035	216	45.2	28.1	22.2	16.5	2.7
29	7139	4527	1939	1520	327	42.8	27.2	21.3	16.9	3.0
30	10 020	6349	2729	2134	475	43.0	27.2	21.3	17.4	3.0
31	12 951	8156	3434	2667	613	42.1	26.5	20.6	17.9	2.9
32	15 832	10 066	4184	3249	755	41.6	26.4	20.5	18.0	3.2
33	18 966	12 138	4909	3784	900	40.4	25.9	20.0	18.3	3.1
34	22 690	14 345	5649	4302	1120	39.4	24.9	19.0	19.8	2.7
35	25 444	16 180	6284	4727	1288	38.8	24.7	18.6	20.5	3.8
36	28 303	17 667	6412	4661	1467	36.3	22.7	16.5	22.9	3.4
37	31 195	19 264	6926	4899	1716	36.0	22.2	15.7	24.8	3.6
38	34 733	20 929	6759	4676	1782	32.3	19.5	13.5	26.4	3.3
39	38 677	22 607	6703	4454	1953	29.7	17.3	11.5	29.1	3.5
40	39 752	22 168	5773	3567	1978	26.0	14.5	9.0	34.3	3.8
41	39 219	20 971	4771	2691	1895	22.8	12.2	6.9	39.7	3.2
42	38 048	19 208	3397	1717	1532	17.7	8.9	4.5	45.1	2.5
43	29 011	13 771	1918	820	1009	13.9	6.6	2.8	52.6	2.7
44	20 313	8823	930	330	565	10.5	4.6	1.6	60.8	2.4
45	12 560	4961	319	92	208	6.4	2.5	0.7	65.2	2.0
46	6437	2389	112	36	73	4.7	1.7	0.6	65.2	0.0
47	3418	1146	33	10	22	2.9	1.0	0.3	66.7	0.0
48	1716	547	9	1	8	1.6	0.5	0.1	88.9	0.0
49	772	243	6	1	4	2.5	0.8	0.1	66.7	0.0
Over 50s	481	158	5	3	2	3.2	1.0	0.6	40.0	0.0

ET, embryo transfer.

[a]Multiple pregnancies were defined according to the number of gestational sacs in utero.

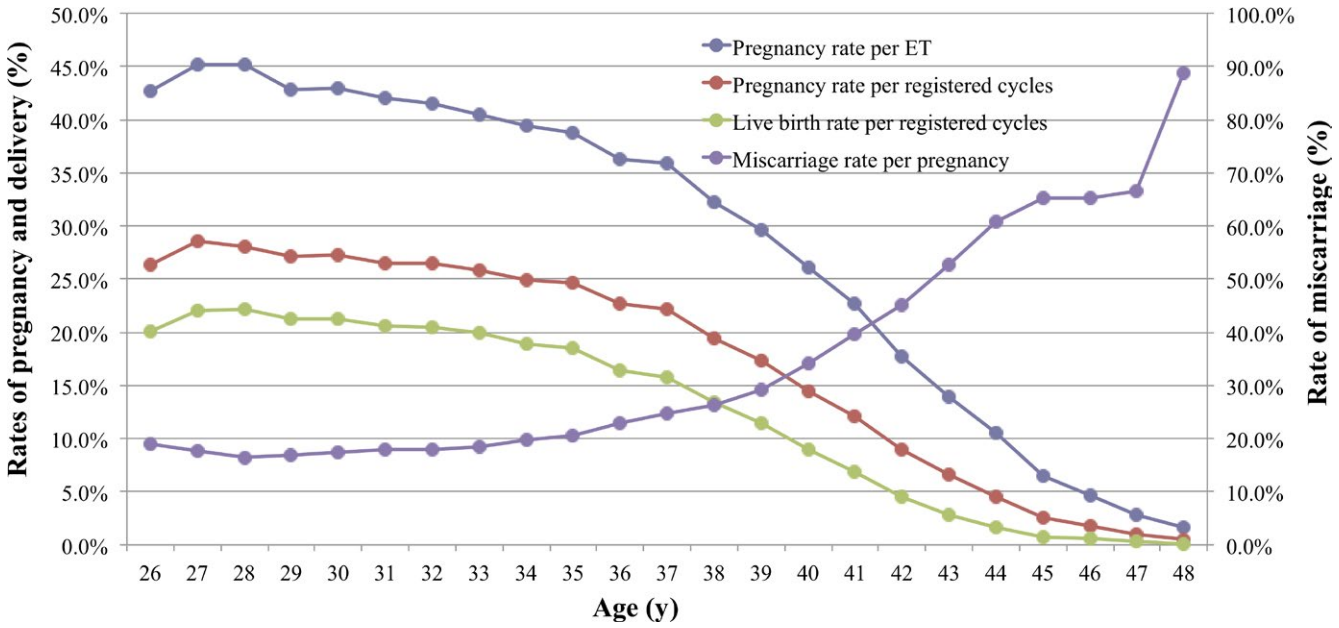

FIGURE 2 Pregnancy, live birth, and miscarriage rates according to patients' age. Adapted from the Japan Society of Obstetrics and Gynecology assisted reproductive technology Databook 2016 (http://plaza.umin.ac.jp/~jsog-art/2016data_20180930.pdf). ET, embryo transfer

experienced recurrent implantation failure. As a result, the rate of single ET dramatically increased from 49.9% in 2007 to 73.0% in 2010[5] and continues to rise (82.7% in FET cycles in 2016). The single ET policy has been credited with improving other indicators of perinatal outcomes in Japan.[6]

There was a significant transition to the freeze-all policy (Table 1). Freeze-all provides an effective treatment option for patients at high risk for ovarian hyper-stimulation syndrome (OHSS), preventing the symptoms and severity becoming worse.[7] A randomized controlled trial (RCT) in China demonstrated that the freeze-all strategy had a significantly decreased risk for adverse outcomes such as OHSS and miscarriage, and a significantly higher rate of live birth among polycystic ovary syndrome (PCOS) patients.[8] Whether the freeze-all strategy would improve ART outcomes among non-PCOS patients remains unresolved. Observational investigations demonstrated that FET cycles resulted in better pregnancy and perinatal outcomes than fresh cycles,[6,9,10] however, two RCTs published in 2018 revealed that the effect of the freeze-all strategy on pregnancy outcomes (ongoing pregnancy and live birth rate) was not different between patients who had the freeze-all strategy and who received fresh ET after oocyte retrievals.[11,12]

The strengths of the Japanese ART registry system include its mandatory reporting system and high compliance rate. Patients cannot receive a government subsidy for a cycle if their ART facility does not register the cycle-specific information. Almost all the participating ART clinics and hospitals (603 out of 604 facilities) registered cycle-specific information, which is high among participating countries of the International Committee for Monitoring Assisted Reproductive Technologies.[1] Since the Japanese ART registry system has such a significant compliance, the next step for improving the registration system is maintaining the quality of the database. In order to use the registry database for research purposes and for important feedback to participating ART facilities and patients, we need to maintain the integrity of registration, and to assess the validity of the registry, as done by other countries.[13,14] For example, by maintaining data quality, the United States registry system developed a patients' and clinicians' platform for the prediction of pregnancy and live birth rate (https://www.sart.org/), helpful for patients' education and promoting appropriate informed consent at ART facilities. Thus, the need for ongoing improvements in the registration system for participating ART facilities and patients appears inevitable.

In conclusion, our analysis of the ART registry for 2016 demonstrated that the total number of ART cycles increased and resulted in 54 110 neonates (one in 18.1 neonates in Japan). The patients' age receiving ART was significantly higher than the mean age of patients who had live birth. Single ET was performed at a rate of more than 80%, resulting in a 96% singleton live birth rate. Ongoing investigation is required to determine the effect of the increasing use of freeze-all cycles. These data represent the latest clinical practices of ART in Japan, and further improvements in the registration system in Japan will be important.

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TABLE 5 Treatment outcomes of embryo transfers using frozen-thawed oocytes based on medical indications in assisted reproductive technology, Japan, 2016

Variables	Embryo transfer using frozen-thawed oocyte
No. of registered cycles	199
No. of ET	106
No. of cycles with pregnancy	23
Pregnancy rate per ET	21.7%
SET cycles	68
Pregnancy following SET cycles	15
Rate of SET cycles	64.2%
Pregnancy rate following SET cycles	22.1%
Miscarriages	4
Miscarriage rate per pregnancy	17.4%
Singleton pregnancies[a]	23
Multiple pregnancies[a]	0
Twin pregnancies[a]	0
Triplet pregnancies[a]	0
Quadruplet pregnancies[a]	0
Multiple pregnancy rate[a]	0
Live births	16
Live birth rate per ET	15.1%
Total number of neonates	16
Singleton live births	16
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
Still births	0
Fetal reduction	0
Unknown cycles for pregnancy outcomes	3

ET, embryo transfer; SET, single embryo transfer.
[a]Singleton, twin, triplet and quadruplet pregnancies were defined according to the number of gestational sacs in utero.

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ETHICAL APPROVAL

This study was approved by the Institutional Review Board at Saitama Medical University and the ethics committee at the JSOG.

DISCLOSURES

Conflict of interest: There is no conflict of interest regarding the publication of this study. *Human rights statement and informed consent*: All the procedures accorded with the ethical standards of the relevant committees on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and its later amendments. Informed consent was obtained from all the patients in the study. *Animal rights*: This article does not contain any study that was performed by any of the authors that included animal participants.

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