Received: 7 October 2017 | Accepted: 16 October 2017

DOI: 10.1002/rmb2.12074

ORIGINAL ARTICLE

WILEY Reproductive Medicine and Biology

Assisted reproductive technology in Japan: a summary report for 2015 by The Ethics Committee of The Japan Society of Obstetrics and Gynecology

Hidekazu Saito[1] | Seung Chik Jwa[2,3] | Akira Kuwahara[4] | Kazuki Saito[5] | Tomonori Ishikawa[5] | Osamu Ishihara[2] | Koji Kugu[6] | Rintaro Sawa[7,8] | Kouji Banno[9] | Minoru Irahara[4]

[1]Division of Reproductive Medicine, Center of Maternal-Fetal, Neonatal, and Reproductive Medicine, National Center for Child Health and Development, Tokyo, Japan

[2]Department of Obstetrics and Gynecology, Saitama Medical University, Saitama, Japan

[3]Sora no Mori Clinic, Okinawa, Japan

[4]Department of Obstetrics and Gynecology, Graduate School of Biomedical Sciences, Tokushima University, Tokushima, Japan

[5]Department of Comprehensive Reproductive Medicine, Graduate School, Tokyo Medical and Dental University, Tokyo, Japan

[6]Department of Obstetrics and Gynecology, Tokyo Metropolitan Bokutoh Hospital, Tokyo, Japan

[7]Department of Obstetrics and Gynecology, Nippon Medical School, Tokyo, Japan

[8]Japan Medical Association Research Institute, Tokyo, Japan

[9]Department of Obstetrics and Gynecology, School of Medicine, Keio University, Tokyo, Japan

Correspondence
Seung Chik Jwa, Department of Obstetrics and Gynecology, Saitama Medical University, Morohongo, Moroyama, Saitama, Japan.
Email: jwa.seung@gmail.com

Abstract

Purpose: The Japan Society of Obstetrics and Gynecology (JSOG) implemented an assisted reproductive technology (ART) registry system in 1986. Here are reported the characteristics and treatment outcomes of ART cycles that were registered in 2015.

Methods: JSOG has requested all participating ART facilities to register cycle-specific information for all ART cycles since 2007. A descriptive analysis was performed by using the registry database for 2015.

Results: In total, 424 151 cycles and 51 001 neonates (1 in 19.7 neonates born in Japan) were registered in 2015. The patients' mean age was 38.2 years (standard deviation = 4.5). Among the fresh cycles, 94 158 of 244 718 (38.5%) egg retrieval cycles were cycles with freeze-all embryos or oocytes, while fresh embryo transfer (ET) was performed in 70 254 cycles, signaling a decrease from 2014. There were 169 898 frozen-thawed ET cycles, resulting in 56 355 pregnancies and 40 599 neonates. Single ET was performed at a rate of 79.7% for fresh and 81.8% for frozen cycles and the singleton pregnancy/live birth rates were 96.9%/96.5% and 96.8%/96.4% for the respective cycles.

Conclusion: The total ART cycles and live births resulting from ART has been increasing in Japan. Single ET was performed at a rate of almost 80% and ET cycles have shifted from fresh to frozen cycles.

KEYWORDS

assisted reproductive technology, in vitro fertilization, intracytoplasmic sperm injection, single embryo transfer, The Japan Society of Obstetrics and Gynecology

1 | INTRODUCTION

Since the first baby was born as a result of in vitro fertilization (IVF) in the UK in 1978,[1] assisted reproductive technology (ART) has been used as infertility treatment globally. More than 1 million babies worldwide were reportedly born as a result of ART between 2008 and 2010.[2] In Japan, the first baby born after IVF was reported by Tohoku University in 1983.[3] Since then, the number of ART cycles has

TABLE 1 Trends in the number of registered cycles, egg retrievals, pregnancies, and neonates by in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), and frozen-thawed embryo transfer cycle in Japan from 1985 to 2015

	Fresh cycles													Frozen-thawed ET cycles[c]		
	IVF[a]						ICSI[b]									
Year	No. of registered cycles	No. of egg retrievals	No. of ET cycles	No. of cycles with freeze-all embryos/ oocytes	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of egg retrievals	No. of ET cycles	No. of cycles with freeze-all embryos/ oocytes	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	28 228	7626	7416	5144	61 813	60 294	34 032	11 541	7784	5194	45 478	43 589	13 965	9257

	Fresh cycles													Frozen-thawed ET cycles[c]		
	IVF[a]						ICSI[b]									
Year	No. of registered cycles	No. of egg retrievals	No. of ET cycles	No. of cycles with freeze-all embryos/ oocytes	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of egg retrievals	No. of ET cycles	No. of cycles with freeze-all embryos/ oocytes	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates
2008	59 148	57 217	29 124	10 139	6897	4664	71 350	69 864	34 425	15 390	7017	4615	60 115	57 846	18 597	12 425
2009	63 083	60 754	28 559	11 800	6891	5046	76 790	75 340	35 167	19 046	7330	5180	73 927	71 367	23 216	16 454
2010	67 714	64 966	27 905	13 843	6556	4657	90 677	88 822	37 172	24 379	7699	5277	83 770	81 300	27 382	19 011
2011	71 422	68 651	27 284	16 202	6341	4546	102 473	100 518	38 098	30 773	7601	5415	95 764	92 782	31 721	22 465
2012	82 108	79 434	29 693	20 627	6703	4740	125 229	122 962	40 829	41 943	7947	5498	119 089	116 176	39 106	27 715
2013	89 950	87 104	30 164	25 085	6817	4776	134 871	134 871	41 150	49 316	8027	5630	141 335	138 249	45 392	32 148
2014	92 269	89 397	30 414	27 624	6970	5025	144 247	141 888	41 437	55 851	8122	5702	157 229	153 977	51 458	36 595
2015	93 614	91 079	28 858	30 498	6478	4629	155 797	153 639	41 396	63 660	8169	5761	174 740	171 495	56 888	40 611

[a]Includes gamete intrafallopian transfers; [b]includes split ICSI cycles; [c]includes cycles using frozen-thawed oocytes. ET, embryo transfer.

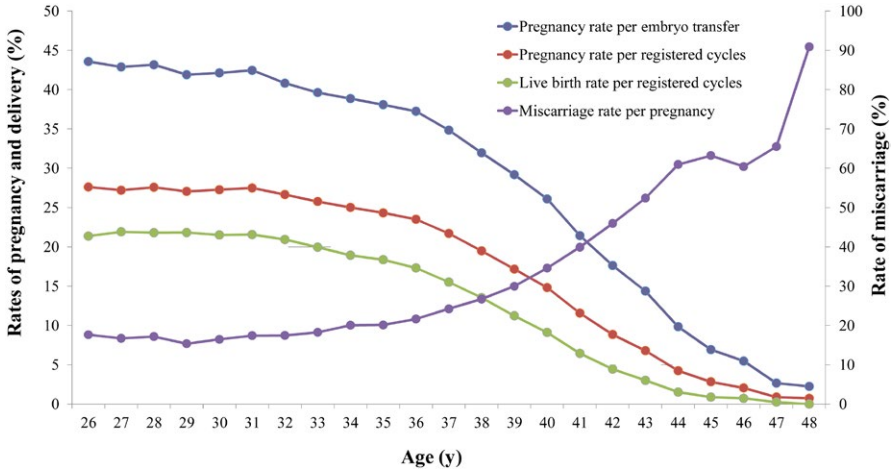

FIGURE 1 Age distribution of the registered cycles, cycles with embryo transfer, pregnancies, and live births in Japan in 2015, according to the Assisted Reproductive Technology registry. Adapted from The Japan Society of Obstetrics and Gynecology ART Databook 2015 (http://plaza.umin.ac.jp/~jsog-art/2015data_201709.pdf) (in Japanese)

increased dramatically and Japan has reportedly become one of the largest contributors of ART worldwide in terms of the annual number of procedures done.[2]

In order to record the characteristics and clinical outcomes of ART that are implemented in Japan, The Japan Society of Obstetrics and Gynecology (JSOG), Tokyo, Japan, developed an ART registry system in 1986. In 2007, JSOG launched an online registration system to collect cycle-specific information for all ART treatment cycles. Here are reported the characteristics and treatment outcomes of the ART cycles that were performed between 1 January and 31 December, 2015.

2 | MATERIALS AND METHODS

Since 2007, JSOG has requested that all ART clinics and hospitals register cycle-specific information for all ART cycles, including patient characteristics, information on ART treatment, and pregnancy and obstetric outcomes. Details on the information that has been collected in the registry have been reported previously.[4] For the period from 1 January to 31 December, 2015, JSOG requested that information on each treatment cycle that was performed at all participating institutions be registered via an online registry system by the end of November, 2016. This study was approved by the Institutional Review Board at the National Center for Child Health and Development, Tokyo, Japan, and the Ethical Review Board at JSOG.

Using the ART registry database in 2015, a descriptive analysis was performed to investigate the characteristics and treatment outcomes of registered fresh and frozen cycles. The number of registered cycles, egg retrievals, embryo transfer (ET) cycles, fresh cycles with freeze-all embryos or oocytes, pregnancies, and neonates was compared with that in previous years. The characteristics of the registered cycles and treatment outcomes were described for the fresh and the frozen cycles. The treatment outcomes included the pregnancy, miscarriage, and live birth rates, multiple pregnancies, and pregnancy outcomes for an ectopic pregnancy, intrauterine pregnancy coexisting with an ectopic pregnancy, artificial abortion, stillbirth, and fetal reduction. Furthermore, the treatment outcomes of pregnancy and the live birth and miscarriage rates were analyzed by patient age finally; the treatment outcomes for frozen-thawed ET using frozen-thawed oocytes also were investigated.

3 | RESULTS

There were 607 registered ART facilities in 2015, of which 603 participated in the ART registration system. The number of facilities that actually provided information on cycle-specific information for ART treatment in 2015 was 574; the number of implemented cycles was zero at 29 facilities. The trends in the number of registered cycles, egg retrievals, pregnancies, and neonates for IVF, intracytoplasmic sperm injection (ICSI), and frozen-thawed ET cycles from 1985 to 2015 are shown in Table1. In 2015, 424 151 cycles were registered and 51 001 neonates, accounting for 1 in 19.7 neonates who were born in Japan, were recorded. The total number of registered cycles showed an increasing trend from 1985 to 2015 for both fresh and frozen cycles. In 2015, the number of cycles that was registered for fresh IVF, fresh ICSI, and frozen cycles was 93 614, 155 797, and 174 740, respectively. The total number of fresh cycles with freeze-all embryos or oocytes showed an increasing trend both for IVF and ICSI cycles and 30 498 IVF (32.6%) and 63 660 ICSI (40.9%) cycles were cycles with freeze-all embryos or oocytes in 2015, resulting in fewer fresh ET cycles in 2015 than in 2014. In terms of frozen cycles, 171 495 frozen ETs were performed, resulting in 56 888 pregnancies and 40 611 births in 2015.

The age distribution of the women who were treated with ART in 2015 is shown in Figure 1. The patients' mean age for the registered cycles was 38.2 years (standard deviation [SD] = 4.5), while the mean age for pregnancy and live birth cycles was 36.2 years (SD = 4.1) and 35.7 years (SD = 4.0), respectively.

The characteristics and treatment outcomes of the registered fresh cycles are shown in Table2. There were 89 780 registered IVF cycles, 22 860 split ICSI cycles, 130 132 ICSI cycles using ejaculated sperm, 2803 ICSI cycles using testicular sperm extraction (TESE), 50 gamete intrafallopian transfer (GIFT) cycles, 374 cycles with oocyte freezing based on medical indications, and 3410 other

TABLE 2 Characteristics and treatment outcomes of the registered fresh cycles using assisted reproductive technology in Japan in 2015

Variable	IVF-ET	Split ICSI	ICSI		GIFT	Oocyte freezing	Others[a]	Total
			Ejaculated sperm	TESE				
No. of registered cycles	89 780	22 862	130 132	2803	50	374	3410	249 411
No. of egg retrievals	87 425	22 679	128 160	2800	50	366	3238	244 718
No. of fresh ET cycles	28 388	6597	33 807	992	39	0	431	70 254
No. of cycles with freeze-all embryos or oocytes	29 541	13 173	49 291	1196	4	312	641	94 158
No. of cycles with a pregnancy	6403	1609	6394	166	4	—	71	14 647
Pregnancy rate per ET	22.6%	24.4%	18.9%	16.7%	10.3%	—	16.5%	20.8%
Pregnancy rate per egg retrieval	7.3%	7.1%	5.0%	5.9%	8.0%	—	2.2%	6.0%
Pregnancy rate per egg retrieval excluding cycles with freeze-all embryos	11.1%	16.9%	8.1%	10.3%	8.7%	—	2.7%	9.7%
SET cycles	22 947	5677	26 457	573	9	—	308	55 971
Pregnancy following SET cycles	5234	1414	5054	105	0	—	57	11 864
Rate of SET cycles	80.8%	86.1%	78.3%	57.8%	23.1%	—	71.5%	79.7%
Pregnancy rate following SET	22.8%	24.9%	19.1%	18.3%	0.0%	—	18.5%	21.2%
Miscarriages	1666	348	1838	54	3	—	16	3925
Miscarriage rate per pregnancy	26.0%	21.6%	28.7%	32.5%	75.0%	—	22.5%	26.8%
Singleton pregnancies[b]	6003	1536	5991	142	3	—	69	13 744
Multiple pregnancies[b]	190	40	200	8	1	—	1	440
Twin pregnancies[b]	186	40	198	8	1	—	1	434
Triplet pregnancies[b]	3	0	2	0	0	—	0	5
Quadruplet pregnancies[b]	1	0	0	0	0	—	0	1
Multiple pregnancy rate	3.1%	2.5%	3.2%	5.3%	25.0%	—	1.4%	3.1%
Live births	4448	1185	4316	104	1	—	51	10 105
Live birth rate per ET	15.7%	18.0%	12.8%	10.5%	2.6%	—	11.8%	14.4%
Total number of neonates	4577	1220	4432	109	1	—	51	10 390
Singleton live births	4285	1147	4167	99	1	—	51	9750
Twin live births	143	35	131	5	0	—	0	314
Triplet live births	2	1	1	0	0	—	0	4
Quadruplet live births	1	0	0	0	0	—	0	1
Pregnancy outcomes								
Ectopic pregnancies	103	24	70	2	0	—	1	200
Intrauterine pregnancies coexisting with an ectopic pregnancy	0	0	1	0	0	—	0	1
Artificial abortions	15	6	26	0	0	—	1	48
Stillbirths	25	10	22	1	0	—	2	60
Fetal reductions	6	0	1	0	0	—	0	7
Unknown cycles for pregnancy outcomes	112	24	89	4	0	—	0	229

[a]"Others" includes zygote intrafallopian transfer; [b]Singleton, twin, triplet, and quadruplet pregnancies were defined according to the number of gestational sacs in utero. 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.

cycles. Single ET was performed at a rate of 79.7%. The pregnancy rate per ET was 22.6% for IVF, 24.4% for split ICSI, 18.9% for ICSI using ejaculated sperm, 16.7% for ICSI with TESE, and 10.3% for GIFT. The miscarriage rate per pregnancy was 26.0% for IVF, 21.6% for split ICSI, 28.7% for ICSI using ejaculated sperm, and 32.5% for ICSI with TESE, resulting in the respective live birth rate per ET of 15.7%, 18.0%, 12.8%, and 10.5%, respectively. The singleton pregnancy rate and live birth rate were 96.9% and 96.5%, respectively.

The characteristics and treatment outcomes of the frozen cycles are shown in Table3. There were 172 946 registered frozen-thawed

TABLE 3 Characteristics and treatment outcomes of frozen cycles using assisted reproductive technology in Japan in 2015

Variable	Frozen-thawed embryo transfer	Others	Total
Total number of registered cycles	172 946	1563	174 509
Total number of FETs	169 898	1462	171 360
Number of cycles with a pregnancy	56 355	518	56 873
Pregnancy rate per embryo transfer	33.2%	35.4%	33.2%
SET cycles	139 027	1078	140 105
Pregnancy following SET cycles	47 582	377	47 959
Rate of SET cycles	81.8%	73.7%	81.8%
Pregnancy rate following SET	34.2%	35.0%	34.2%
Miscarriages	14 877	147	15 024
Miscarriage rate per pregnancy	26.4%	28.4%	26.4%
Singleton pregnancies[a]	53 520	404	53 924
Multiple pregnancies	1770	33	1803
Twin pregnancies[a]	1736	33	1769
Triplet pregnancies[a]	33	0	33
Quadruplet pregnancies[a]	1	0	1
Multiple pregnancy rate	3.2%	7.6%	3.2%
Live birth rate per embryo transfer	23.0%	23.1%	23.0%
Total number of neonates	40 242	357	40 599
Singleton live births	37 740	315	38 055
Twin live births	1233	21	1254
Triplet live births	12	0	12
Ectopic pregnancies	348	1	349
Intrauterine pregnancies coexisting with an ectopic pregnancy	6	6	12
Artificial abortions	219	0	219
Stillbirths	203	3	206
Fetal reductions	4	20	24

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

ET cycles, of which 169 898 were performed and from which 56 355 pregnancies resulted (the pregnancy rate per frozen-thawed ET = 33.2%). The miscarriage rate per pregnancy was 26.4%, resulting in a 23.0% live birth rate per ET. Single ET was performed at a rate of 81.8% and the singleton pregnancy rate was 96.8%. Among the live births, 96.4% were singletons.

The total number of registered ET cycles, the number and rate of pregnancies, and the rate of live births and miscarriages by patient age in 2015 are shown in Table4. The distribution of the pregnancy, live birth, and miscarriage rates for each age is shown in Figure2. The pregnancy rate per ET exceeded 40% up to 32 years of age and 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 who were under 32 years of age and it gradually increased with an increase in patient age. The miscarriage rate was 34.6% for those who were 40 years of age and 52.4% for those who were 43 years of age. The live birth rate per registered cycle was ~20% up to 33 years of age and it decreased to 9.1% by 40 years of age and 3.0% by 43 years of age.

The treatment outcomes for ET using frozen-thawed oocytes are shown in Table 5. The total number of ETs using frozen oocytes was 135 cycles, of which 15 cycles resulted in a pregnancy (the pregnancy rate per ET = 11.1%). The miscarriage rate per pregnancy was 26.7%, resulting in an 8.1% live birth rate per ET.

4 | DISCUSSION

Using the ART registry system, this study demonstrated that the total number of registered ART cycles (424 151 cycles) and resultant live births (51 001 neonates, or 1 in 19.7 neonates who were born in Japan) were largest in 2015. Single ET was performed at a rate of almost 80% for both fresh and frozen cycles, resulting in a singleton live birth rate of 96%. The number of fresh cycles with freeze-all embryos or oocytes increased, resulting in a reduction in the number of fresh ET cycles. These results represent the latest clinical practice of ART in Japan.

One of the reasons for the increasing number of ART cycles is the age of the patients who are receiving ART. In the registered cycles, the mean age of the patients was 38.2 years (SD = 4.5) and the mean age for the cycles with live births was 35.7 years (SD = 4.0). Both figures were very high, compared with the mean age of Japanese women who have given birth. According to a 2015 report from the Ministry of Health, Labour and Welfare, the mean maternal age at the time of the first birth is 30.7 years.[5] Maternal age was the most important factor to determine the probability of a live birth after ART. As the pregnancy and live birth rates decreased as the maternal age increased (Table 4), the number of ET cycles resulting in a live birth theoretically would exceed that in mothers of a younger age.

Single ET was performed at a rate of almost 80%, both for fresh and frozen cycles. In 2008, JSOG recommended restricting the number of ETs to one in order to prevent multiple pregnancies but double ET was allowed for women who are older than 35 years of age or for women who have experienced recurrent implantation failure. As a result, the number of single ETs has increased from 49.9% in 2007 to 73.0% in 2010, while multiple pregnancies have decreased from 11.5% in 2007 to 4.8% in 2010.[6] The single ET policy has been credited with improving other indicators of perinatal outcomes in Japan.[7]

There was a significant increasing trend in the number of fresh cycles with freeze-all embryos and oocytes (Table 1). Frozen-thawed ET

TABLE 4 Treatment outcomes of registered cycles according to the patients' age in Japan in 2015

Age (years)	No. of registered cycles	No. of ET cycles	Pregnancies	Live births	Miscarriages	Pregnancy rate per ET (%)	Pregnancy rate per registered cycles (%)	Live birth rate per registered cycle (%)	Miscarriage rate per pregnancy (%)
Under 20s	33	6	2	2	0	33.3	6.1	6.1	0.0
21	31	14	9	9	0	64.3	29.0	29.0	0.0
22	57	28	12	11	0	42.9	21.1	19.3	0.0
23	123	71	27	24	2	38.0	22.0	19.5	7.4
24	300	174	85	61	15	48.9	28.3	20.3	17.6
25	662	407	182	140	29	44.7	27.5	21.1	15.9
26	1315	833	363	281	64	43.6	27.6	21.4	17.6
27	2415	1532	657	529	110	42.9	27.2	21.9	16.7
28	4326	2764	1193	943	205	43.2	27.6	21.8	17.2
29	6787	4382	1836	1481	282	41.9	27.1	21.8	15.4
30	9330	6040	2544	2007	419	42.1	27.3	21.5	16.5
31	12 072	7815	3318	2602	578	42.5	27.5	21.6	17.4
32	14 338	9358	3820	3001	667	40.8	26.6	20.9	17.5
33	16 992	11 048	4378	3390	800	39.6	25.8	20.0	18.3
34	20 988	13 505	5249	3973	1054	38.9	25.0	18.9	20.1
35	24 206	15 465	5889	4445	1186	38.1	24.3	18.4	20.1
36	26 663	16 828	6268	4618	1356	37.2	23.5	17.3	21.6
37	29 958	18 667	6505	4646	1577	34.8	21.7	15.5	24.2
38	32 641	19 895	6360	4418	1699	32.0	19.5	13.5	26.7
39	36 670	21 566	6293	4119	1886	29.2	17.2	11.2	30.0
40	38 455	21 847	5702	3505	1972	26.1	14.8	9.1	34.6
41	38 383	20 726	4441	2476	1773	21.4	11.6	6.5	39.9
42	35 406	17 772	3133	1577	1439	17.6	8.8	4.5	45.9
43	27 936	13 213	1899	843	995	14.4	6.8	3.0	52.4
44	20 080	8669	853	308	520	9.8	4.2	1.5	61.0
45	11 641	4745	329	103	208	6.9	2.8	0.9	63.2
46	6505	2446	134	48	81	5.5	2.1	0.7	60.4
47	3248	1088	29	8	19	2.7	0.9	0.2	65.5
48	1492	488	11	0	10	2.3	0.7	0.0	90.9
49	627	191	8	2	4	4.2	1.3	0.3	50.0
Over 50s	471	166	6	3	3	3.6	1.3	0.6	50.0

ET, embryo transfer.

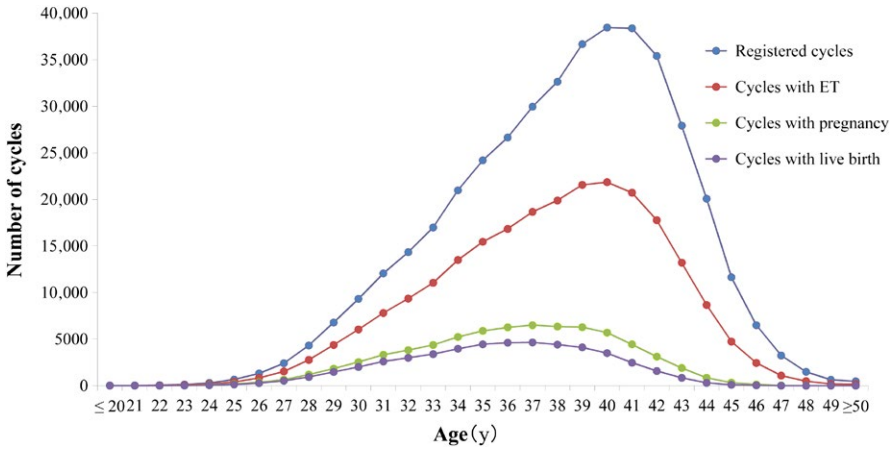

FIGURE 2 Rates of pregnancy, live,births, and miscarriage by patient age in Japan in 2015, according to the assisted reproductive technology registry. Adapted from The Japan Society of Obstetrics and Gynecology ART Databook 2015 (http://plaza.umin.ac.jp/~jsog-art/2015data_201709.pdf) (in Japanese). ET, embryo transfer

TABLE 5 Treatment outcomes of embryo transfers using frozen-thawed oocytes and assisted reproductive technology in Japan in 2015

Variable	Embryo transfer using frozen-thawed oocytes
Total number of registered cycles	231
Total number of embryo transfers	135
Number of cycles with a pregnancy	15
Pregnancy rate per embryo transfer	11.1%
SET cycles	88
Pregnancy following SET cycles	10
Rate of SET cycles	65.2%
Pregnancy rate following SET	11.4%
Miscarriages	4
Miscarriage rate per pregnancy	26.7%
Singleton pregnancies[a]	10
Multiple pregnancies	1
Twin pregnancies[a]	1
Triplet pregnancies[a]	0
Quadruplet pregnancies[a]	0
Multiple pregnancy rate	9.1%
Live births	11
Live birth rate per embryo transfer	8.1%
Total number of neonates	12
Singleton live births	10
Twin live births	1
Triplet live births	0
Ectopic pregnancies	0
Intrauterine pregnancies coexisting with an ectopic pregnancy	0
Artificial abortions	0
Stillbirths	0
Fetal reduction	0
Unknown cycles for pregnancy outcomes	0

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

cycles reportedly result in better pregnancy and perinatal outcomes than fresh cycles,[7-9] and recently, strategies for fresh cycles using freeze-all embryos has been suggested.[10] In order to avoid the risk of ovarian hyperstimulation syndrome, fresh cycles with freeze-all embryos probably will increase in the future.

The strengths of the ART registry system in Japan are 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 procedure. As almost all participating ART clinics and hospitals register cycle-specific information (99.3%), information on the latest clinical practices of ART in Japan are available. In contrast, the registry has several limitations. First, it includes multiple cycles for each patient over the years and it is impossible to distinguish cycles for a given patient; therefore, the correlations within a single patient could bias the clinical outcomes. Second, the registration of cycle-specific information and pregnancy outcomes depends on each ART facility; therefore, standardization of the data registration is important. Although JSOG publishes frequently asked questions and answers about registering data online and periodically scrutinizes these data in order to maintain their integrity, assessing the validity of the registry will continue to be very important in the future.[11,12]

In conclusion, this analysis of the ART registry for 2015 demonstrated that the total number of ART cycles increased and resulted in 51 001 neonates (1 in 19.7 neonates who were born in Japan). The patients' age when they received an ART procedure was higher than the mean age of primiparae in Japan. Single ET was performed at a rate of almost 80% and 96% of live births were singletons. The ET cycles have shifted from fresh to frozen cycles as fresh cycles with freeze-all embryos have increased. These data represent the latest clinical practices of ART in Japan and the registry has greatly contributed to improving the success and safety of ART in Japan.

ACKNOWLEDGEMENTS

We thank all of the registered facilities for their cooperation in providing their responses. We also would like to encourage these facilities to continue to promote the use of the online registry system and to assist us with our research.

DISCLOSURES

Conflict of interest: The authors declare no conflict of interest. *Human and Animal Rights*: 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. This study was approved by the Institutional Review Board at the National Center for Child Health and Development and the Ethical Review Board at the JSOG. This article does not contain any study that was performed by any of the authors that included animal participants.

ORCID

Seung Chik Jwa http://orcid.org/0000-0002-8815-5714
Kazuki Saito http://orcid.org/0000-0002-0597-9479
Tomonori Ishikawa http://orcid.org/0000-0002-1012-1557

REFERENCES

1. Steptoe PC, Edwards RG. Birth after the reimplantation of a human embryo. *Lancet*. 1978;2:366.
2. Dyer S, Chambers GM, de Mouzon J, et al. International committee for monitoring assisted reproductive technologies world report: assisted reproductive technology 2008, 2009 and 2010. *Hum Reprod*. 2016;31:1588-1609.
3. Suzuki M, Hoshi K, Hoshiai H, et al. Pregnancy achieved through in vitro fertilization and embryo transfer. *Jpn J Fert Steril*. 1983;28:439-443.
4. Irahara M, Kuwahara A, Iwasa T, et al. Assisted reproductive technology in Japan: a summary report of 1992–2014 by the Ethics Committee, Japan Society of Obstetrics and Gynecology. *Reprod Med Biol*. 2017;16:126-132.
5. Annual Report for Viatal Statistics. 2015. Ministry of Health, Labour and Welfare, Japan. Available at: http://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei15/index.html Accessed December 5, 2016 (in Japanese).
6. Takeshima K, Saito H, Nakaza A, et al. Efficacy, safety, and trends in assisted reproductive technology in Japan analysis of four-year data from the national registry system. *J Assist Reprod Genet*. 2014;31:477-484.
7. Takeshima K, Jwa SC, Saito H, et al. Impact of single embryo transfer policy on perinatal outcomes in fresh and frozen cycles – analysis of the Japanese Assisted Reproduction Technology registry between 2007 and 2012. *Fertil Steril*. 2016;105:e3.
8. Pinborg A, Wennerholm UB, Romundstad LB, et al. Why do singletons conceived after assisted reproduction technology have adverse perinatal outcome? Systematic review and meta-analysis. *Hum Reprod Update*. 2013;19:87-104.
9. Pinborg A, Loft A, Aaris Henningsen AK, Rasmussen S, Andersen AN. Infant outcome of 957 singletons born after frozen embryo replacement: the Danish National Cohort Study 1995-2006. *Fertil Steril*. 2010;94:1320-1327.
10. Roque M, Valle M, Guimaraes F, Sampaio M, Geber S. Freeze-all policy: fresh vs. frozen-thawed embryo transfer. *Fertil Steril*. 2015;103:1190-1193.
11. Toner JP, Coddington CC, Doody K, et al. Society for Assisted Reproductive Technology and assisted reproductive technology in the United States: a 2016 update. *Fertil Steril*. 2016;106:541-546.
12. Stern JE, Gopal D, Liberman RF, Anderka M, Kotelchuck M, Luke B. Validation of birth outcomes from the Society for Assisted Reproductive Technology Clinic Outcome Reporting System (SART CORS): population-based analysis from the Massachusetts Outcome Study of Assisted Reproductive Technology (MOSART). *Fertil Steril*. 2016;106:e2.

How to cite this article: Saito H, Jwa SC, Kuwahara A, et al. Assisted reproductive technology in Japan: a summary report for 2015 by The Ethics Committee of The Japan Society of Obstetrics and Gynecology. *Reprod Med Biol*. 2018;17:20-28. https://doi.org/10.1002/rmb2.12074