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SPECIAL REPORT

Assisted reproductive technology in Japan: A summary report for 2022 by the Ethics Committee of the Japan Society of Obstetrics and Gynecology

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Abstract

Purpose: This descriptive analysis evaluated the 2022 assisted reproductive technology (ART) data collected by the Japan Society of Obstetrics and Gynecology registry.

Methods and Results: In 2022 (cutoff date 30 November 2023), 634 of 635 registered ART facilities participated; 602 implemented ART treatment, with 543 630 registered cycles and 77 206 neonates (9.1% and 10.6% increases from the previous year). For fresh cycles, freeze-all in vitro fertilization and intracytoplasmic sperm injection cycles increased, resulting in 2183 and 2822 neonates, respectively. In total, 275 296 cycles resulted in oocyte retrieval, with 158 247 (57.5%) freeze-all cycles. Total single embryo transfer (ET) and singleton pregnancy rates were 82.4% and 97.2%, respectively. The singleton live birth rate was 97.4%. The number of frozen–thawed ET (FET) cycles was 264 412, with 98 348 pregnancies and 72 201 neonates. The single ET rate was 85.3%. The rate of singleton pregnancies was 96.9%; that of singleton live births was 96.9%. Per registered cycle, women had a mean age of 37.6 (standard deviation: 4.8) years; 210 322 cycles (38.7%) were conducted for women aged ≥40 years.

Conclusions: Significant growth in ART cycles and outcomes reflects the impact of recent expanded insurance coverage.

KEYWORDS
assisted reproductive technologies, fertility rate, in vitro fertilization, intracytoplasmic sperm injections, Japan

1 | INTRODUCTION

Fertility rates in Japan have been trending downward over the past four decades,[1] with rapidly declining birth rates and accelerated aging. By 2020, the total fertility rate in Japan had decreased to 1.33 births per woman,[2] lower than the previous record of 1.36 in 2019 and significantly down from the 1.44 rate in 2016.[2] More recent data indicate that the total fertility rate in Japan has continued to decrease yearly to historically low rates of 1.26 and 1.20 births per woman in 2022 and 2023.[3] The World Bank reported a global fertility rate of 2.4 in 2019, 2.3 in 2020, and 2.3 in 2022, depicting a similar global trend in declining fertility rates.[4] The underlying causes of this phenomenon are complex, with a range of factors thought to have impacted fertility and birth rates in Japan. These may include tendencies to marry late or not at all,[5,6] increasing trends in later childbearing that accompany women's empowerment in education and the workforce,[7] increased burdens of parenting and rising costs of raising children, difficulties women experience in continuing to work,[8] increases in the rate of irregular employment,[9,10] and growth of a super-aged population.[11,12]

The Japanese government has made extensive efforts to reverse these fertility trends, among which perhaps the most impactful measures might be the doubling of government spending on child-related programs and coverage of assisted reproductive technology (ART) and male infertility treatments by public insurance since April 2022.[13,14] Given the increasing trend toward later childbearing, Japan's ART field has seen significant advancements and changes over the years, reflecting evolving societal attitudes and advancements in medical technology.[14,15] Indeed, Japan is a leading country in the use of ART.[16] In 2021, 498 140 cycles of ART were performed in Japan, which led to 69 797 live births, representing increases of 10.7% and 15.5%, respectively, from the numbers reported in 2020.[17]

The Ethics Committee of the Japan Society of Obstetrics and Gynecology (JSOG) has been monitoring and reporting developments in ART since 1986. In 2007, it implemented an online ART registration system. The committee publishes an annual report that provides a comprehensive overview of ART practices, trends, and ethical considerations in Japan. This examination of data from registered ART facilities may be helpful in updating policymakers, health care providers, and the public about the evolving landscape of reproductive medicine. The following report will examine the detailed findings and implications of the 2022 ART data collected by the JSOG and compare the present results with those from previous years.

2 | MATERIALS AND METHODS

2.1 | Data source and data collection

The JSOG registry collects data from registered ART facilities across Japan. It collects demographic and background characteristics of patients, clinical information such as infertility diagnosis, treatment information, and pregnancy and obstetric outcomes following treatment as ART-cycle-specific data.[18] The present descriptive analysis investigated registered cycle characteristics and treatment outcomes using data from the Japanese ART registry in 2022 with a cutoff date of 30 November 2023.

2.2 | Variables of interest

Data for the following variables by fertilization method (in vitro fertilization [IVF], intracytoplasmic sperm injection [ICSI], and frozen–thawed embryo transfer [FET]) were collected, analyzed, and compared with data from previous years: number of registered cycles, oocyte retrievals, embryo transfer (ET) cycles, freeze-all-embryo/oocyte cycles, and numbers of pregnancies and neonates. Characteristics of registered cycles and pregnancy outcomes were described for fresh and FET cycles. Fresh cycle data were stratified by fertilization method (i.e., IVF and ICSI).

2.3 | Outcomes

The list and definitions of the treatment outcomes analyzed and compared were as follows: pregnancy (confirmation of a gestational sac in utero), miscarriage (spontaneous or unplanned loss of a fetus from the uterus before 22 weeks of gestation), live birth (delivery of at least one live neonate after 22 weeks of gestation), and multiple pregnancy rates.

The pregnancy outcomes analyzed and compared were ectopic pregnancy, heterotopic pregnancy, artificially induced abortion, stillbirth, and fetal reduction. The following outcomes were also analyzed by patient age: pregnancy, live birth, miscarriage, and multiple pregnancy rates. Treatment outcomes for FET cycles using frozen–thawed oocytes were also analyzed.

2.4 | Statistical analysis

All analyses were conducted using the STATA MP statistical package, version 18.5 (Stata, College Station). Statistical testing was not conducted as this study focuses on descriptive analysis.

3 | RESULTS

In 2022, of the 635 registered ART facilities, 634 participated in the JSOG registry and, of these, 602 actually implemented ART treatment.

Table 1 summarizes the main trends in the numbers of registered cycles, egg retrievals, pregnancy, and neonate births categorized by IVF, ICSI, and FET cycles in Japan (2007–2022). In 2022, 543 630 cycles were registered for IVF, ICSI, and FET, and a total of 77 206 neonates were recorded in Japan, representing 9.1% and 10.6% increases from the previous year. Of note, the number of IVF cycles registered increased by 3.4%, and ICSI cycles increased by 10.3% from the numbers reported in 2021.

TABLE 1 Trends in numbers of registered cycles, oocyte retrieval, pregnancy, and neonates based on IVF, ICSI, and frozen–thawed embryo transfer cycles in Japan, 2007–2022.

	IVF[a]						ICSI[b]						FET cycle[c]			
Year	No. of registered cycles	No. of egg retrievals	No. of freeze-all cycles	No. of ET cycles	No. of cycles with pregnancy	No. of neonates	No. of registered cycles	No. of egg retrievals	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
2007	53873	52165	7626	28228	7416	5144	61813	60294	11541	34032	7784	5194	45478	43589	13965	9257
2008	59148	57217	10139	29124	6897	4664	71350	69864	15390	34425	7017	4615	60115	57846	18597	12425
2009	63083	60754	11800	28559	6891	5046	76790	75340	19046	35167	7330	5180	73927	71367	23216	16454
2010	67714	64966	13843	27905	6556	4657	90677	88822	24379	37172	7699	5277	83770	81300	27382	19011
2011	71422	68651	16202	27284	6341	4546	102473	100518	30773	38098	7601	5415	95764	92782	31721	22465
2012	82108	79434	20627	29693	6703	4740	125229	122962	41943	40829	7947	5498	119089	116176	39106	27715
2013	89950	87104	25085	30164	6817	4776	134871	134871	49316	41150	8027	5630	141335	138249	45392	32148
2014	92269	89397	27624	30414	6970	5025	144247	141888	55851	41437	8122	5702	157229	153977	51458	36595
2015	93614	91079	30498	28858	6478	4629	155797	153639	63660	41396	8169	5761	174740	171495	56888	40611
2016	94566	92185	34188	26182	5903	4266	161262	159214	70387	38315	7324	5166	191962	188338	62749	44678
2017	91516	89447	36441	22423	5182	3731	157709	155758	74200	33297	6757	4826	198985	195559	67255	48060
2018	92552	90376	38882	20894	4755	3402	158859	157026	79496	29569	5886	4194	203482	200050	69395	49383
2019	88074	86334	40561	17345	4002	2974	154824	153014	83129	24490	4789	3433	215203	211758	74911	54188
2020	82883	81286	42530	13362	3094	2282	151732	150082	87697	19061	3626	2596	215285	211914	76196	55503
2021	88362	86901	42016	13219	3115	2268	170350	168659	86992	19740	3875	2850	239428	236211	87174	64679
2022	91402	89807	49433	12211	3007	2183	187816	185489	108814	19299	3878	2822	264412	260101	98348	72201

Abbreviations: ET, embryo transfer; FET, frozen–thawed embryo transfer; GIFT, gamete intrafallopian transfer; ICSI, intracytoplasmic sperm injection; IVF, in vitro fertilization.

[a]Including GIFT and other.

[b]Including split-ICSI cycles.

[c]Including cycles using frozen–thawed oocyte.

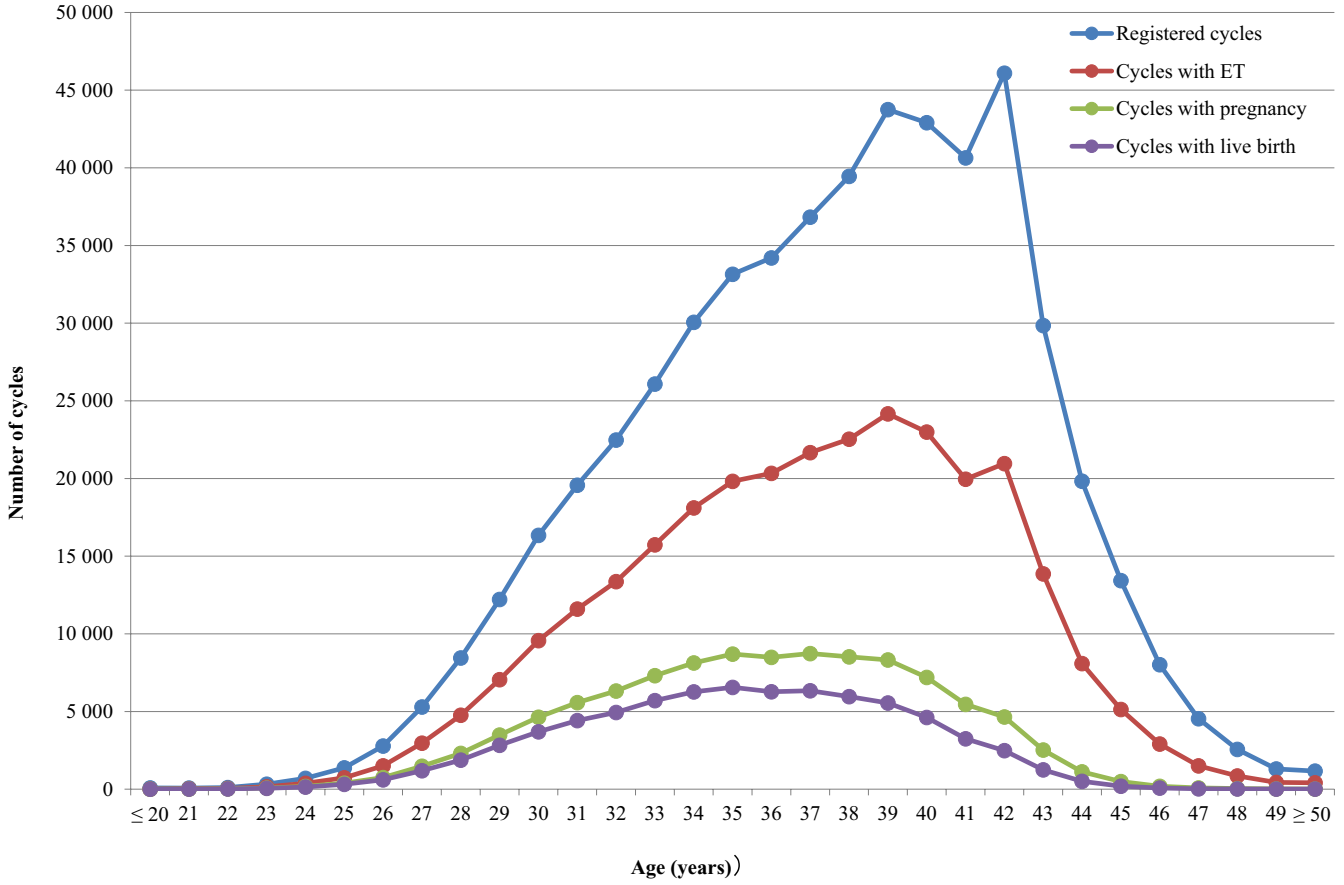

FIGURE 1 Distribution of maternal age from all registered cycles, cycles for ET, cycles leading to pregnancy, and cycles leading to live births in 2022. Adapted from the Japan Society of Obstetrics and Gynecology ART Databook 2022 (https://www.jsog.or.jp/activity/art/2022_JSOG-ART.pdf). ET, embryo transfer.

In contrast with 2021, freeze-all IVF and ICSI increased by 17.7% and 25.1%, respectively. The number of neonates born by IVF-ET cycles was 2183 and 2822 by ICSI, representing slight decreases (3.7% and 1.0%) from the previous year. The continuously increasing trend seen for FET cycles since 2007 was maintained in 2022, with a 10.4% increase. The number of FET cycles was 264 412, with 98 348 pregnancies and 72 201 neonates.

Figure 1 shows the age distributions for all registered cycles and different subgroups of cycles for ET, pregnancy, and live births in 2022. The mean patient age for registered cycles was 37.6 years (standard deviation [SD] ± 4.8); the mean age for pregnancy and live birth cycles was 35.7 years (SD ± 4.3) and 35.2 years (SD ± 4.2), respectively. In 2022, 38.7% of ART cycles (210 322 cycles) registered were undertaken for women aged 40 years or over. Of note, there was a peak in registered cycles (46095) among patients aged 42 years.

3.1 | Treatment and pregnancy outcomes

The detailed characteristics and treatment outcomes of registered fresh cycles are shown in Table 2. In 2022, 85 124 IVF cycles, 34 581 split-ICSI cycles, 150 958 ICSI cycles using ejaculated spermatozoa, 2277 ICSI cycles using testicular sperm extraction (TESE), 2628 cycles for oocyte freezing, and 3650 other cycles were registered. In total, 275 296 cycles resulted in oocyte retrieval, of which 158 247 (57.5%) were freeze-all cycles. The pregnancy rate was 24.6% per ET cycle of IVF, and 19.2% for ICSI using ejaculated spermatozoa. The total single ET rate was 82.4%, and the pregnancy rate following a single ET cycle was 22.6%. Live birth rates per ET were 17.4% for IVF, 19.0% for split-ICSI, 13.5% for ICSI using ejaculated spermatozoa, and 8.6% for ICSI with TESE. There were 6556 singleton pregnancies and 4758 singleton live births. In 2022, 2628 cycles for oocyte freezing were registered, and 2608 oocyte retrievals were conducted. Of these, 2402 cycles led to successfully frozen oocytes. The singleton pregnancy rate was 97.2%, and the singleton live birth rate was 97.4%.

Table 3 summarizes the characteristics and treatment outcomes of FET cycles. In 2022, a total of 264 015 cycles were registered. Of these, 262 146 were registered as FET cycles. Of the latter, 258 217 FETs were conducted. With a pregnancy rate of 37.8%, FET cycles resulted in 97 664 pregnancies. FET cycles resulted in 24 969 miscarriages. The miscarriage rate per pregnancy was 25.6%, and the live birth rate per FET increased slightly to 27.0% from 26.6% observed in 2021. The single ET rate was 85.3%, somewhat higher than in 2021 (84.9%), resulting in a slightly increased pregnancy rate of 38.8% from 38.1% in 2021. The rate of singleton pregnancies was 96.9%, and singleton live births was 96.9%.

TABLE 2 Characteristics and treatment outcomes of registered fresh cycles in assisted reproductive technology in Japan, 2022.

Variables	IVF	Split-ICSI	ICSI		Frozen oocyte	Other[a]	Total
			Ejaculated sperm	TESE			
No. of registered cycles	85124	34581	150958	2277	2628	3650	279218
No. of egg retrievals (0 or more)	83586	34293	148923	2273	2608	3613	275296
No. of fresh ET cycles (1 or more)	11951	2907	16088	304	0	260	31510
No. of freeze-all cycles	45068	27010	80436	1368	2402	1963	158247
No. of cycles with pregnancy	2942	752	3084	42	0	65	6885
Pregnancy rate per ET	24.6%	25.9%	19.2%	13.8%		25.0%	21.9%
Pregnancy rate per egg retrieval	3.5%	2.2%	2.1%	1.9%		1.8%	2.5%
Pregnancy rate per egg retrieval excluding freeze-all cycles	4.5%	3.6%	2.7%	2.6%		2.0%	3.3%
SET cycles	10321	2529	12721	186		220	25977
Pregnancy following SET cycles	2586	686	2515	32		61	5880
Rate of SET cycles	86.4%	87.0%	79.1%	61.2%		84.6%	82.4%
Pregnancy rate following SET cycles	25.1%	27.1%	19.8%	17.2%		27.7%	22.6%
Miscarriages	709	158	785	14		12	1678
Miscarriage rate per pregnancy	24.1%	21.0%	25.5%	33.3%		18.5%	24.4%
Singleton pregnancies[b]	2801	720	2931	41		63	6556
Multiple pregnancies[b]	74	20	90	0		2	186
Twin pregnancies	73	20	88	0		0	183
Triplet pregnancies	1	0	2	0		0	3
Quadruplet pregnancies	0	0	0	0		0	0
Multiple pregnancy rate	2.6%	2.7%	3.0%	0.0%		3.1%	2.8%
Live births	2082	553	2172	26		50	4883
Live birth rate per ET	17.4%	19.0%	13.5%	8.6%		19.2%	15.5%
Total no. of neonates	2133	568	2228	26		50	5005
Singleton live births	2031	538	2113	26		50	4758
Twin live births	51	15	56	0		0	122
Triplet live births	0	0	1	0		0	1
Quadruplet live births	0	0	0	0		0	0
Ectopic pregnancies	39	4	39	1		1	84
Heterotopic pregnancies	1	0	0	0		0	1
Artificial abortions	11	4	19	1		1	36
Still births	12	1	9	0		0	22
Fetal reductions	0	0	1	0		0	1
Cycles with unknown pregnancy outcomes	57	27	47	0		1	132

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

[a]Others include ZIFT.

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

3.2 | Outcomes by patient age

Table 4 shows the treatment outcomes of registered cycles by patient age in Japan in 2022. The pregnancy rate per ET exceeded 40% for women aged between 21 and 37 years. Gradual decreases in pregnancy rates per ET were observed with increasing maternal age, starting at age 26 years. Rates fell below 30% for women aged >41 years, below 20% among women aged >43 years, below 10% for women aged >45 years, and below 5% for women aged >48 years. The miscarriage rates tended to be below 20% for all women aged between 22 and 34 years and increased gradually with increasing maternal age. Women in their early forties had miscarriage rates generally between 33% and 52%, while women in their mid-forties had miscarriage rates over 57%. The live birth rate per registered

cycle was the highest for women aged 29 years (23.2%). Rates declined sharply to below 15.0% at 39 years of age and below 10.0% among women >41 years of age.

Figure 2 shows the rates of pregnancy, live birth, and miscarriage by patient age in all registered cycles in 2022. Of note, the pregnancy rate per ET was around 50% at ages 26 and 27 and generally above 45% between ages 28 and 34 years. There was then a progressive decline from that point, which became even more marked beyond the age of 40 years, similar to that reported in the previous year. Similar trends were observed for pregnancy and live birth rates (below 30% and 25%, respectively), with progressive declines starting as early as 35 years of age. Conversely, miscarriage rates gradually increased from the early thirties up to 38 years of age and increased rapidly thereafter until the late forties.

TABLE 3 Characteristics and treatment outcomes of frozen cycles in assisted reproductive technology in Japan, 2022.

Variables	FET	Other[a]	Total
No. of registered cycles	262 146	1869	264 015
No. of FET	258 217	1688	259 905
No. of cycles of pregnancy	97 664	643	98 307
Pregnancy rate per FET	37.8%	38.1%	37.8%
SET cycles	220 292	1386	221 678
Pregnancy following SET cycles	85 432	538	85 970
Rate of SET cycles	85.3%	82.1%	85.3%
Pregnancy rate following SET cycles	38.8%	38.8%	38.8%
Miscarriages	24 969	181	25 150
Miscarriage rate per pregnancy	25.6%	28.2%	25.6%
Singleton pregnancies[b]	93 406	617	94 023
Multiple pregnancies[b]	3000	16	3016
Twin pregnancies	2939	16	2955
Triplet pregnancies	54	0	54
Quadruplet pregnancies	6	0	6
Quintuplet pregnancies	1	0	1
Multiple pregnancy rate	3.1%	2.5%	3.1%
Live births	69 834	435	70 269
Live birth rate per FET	27.0%	25.8%	27.0%
Total no. of neonates	71 733	446	72 179
Singleton live births	67 646	424	68 070
Twin live births	2018	11	2029
Triplet live births	17	0	17
Quadruplet live births	0	0	0
Ectopic pregnancies	476	1	477
Heterotopic pregnancies	23	0	23
Artificial abortions	436	4	440
Stillbirths	239	5	244
Fetal reductions	18	0	18
Cycles with unknown pregnancy outcomes	1430	8	1438

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

[a]Including cycles using frozen–thawed oocytes.

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

3.3 | Treatment outcomes for FET cycles using frozen–thawed oocytes

Table 5 shows the primary treatment outcomes of embryo transfers using frozen–thawed oocytes in Japan in 2022. In 2022, 397 cycles using frozen–thawed oocytes were registered in Japan, of which 196 FETs were actually implemented. Forty-one pregnancies were achieved, with a pregnancy rate per FET of 20.9% and a live birth rate of 10.2%. The miscarriage rate per pregnancy was 39.0%.

4 | DISCUSSION

We described the characteristics and outcomes of ART cycles registered in the Japanese ART registry system during 2022 and compared the present results with those from 2021[17] and previous years.[19–22] The main findings of the Japanese ART registry in 2022 were as follows: in 2022, 543 630 cycles were registered; 105 233 pregnancies and a total of 77 206 neonate births were recorded by the JSOG in Japan.

In 2022, there were significant increases in ART cycles. IVF cycles increased by 3.4%, and ICSI cycles increased by 10.3%. Freeze-all cycles accounted for 57.5% of cycles with oocyte retrieval, resulting in a 3.7% decrease in neonates born from IVF-ET cycles and a 1.0% decrease in those born from ICSI cycles. FET cycles also increased by 10.4%. A total of 210 322 cycles (38.7%) were for cycles in women aged 40 years or over. The total single ET and singleton pregnancy rates for fresh cycles were 82.4% and 97.2%, respectively, and the singleton live birth rate was 97.4%. For frozen cycles, the single ET rate was 85.3%. The rates of singleton pregnancies and singleton live births were both 96.9%.

This report also reflects the impact of the first year since the expansion of insurance coverage for ART (April 2022). This expansion is perhaps the most impactful influence on the increase in the number of ART treatments in Japan, with an increased number of cycles and live births in 2022 (543 630 and 77 206, respectively) compared with 2021 (498 140 and 69 797, respectively).[17] This coverage marks a significant improvement in access to fertility treatments in Japan. It not only alleviates the financial burden on patients but also represents a crucial step toward equity in reproductive health care. For low-income couples who aspire to become parents, the cost of ART can be prohibitively high, often leading to emotional distress and limiting their options. With insurance coverage, these couples can pursue treatments without the constant worry of overwhelming expenses, thereby fostering a more supportive environment for

TABLE 4 Treatment outcomes of registered cycles based on patient age in Japan, 2022.

Age (years)	No. of registered cycles	No. of ET cycles	No. of cycles with pregnancy	Multiple pregnancies	Miscarriage	Cycles with live birth	Pregnancy rate/ registered ET (%)	Pregnancy rate/ registered cycles (%)	Live birth rate/ registered cycles	Miscarriage rate (%)	Multiple pregnancy rate (%)[a]
≤20	80	8	4	0	1	3	50.0	5.0	3.8	25.0	0.0
21	73	32	13	2	2	9	40.6	17.8	12.3	15.4	8.3
22	106	46	25	1	7	18	54.4	23.6	17.0	28.0	4.0
23	321	155	72	3	10	60	46.5	22.4	18.7	13.9	4.2
24	704	379	182	6	37	141	48.0	25.9	20.0	20.3	1.7
25	1375	730	386	24	50	317	52.9	28.1	23.1	13.0	3.5
26	2777	1507	752	20	122	603	49.9	27.1	21.7	16.2	2.0
27	5290	2961	1477	72	236	1193	49.9	27.9	22.6	16.0	3.4
28	8452	4764	2306	92	365	1869	48.4	27.3	22.1	15.8	2.7
29	12217	7054	3489	148	559	2831	49.5	28.6	23.2	16.0	3.1
30	16342	9563	4639	196	830	3692	48.5	28.4	22.6	17.9	3.3
31	19571	11596	5574	215	1000	4415	48.1	28.5	22.6	17.9	2.7
32	22481	13366	6323	236	1201	4939	47.3	28.1	22.0	19.0	2.5
33	26083	15732	7312	312	1391	5704	46.5	28.0	21.9	19.0	3.0
34	30060	18109	8132	319	1628	6268	44.9	27.1	20.9	20.0	2.9
35	33153	19818	8702	394	1867	6558	43.9	26.3	19.8	21.5	3.0
36	34198	20337	8486	392	1940	6271	41.7	24.8	18.3	22.9	3.3
37	36825	21664	8734	389	2138	6335	40.3	23.7	17.2	24.5	3.2
38	39450	22535	8522	416	2290	5960	37.8	21.6	15.1	26.9	3.6
39	43750	24167	8320	377	2517	5550	34.4	19.0	12.7	30.3	3.4
40	42903	22990	7199	337	2344	4616	31.3	16.8	10.8	32.6	3.3
41	40639	19954	5460	231	2047	3249	27.4	13.4	8.0	37.5	3.3
42	46095	20960	4651	219	2007	2484	22.2	10.1	5.4	43.2	3.2
43	29849	13859	2524	98	1194	1246	18.2	8.5	4.2	47.3	2.6
44	19824	8085	1116	45	577	508	13.8	5.6	2.6	51.7	2.5
45	13425	5131	490	13	280	197	9.6	3.6	1.5	57.1	1.7
46	8019	2908	190	7	113	77	6.5	2.4	1.0	59.5	1.6
47	4542	1506	85	3	55	29	5.6	1.9	0.6	64.7	0.0
48	2561	851	39	1	22	16	4.6	1.5	0.6	56.4	0.0
49	1302	432	17	2	8	8	3.9	1.3	0.6	47.1	11.8
≥50	1163	412	12	1	6	6	2.9	1.0	0.5	50.0	0.0
Total	543630	291611	105233	4571	26844	75172	36.1	19.4	13.8	25.5	3.1

Abbreviation: ET, embryo transfer.

[a]Multiple pregnancies were defined on the basis of the number of gestational sacs in utero.

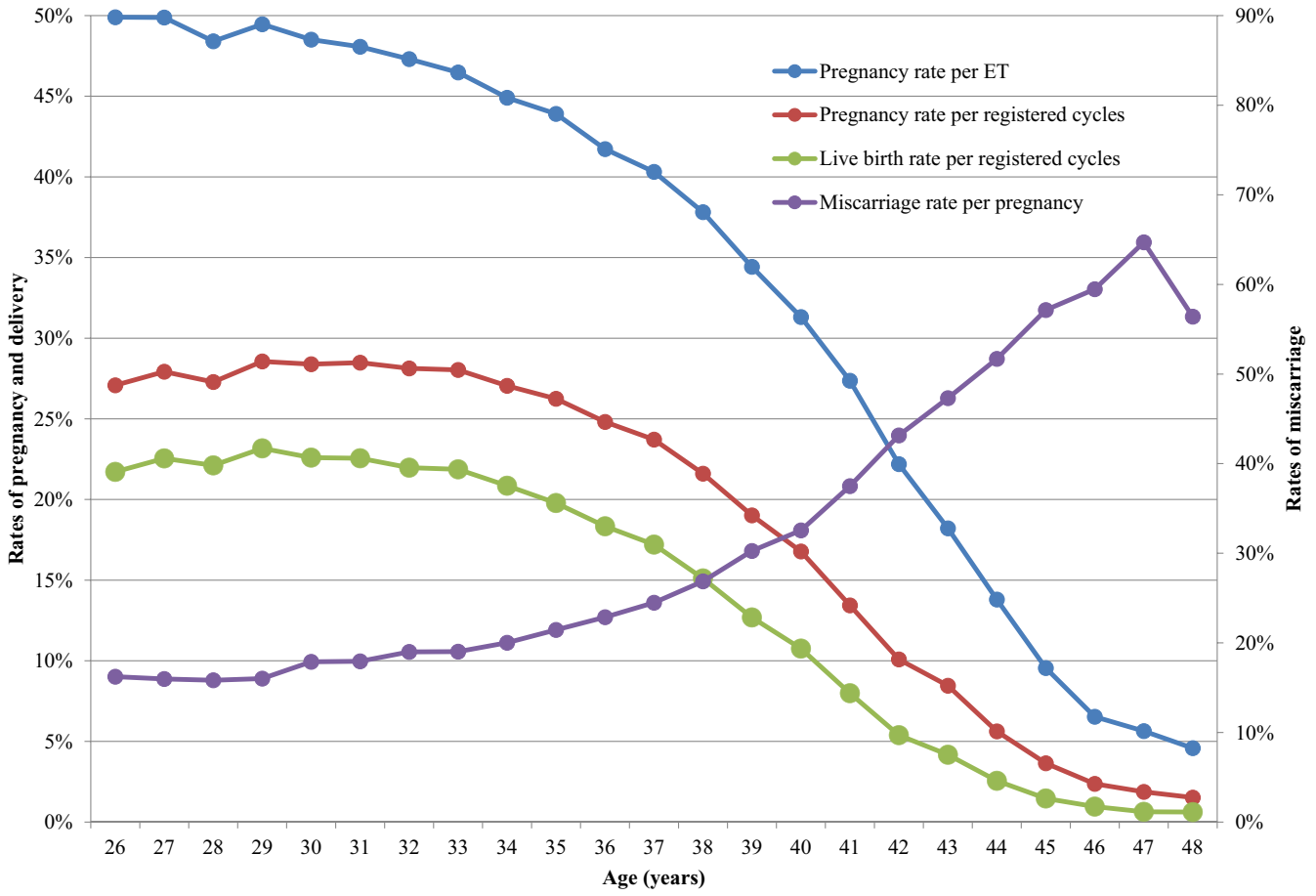

FIGURE 2 Pregnancy, live birth, and miscarriage rates according to patient age in all registered cycles 2022. Adapted from the Japan Society of Obstetrics and Gynecology ART Databook 2022 (https://www.jsog.or.jp/activity/art/2022_JSOG-ART.pdf). ET, embryo transfer.

family planning. In addition, young couples, who may be navigating the challenges of establishing their careers and finances, also stand to benefit significantly. By reducing the out-of-pocket costs associated with ART, insurance coverage enables them to make informed decisions about starting a family without the immediate pressure of financial constraints.

Additionally, the implementation of the "High-cost Medical Expense Benefit" is a noteworthy aspect of this initiative. If the co-payment, calculated on the basis of certain standards, exceeds the maximum, the excess amount will be paid as High-cost Medical Care Benefits. This program provides further financial support to individuals who face very high medical expenses, ensuring that those requiring extensive ART services are not unduly burdened.[23] By minimizing the financial risks associated with fertility treatments, this benefit can enhance treatment adherence and, ultimately, improve reproductive outcomes.

Some patients may face greater financial strain, even under the new insurance coverage system. Several local governments have started offering subsidies for advanced ART treatments not covered by public insurance. Such treatments are combined with ART procedures and are usually paid for entirely by the patient. The effect of those additional subsidies—especially for boosting the fertility rate—are, as yet, unknown. Despite being the most accessible region for ART treatments, Tokyo has the lowest fertility rate.[24] This suggests that simply reducing the financial burden of ART may not be enough to improve fertility trends.

The current system is well organized, but concerns have been raised about developing new ART treatments. Individual clinics usually innovate and develop new ART treatments, but insurance coverage seems to focus on standardized procedures. This could be, in part, because standardized treatments have established success rates and are easier to regulate and cover under insurance policies. As new treatments emerge, integrating them into the existing system, which currently leans toward standard ART, may pose certain challenges.

Another important factor that may limit families from receiving the ART insurance coverage benefit is that the couple's relationship is also scrutinized.[25] In Japan, there is no specific legislation governing the use of third-party gametes or embryos for ART. JSOG provides guidelines, but these are not legally binding.[26,27] Thus, ongoing discussion is needed regarding the creation of more comprehensive regulations.[28]

In 2022, out of 2628 oocyte freezing cycles, 2402 resulted in successfully frozen oocytes, while in 2021, out of 1103 cycles, 830 resulted in the successful freezing of oocytes. This represents success rates of approximately 91.4% in 2022 and approximately 75.2%

TABLE 5 Treatment outcomes of embryo transfers using frozen–thawed oocyte in assisted reproductive technology in Japan, 2022.

Variables	Embryo transfers using frozen–thawed oocytes
No. of registered cycles	397
No. of ET	196
No. of cycles with pregnancy	41
Pregnancy rate per ET	20.9%
SET cycles	120
Pregnancy following SET cycles	29
Rate of SET cycles	61.2%
Pregnancy rate following SET cycles	24.2%
Miscarriages	16
Miscarriage rate per pregnancy	39.0%
Singleton pregnancies[a]	36
Multiple pregnancies[a]	1
Twin pregnancies	1
Triplet pregnancies	0
Quadruplet pregnancies	0
Multiple pregnancy rate	2.7%
Live births	20
Live birth rate per ET	10.2%
Total number of neonates	22
Singleton live births	18
Twin live births	2
Triplet live births	0
Quadruplet live births	0
Ectopic pregnancies	0
Intrauterine pregnancies coexisting with ectopic pregnancy	0
Artificial abortions	1
Still births	1
Fetal reductions	0
Cycles with unknown pregnancy outcomes	2

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

in 2021, indicating a considerable increase in the success rate of oocyte freezing from 2021 to 2022.[17]

Several factors could contribute to this improvement. Fertility preservation in Japan, especially for medical reasons such as cancer, has become more popular. The Japanese government has established subsidy systems to support this. Patients can apply for subsidies from both local and central governments to help cover the costs of fertility preservation and subsequent ART.[29,30] Advances in cryopreservation techniques, such as vitrification, have improved oocyte survival rates during freezing and thawing,[31,32] with live birth rates varying based on the age at which oocytes were frozen.[31] The higher number of oocyte freezing in 2022 compared with 2021 underscores the positive impact of both technological advancements and diffusion of fertility preservation using ART in Japan.

The pregnancy rate per FET cycle has shown a secular trend, with a slight increase from 36.9% in 2021 to 37.8% in 2022. This trend is an interesting finding and might be influenced by the introduction of preimplantation genetic testing for aneuploidy (PGT-A) in Japan, following a clinical trial conducted by the JSOG.[33] PGT-A helps select chromosomally normal embryos, potentially improving implantation and pregnancy rates per embryo transfer.[34] Because of this technique, the single ET rate might increase for FET. In the future, it may be beneficial to assess pregnancy rates separately by PGT-A status in FET cycles.

This study has some strengths and limitations that have been previously reported.[17]

The main strength is that registered ART facilities nationwide must provide annual reports, leading to high reporting compliance. Furthermore, the standardization of procedures and definitions for cycle-specific information across registered ART facilities has reduced reporting bias. A major limitation is that some data for which collection is not standardized, such as background information, may be more likely incomplete or missing. Furthermore, the registration procedure is somewhat cumbersome in that participating ART facilities are assumed to register cycle-specific information manually one-by-one. Therefore, it is possible that burdens relating to data input are very high and that errors might occur. To address this, the JSOG has launched a subcommittee to debate an effective registration system from 2024, and aims to introduce a batch registration system in the near future.

The 2022 ART data analysis from the Japanese ART registry administered by the JSOG highlights significant growth in ART cycles and outcomes, reflecting the impact of the recent expansion of insurance coverage. Despite the increase in ART cycles, success rates and outcomes vary by age, emphasizing the need for continued advancements and monitoring regarding ART treatments. The data underscore the importance of age in ART outcomes, with higher pregnancy and live birth rates among younger age groups. The expansion of insurance coverage and local government subsidies have contributed to a notable increase in ART use in Japan. However, financial strain and regional disparities in fertility rates suggest that further measures are needed to address underlying challenges and improve overall fertility trends. This annual analysis is essential to comprehending the changing trends and patterns in ART, especially given the continuously declining fertility rate, growing elderly population, and decreasing population growth worldwide, particularly in Japan. As Japan continues to lead ART, integrating new treatments into the standardized insurance-covered procedures will be crucial. Addressing the financial and logistical barriers faced by patients, especially in regions with lower fertility rates, will be essential for sustaining and enhancing the success of ART programs.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to disclose about the present work. "Seung Chik, Jwa", "Akira, Iwase", "Takeshi, Iwasa", are an Editorial Board member of Reproductive Medicine and Biology and a coauthor of this article. To minimize bias, they were excluded from all editorial decision-making related to the acceptance of this article for publication.

HUMAN RIGHTS STATEMENTS AND INFORMED CONSENT

All procedures were performed according to the ethical standards of the relevant committees on human experimentation (institutional and national), as well as the Helsinki Declaration of 1964 and its later amendments.

ANIMAL RIGHTS

This report contains no studies performed by any authors that included animals.

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