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Assisted reproductive technology trends in Korea: Annual report for 2022

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Objective: The Korean government implemented national insurance coverage for infertility treatment in 2017 and established a nationwide infertility treatment data collection system in 2018. This report analyzes infertility treatment cycles performed in 2022 based on this national registry.

Methods: Data were retrospectively collected from 201 certified infertility treatment institutions in Korea. Standardized treatment forms for intrauterine insemination (IUI) and *in vitro* fertilization (IVF) were submitted to the Health Insurance Review and Assessment Service for all infertility treatment cycles conducted in 2022.

Results: A total of 200,007 infertility treatment cycles were reported in 2022, consisting of 33,137 IUI cycles and 166,870 IVF cycles. Among IVF cycles, 64.6% were initiated for fresh embryo transfers and 35.4% for frozen-thawed embryo transfers. In IVF cycles, the overall clinical pregnancy rate per embryo transfer was 30.2% for fresh and 42.0% for frozen-thawed embryo transfers. The proportion of single embryo transfers has risen steadily since 2019. The most common indication for IVF was diminished ovarian reserve, while IUI was mainly performed for unexplained or male factor infertility.

Conclusion: Nationwide infertility treatment cycle reporting in Korea has enabled detailed monitoring of infertility treatment trends and outcomes. The data show a substantial increase in IVF utilization, a growing preference for frozen-thawed embryo transfer, and broader adoption of single embryo transfer consistent with global practices. Further integration with birth outcome data and longitudinal patient tracking will be essential to evaluate cumulative success rates and overall effectiveness. This national registry provides a foundation for optimizing infertility care and facilitates international benchmarking.

Keywords: Clinical pregnancy rate; Fertilization in vitro; Intrauterine insemination; Korea; Reproductive techniques, assisted

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Introduction

Low birth rates have emerged as a critical social issue in contemporary Korean society. According to official data from Statistics Korea, the total fertility rate declined to 0.75 births per woman of reproductive age in 2024 [1]. Delayed marriage has become increasingly common, naturally contributing to an older maternal age at childbirth. As a result, the proportion of mothers aged 35 years or older continues to grow. These demographic changes have led to increasing challenges in conception and childbirth, and the number of women and men experiencing infertility has risen accordingly. Consequently, medical expenditures related to infertility treatment have continued to increase.

To address the societal impact of low birth rates and reduce the financial burden of infertility treatments, the Korean government incorporated infertility procedures into National Health Insurance coverage in 2017 and progressively expanded the eligibility criteria for reimbursement. These policy measures have lowered out-of-pocket costs for infertility care, thereby improving access to treatment and increasing the number of couples who can benefit from such services.

The Ministry of Health and Welfare (MOHW) of the Republic of Korea designates infertility treatment institutions based on legal criteria that include appropriately trained personnel, adequate facilities, and required equipment. As the number of infertility procedures has risen, the need to evaluate these designated medical institutions has become more apparent. In response, the MOHW and the Health Insurance Review and Assessment Service (HIRA) developed an assessment framework to enhance the quality and safety of infertility care. This system includes institutional surveys and standardized infertility treatment record forms for both intrauterine insemination (IUI) and *in vitro* fertilization (IVF) submitted by all designated fertility clinics to evaluate compliance with designation standards and quality indicators.

After pilot data collection in 2018, full-scale data collection began in 2019. The establishment of this nationwide database has facilitated comprehensive analysis of high-quality information on infertility treatments and supported the systematic collection and interpretation of national statistics. Previously, Korean national statistics on infertility procedures relied on voluntary reporting by individual clinics through the Korean Society of Assisted Reproduction (KOSAR), which limited data completeness and representativeness [2].

This study aims to analyze the key results of recent national infertility treatment statistics in Korea and compare them with previously published domestic and international data. Key features from the evaluation period were compared with the most recent nationwide IVF statistics published by KOSAR, which were last updated in 2011. Through this analysis, we aim to provide an updated overview of the current status of infertility treatments in the Republic of Korea.

Methods

In accordance with relevant national legal regulations, the MOHW of the Republic of Korea designates infertility treatment institutions that meet specific requirements regarding staffing, facilities, and equipment. Only institutions that satisfy these criteria are authorized to perform infertility procedures. This study included all institutions that maintained their official designation as infertility treatment facilities throughout 2022, as well as those newly designated during that year.

The evaluation period spanned from January to December in 2022. During this period, standardized infertility treatment record forms were collected for all IVF procedures of assisted reproductive technology (ART) as well as IUI performed at the designated institutions. These standardized forms, developed and maintained by the HIRA, are publicly accessible via the agency's website [3]. The data used in this analysis were collected by a national governmental agency for public purposes and were processed to remove all personally identifiable information before being made accessible. Accordingly, the dataset met all criteria for exemption from Institutional Review Board (IRB) review.

The primary data collected included:

(1) Basic demographic and clinical information of the infertile couple, including underlying causes of infertility, duration of attempted conception, obstetric history, number of previous infertility treatment attempts, and whether diagnostic evaluations for infertility had been performed.

(2) IUI procedure details, such as ovulation induction method, sperm retrieval method, whether the IUI procedure was conducted, treatment outcomes, and reasons for cycle cancellation when applicable.

(3) IVF procedure details, including the use of fresh or frozen embryos, autologous or donor oocytes, ovulation induction protocol, sperm collection method, whether oocyte retrieval was performed, whether embryo transfer was conducted, the number and type of embryos transferred, treatment outcomes, reasons for cancellation, and whether all embryos were electively frozen.

The ovulation induction protocol was classified as conventional controlled ovarian stimulation, mild stimulation, *in vitro* maturation, natural cycle, or other methods. Mild stimulation was defined as the use of a daily dose of ≤150 IU gonadotrophins, with or without oral agents. Modified natural cycles, in which no ovarian stimulation was performed but medication was administered to induce ovulation, were also categorized as natural cycles.

In the infertility treatment records used for this survey, treatment outcomes were categorized as clinical pregnancy, ectopic pregnancy, biochemical pregnancy, failed pregnancy, or indeterminate. Clinical pregnancy was defined as a cycle in which a gestational sac was identified, and the number of gestational sacs was recorded. For fresh embryo transfer cycles, ultrasound examination was recommended 3 to 5 weeks after the oocyte retrieval date, while for frozen-thawed embryo transfer cycles, ultrasound was advised approximately 3 to 5 weeks after the initiation of progestogen. Accordingly, pregnancy outcomes in this dataset were documented based on the presence or absence of a gestational sac.

The dataset included both infertility treatment cycles supported by the National Health Insurance and those conducted outside the insurance system. Treatment cycles that were initiated but subsequently discontinued were also included, with reasons for discontinuation recorded on the treatment forms. Data were collected retrospectively each year following treatment, with each institution submitting completed forms during the designated reporting period. Individual infertility treatment cycle data submitted through this process underwent HIRA's data verification procedures before being used for statistical analysis.

Results

1. Volume of infertility treatment procedures

In 2022, a total of 201 institutions were registered as certified infertility treatment centers and conducted infertility treatment procedures. According to the data collected from these centers, 33,137 IUI cycles and 166,870 IVF cycles were performed (Figure 1). A year-by-year comparison beginning in 2019 shows a steadily increasing trend in the total number of infertility treatment cycles. Notably, the number of IVF cycles increased markedly by 51.2%, rising from 110,390 in 2019 to 166,870 in 2022. In contrast, the number of IUI cycles remained relatively stable, decreasing slightly from 35,964 in 2019 to 33,137 in 2022.

To assess the age distribution of women undergoing infertility treatment, the age groups of those who received treatment in 2022 were analyzed in Table 1. Because some women may have undergone multiple treatment cycles in 2022, duplicate cases were excluded from the dataset. The largest proportion of patients belonged to the 35–39 age group (37.4%), followed by the 30–34 group (26.5%) and the 40–44 group (26.1%). When comparing mean age by treatment type, the average age for IUI was 35.0 years, identical to that in 2021, while the average age for IVF was 38.4 years, reflecting a 0.2-year increase compared with 2021 (Figure 2). By age group, IVF was most frequently performed among women aged 35–44, whereas IUI was most common in women aged 30–39 (Table 2, Figure 3).

2. Characteristics of patients undergoing infertility treatment

Among the 78,543 women who underwent infertility treatment in 2022, 33,717 (42.9%) had a previous pregnancy history, and 14,554 (18.5%) had given birth in the past. The duration of natural conception attempts is summarized in Table 3. Among women who under-

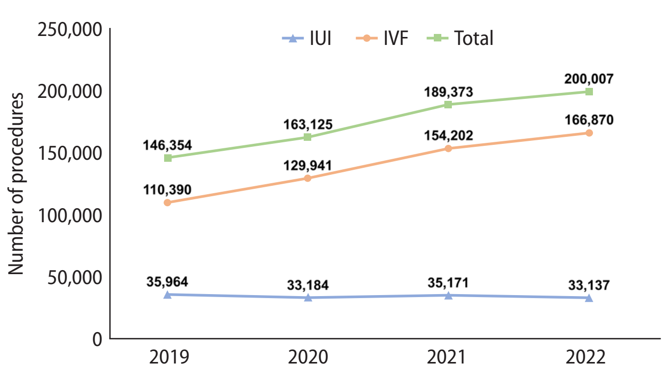

Figure 1. Annual trends in infertility treatment cycles, 2019 to 2022. IUI, intrauterine insemination; IVF, *in vitro* fertilization.

Table 1. Age distribution of women undergoing infertility treatment in 2022

Age (yr)	No. (%)
< 25	158 (0.2)
25–29	2,667 (3.4)
30–34	20,804 (26.5)
35–39	29,403 (37.4)
40–44	20,536 (26.1)
≥ 45	4,976 (6.3)
Total	78,543 (100)

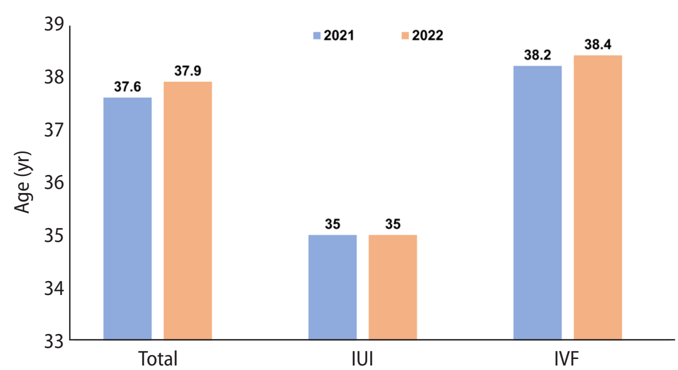

Figure 2. Mean age of patients undergoing infertility treatment by treatment type in 2022. IUI, intrauterine insemination; IVF, *in vitro* fertilization.

Table 2. Number of infertility treatment cycles by age group in 2022

Age (yr)	IUI	IVF	Total
< 25	114 (0.3)	203 (0.1)	317 (0.2)
25–29	1,937 (5.8)	3,758 (2.3)	5,695 (2.8)
30–34	14,246 (43.0)	33,553 (20.1)	47,799 (23.9)
35–39	12,452 (37.6)	57,122 (34.2)	69,574 (34.8)
40–44	3,782 (11.4)	55,040 (33.0)	58,822 (29.4)
≥ 45	606 (1.8)	17,194 (10.3)	17,800 (8.9)
Total	33,137 (100)	166,870 (100)	200,007 (100)

Values are presented as number (%).
IUI, intrauterine insemination; IVF, *in vitro* fertilization.

went IUI, the most common duration of attempting natural conception was ≥1 and <2 years (39.1%). In contrast, among women who underwent IVF, the most common duration was ≥3 years (46.6%). Of the 19,633 women who received IUI, 15,873 (80.8%) had no prior infertility treatment experience. Among the 58,910 women who underwent IVF, only 21,403 (36.3%) were undergoing infertility treatment for the first time.

Regarding the etiology of infertility by sex, male factor infertility accounted for 29,963 cases (15.0%), female factor infertility for 128,388 cases (64.2%), and combined male and female factor infertility for 41,656 cases (20.8%). Detailed causes of infertility are shown in Table 4. Among single etiologies in IVF cycles, diminished ovarian reserve was the most common cause, followed by unexplained infertility (17.5%). In contrast, unexplained infertility was the most frequent cause of IUI cycles, followed by male factor infertility. Among the 200,007 infertility treatment cycles performed in 2022, ovulatory dysfunction and unexplained infertility were more common in younger women, whereas diminished ovarian reserve increasingly predominated with advancing age (Table 5, Figure 4).

Analysis of treatment cycles according to the number of attempts showed that, for IUI, first–second attempts accounted for 81.4% of all cycles. For IVF, first–fourth attempts represented 78.3% of total cycles, although higher-order attempts were also consistently performed (Table 6).

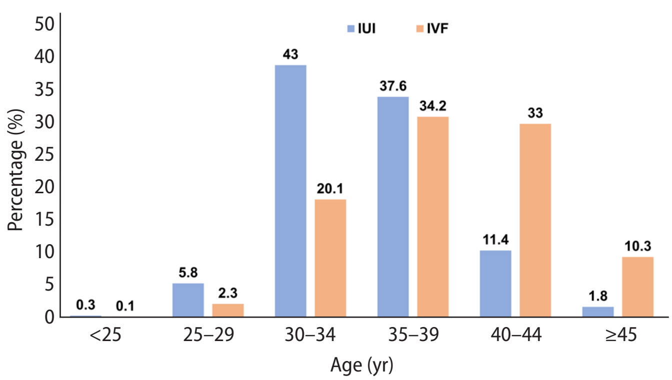

Figure 3. Proportion of infertility treatments by age group in 2022. IUI, intrauterine insemination; IVF, *in vitro* fertilization.

3. IUI outcomes

Of the 33,137 IUI cycles initiated in 2022, insemination was actually performed in 31,454 cycles (94.9%). The overall clinical pregnancy rate among these cycles was 13.0%. Age-specific pregnancy rates are summarized in Table 7. The highest success rate occurred in women under 25 years of age (17.3%), whereas the clinical pregnancy rate declined to below 10% among women aged 40 years and older.

4. IVF outcomes

Among the 166,870 IVF cycles initiated in 2022, 107,716 cycles (64.6%) were performed for embryo creation, whereas 59,154 cycles

Table 3. Distribution of the duration of infertility in 2022

	< 1 year	≥ 1 and < 2 years	≥ 2 and < 3 years	≥ 3 years	Total
IUI	3,650 (18.6)	7,685 (39.1)	3,249 (16.5)	5,049 (25.7)	19,633
IVF	6,924 (11.8)	14,274 (24.2)	10,251 (17.4)	27,461 (46.6)	58,910
Total	10,574	21,959	13,500	32,510	78,543

Values are presented as number (%).
IUI, intrauterine insemination; IVF, *in vitro* fertilization.

Table 4. Causes of infertility diagnosis in 2022

Cause	IUI	IVF	Total
Male factor	6,908 (20.8)	23,055 (13.8)	29,963 (15.0)
Ovulatory dysfunction	4,769 (14.4)	11,656 (7.0)	16,425 (8.2)
Diminished ovarian reserve	1,713 (5.2)	34,097 (20.4)	35,810 (17.9)
Tubal factor	607 (1.8)	6,645 (4.0)	7,252 (3.6)
Uterine factor	1,149 (3.5)	5,845 (3.5)	6,994 (3.5)
Endometriosis	587 (1.8)	2,694 (1.6)	3,281 (1.6)
Unexplained factor	12,358 (37.3)	29,283 (17.5)	41,641 (20.8)
Other reasons	30 (0.1)	1,538 (0.9)	1,568 (0.8)
Mixed factor	5,016 (15.1)	52,057 (31.2)	57,073 (28.5)
Total	33,137 (100)	166,870 (100)	200,007 (100)

Values are presented as number (%).
IUI, intrauterine insemination; IVF, *in vitro* fertilization.

Table 5. Age-stratified distribution of infertility treatments by etiologies in 2022

Cause	Age (yr)						Total
	< 25	25–29	30–34	35–39	40–44	≥ 45	
Male factor	70 (22.1)	1,075 (18.9)	9,943 (20.8)	13,331 (19.2)	5,109 (8.7)	435 (2.4)	29,963
Ovulatory dysfunction	76 (24.0)	1,121 (19.7)	7,070 (14.8)	6,309 (9.1)	1,725 (2.9)	124 (0.7)	16,425
Diminished ovarian reserve	5 (1.6)	213 (3.7)	2,606 (5.5)	6,958 (10.0)	17,687 (30.1)	8,341 (46.9)	35,810
Tubal factor	18 (5.7)	313 (5.5)	2,030 (4.2)	2,915 (4.2)	1,803 (3.1)	173 (1.0)	7,252
Uterine factor	3 (0.9)	70 (1.2)	1,330 (2.8)	3,221 (4.6)	2,143 (3.6)	227 (1.3)	6,994
Endometriosis	0	133 (2.3)	1,257 (2.6)	1,365 (2.0)	502 (0.9)	24 (0.1)	3,281
Unexplained factor	71 (22.4)	1,480 (26.0)	13,341 (27.9)	17,850 (25.7)	8,048 (13.7)	851 (4.8)	41,641
Other reasons	1 (0.3)	53 (0.9)	386 (0.8)	556 (0.8)	489 (0.8)	83 (0.5)	1,568
Mixed factor	73 (23.0)	1,237 (21.7)	9,836 (20.6)	17,069 (24.5)	21,316 (36.2)	7,542 (42.4)	57,073
Total	317	5,695	47,799	69,574	58,822	17,800	200,007

Values are presented as number (%).

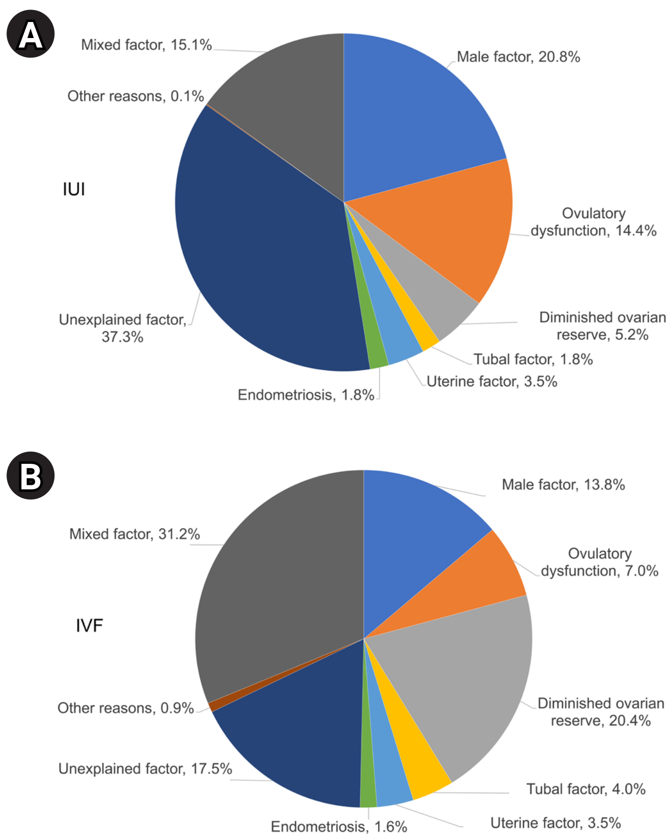

Figure 4. Causes of infertility in 2022. (A) Intrauterine insemination (IUI) and (B) *in vitro* fertilization (IVF).

Table 6. Number of attempts by treatment type in 2022

Cycle number	IUI	IVF
1st	17,309 (52.2)	62,300 (37.3)
2nd	9,683 (29.2)	33,985 (20.4)
3rd	4,083 (12.2)	20,767 (12.4)
4th	1,353 (4.1)	13,539 (8.1)
5th	486 (1.5)	9,174 (5.5)
6th	128 (0.4)	6,703 (4.0)
7th	55 (0.2)	4,937 (3.0)
8th	36 (0.1)	3,799 (2.3)
9th	16 (0.05)	2,948 (1.8)
≥ 10th	33 (0.1)	8,718 (5.2)
Total	33,137 (100)	166,870 (100)

Values are presented as number (%).
IUI, intrauterine insemination; IVF, *in vitro* fertilization.

Table 7. Clinical pregnancy rate following intrauterine insemination in 2022

Age (yr)	Insemination cycle	Pregnancy	Pregnancy rate (%)
< 25	110	19	17.3
25–29	1,865	309	16.6
30–34	13,580	1,968	14.5
35–39	11,782	1,521	12.9
40–44	3,574	260	7.3
≥ 45	543	4	0.7
Total	31,454	4,081	13.0

(35.4%) used previously frozen embryos. Of the 107,716 embryo-creation cycles, 107,244 used the patient's own fresh oocytes, 161 used the patient's own frozen oocytes, and 61 used donor oocytes; in the remaining 250 cycles, the oocyte source could not be determined. When examining ovarian stimulation methods used for oocyte retrieval, most cycles (79.1%) employed conventional controlled ovarian stimulation; however, with advancing maternal age, the proportion of IVF cycles utilizing mild stimulation or natural cycles increased (Table 8).

Among the 107,244 cycles intended for fresh oocyte retrieval, oocyte pickup was actually performed in 96,872 cases. Of these, at least one oocyte was successfully retrieved in 92,455 cycles (95.4%), whereas no oocytes were obtained in 4,417 cycles (4.6%). Analysis of the number of oocytes retrieved by age showed a progressive decline with increasing age, with women aged 40 years or older yielding fewer than 10 oocytes on average (Table 9).

Among the 92,950 cycles using partner sperm, 89,398 cycles (95.9%) involved sperm collection via ejaculation, 804 (1.3%) used surgically retrieved sperm, and 2,748 (2.9%) used frozen sperm. A total of 347 cycles (0.4%) utilized donor sperm. Of the 91,180 cycles that proceeded to fertilization, conventional IVF was performed in 15,753 cycles (17.3%), intracytoplasmic sperm injection in 66,323 cycles (72.7%), and a combination of both methods in 9,104 cycles (10.0%). For frozen-thawed embryo transfers, 59,154 cycles were initiated, and 53,947 cycles proceeded to embryo transfer.

Among the 166,870 IVF cycles performed in 2022, embryo transfer was carried out in 94,175 cycles (40,228 fresh embryo transfers and 53,947 frozen-thawed embryo transfers). The proportion of frozen-thawed embryo transfers decreased with increasing maternal age, while the rate of treatment discontinuation increased. In contrast, the proportion of cycles in which all embryos were cryopreserved remained relatively consistent across age groups (Table 10). A total of 33,029 cycles were discontinued, and 39,666 cycles involved freezing all embryos. Analysis of the 33,029 discontinued cycles revealed that 10,812 cases (32.7%) were due to failure of oocyte retrieval and 12,927 cases (39.1%) were due to failure of embryo development. Other reasons included personal circumstances (4,098 cases, 12.4%), medical conditions (3,439 cases, 10.4%), inadequate endometrium (1,650 cases, 5.0%), spontaneous conception (58 cases, 0.2%), and ovarian hyperstimulation syndrome (45 cases, 0.1%).

When analyzing age-specific clinical pregnancy rates per embryo transfer, the overall clinical pregnancy rate for fresh embryo transfers was 30.2%, with the highest rate observed in women aged 25–29 years (43.8%) (Table 11, Figure 5). Pregnancy rates declined with advancing maternal age, reaching only 4.5% in women older than 45 years. For frozen-thawed embryo transfers, the average clinical pregnancy rate was 42.0%, with the highest success again noted in the 25–29 age group (50.9%). As with fresh transfers, pregnancy rates declined with age, decreasing to 31.9% in the 40–44 age group and 9.4% in women aged 45 or older. Because pregnancy success rates decreased steeply beyond the age of 40, we conducted a further analysis of clinical pregnancy rates at 1-year intervals for women aged 40 years and above (Table 12, Figure 6). This analysis confirmed a markedly sharper annual decline in pregnancy rates compared with women under 40, as shown in the graph.

To examine yearly trends in IVF, the proportion of embryo transfer cycles involving frozen embryos was analyzed. Since 2019, the proportion of frozen-thawed embryo transfers has steadily increased, with more than half of embryo transfer cycles in recent years utilizing frozen embryos (Figure 7). Analysis of annual trends in the number of embryos transferred showed a consistent increase in the use of single embryo transfer (SET) (Table 13). In IVF cycles resulting in clinical pregnancy, the incidence of multiple pregnancies displayed a steady downward trend (Table 14). Finally, an analysis of annual

Table 8. Ovarian stimulation methods used for *in vitro* fertilization cycles in 2022

Age (yr)	Conventional controlled ovarian stimulation	Mild stimulation	Natural cycle	In vitro maturation	Total
< 25	103 (94.5)	6 (5.5)	0	0	109
25–29	1,854 (92.7)	114 (5.7)	27 (1.3)	6 (0.3)	2001
30–34	16,214 (90.9)	1,241 (7.0)	330 (1.9)	43 (0.2)	17828
35–39	29,225 (87.1)	3,342 (10.0)	955 (2.8)	40 (0.1)	33562
40–44	29,953 (75.6)	7,201 (18.2)	2,450 (6.2)	18 (0.04)	39622
≥ 45	7,528 (53.3)	4,454 (31.5)	2,138 (15.1)	2 (0.01)	14122
Total	84,877 (79.1)	16,358 (15.3)	5,900 (5.5)	109 (0.1)	107244

Values are presented as number (%).

Table 9. Number of oocytes retrieved by age group in 2022

Age (yr)	1–4 oocytes	5–9 oocytes	10–19 oocytes	20–29 oocytes	≥ 30 oocytes	Mean
< 25	6 (5.8)	18 (17.3)	38 (36.5)	28 (26.9)	14 (13.5)	17.5
25–29	170 (9.0)	486 (25.7)	539 (28.5)	511 (27.0)	188 (9.9)	15.8
30–34	1,722 (10.4)	5,251 (31.7)	4,903 (29.6)	3,641 (22.0)	1,059 (6.4)	13.8
35–39	5,685 (18.7)	11,911 (39.2)	7,690 (25.3)	4,232 (13.9)	862 (2.8)	10.6
40–44	12,467 (37.2)	14,205 (42.4)	4,907 (14.7)	1,707 (5.1)	184 (0.5)	6.7
≥ 45	6,440 (64.2)	3,044 (30.3)	435 (4.3)	103 (1.0)	9 (0.1)	3.7
Total	26,490 (28.7)	34,915 (37.8)	18,512 (20.0)	10,222 (11.1)	2,316 (2.5)	9.1

Values are presented as number (%).

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Table 10. Status of IVF cycles by age group in 2022: completion through embryo transfer

Age (yr)	No. of IVF cycles initiated	Embryo transfer			Treatment discontinuation	Embryo freeze-all
		Total	Fresh	Frozen		
< 25	203	144 (100)[a]	53 (36.8)[a] 70.9%	91 (63.2)[a]	11 (5.4)	48 (23.6)
25–29	3,758	2,504 (100)[a]	859 (34.3)[a] 66.6%	1,645 (65.7)[a]	297 (7.9)	957 (25.5)
30–34	33,553	22,467 (100)[a]	7,797 (34.7)[a] 67.0%	14,670 (65.3)[a]	3,011 (9.0)	8,075 (24.1)
35–39	57,122	35,916 (100)[a]	14,415 (40.1)[a] 62.9%	21,501 (59.9)[a]	7,677 (13.4)	13,529 (23.7)
40–44	55,040	27,368 (100)[a]	13,819 (50.5)[a] 49.7%	13,549 (49.5)[a]	14,374 (26.1)	13,298 (23.7)
≥ 45	17,194	5,776 (100)[a]	3,285 (56.9)[a] 33.6%	2,491 (43.1)[a]	7,659 (44.5)	3,759 (21.9)
Total	166,870	94,175 (100)[a]	40,228 (42.7)[a] 56.4%	53,947 (57.3)[a]	33,029 (19.8)	39,666 (23.8)

Values are presented as number (%).
IVF, *in vitro* fertilization.
[a]The percentage indicates the proportion of fresh or frozen-thawed embryo transfers within the total number of embryo transfer cycles.

Table 11. Clinical pregnancy rate per embryo transfer following *in vitro* fertilization by age group in 2022

Age (yr)	Fresh embryos			Frozen embryos		
	Embryo transfer	Clinical pregnancy	Clinical pregnancy rate (%)	Embryo transfer	Clinical pregnancy	Clinical pregnancy rate (%)
< 25	53	22	41.5	91	40	44.0
25–29	859	376	43.8	1,645	837	50.9
30–34	7,797	3,348	42.9	14,670	7,234	49.3
35–39	14,415	5,411	37.5	21,501	9,994	46.5
40–44	13,819	2,829	20.5	13,549	4,317	31.9
≥ 45	3,285	149	4.5	2,491	235	9.4
Total	40,228	12,135	30.2	53,947	22,657	42.0

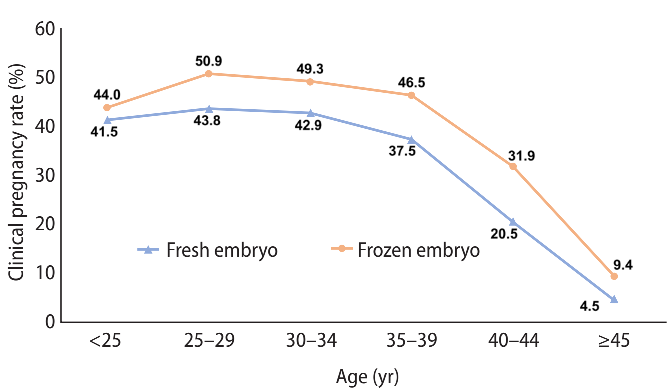

Figure 5. Clinical pregnancy rate by patient age group according to the type of embryo transfer in 2022.

trends in IVF cycles using donor oocytes and donor sperm indicated that such cycles remain relatively uncommon in Korea (Figure 8).

Discussion

Through this study, we were able to comprehensively examine the distribution of infertility treatment cycles by type, the characteristics of couples who underwent treatment, and the clinical outcomes based on data collected from 201 certified infertility treatment institutions in the Republic of Korea in 2022. Because these data were obtained through close collaboration between the government and infertility treatment institutions, the survey encompassed all infertility treatment cycles nationwide. In addition to conventional ART, the survey also included data on IUI, enabling precise analysis of IUI-related statistics through comprehensive national data collection. This broad coverage lends particular significance to the findings, as they

Table 12. Clinical pregnancy rate per embryo transfer following *in vitro* fertilization in women aged 40 years and older in 2022

Age (yr)	Fresh embryos			Frozen embryos		
	Embryo transfer	Clinical pregnancy	Clinical pregnancy rate (%)	Embryo transfer	Clinical pregnancy	Clinical pregnancy rate (%)
40	3,253	946	29.1	3,808	1,496	39.3
41	3,070	736	24.0	3,299	1,154	35.0
42	2,957	556	18.8	2,770	828	29.9
43	2,526	392	15.5	2,160	569	26.3
44	2,013	199	9.9	1,512	270	17.9
≥ 45	3,285	149	4.5	2,491	235	9.4
Total	13,819	2,829	20.5	13,549	4,317	31.9

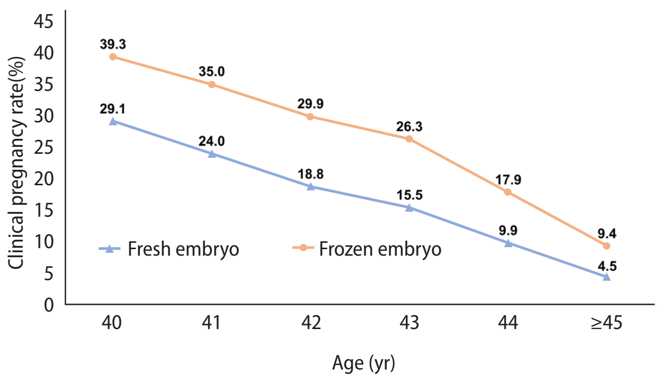

Figure 6. Clinical pregnancy rates by patient age according to the type of embryo transfer in women aged 40 years and older in 2022.

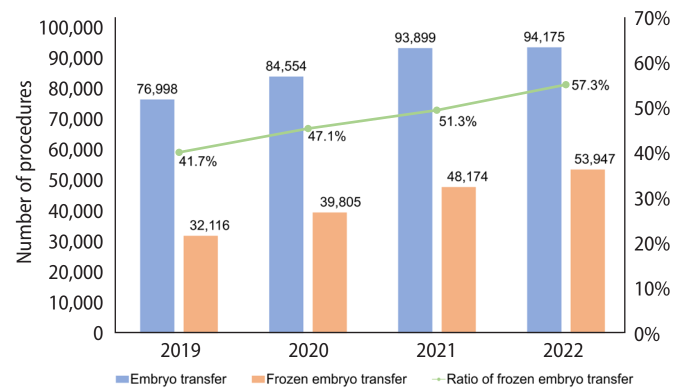

Figure 7. Proportion of frozen-thawed embryo transfers among completed embryo transfer cycles by year.

Table 13. Number of embryos transferred by year

	Year			
	2019	2020	2021	2022
No. of cycles	76,998	84,554	93,899	94,175
1 embryo	21,695 (28.2)	25,512 (30.2)	30,501 (32.5)	33,810 (35.9)
2 embryos	38,982 (50.6)	41,121 (48.6)	44,338 (47.2)	42,119 (44.7)
3 embryos	16,245 (21.1)	17,791 (21.0)	18,962 (20.2)	18,151 (19.3)
4 embryos	57 (0.1)	53 (0.1)	72 (0.1)	81 (0.1)
≥ 5 embryos	19 (0.02)	77 (0.1)	26 (0.03)	13 (0.01)

Values are presented as number (%).

Table 14. Trends in the rate of multiple pregnancies following embryo transfer by year

	Year			
	2019	2020	2021	2022
No. of cycles	76,998	84,554	93,899	94,175
Clinical pregnancy	26,264	29,344	33,996	34,792
Singleton	20,853 (79.4)	23,644 (80.6)	27,490 (80.9)	28,583 (82.2)
Twin	5,139 (19.6)	5,417 (18.4)	6,208 (18.3)	5,923 (17.0)
Triplets or higher	272 (1.0)	283 (1.0)	298 (0.9)	286 (0.8)

Values are presented as number (%).

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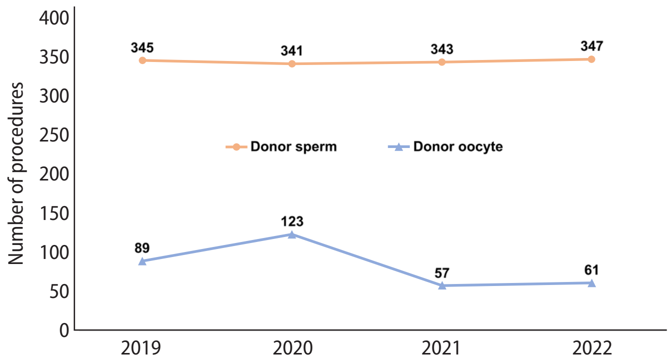

Figure 8. Number of embryo transfer cycles using donor oocytes and donor sperm by year.

accurately reflect real-world clinical practice.

The number of infertility treatment cycles has shown a continuous upward trend, driven primarily by the increase in IVF cycles rather than IUI. This rise appears to be associated with the increasing age at which individuals attempt conception, which corresponds to a higher prevalence of infertility among women. As described in the introduction, the age of women planning childbirth in Korea has been steadily rising. From a societal perspective, supporting these women in achieving pregnancy holds considerable importance. Accordingly, the government has expanded infertility treatment coverage under the National Health Insurance system and progressively relaxed eligibility criteria by increasing the number of reimbursable treatment attempts and eliminating the upper age limit for coverage. These policy measures, together with the broader societal trend of delayed childbearing, have contributed to the observed increases in maternal age at treatment and the number of treatment attempts, as demonstrated in the nationwide data. As is well recognized, advancing maternal age is associated with the need for a greater number of infertility treatment attempts to achieve pregnancy, which in turn has fueled the accelerated growth in IVF cycles. Indeed, diminished ovarian reserve was the most common primary indication for IVF. By contrast, IUI is generally indicated for cases of unexplained infertility or mild to moderate male factor infertility. Because the prevalence of these conditions has remained relatively stable over time, the number of IUI procedures has also remained relatively steady, consistent with the present findings.

In 2022, the mean age of women undergoing IVF in Korea was 38.4 years, with 77.5% aged ≥35 years and 43.3% aged ≥40 years. In comparison, data from 2011 indicated that 53.0% were aged ≥35 years and 16.6% were aged ≥40 years, demonstrating a marked upward trend in the proportion of older women receiving IVF [2]. Representative international statistics show comparatively lower maternal ages at treatment: according to the U.S. Centers for Disease Control and Prevention (CDC) ART summary, the mean age of women undergoing ART was 36.3 years, with 64% aged ≥35 years, while the U.K. Human Fertilization and Embryology Authority (HFEA) reported a mean age of 36.0 years for women undergoing IVF in 2021 [4,5]. These comparisons highlight that the average age of women receiving IVF in Korea is notably higher than in other countries. Analysis of the present dataset further confirmed that IVF success rates decline sharply after age 40, with year-by-year evaluation underscoring the profound impact of age on clinical outcomes in this group. Among older women undergoing infertility treatment, repeated failures and increasing numbers of attempts raise concerns regarding both short-term and long-term women's health. Furthermore, even when pregnancy is achieved, advanced maternal age is associated with a higher risk of obstetric complications. These challenges translate into increased medical resource utilization and broader societal burdens. Therefore, the findings provide valuable evidence for refining national policies on infertility treatment support. Social strategies to encourage earlier initiation of infertility evaluation are also warranted, including support for fertility screening programs aimed at improving awareness of diminished ovarian reserve and facilitating timely intervention.

Review of national data on IVF outcomes further revealed differences in success rates between fresh and frozen-thawed embryo transfers. The relative advantage of frozen-thawed embryo transfer appears to vary by maternal age. In younger women, supraphysiologic estrogen levels during ovarian stimulation may impair endometrial receptivity, and the use of frozen embryos may reduce this risk. In older women, frozen-thawed embryo transfers are often performed to allow preimplantation genetic testing for aneuploidy (PGT-A). Among women aged ≥40 years, the clinical pregnancy rate with frozen-thawed embryo transfer was approximately 10% higher than with fresh transfer. The marked difference in clinical pregnancy rates between fresh and frozen-thawed embryo transfers in this age group suggests that variations in utilization patterns may contribute to this disparity. However, the actual impact of PGT-A on outcomes among older women requires further investigation through dedicated studies.

Previously, national infertility treatment statistics in Korea were compiled by the KOSAR, which distributed surveys to fertility clinics across the country. Infertility treatment cycle data were collected based on voluntary submissions from each institution. Because participation in this survey was not mandatory, only 74 institutions provided data in 2011. This approach had inherent limitations, as it tended to capture data primarily from larger medical centers with well-established reporting systems. In addition, institutions with less favorable treatment outcomes may have been reluctant to submit data, potentially introducing reporting bias and limiting the accuracy of national statistics. As fertility rates have declined and the number of infertile individuals has steadily increased, public attention to and recognition of the importance of infertility treatment have grown. In response, the MOHW of the Republic of Korea expanded governmental support for infertility treatment and recognized the need to systematically manage both the quantity and quality of infertility services at the national level. Accordingly, alongside the implementation of national insurance coverage for infertility treatment procedures, the government established a legal framework mandating the collection of data on each infertility treatment cycle performed by registered fertility clinics. This comprehensive data collection system has enabled the generation of high-quality nationwide infertility statistics, as demonstrated in the present analysis. These data have facilitated the identification of infertility treatment trends over time, the characterization of the infertile population, and the evaluation of treatment volume and outcomes. Furthermore, such systematic national data not only support continuous quality improvement in infertility treatment but also promote safe and standardized clinical practices. They additionally enable monitoring of changes in infertility treatment trends and allow for international comparisons with other countries.

Globally, several countries have implemented robust systems for national infertility treatment data reporting. In the United States, the Fertility Clinic Success Rate and Certification Act requires all infertility treatment clinics to report standardized pregnancy outcome data to the CDC. As a result, IVF cycle data are prospectively collected, and both the U.S. Department of Health and Human Services and CDC publish annual national summary reports on IVF outcomes on their official websites [4]. In the United Kingdom, the HFEA has collected national IVF data and published annual reports since 1992, making results publicly available through the HFEA website [5]. In Japan, the Japan Society of Obstetrics and Gynecology established a national ART registry in 1986 and began publishing annual reports in 1989. Since 2007, a nationwide online registration system has enabled the retrospective aggregation of all IVF cycles performed at certified facilities, with periodic publication of results by the society [6].

Since 2018, Korea has implemented a national data collection system encompassing all infertility treatment cycles, enabling the analysis of long-term trends and allowing comparisons with outcomes and trajectories reported in other countries. In the 2010 national dataset from Korea, fresh embryo transfer cycles accounted for 78.9% of all embryo transfers, whereas frozen-thawed embryo transfer cycles comprised only 20.4%. By 2022, however, the proportion of frozen-thawed embryo transfer cycles had increased to 35.4%, while fresh embryo transfer cycles had decreased to 64.6%. This shift reflects emerging evidence suggesting that frozen-thawed embryo transfer cycles may achieve higher pregnancy rates than fresh cycles, a trend also observed in the present Korean dataset [7]. Regarding whether frozen-thawed embryo transfer is superior to fresh embryo transfer in terms of live birth rate, recent randomized controlled trials have shown inconclusive results, highlighting the need for continued data collection and further research [8]. Nonetheless, even in those studies, frozen-thawed embryo transfer demonstrated the advantage of a lower incidence of ovarian hyperstimulation syndrome, which remains one of its major benefits. Concurrently, there has been a global effort to reduce multiple pregnancy rates—an important outcome associated with increased maternal and neonatal complications—by promoting the use of SET [9]. A related meta-analysis demonstrated that elective SET, compared with two-embryo transfer, was associated with reductions in preterm birth and low birth weight [10]. Because of this association, the United States monitors multiple births through its IVF surveillance system and publishes regular reports on the use of SET [11]. Similarly, the HFEA in the United Kingdom continuously publishes official reports detailing trends in multiple births associated with fertility treatment. In the present analysis, the proportion of SET cycles showed a marked increase in 2019 compared with 2018 and continued to rise steadily in subsequent years. As a result, a gradual increase in the rate of singleton pregnancies per embryo transfer was also observed. These findings highlight a growing alignment between clinical practice and emerging scientific evidence within Korean infertility centers. The data indicate that clinicians are increasingly incorporating research-based strategies to optimize IVF outcomes while minimizing complications, thereby contributing to safer and more effective infertility care.

As nationwide data collection for infertility treatment in Korea has only recently begun, several limitations remain that warrant future improvement. One major limitation is the lack of linkage with birth outcome data. Because the ultimate goal of infertility treatment is the delivery of a healthy live-born infant, future datasets must include information on birth outcomes, including live birth rates, multiple pregnancy rates, obstetric complications, and neonatal health indicators. Additionally, the current system collects data annually on a per-cycle basis to protect personal information, which limits the ability to conduct long-term follow-up of individuals undergoing multiple infertility treatment cycles over several years. However, long-term patient-level data are of considerable medical and policy relevance, and the development of a system that allows longitudinal linkage and analysis of these segmented annual data is needed. Such a system would make it possible to evaluate cumulative pregnancy and live birth rates per oocyte retrieval cycle, which are key metrics for assessing the overall success of infertility treatments.

As a result of the Korean government's national-level support for infertility treatment and the active cooperation of medical professionals engaged in infertility care, a comprehensive system has been established to collect, analyze, and longitudinally monitor infertility

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treatment outcomes across the country. This system has enabled the production of highly accurate national infertility treatment statistics and has provided meaningful insights into evolving trends in Korea that parallel global developments. The number of IVF procedures has increased sharply in recent years. At the same time, the use of frozen-thawed embryo transfer has expanded, and the proportion of SETs has risen, reflecting ongoing efforts to reduce multiple pregnancies and enhance the safety of ART. With continued accumulation of longitudinal data and supplementation of currently missing information, this system will not only support the optimization of infertility treatment outcomes and improvements in patient safety but also enable objective international comparisons of treatment results and emerging trends.

Conflict of interest

Young Sik Choi is an associate editor and Jung Ryeol Lee and Dayong Lee are editorial board members of the journal, but they were not involved in the peer reviewer selection, evaluation, or decision process of this article. No other potential conflicts.

Author contributions

Conceptualization: YC, KH, JSJ, JRL. Methodology: MES, HJL. Formal analysis: MES, HJL. Data curation: DL, MES, HJC, HJL, YC, JSJ, JRL. Visualization: MES, HJL. Supervision: YSC, YC, KH, JSJ, JRL. Writing-original draft: DL, MES. Writing-review & editing: DL, JRL. Approval of final manuscript: KH, JSJ, JRL.

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