2015 Assisted Reproductive Technology

National Summary Report

National Center for Chronic Disease Prevention and Health Promotion
Division of Reproductive Health

Updates to this report will be posted on the CDC website at the following address:
https://www.cdc.gov/art/artdata/index.html
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Or write to CDC, ATTN: ART Surveillance and Research Team
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October 2017

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2015 National Report

INTRODUCTION TO THE 2015 NATIONAL REPORT

Data provided by United States clinics that use assisted reproductive technology (ART) to treat infertility are a rich source of information about the factors that contribute to a successful ART treatment—the delivery of a healthy live-born infant. Pooling the data from all reporting clinics provides a national picture that could not be obtained by examining data from an individual clinic.

A woman's chances of having a pregnancy and a live birth when using ART are influenced by many factors, some of which are patient-related and outside a clinic's control (for example, the woman's age or the cause of infertility). Because the national data include information on many of these factors, this can give potential ART patients an idea of the average chances of success. Average chances, however, do not necessarily apply to a particular individual or couple. People considering ART should consult their physician to discuss all the factors that apply in their particular case.

The data for this national report come from the 464 fertility clinics in operation in 2015 that provided and verified data on the outcomes of all ART cycles started in their clinics. Of the 231,936 ART cycles performed in 2015 at these reporting clinics, 186,157 cycles (80%) were started with the intent to transfer at least one embryo. These 186,157 cycles resulted in 60,778 live births (deliveries of one or more living infants) and 72,913 infants.

Of the 186,157 ART cycles started in 2015 with the intent to transfer at least one embryo, 4,003 cycles were reported with the intent to thaw a previously frozen egg, fertilize the egg, and then transfer the resulting embryo. However, because this cycle type (a frozen egg cycle) does not contribute to the calculation of any success rates for the 464 clinics included in the *2015 Assisted Reproductive Technology Fertility Clinic Success Rates Report* (hereafter called the *2015 Fertility Clinic Success Rates Report*), the 4,003 frozen egg cycles are not included in the majority of this national report. The majority of the report includes the remaining 182,154 cycles.

Of the 231,936 ART cycles performed in 2015, 45,779 cycles (20%) were started with the intent of cryopreserving (freezing) and storing all resulting eggs or embryos for potential future use. However, because this cycle type (a banking cycle) cannot result in immediate pregnancy, the 45,779 banking cycles started in 2015 are not included in the majority of this national report.

The 231,936 total ART cycles performed in 2015 excludes 1 cycle started in which a new treatment procedure was being evaluated. The 1 new procedure cycle is not included in the majority of this national report because it does not contribute to the calculation of any success rates for the 464 clinics included in the *2015 Fertility Clinic Success Rates Report*.

The 2015 National Summary table on page 5 combines data from all 231,936 cycles reported by the 464 clinics. For an explanation of how to read this table, see pages 11–20 of the *2015 Fertility Clinic Success Rates Report* available at https://www.cdc.gov/art/artdata/index.html.

This national report consists of graphs and charts that use 2015 data to answer specific questions related to ART success rates. These figures are organized according to the type of ART procedure used. Some ART procedures use a woman's own eggs (nondonor cycles), and others use donated eggs or embryos (donor cycles). Although sperm used to create an embryo also may be either from a woman's partner or from a sperm donor, ART cycles in this report are classified according to the source of the egg.

In some procedures, the embryos that develop after fertilization are transferred back to the woman without having been frozen (fresh embryo transfer); in others, embryos that previously have been frozen (cryopreserved) for transfer at a later date are thawed and transferred to the woman (frozen embryo transfer).

The national report has five sections:

- Section 1 (Figures 1 through 6) presents overall information about the different types of ART cycles performed in 2015. Figure 2 is the only figure in this report that includes information about ART cycles in which a new treatment procedure was being evaluated (1 cycle that was not counted as part of the 231,936 total ART cycles performed in 2015). Figures 1 through 3 and Figure 6 are the only figures in the report to include information about frozen egg cycles (4,003 cycles of the 231,936 total). Figures 1 through 3 (and Figure 45 in Section 5) are the only figures in the report to include information about egg/embryo banking cycles (45,779 cycles of the 231,936 total). Thus, data presented in Figures 4 and 5 in Section 1 and in other sections of the report are based on the total of 182,154 fresh nondonor, frozen nondonor, fresh donor, and frozen donor ART cycles performed in 2015 with the intent to transfer at least one egg or embryo.
- Section 2 (Figures 7 through 36) presents information on the ART cycles that used only fresh nondonor eggs or embryos or, in approximately 1% of cases, a mixture of fresh and frozen nondonor embryos (91,090 cycles resulting in 59,336 transfers).
- Section 3 (Figures 37 through 39) presents information on the ART cycles that used only frozen nondonor embryos (69,882 cycles resulting in 65,235 transfers).
- Section 4 (Figures 40 through 43) presents information on the ART cycles that used only donated eggs or embryos (21,182 cycles resulting in 18,749 transfers).
- Section 5 (Figures 44 through 54) presents trends in the number of ART procedures and measures of success over the past 10 years, from 2006 through 2015.

2015 NATIONAL SUMMARY

Technical terms are defined in the Glossary of Terms (Appendix A, pages 63–66). For more information on how to interpret the statistics in this table, see pages 11–20 in the *2015 Assisted Reproductive Technology Fertility Clinic Success Rates Report.*

2015 ART CYCLE PROFILE

Type of ART and Procedural Factors[a]

IVF	>99%	With ICSI	69%
Unstimulated	1%	PGD/PGS	5%
Used gestational carrier	<1%		

Patient Diagnosis[b]

Tubal factor	13%	Uterine factor	6%	*Multiple Factors:*	
Ovulatory dysfunction	15%	Male factor	33%	Female factors only	12%
Diminished ovarian reserve	31%	Other factor	17%	Female & male factors	17%
Endometriosis	8%	Unknown factor	13%		

2015 ART SUCCESS RATES[c]

Total number of cycles[d]: 231,936 (includes 4,003 cycle[s] using frozen eggs)

Type of Cycle	Age of Woman					
	<35	35–37	38–40	41–42	43–44	>44
Fresh Embryos from Nondonor Eggs						
Number of cycles	39,302	19,023	17,191	8,872	4,940	1,762
Percentage of cancellations before retrieval (%)	6.5	10.6	15.3	19.6	21.9	23.8
Average number of embryos transferred	1.6	1.8	2.1	2.5	2.6	2.4
Percentage of embryos transferred resulting in implantation (%)	41.3	32.1	21.0	10.7	5.2	1.9
Percentage of elective single embryo transfers (eSET) (%)	34.7	20.8	8.1	2.4	0.8	1.1
Outcomes per Cycle						
Percentage of cycles resulting in term, normal weight & singleton live births[e] (%)	21.3	17.0	11.1	5.7	2.3	0.6
Percentage of cycles resulting in singleton live births (%)	25.1	20.2	13.5	7.0	2.8	0.7
Percentage of cycles resulting in twin live births (%)	7.8	5.8	3.2	1.2	0.4	0.1
Percentage of cycles resulting in live births (%)	33.1	26.1	16.9	8.3	3.2	0.8
Percentage of cycles resulting in pregnancies (%)	38.3	32.0	23.1	13.7	7.2	2.7
Outcomes per Transfer						
Number of transfers	27,951	12,944	10,573	4,750	2,396	722
Percentage of transfers resulting in term, normal weight & singleton live births[e] (%)	30.0	25.0	18.0	10.7	4.8	1.4
Percentage of transfers resulting in singleton live births (%)	35.3	29.7	22.0	13.2	5.8	1.8
Percentage of transfers resulting in twin live births (%)	10.9	8.5	5.2	2.2	0.8	0.1
Percentage of transfers resulting in live births (%)	46.5	38.4	27.4	15.5	6.6	1.9
Percentage of transfers resulting in pregnancies (%)	53.8	47.0	37.5	25.5	14.9	6.6
Frozen Embryos from Nondonor Eggs						
Number of cycles	32,604	16,998	12,589	4,759	2,044	888
Number of transfers	30,806	15,837	11,684	4,341	1,815	752
Estimated average number of transfers per retrieval	1.2	1.0	0.8	0.6	0.5	0.4
Average number of embryos transferred	1.5	1.4	1.5	1.6	1.7	1.8
Percentage of embryos transferred resulting in implantation (%)	47.1	43.6	38.3	31.4	23.4	16.2
Percentage of transfers resulting in term, normal weight & singleton live births[e] (%)	32.8	31.8	28.7	25.6	21.2	13.6
Percentage of transfers resulting in singleton live births (%)	39.4	37.6	34.5	31.0	25.7	16.9
Percentage of transfers resulting in twin live births (%)	9.1	6.8	5.4	3.5	1.8	1.6
Percentage of transfers resulting in live births (%)	48.7	44.5	40.0	34.6	27.5	18.5
Percentage of transfers resulting in pregnancies (%)	58.3	54.9	51.2	46.1	39.8	29.5
Number of Egg/Embryo Banking Cycles	12,996	10,298	11,303	5,955	3,296	1,931

Donor Eggs	**Fresh Embryos[f]**	**Frozen Embryos[f]**
Number of cycles	7,336	13,846
Number of transfers	5,835	12,914
Average number of embryos transferred	1.6	1.5
Percentage of embryos transferred resulting in implantation (%)	53.6	40.2
Percentage of transfers resulting in term, normal weight & singleton live births[e] (%)	32.5	26.7
Percentage of transfers resulting in singleton live births (%)	40.2	34.8
Percentage of transfers resulting in twin live births (%)	15.2	7.4
Percentage of transfers resulting in live births (%)	55.6	42.3
Percentage of transfers resulting in pregnancies (%)	65.9	52.3

CURRENT SERVICES & PROFILE

Number of reporting clinics: 464

Percentage of clinics that allow cycles involving:

Donor eggs	91%	Gestational carriers	87%
Donor embryos	74%	Embryo cryopreservation	>99%
Single women	98%		

Clinic profile:

SART member	81%
Verified lab accreditation	
Yes	92%
No	6%
Pending	2%

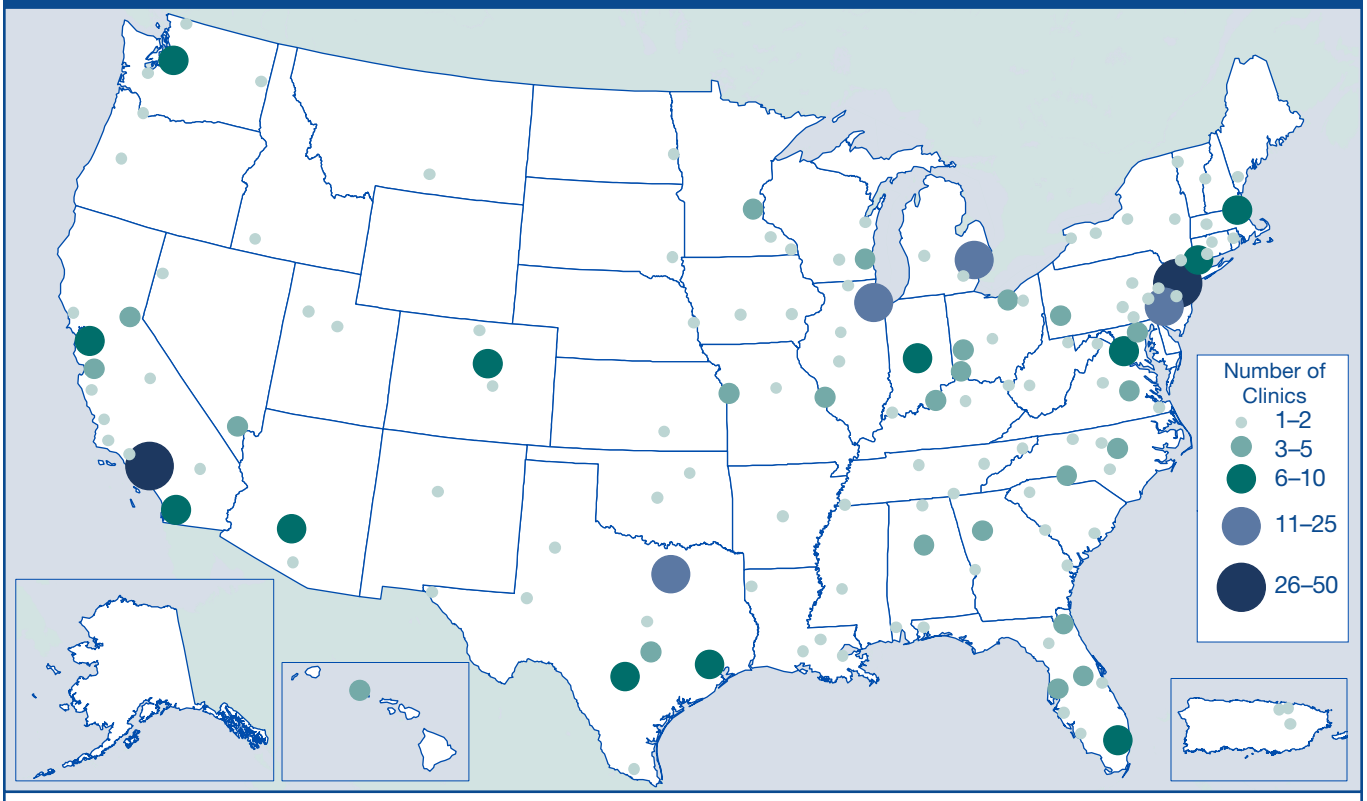
[a] Reflects features of fresh nondonor cycles. If IVF is less than 100%, the remaining cycles are GIFT, ZIFT, or a combination of these procedures with IVF.
[b] Total patient diagnosis percentages may be greater than 100% because more than one diagnosis can be reported for each ART cycle.
[c] Multiple-infant births (for example, twins) with at least one live infant are counted as one live birth.
[d] Total cycle number includes those using frozen eggs. It excludes 1 cycle(s) evaluating new procedures. Both cycle types are excluded from ART success rates.
[e] In this report, births are defined as term if at least 37 full weeks gestation and normal birth weight if at least 2,500 grams (approximately 5 pounds, 8 ounces).
[f] All ages are reported together because previous data show that patient age does not materially affect success with donor eggs.

SECTION 1: OVERVIEW

Where are ART clinics located?

ART clinics are located throughout the United States. Figure 1 shows the locations of the 464 reporting clinics. Individual clinic tables with success rates and clinic profiles are published in the *2015 Fertility Clinic Success Rates Report,* arranged in alphabetical order by state, city, and clinic name. The number of clinics, cycles performed, live-birth deliveries, and infants born as a result of ART all have increased steadily since CDC began collecting this information in 1995 (see Section 5, pages 50–60). Because in some cases more than one infant is born during a live-birth delivery (for example, twins), the total number of infants born is greater than the number of live-birth deliveries. CDC estimates that ART accounts for slightly less than 2% of total US births.

Figure 1
Locations of ART Clinics in the United States and Puerto Rico, 2015



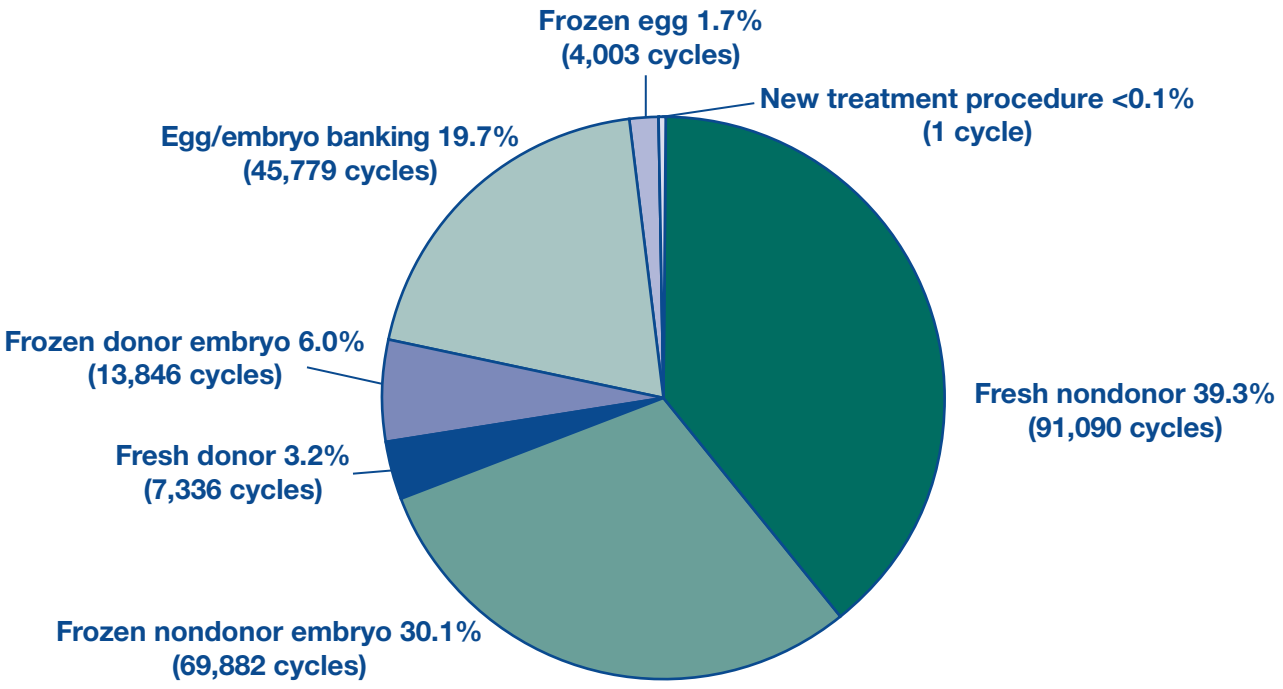
Number of ART clinics in the United States in 2015	499
Number of ART clinics that submitted data in 2015	464
Total number of ART cycles started in 2015 at clinics reporting data	231,936*
Number of live-birth deliveries resulting from ART cycles started in 2015	60,778
Number of infants born as a result of ART cycles started in 2015	72,913

* Total includes 45,779 cycles with the intent to freeze all eggs or embryos. Figure 1 live-birth deliveries and infants born are based on remaining 186,157 cycles with intent to transfer at least one egg or embryo. This includes 4,003 cycles with intent to fertilize previously frozen eggs and transfer resulting embryos. Figure 1 does not include 1 cycle evaluating a new treatment procedure. See the introduction on pages 3–4 for more details about the types of ART cycles performed and included in other figures.

What types of ART cycles were performed?

For about 39% of ART cycles performed in the United States in 2015, fresh nondonor eggs or embryos were used (Figure 2). ART cycles that used frozen nondonor embryos were the next most common type, accounting for 30% of the total. In about 9% of cycles, eggs or embryos were donated by another patient or couple. Slightly less than 2% of cycles were performed with the intent to fertilize previously frozen eggs and transfer resulting embryos. There were 20% of cycles performed with the intent of freezing and storing (banking) all resulting eggs or embryos for potential future use. There was one cycle that involved the evaluation of a new treatment procedure. See the introduction on pages 3–4 for more details about the types of ART cycles performed and included in other figures.

Figure 2
Types of ART Cycles—United States,* 2015

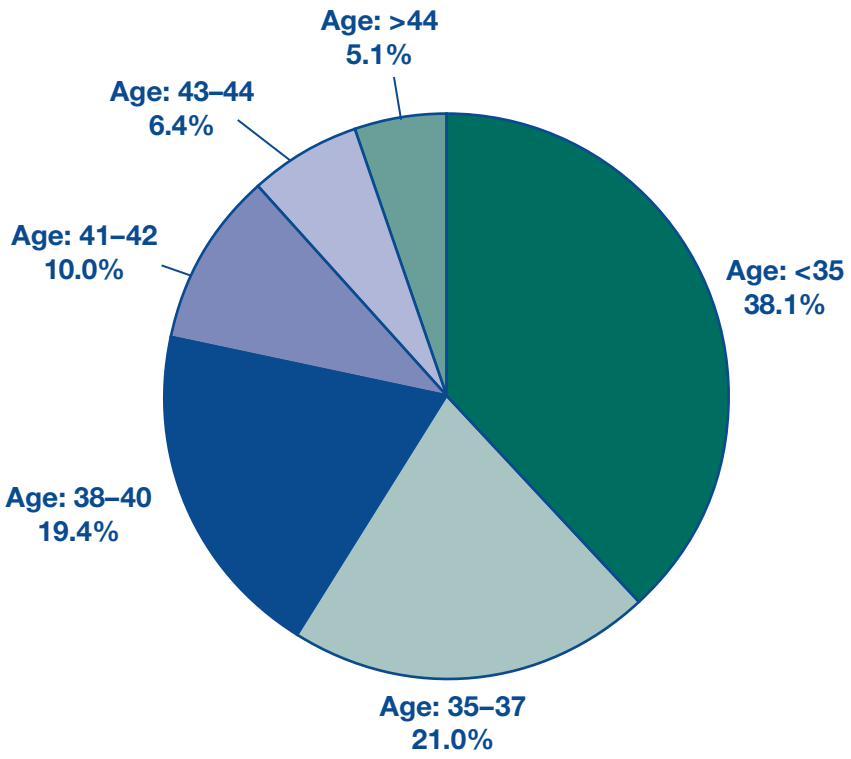


* Total does not equal 100% due to rounding.

How old were women who used ART?

As shown in Figure 3, which presents ART cycles performed in the United States in 2015 according to the age of the woman who had the procedure, the largest group of women using ART services were women younger than age 35. These women represented approximately 38% of all ART cycles performed in 2015. There were 21% of ART cycles performed among women aged 35–37, 19% among women aged 38–40, 10% among women aged 41–42, 6% among women aged 43–44, and 5% among women older than age 44. The average age of women using ART services in 2015 was 36. Cycles using previously frozen eggs and cycles with the intent to bank all eggs or embryos are included in the data for this figure. See the introduction on pages 3–4 for more information about these cycle types.

Figure 3
ART Use by Age Group—United States,* 2015

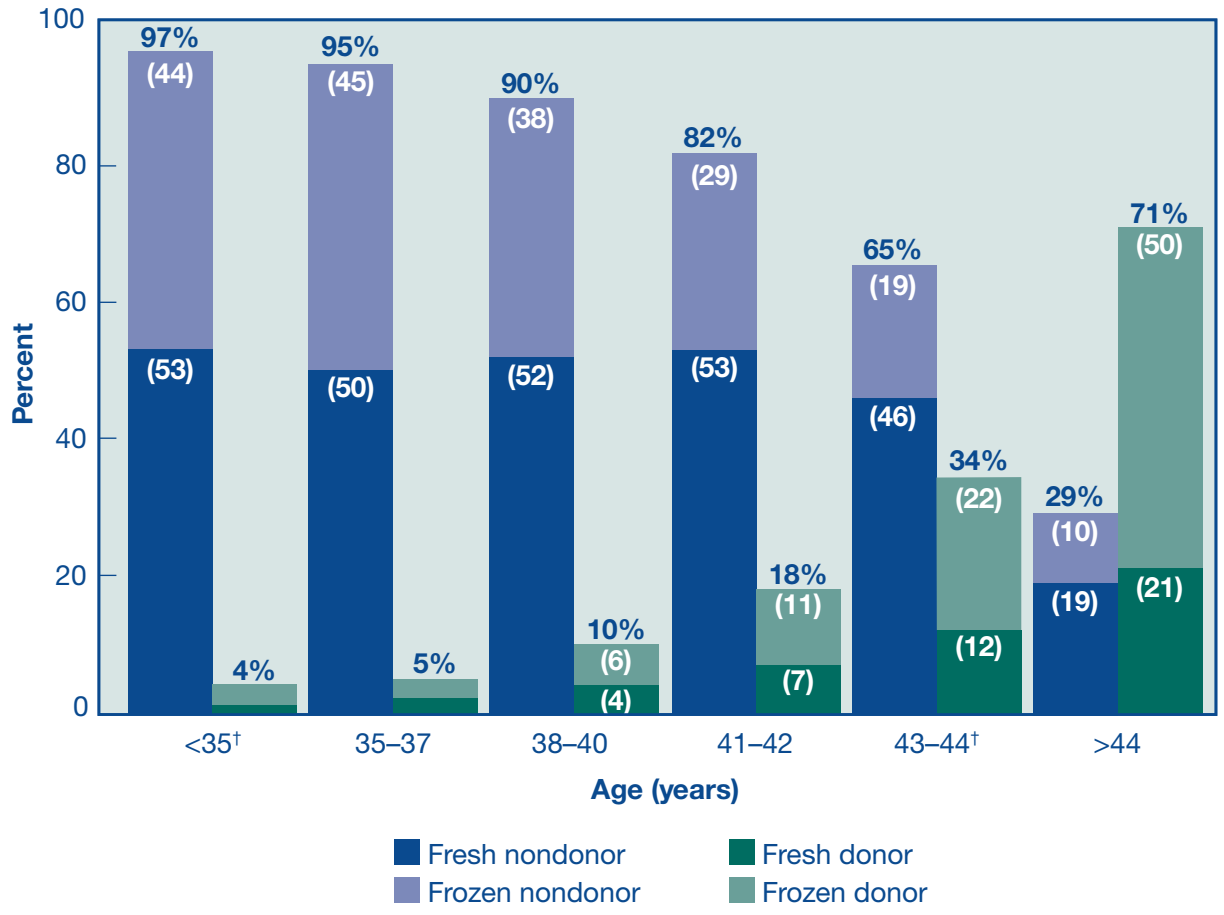


* Based on 231,936 cycles.

How did the types of ART cycles performed differ by a woman's age?

Figure 4 shows that, in 2015, the percentage of ART cycles in which a woman used her own eggs declined with age, while the percentage of ART cycles using a donor egg increased with age. The vast majority (97%) of women younger than age 35 used their own eggs (nondonor), and about 4% used donor eggs, while 34% of women aged 43–44 and 71% of women older than age 44 used donor eggs. Percentages of fresh nondonor cycles performed were greater than frozen nondonor cycles in all age groups. In contrast, percentages of frozen donor cycles were greater than fresh donor cycles in all age groups.

Figure 4
Types of ART Cycles by Age Group—United States,* 2015



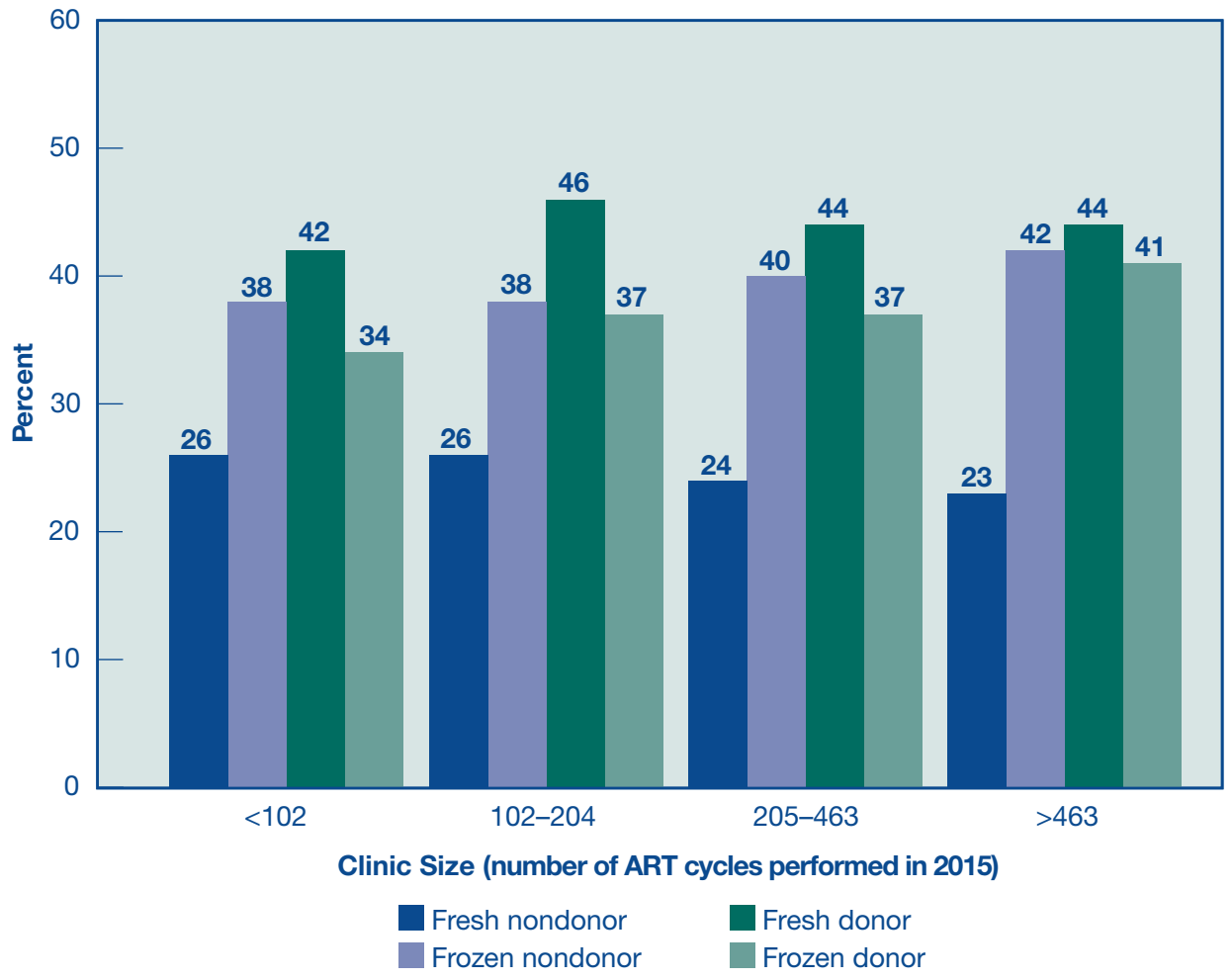
* Percentages of ART cycles that used fresh or frozen embryos from nondonor or donor eggs are in parentheses.
† Totals do not equal 100% due to rounding.

What was the relationship between clinic size and the percentage of ART cycles that resulted in live births?

As shown in Figure 5, the number of ART procedures performed varied among fertility clinics in the United States. In 2015, the percentage of ART cycles that resulted in live births using frozen nondonor or frozen donor embryos generally increased as the clinic size increased. The percentage of cycles resulting in live births generally decreased as the clinic size increased for fresh nondonor cycles.

For Figure 5, clinics were divided equally into four groups from smallest to largest (called quartiles) based on the number of ART cycles they performed in 2015. The percentage for each group by type of ART shows the average percentage of ART cycles that resulted in live births for clinics in that group.

Figure 5
Percentages of ART Cycles That Resulted in Live Births, by Type of ART and Clinic Size—United States, 2015

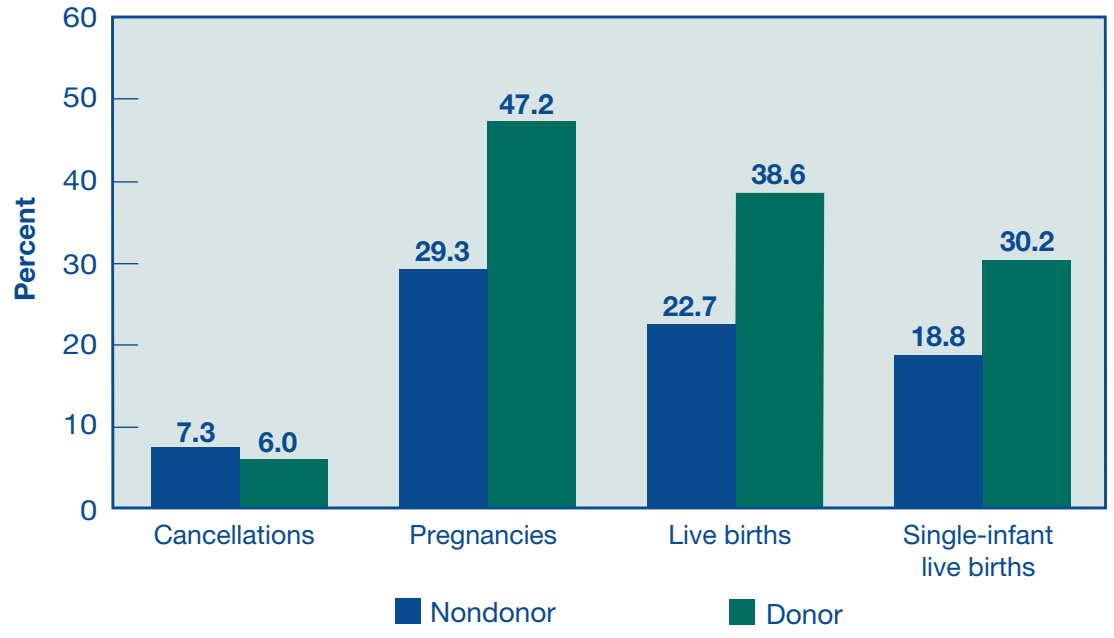


How many frozen egg cycles were conducted and what were the outcomes of these cycles?

As shown in Figure 2 (page 8), about 2% of ART cycles started in 2015 were performed with the intent to fertilize previously frozen and thawed eggs and transfer the resulting fresh embryo(s) during the current cycle. While the 4,003 frozen egg cycles performed in 2015 do not contribute to any success rate calculations in the ART reports, these cycles can produce successful ART outcomes. Figure 6 shows that of the cycles that used a patient's own frozen eggs and a fresh (not frozen) embryo, approximately 7% resulted in cancellations, 29% in pregnancies, 23% in live births, and 19% in single-infant live births.

Of the cycles that used frozen eggs from a donor and a fresh embryo, 6% resulted in cancellations, 47% in pregnancies, 39% in live births, and 30% in single-infant live births. Patients often freeze their own eggs to preserve their future fertility. Reasons a patient may seek fertility preservation include undergoing medical treatments that may affect future fertility (for example, chemotherapy or radiation) or electing to delay childbearing. Patients often use frozen donor eggs when achieving pregnancy with their own eggs is unlikely, for example, in the case of diminished ovarian reserve.

Figure 6
Percentages of ART Cycles Using Fresh Embryos from Frozen Nondonor or Donor Eggs That Resulted in Cancellations, Pregnancies, Live Births, and Single-Infant Live Births,* 2015



* Cycles using both nondonor and donor frozen eggs are excluded.

SECTION 2: ART CYCLES USING FRESH NONDONOR EGGS OR EMBRYOS

What are the steps for an ART cycle?

An ART **cycle is started** when a woman begins taking medication to stimulate the ovaries to develop eggs or, if no drugs are given, when the woman begins having her ovaries monitored (using ultrasound or blood tests) for natural egg production.

If eggs are produced, the cycle then progresses to **egg retrieval**, a surgical procedure in which eggs are collected from a woman's ovaries.

Once retrieved, eggs are combined with sperm in the laboratory. If fertilization is successful, one or more of the resulting embryos are selected for **transfer**, most often into a woman's uterus through the cervix (IVF), but sometimes into the fallopian tubes (GIFT or ZIFT).

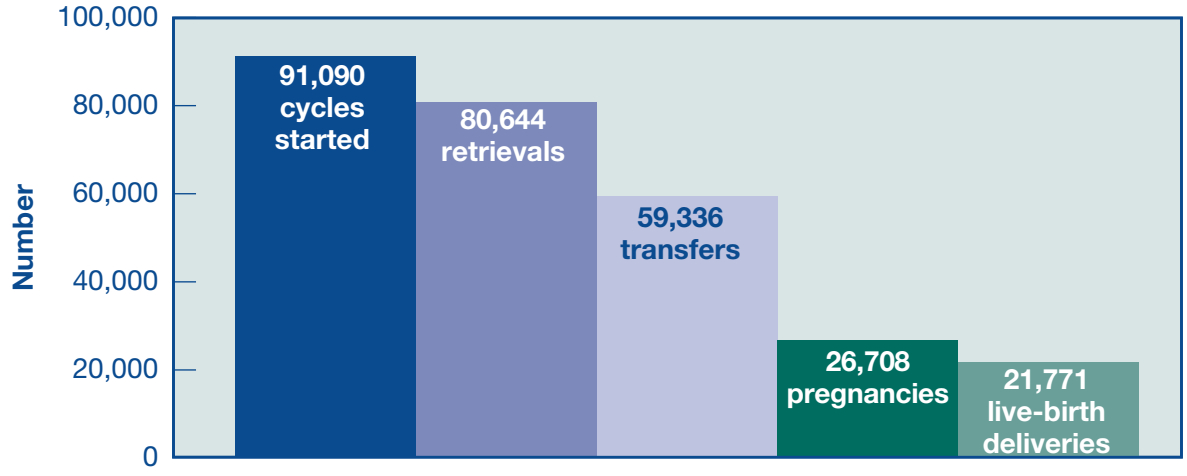
If one or more of the transferred embryos implant within the woman's uterus, the cycle then may progress to clinical **pregnancy**.

Finally, the pregnancy may progress to a **live birth**, the delivery of one or more live-born infants. (The birth of twins, triplets, or more is counted as one live birth.)

A cycle may be stopped at any step for specific medical reasons (for example, no eggs are produced or the embryo transfer was not successful) or by patient choice.

Figure 7 presents the steps for an ART cycle using fresh nondonor eggs or embryos and shows how ART patients in 2015 progressed through these stages toward pregnancy and live birth.

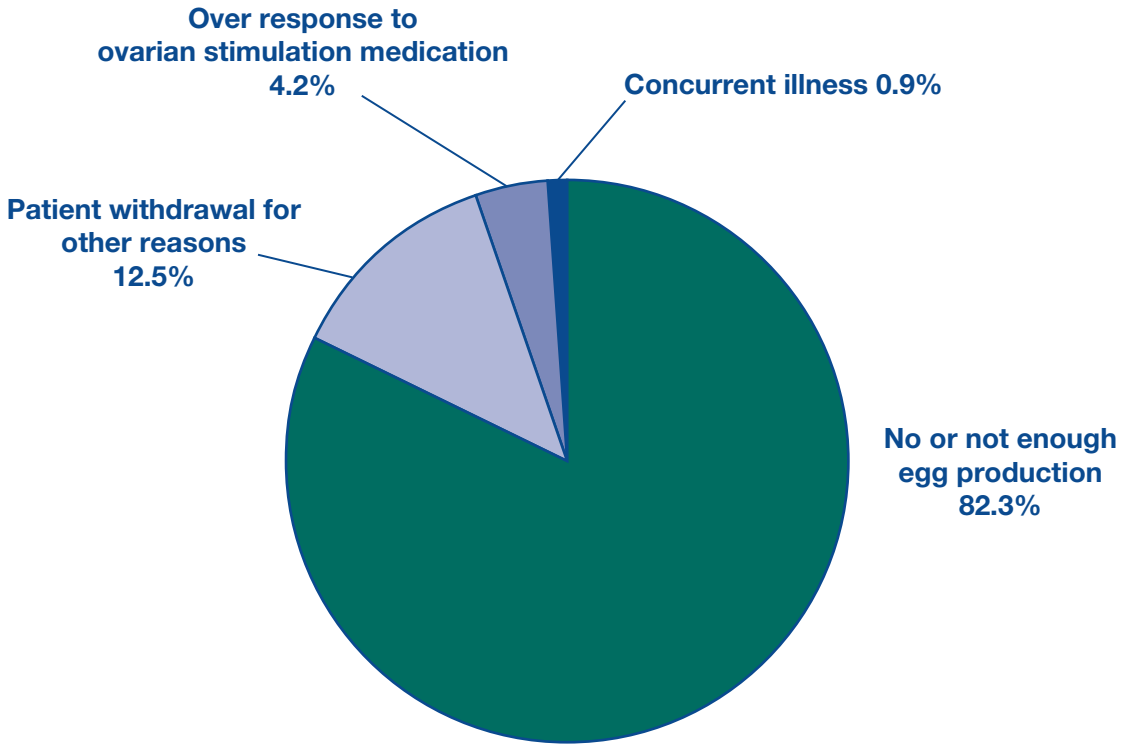
Figure 7
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos, by Stage, 2015



Why were some ART cycles canceled?

In 2015, a total of 10,446 ART cycles (about 11% of all 91,090 cycles using fresh nondonor eggs or embryos) were canceled before the egg retrieval step (see Figure 7, page 13). Figure 8 shows the reasons that the cycles were canceled. For approximately 82% of these cycles, there was no or not enough egg production. Other reasons included an over response to ovarian stimulation medications (that is, a potential for ovarian hyperstimulation syndrome), concurrent illness, or patient withdrawal for other reasons.

Figure 8
Reasons ART Cycles Using Fresh Nondonor Eggs or Embryos Were Canceled,*† 2015



* Based on 10,446 ART cycles.
† Total does not equal 100% due to rounding.

How are success rates of ART measured?

Figure 9 shows success rates for ART cycles using fresh nondonor eggs or embryos in 2015. Most success measures have increased slightly since CDC began monitoring them in 1995 (see Section 5, pages 50–60).

Percentage of *cycles* that resulted in a pregnancy. This rate includes all cycles started, even if they were canceled before retrieval or stopped after retrieval but before transfer. Some cycles are canceled before retrieval for reasons shown in Figure 8 (page 14), or stopped after retrieval but before transfer for reasons such as embryos not surviving or poor quality embryos.

Percentage of *transfers* that resulted in a pregnancy. This rate is higher than the percentage of *cycles* that resulted in a pregnancy because cycles that did not move forward to a transfer are excluded.

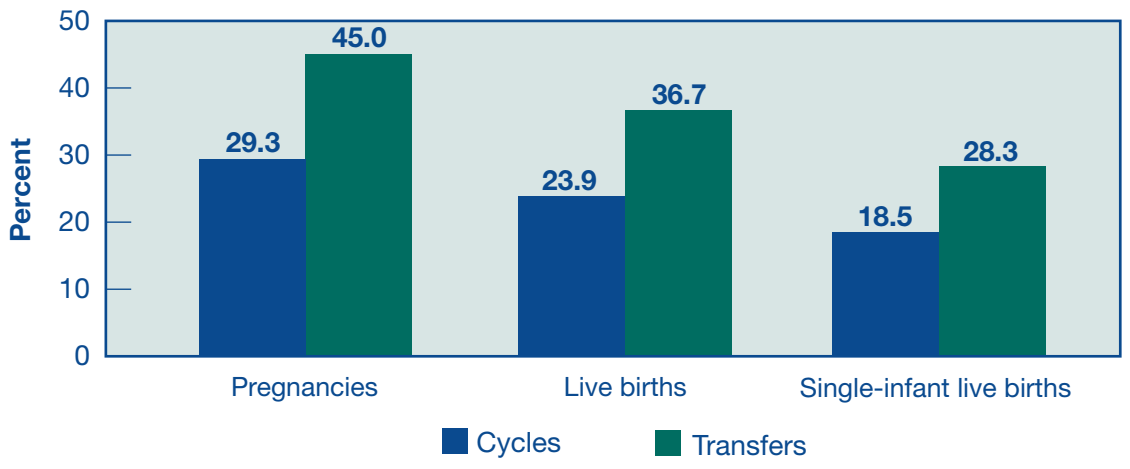
Percentage of *cycles* that resulted in a live birth (delivery of one or more live-born infants). This rate includes all cycles started. This is referred to as the "basic live birth rate" in the Fertility Clinic Success Rate and Certification Act of 1992. This is lower than the percentage of cycles that resulted in a pregnancy, because some pregnancies end in miscarriage, induced abortion, or stillbirth (see Figure 11, page 17).

Percentage of *transfers* that resulted in a live birth. This rate is higher than the percentage of *cycles* that resulted in a live birth because cycles that did not move forward to a transfer are excluded.

Percentage of *cycles* that resulted in a single-infant live birth. This rate is important because single infants have a much lower risk than multiple infants of poor health outcomes, including prematurity, low birth weight, disability, and death.

Percentage of *transfers* that resulted in a single-infant live birth. This rate is higher than the percentage of *cycles* that resulted in a single-infant live birth because cycles that did not move forward to a transfer are excluded.

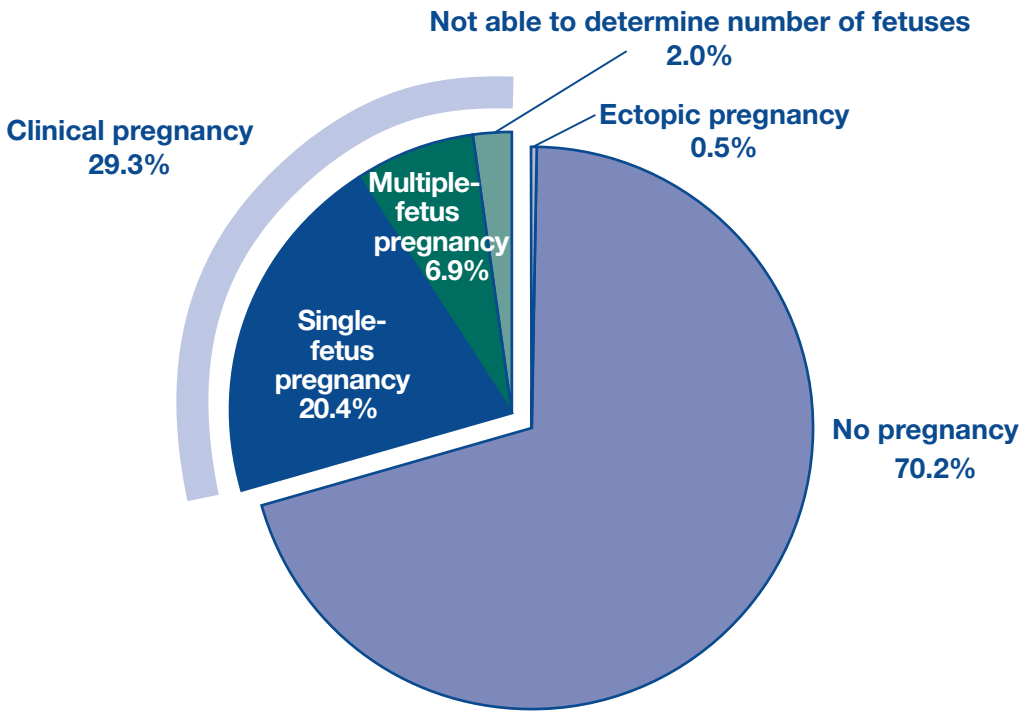
Figure 9
Percentages of ART Cycles and Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Single-Infant Live Births, 2015



What percentage of ART cycles resulted in a pregnancy?

In total, about 29% of cycles using fresh nondonor eggs or embryos that were started in 2015 resulted in clinical pregnancy; about 20% resulted in a single-fetus pregnancy, 7% in a multiple-fetus pregnancy, and 2% in a pregnancy where the number of fetuses could not be determined (Figure 10). However, most of these cycles (approximately 70%) did not produce a pregnancy while a very small proportion (less than 1%) resulted in an ectopic pregnancy with the embryo implanted outside the uterus.

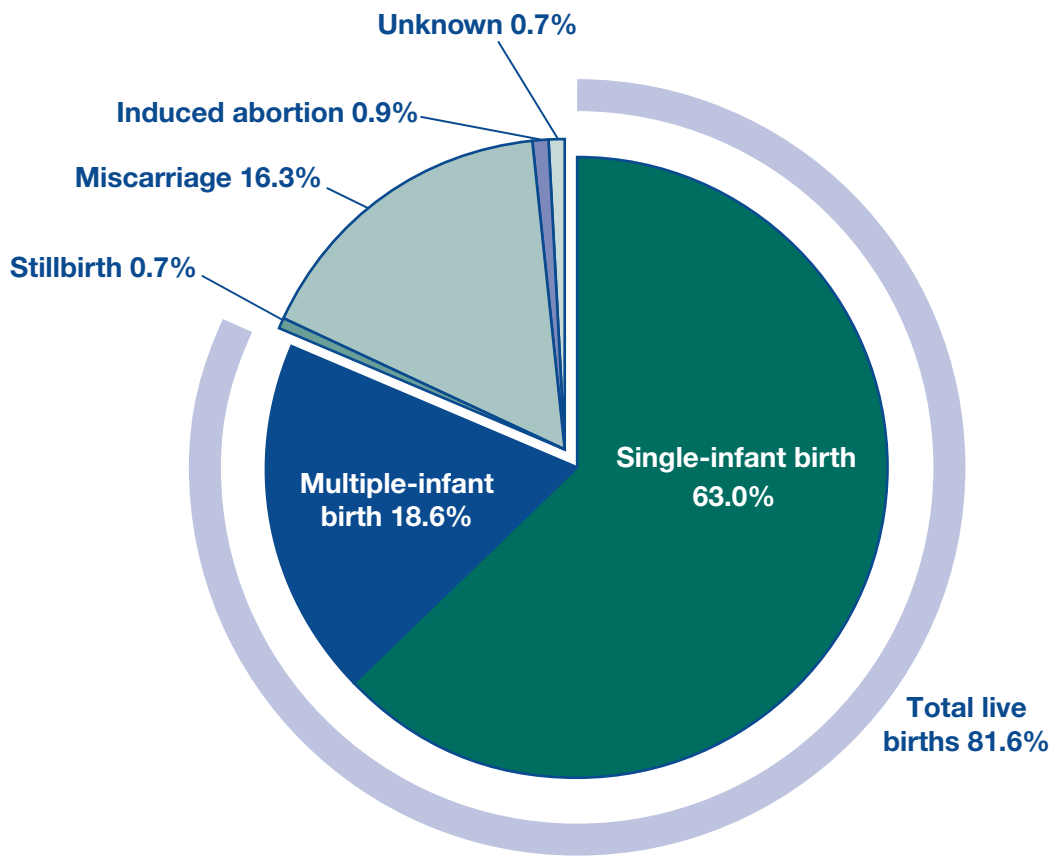
Figure 10
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos, 2015



What percentage of ART pregnancies resulted in a live birth?

Figure 11 shows that approximately 82% of the pregnancies resulting from ART cycles using fresh nondonor eggs or embryos in 2015 produced a live birth (63% were the birth of a single infant and about 19% were the birth of multiple infants). About 18% of pregnancies resulted in miscarriage, stillbirth, induced abortion, or maternal death prior to birth (maternal deaths are not shown in Figure 11 due to the small number). For less than 1% of pregnancies, the outcome was unknown.

Figure 11
Outcomes of Pregnancies That Resulted from ART Cycles Using Fresh Nondonor Eggs or Embryos,*† 2015



* Maternal deaths prior to birth are not displayed due to small number of cycles.
† Total does not equal 100% due to rounding.

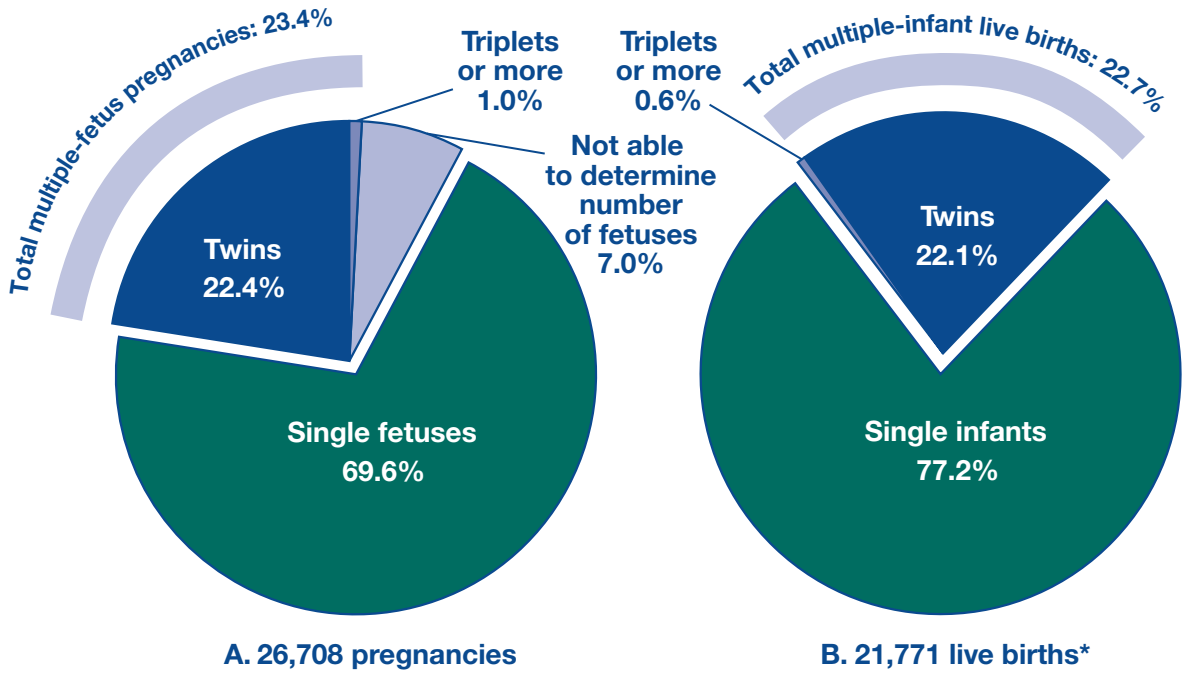
What percentage of ART cycles resulted in a multiple-fetus pregnancy or multiple-infant birth?

Part A of Figure 12 shows that among the 26,708 pregnancies that resulted from ART cycles using fresh nondonor eggs or embryos in 2015, about 70% were single-fetus pregnancies and 23% were multiple-fetus pregnancies. The number of fetuses could not be accurately determined for 7% of pregnancies.

Of the 26,708 pregnancies that resulted from these ART cycles, 21,771 (82%) resulted in live births. Part B of Figure 12 shows that about 23% of these live births resulted in more than one infant (22% twins and 1% triplets or more).

ART pregnancies are more likely to result in multiple-infant births (twins, triplets or more) than pregnancies resulting from natural conception because more than one embryo may be transferred.

Figure 12
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births Among ART Cycles Using Fresh Nondonor Eggs or Embryos, 2015



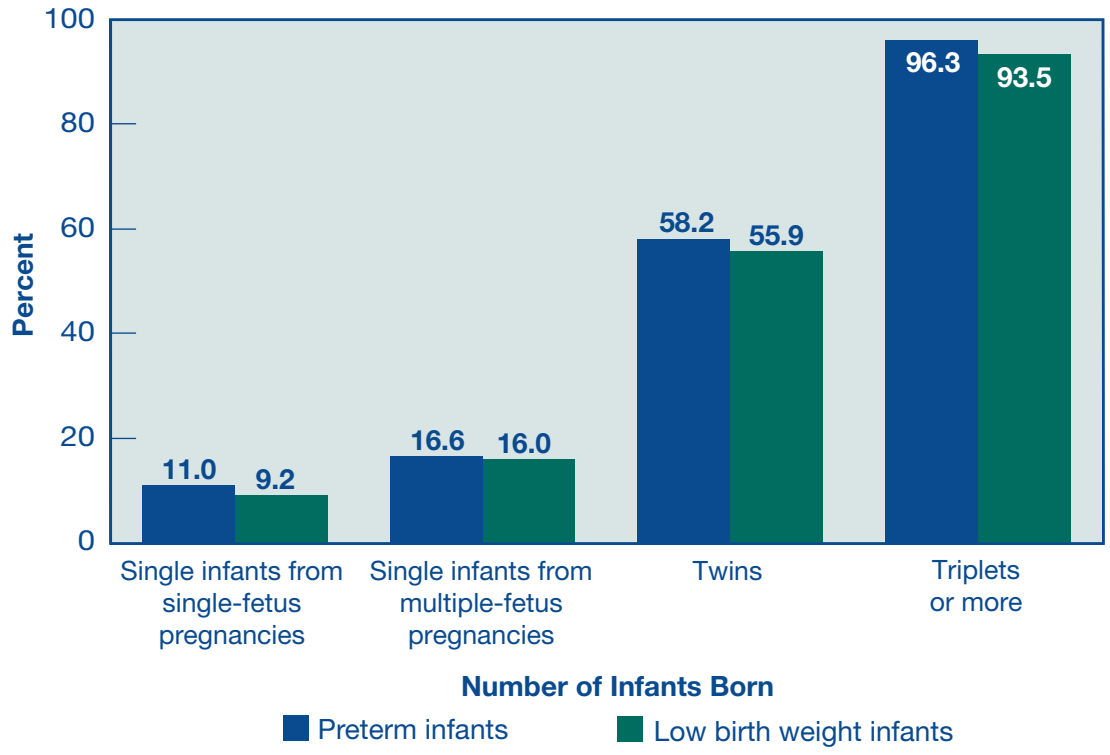
* Total does not equal 100% due to rounding.

What percentage of ART cycles resulted in a preterm or low birth weight infant?

Percentages of preterm and low birth weight infants resulting from ART cycles that used fresh nondonor eggs or embryos in 2015 increased as the number of infants born increased (Figure 13). Preterm infants are born to a woman giving birth before 37 full weeks of pregnancy and low birth weight infants are born weighing less than 2,500 grams (about 5 pounds, 8 ounces). Infants born preterm or with low birth weight are at greater risk of death in the first year of life, as well as other poor health outcomes, including visual and hearing problems, intellectual and learning disabilities, and behavioral and emotional problems throughout life. Preterm and low birth weight infants also can cause considerable emotional and economic burdens for families.

For births resulting in a single live-born infant, percentages of preterm infants and low birth weight infants are shown separately for single- and multiple-fetus pregnancies. Among single live-born infants, percentages of preterm and low birth weight infants were higher for those from multiple-fetus pregnancies. In the general US population, where the live birth of a single infant is almost always the result of a single-fetus pregnancy, 10% of single live-born infants were preterm and 6% of single infants had low birth weight (data not shown).

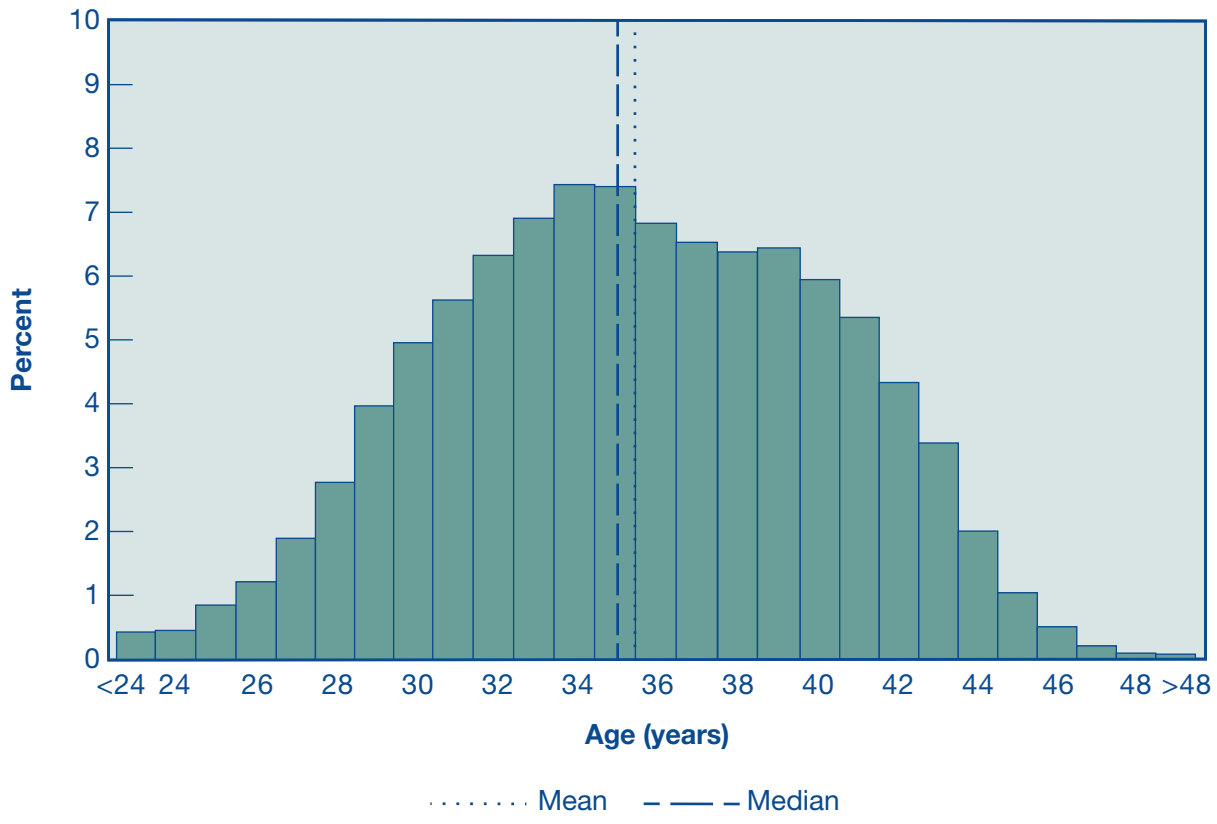
Figure 13
Percentages of Preterm Infants or Infants with Low Birth Weight from ART Cycles Using Fresh Nondonor Eggs or Embryos, by Number of Infants Born, 2015



What were the ages of women who used ART?

The average (mean) age of women who had ART cycles using fresh nondonor eggs or embryos in 2015 was slightly more than 35 and the median age was 35 (Figure 14). About 12% of these cycles were among women younger than age 30, 65% were among women aged 30–39, and 23% were among women aged 40 or older.

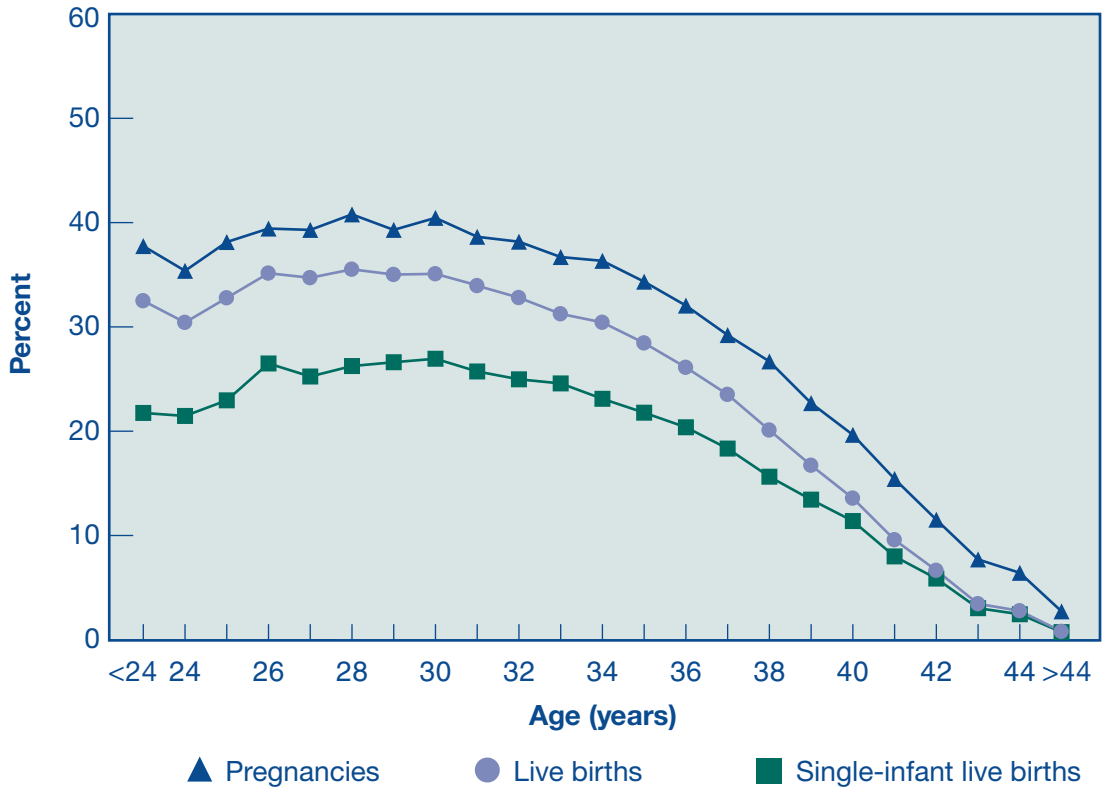
Figure 14
Age Distribution of Women Who Had ART Cycles Using Fresh Nondonor Eggs or Embryos, 2015



Did the percentage of pregnancies, live births, and births of a single live infant differ by a woman's age?

Among women in their 20s, percentages of ART cycles using fresh nondonor eggs or embryos in 2015 that resulted in pregnancies, live births, and single-infant live births were relatively stable; however, percentages declined among women in their 30s onward (Figure 15). A woman's age is the most important factor for having a live birth when her own eggs are used. Percentages of ART cycles resulting in total live births and births of a single live infant are different because multiple-infant deliveries count towards the total live births. The percentage of multiple-infant births is particularly high among women younger than age 35 (see Figure 30, page 36). For additional detail on percentages of ART cycles that resulted in pregnancies, live births, and single-infant live births among women aged 40 or older, see Figure 16 on page 22.

Figure 15
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Single-Infant Live Births, by Age of Woman,* 2015

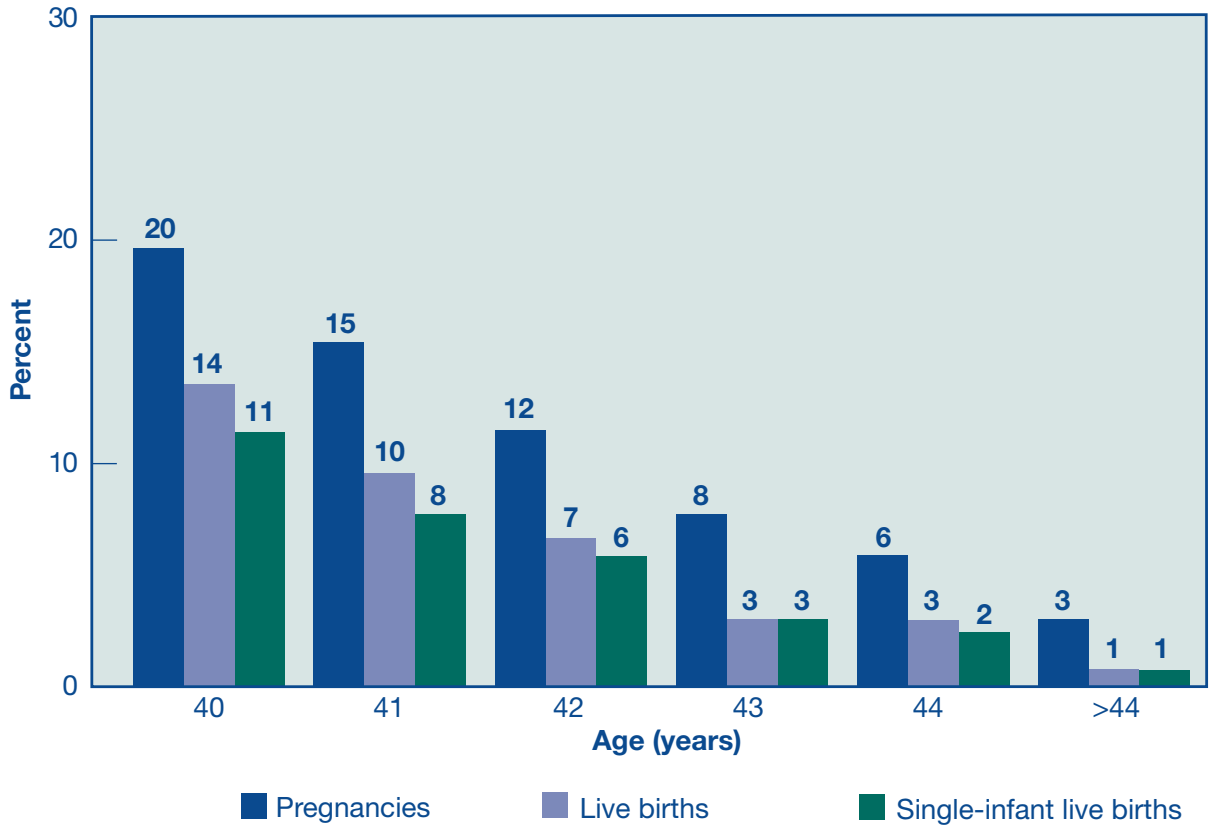


* For consistency, all percentages are based on cycles started.

How did the percentage of ART cycles that resulted in pregnancies, live births, and births of single live infants differ among women aged 40 or older?

For women aged 40 or older, percentages of ART cycles using fresh nondonor eggs or embryos in 2015 that resulted in pregnancies, live births, and single-infant live births declined as a woman's age increased (Figure 16). Among women age 40, the percentage of ART cycles resulting in pregnancy was about 20%, the percentage of ART cycles resulting in live births was 14%, and the percentage of ART cycles resulting in single-infant live births was 11%. Percentages dropped steadily with each 1-year increase in age. Among women older than age 44, percentages of live births and single-infant live births were 1%. Women aged 40 or older generally have much higher percentages of live births using donor eggs (see Figure 41, page 47).

Figure 16
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Single-Infant Live Births Among Women Aged 40 or Older,* 2015



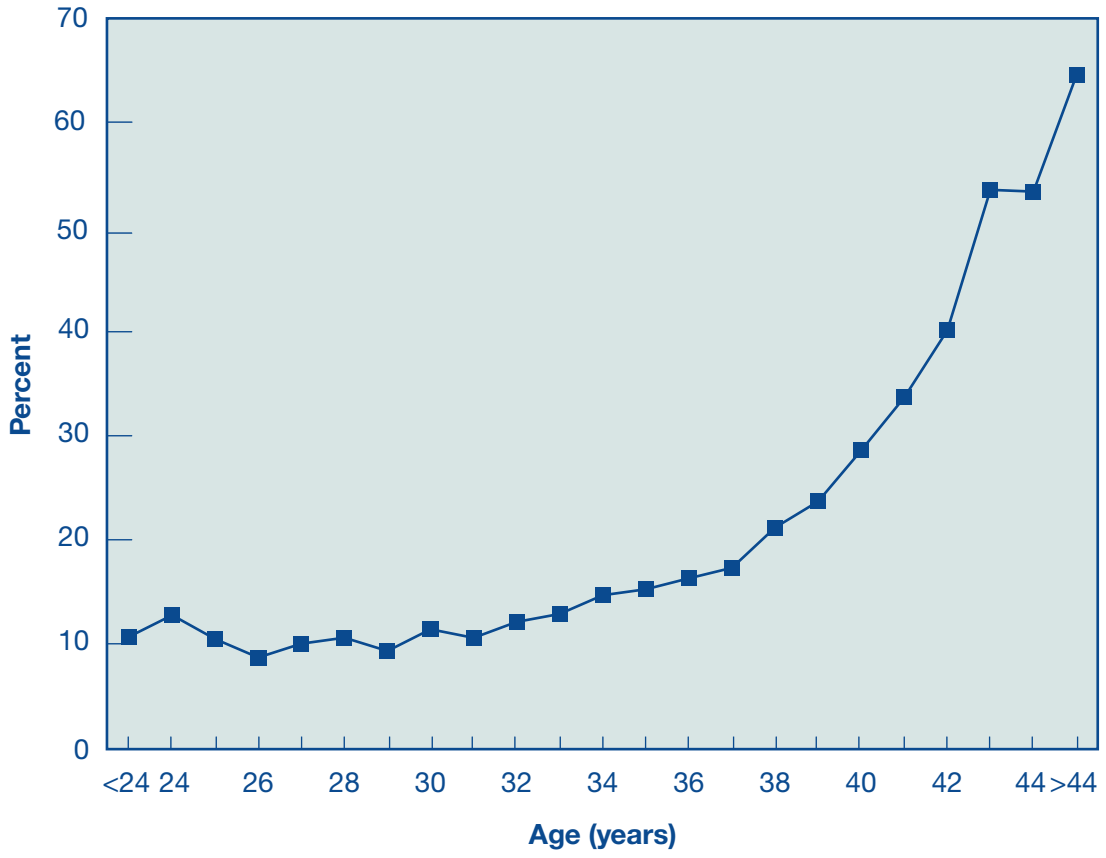
* For consistency, all percentages are based on cycles started.

How did the percentage of cycles that resulted in miscarriage differ by a woman's age?

Percentages of ART cycles using fresh nondonor eggs or embryos in 2015 that resulted in miscarriage were below 15% among women younger than age 35 (Figure 17). The percentage of ART cycles that resulted in miscarriage began to increase rapidly among women in their late 30s and continued to increase as a woman's age increased, reaching almost 29% at age 40 and 65% among women older than age 44.

A woman's age not only affects the percentage of cycles resulting in pregnancy when her own eggs are used, but also her risk of miscarriage. Previous data show that most miscarriages occur before week 14 (during the first trimester) among women of all ages undergoing ART. The risk of miscarriage among women undergoing ART procedures using fresh nondonor eggs or embryos appears to be similar to those reported in various studies of other pregnant women in the United States.

Figure 17
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Miscarriage, by Age of Woman, 2015



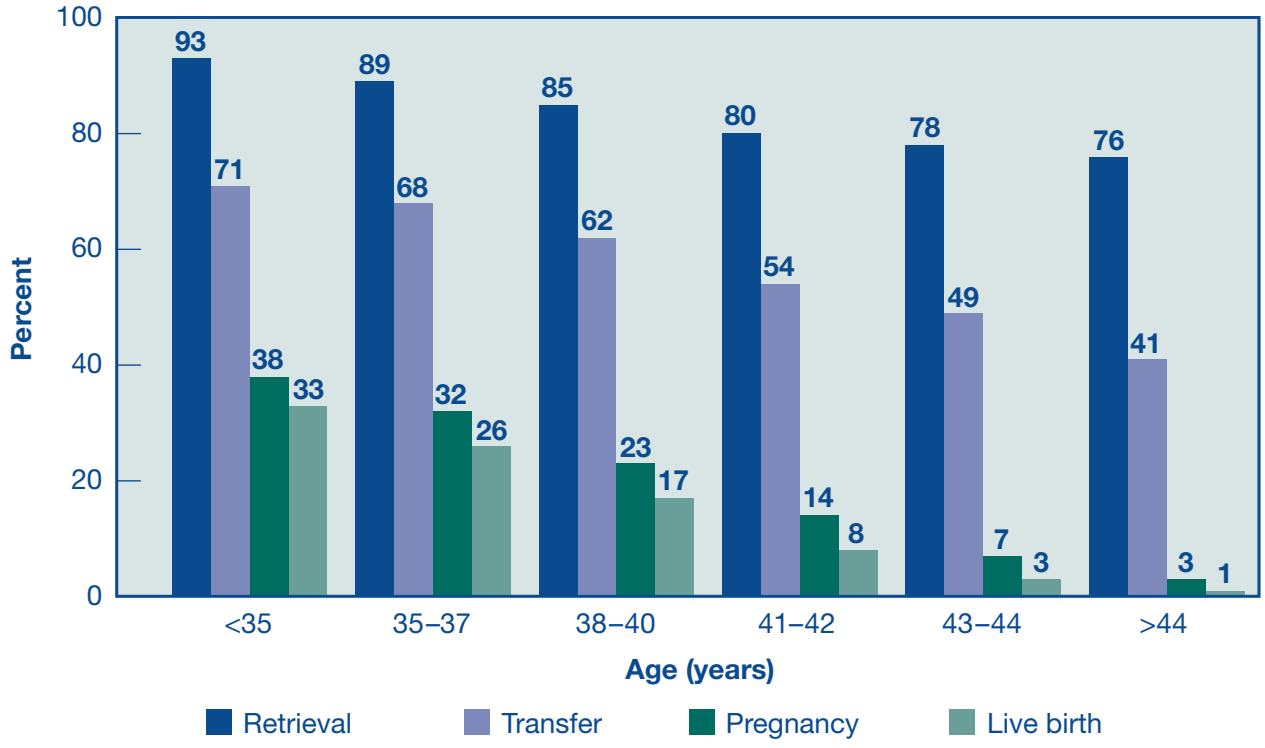
How did a woman's age affect ART cycle progress and outcomes?

Figure 18 shows that the percentage of cycles progressing from the beginning of ART to pregnancy and live birth using a woman's own eggs decreases at every stage of ART as her age increases. Overall, 33% of cycles started in 2015 among women younger than age 35 resulted in live births. This percentage decreased to 26% among women aged 35–37, 17% among women aged 38–40, 8% among women aged 41–42, 3% among women aged 43–44, and 1% among women older than age 44.

As women get older:

- The likelihood of a successful response to ovarian stimulation and progression to **egg retrieval** decreases.
- Cycles that progress to egg retrieval are less likely to reach **transfer**.
- Cycles that progress to transfer are less likely to reach **pregnancy**.
- Cycles that progress to pregnancy are less likely to result in a **live birth** because the percentage of cycles ending in miscarriage increases (see Figure 17, page 23).

Figure 18
Outcomes of ART Cycles Using Fresh Nondonor Eggs or Embryos, by Stage and Age Group, 2015



What were the causes of infertility among ART patients?

Causes of infertility among ART patients include:

Tubal factor. Fallopian tubes are blocked or damaged, making it difficult for the egg to be fertilized or for an embryo to travel to the uterus.

Ovulatory dysfunction. Ovaries are not producing eggs normally. Reasons include polycystic ovary syndrome and multiple ovarian cysts.

Diminished ovarian reserve. The ability of the ovary to produce eggs is reduced. Reasons include congenital, medical, or surgical causes or advanced age.

Endometriosis. The presence of tissue similar to the uterine lining in abnormal locations. This condition can affect both fertilization of the egg and embryo implantation.

Uterine factor. A structural or functional disorder of the uterus that results in reduced fertility.

Male factor. A low sperm count or problems with sperm function that make it difficult for a sperm to fertilize an egg under normal conditions.

Other factor. Includes immunological problems, chromosomal abnormalities, chemotherapy, and serious illnesses.

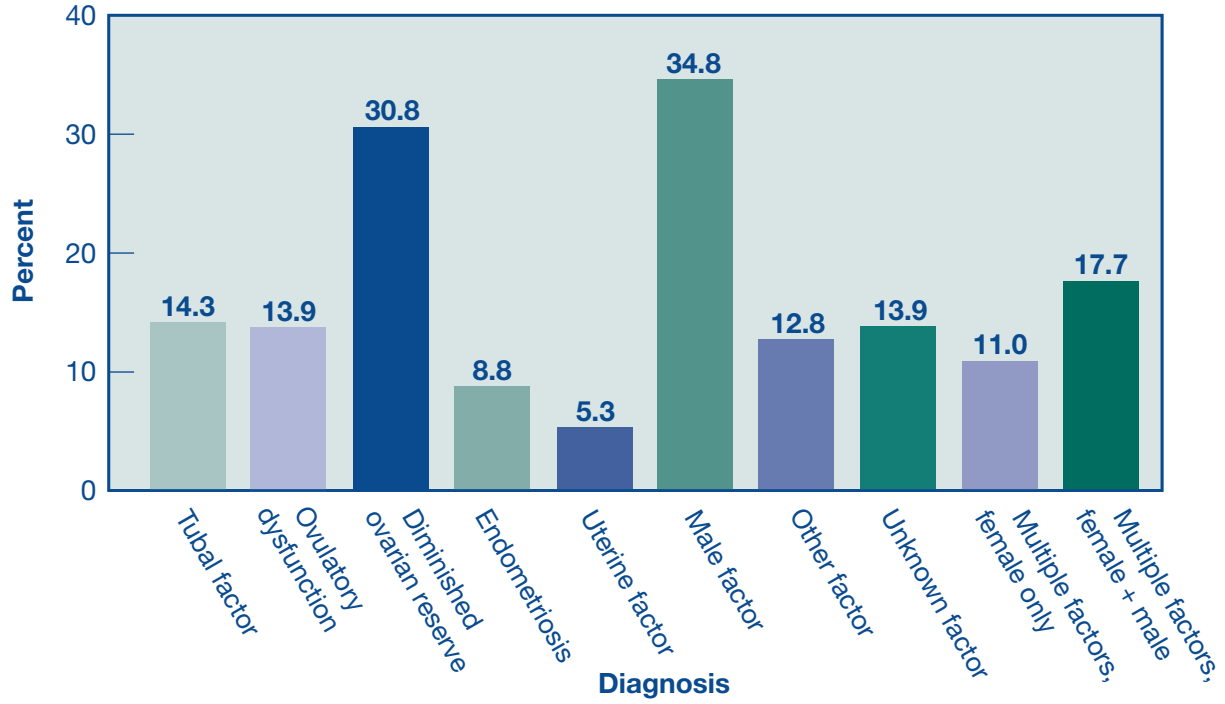
Unknown factor. No clear cause of infertility is found in either partner.

Multiple factors, female only. More than one female cause of infertility, and no male factor infertility.

Multiple factors, female and male. One or more female causes in addition to male factor infertility.

Figure 19 shows infertility diagnoses reported for each ART cycle using fresh nondonor eggs or embryos performed in 2015. Diagnoses ranged from one infertility factor in the patient or partner to multiple infertility factors in either one or both. However, diagnostic procedures may vary among clinics, so the categorizations also may vary.

Figure 19
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos, by Type of Infertility Diagnosis,* 2015

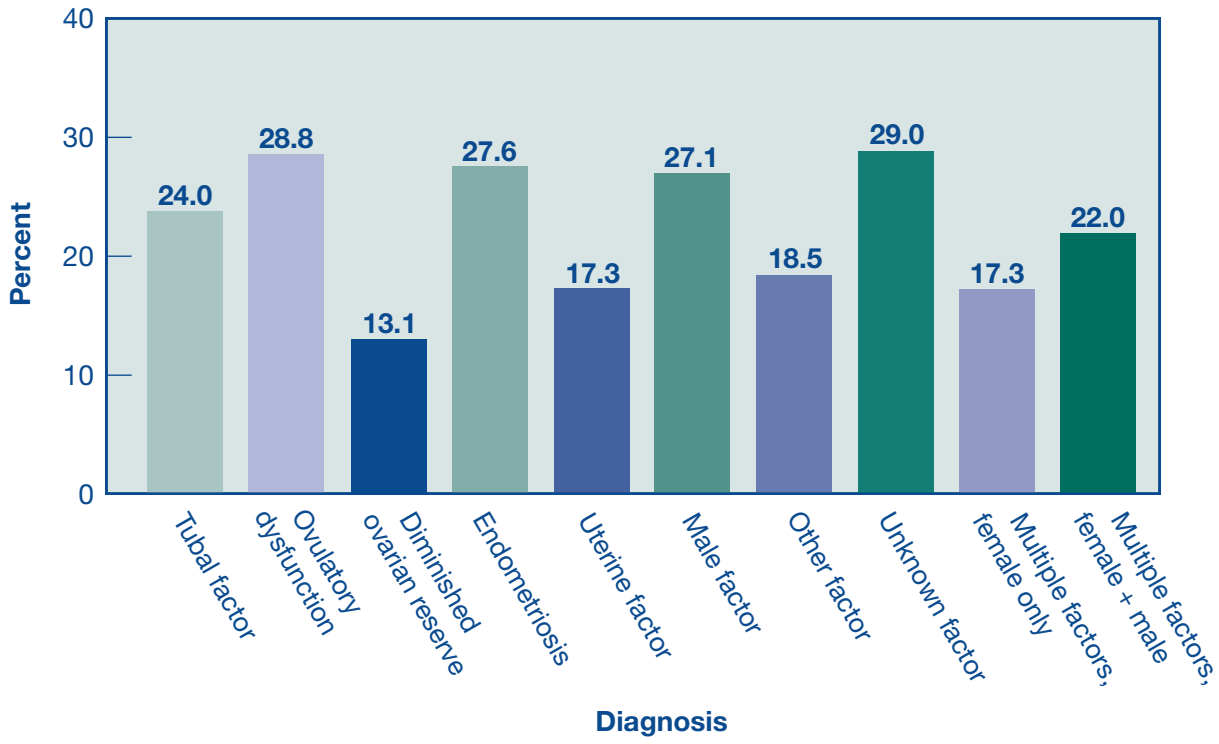


* Total percentages are greater than 100% because more than one diagnosis can be reported for each cycle.

How did the type of infertility diagnosis affect the percentage of ART cycles that resulted in live births?

The national percentage of fresh nondonor ART cycles resulting in live births was slightly less than 24% in 2015 (see Figure 9, page 15). However, this percentage varied depending on the patient's diagnosis. In 2015, the percentage of ART cycles using fresh nondonor eggs or embryos that resulted in live births was *higher* than the national percentage for patients with tubal factor, ovulatory dysfunction, endometriosis, male factor, or unknown factor infertility; it was *lower* for patients with diminished ovarian reserve, uterine factor, "other" factor, or multiple infertility factors (Figure 20).

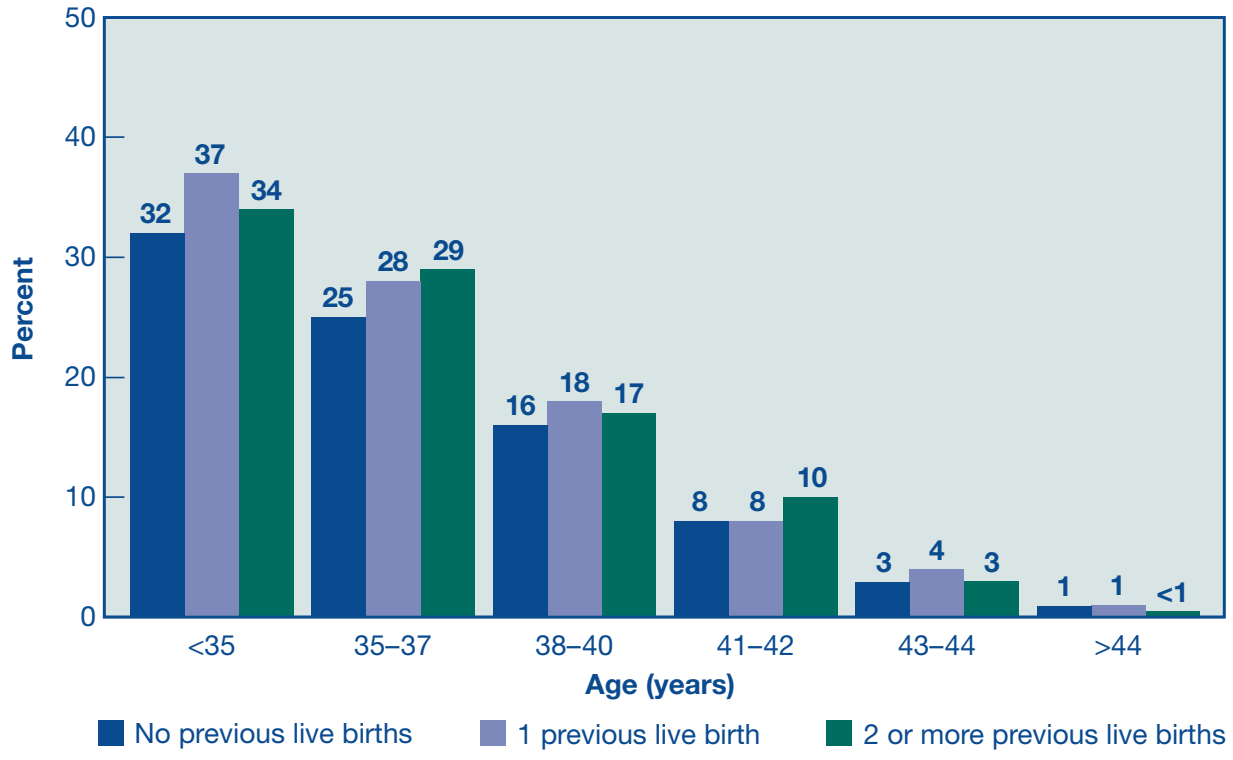
Figure 20
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Type of Infertility Diagnosis, 2015



How did previous birth impact ART live-birth outcomes?

Overall, the percentage of ART cycles using fresh nondonor eggs or embryos in 2015 that resulted in live births decreased with age, regardless of number of previous live births (Figure 21). Previous live-born infants could have been conceived naturally or through ART. In almost all age groups, the percentage of ART cycles that resulted in live births was higher among women who had one or more previous live births compared with women who had no previous live births. About 73% of ART cycles performed in 2015 using fresh nondonor eggs or embryos were among women who had no previous live births, although they may have had a previous pregnancy loss.

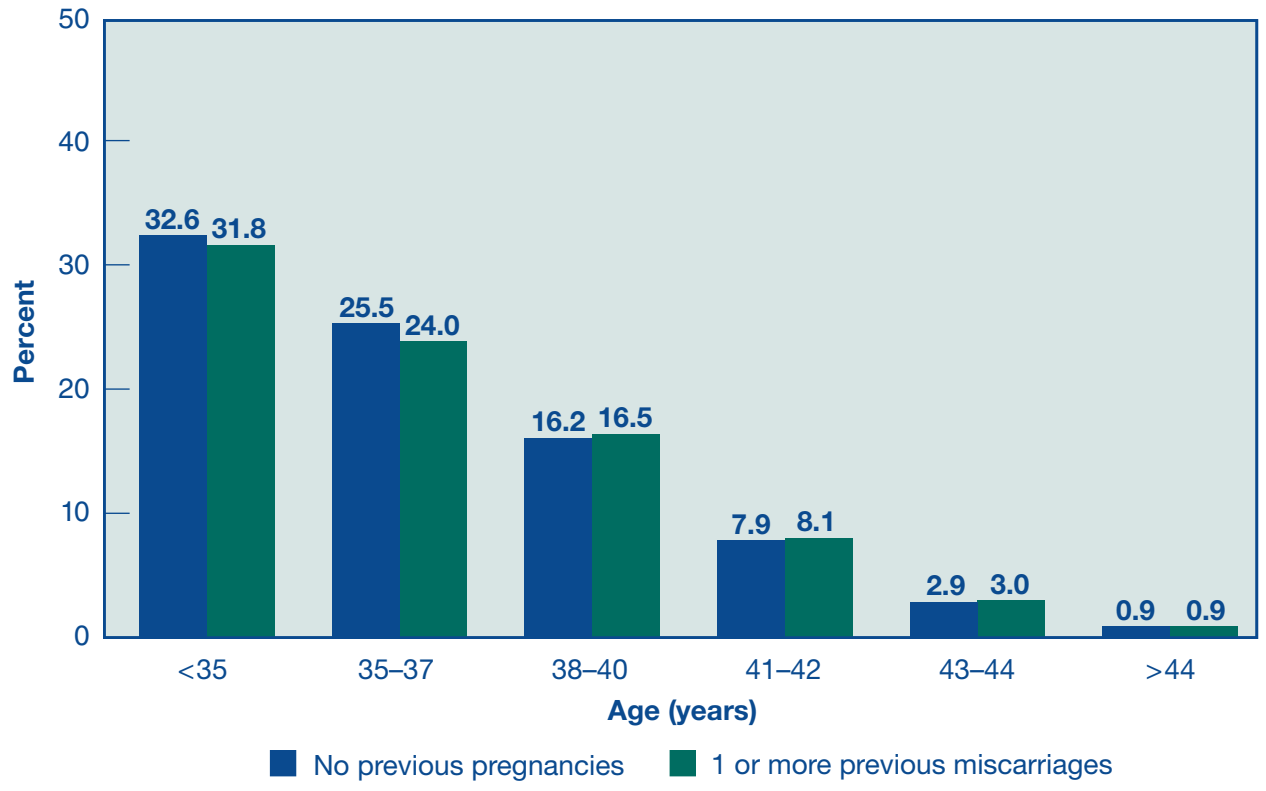
Figure 21
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and Number of Previous Live Births, 2015



How did previous miscarriage impact ART live-birth outcomes among women with no previous births?

Among women aged 37 or younger, the percentage of ART cycles using fresh nondonor eggs or embryos that resulted in live births was lower with one or more previous miscarriages compared with never pregnant (Figure 22). Previous pregnancies ending in miscarriage could have been conceived naturally or through ART. Among women aged 38 or older, the percentage of ART cycles that resulted in live births was higher or about the same with one or more previous miscarriages compared with never pregnant. In 2015, a total of 66,259 ART cycles using fresh nondonor eggs or embryos were performed among women who had not previously given birth. However, about 23% of those cycles were reported by women with one or more previous pregnancies that resulted in miscarriage.

Figure 22
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and History of Miscarriage, Among Women with No Previous Births,* 2015

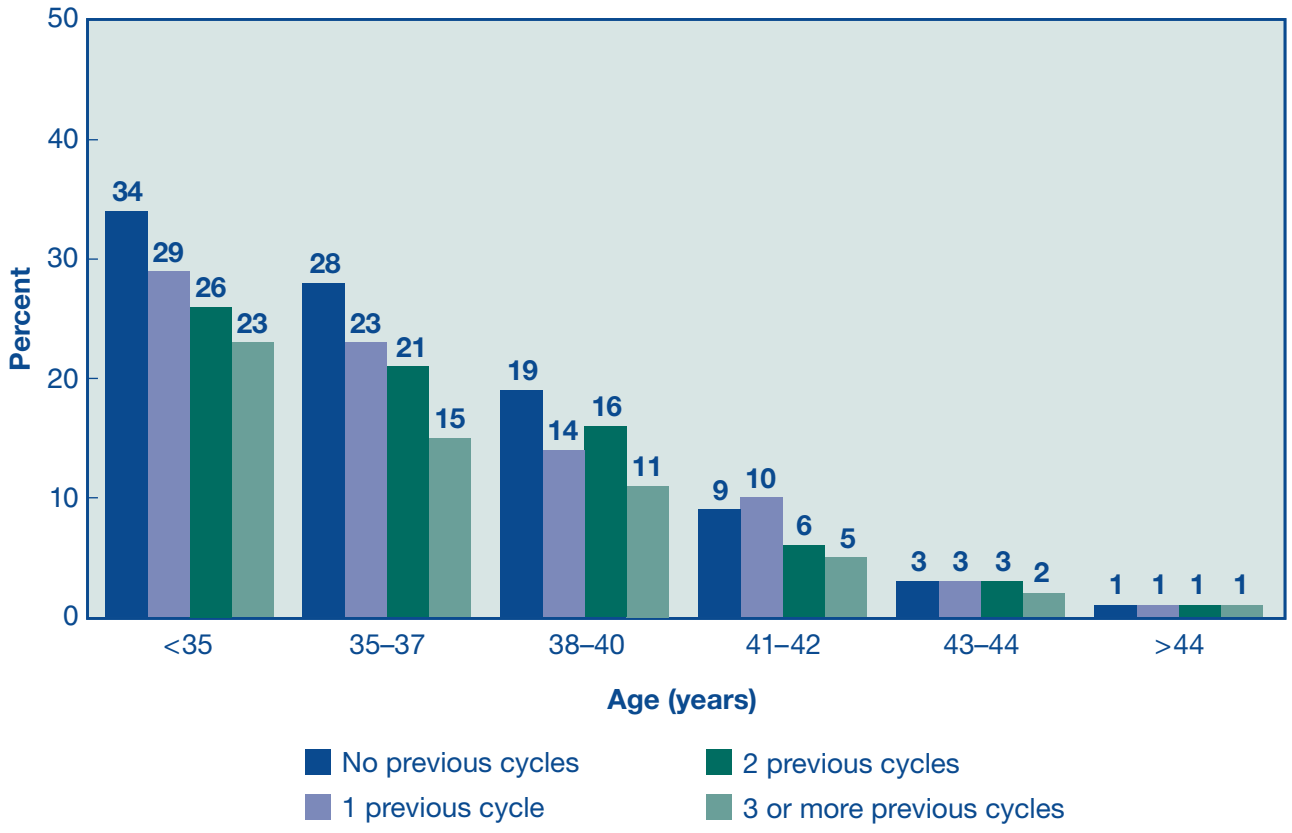


* Women reporting only previous ectopic pregnancies or pregnancies that ended in induced abortion are not included.

How did previous unsuccessful ART use impact ART live-birth outcomes among women with no previous births?

Among women with no previous births, in most age groups, the percentage of ART cycles using fresh nondonor eggs or embryos that resulted in live births was lower with two or more previous unsuccessful ART cycles compared with no previous ART cycles (Figure 23). Among women aged 37 or younger, the percentage of ART cycles resulting in live births decreased as the number of previous unsuccessful ART cycles increased. For about 41% of fresh nondonor ART cycles performed in 2015, one or more previous ART cycles were reported (this percentage includes previous ART cycles using either fresh or frozen embryos).

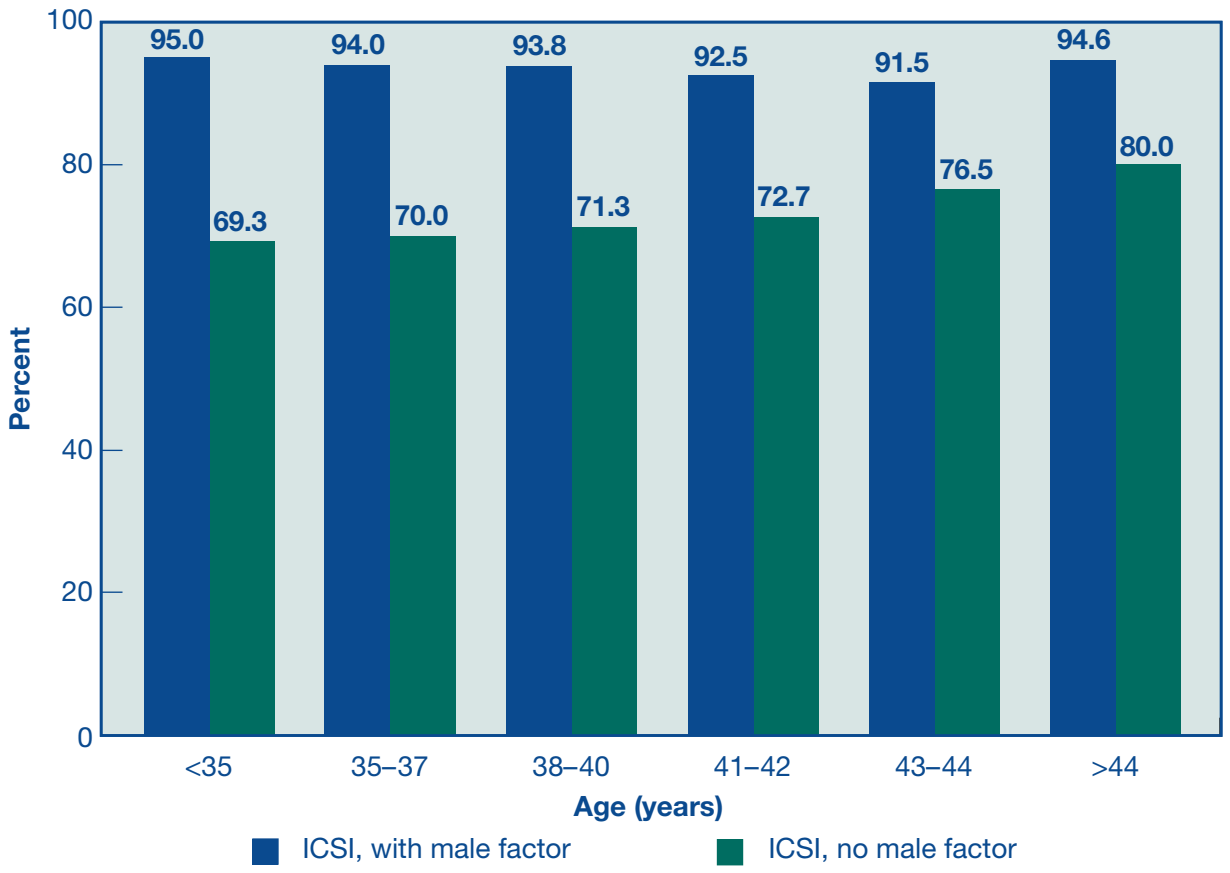
Figure 23
Percentages of ART Cycles Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group and Number of Previous ART Cycles, Among Women with No Previous Live Births, 2015



Did the use of ICSI differ by age group or by male factor infertility diagnosis?

The percentage of retrievals using intracytoplasmic sperm injection (ICSI) among patients without male factor infertility ranged from 69% among patients younger than age 35 to 80% among those older than age 44 (Figure 24). ICSI was developed to overcome problems with fertilization that sometimes occur with a diagnosis of male factor infertility. The use of ICSI among patients with a diagnosis of male factor infertility was high among all female patient age groups, ranging from 92% to 95%. In all age groups, the percentage of fresh nondonor retrievals that used ICSI was lower for patients with no diagnosis of male factor infertility than among patients with a male factor diagnosis.

Figure 24
Percentages of Retrievals Using Fresh Nondonor Eggs or Embryos That Used ICSI,* 2015



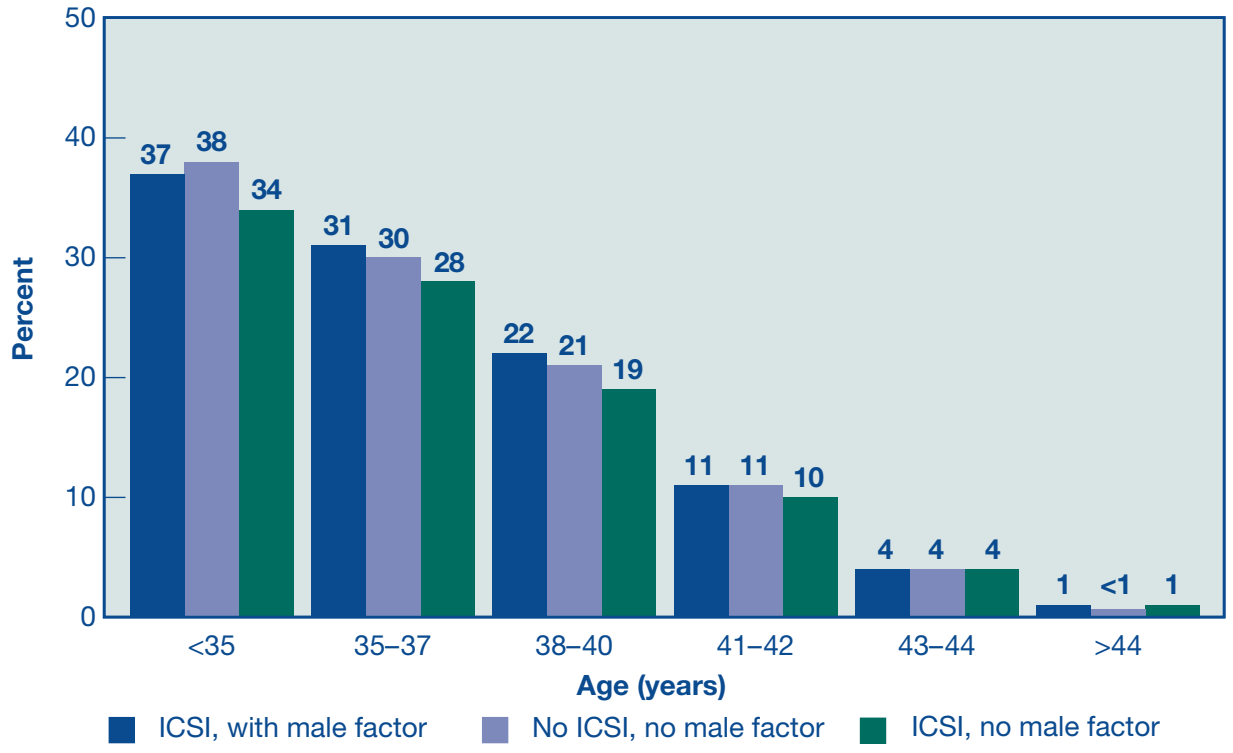
* Cycles using GIFT are excluded.

How did ICSI use and male factor infertility impact live-birth outcomes?

Among women aged 42 or younger, percentages of retrievals that resulted in live births were higher when ICSI was used with a diagnosis of male factor infertility than when ICSI was used without a diagnosis of male factor infertility (Figure 25).

Also among women aged 42 or younger, for patients without male factor infertility, percentages of retrievals resulting in live births were lower for those using ICSI compared with those not using ICSI.

Figure 25
Percentages of Fresh Nondonor Retrievals That Resulted in Live Births Among Patients with or Without Diagnosed Male Factor Infertility, by Age Group and Use of ICSI,* 2015

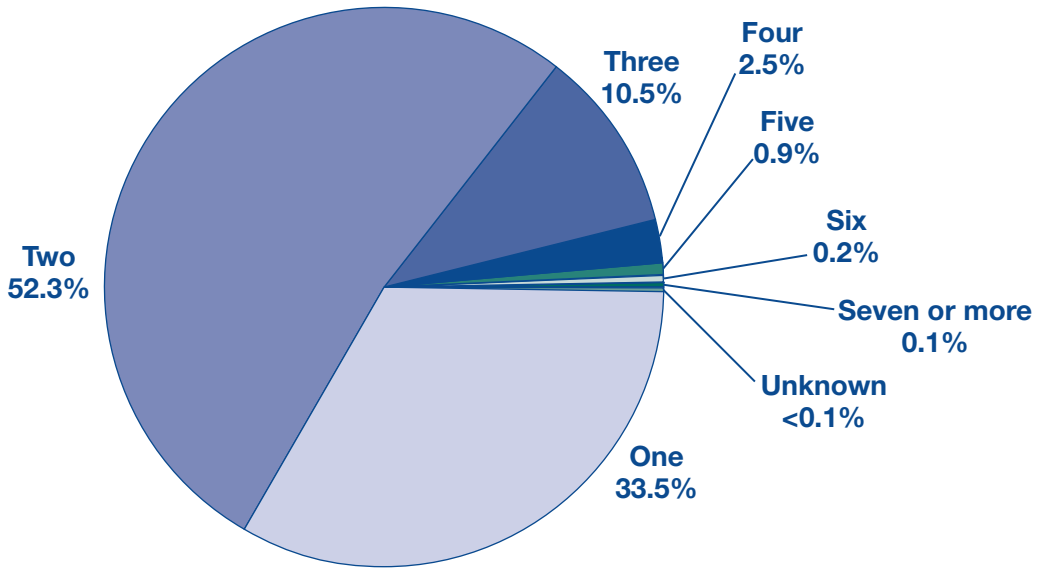


* Cycles using GIFT are excluded.

How many embryos were typically transferred in an ART procedure?

Figure 26 shows that in 2015, the majority (86%) of ART cycles that used fresh nondonor eggs or embryos and progressed to the embryo transfer stage involved the transfer of one or two embryos. About 11% involved the transfer of three embryos, 3% involved the transfer of four embryos, and 1% involved the transfer of five or more embryos.

Figure 26
Numbers of Embryos Transferred Among All Transfers Using Fresh Nondonor Eggs or Embryos,* 2015

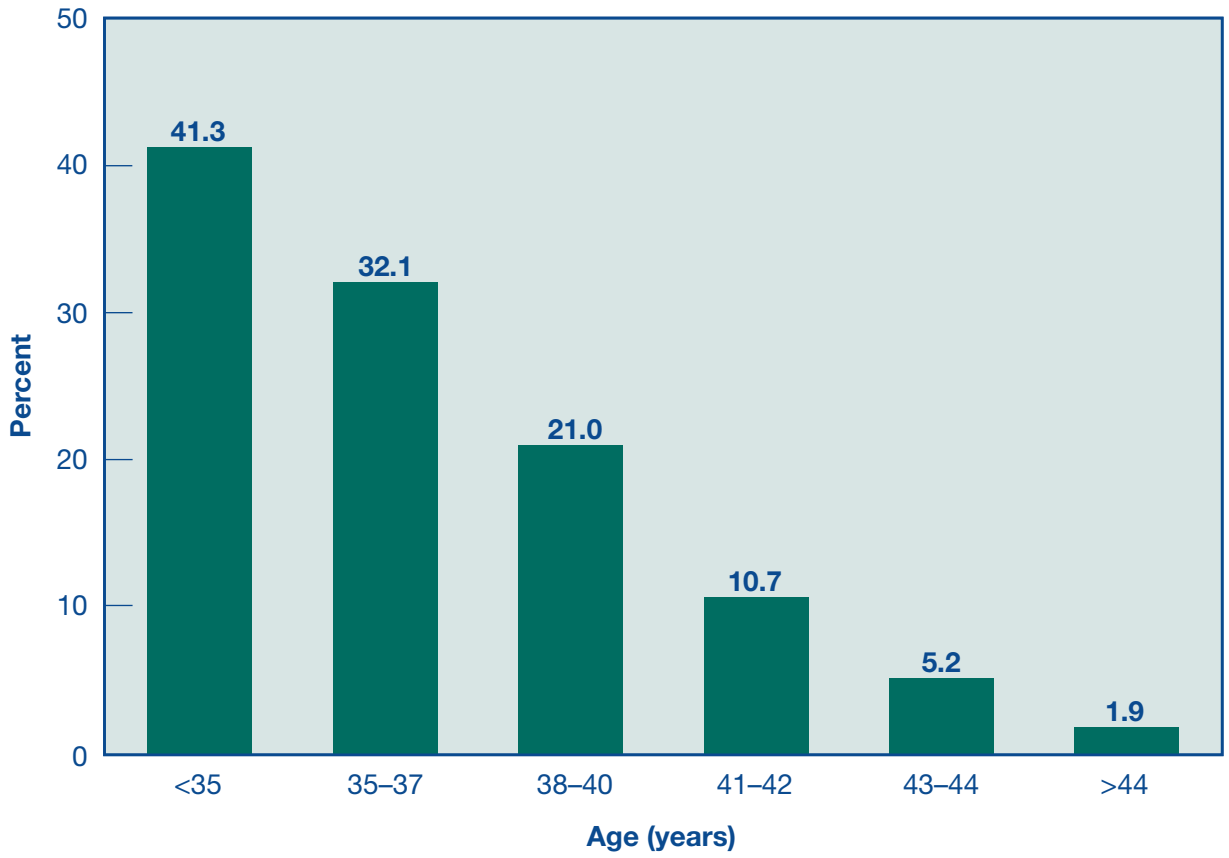


* Total does not equal 100% due to rounding.

Did the implantation rate differ by a woman's age?

The percentage of transferred fresh nondonor eggs or embryos that implanted decreased as the age of the woman increased (Figure 27). In 2015, the percentage of transferred nondonor eggs or embryos that resulted in implantation was highest (approximately 41%) among women younger than age 35. The implantation percentage was lowest (about 2%) among women older than age 44.

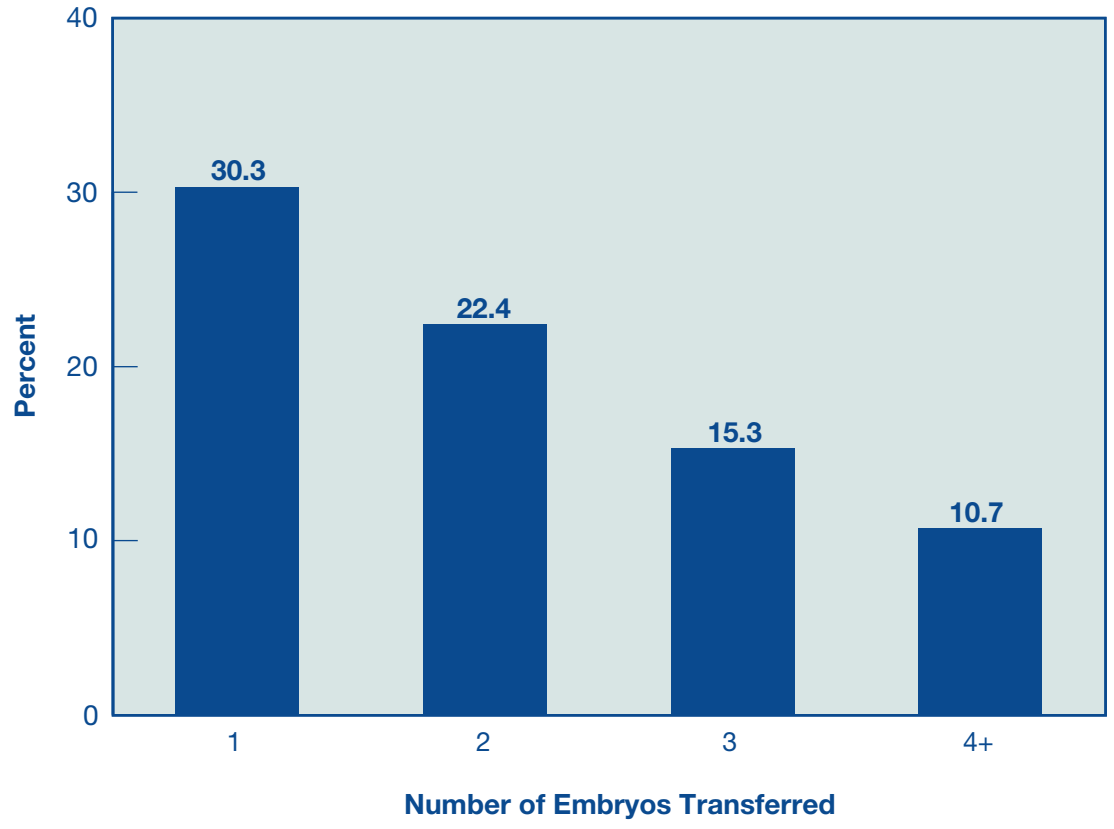
Figure 27
Percentages of Embryos Transferred That Implanted Using Fresh Nondonor Eggs or Embryos, by Age Group, 2015



Did the number of embryos transferred impact the percentage of single, term, and normal birth weight infants born?

The percentage of transfers of fresh nondonor eggs or embryos in 2015 resulting in the live birth of a single, term, and normal birth weight infant decreased as the number of embryos transferred increased (Figure 28). An infant is defined as term if born at 37 or more full weeks of pregnancy and as normal birth weight if at least 2,500 grams (about 5 pounds, 8 ounces). The percentage of transfers resulting in the live birth of a single, term, and normal birth weight infant decreased from approximately 30% among cycles that involved the transfer of one embryo to 11% among cycles that involved the transfer of four or more embryos. Transferring more embryos increases the percentage of multiple-fetus pregnancies. Multiple-fetus pregnancies are associated with increased risk of poor outcomes for mothers and infants, including higher rates of prematurity, low birth weight, and pregnancy complications.

Figure 28
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births of Single, Term, and Normal Birth Weight Infants, by Number of Embryos Transferred, 2015

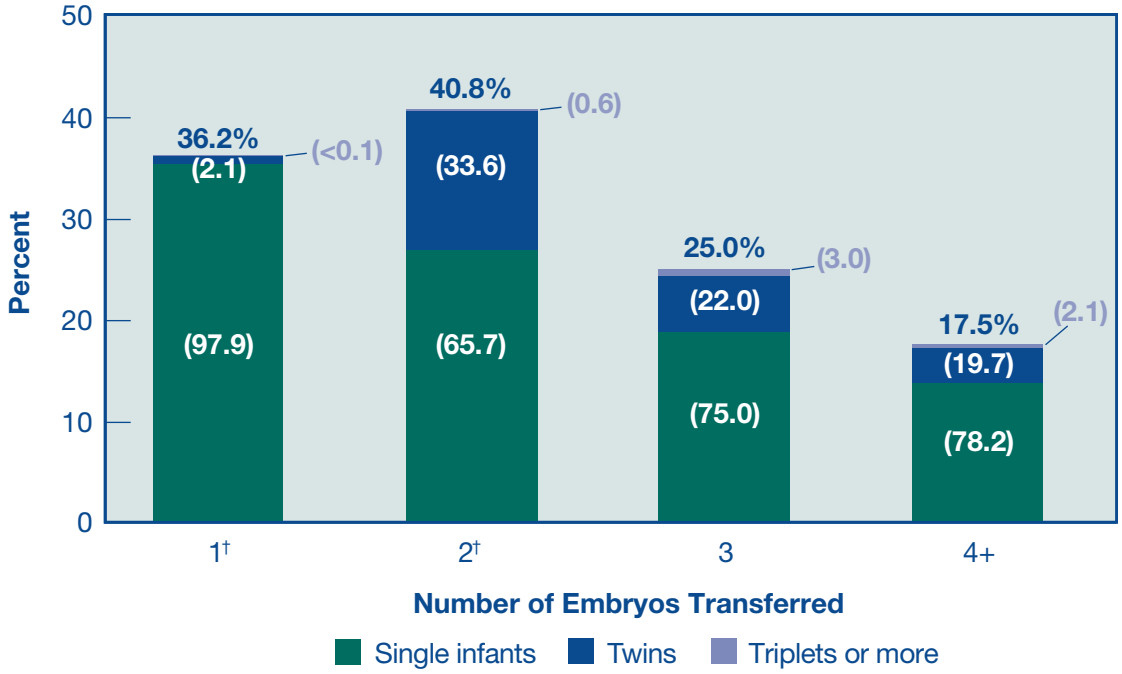


Was the percentage of multiple-infant births higher if more embryos were transferred?

Among transfers of fresh eggs or embryos for cycles performed among women who used their own eggs, the percentage of multiple-infant births was lowest if one embryo was transferred, highest if two embryos were transferred, and otherwise decreased as more embryos were transferred (Figure 29). In 2015, the percentage of transfers that resulted in live births was highest (41%) when two embryos were transferred; however, the percentage of multiple-infant births also was highest (34%). Note that in rare cases a single embryo may divide and thus produce multiple-infant births. For this reason, small percentages of twins and triplets or more resulted from a single embryo transfer, and a small percentage of triplets or more resulted when two embryos were transferred.

The relationship between the number of embryos transferred, the percentage of transfers resulting in live births, and the percentage of multiple-infant births is influenced by several factors, such as the woman's age and day of embryo transfer. See Figures 30 and 34 (pages 36 and 40) for more details on cycles with a higher percentage of transfers resulting in multiple-infant births.

Figure 29
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births and Distribution of Number of Infants Born, by Number of Embryos Transferred,* 2015



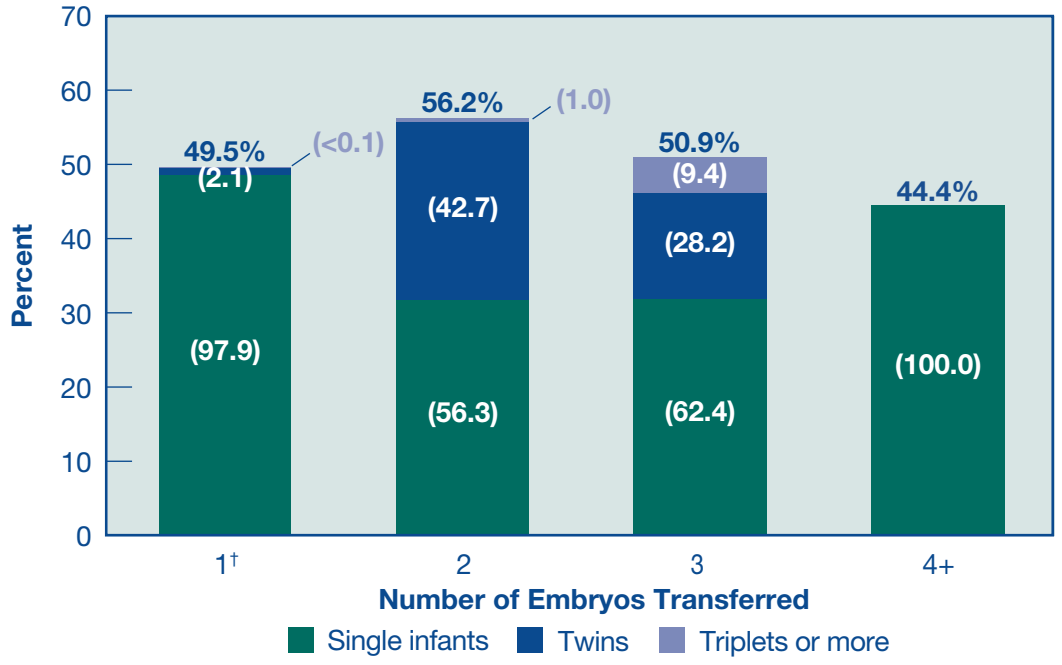
* Percentages of transfers resulting in live births are shown on top of each bar graph. Percentages of live births that were single infants, twins, and triplets or more are in parentheses.
† Totals do not equal 100% due to rounding.

Was the percentage of live births higher if more embryos were transferred for good-prognosis women?

In 2015, among good-prognosis women, the percentage of transfers of fresh nondonor eggs or embryos that resulted in live births was highest (56%) when two embryos were transferred; however, among transfers that resulted in live births, the percentage of single-infant live births was highest with the transfer of one embryo (98%) (Figure 30). Good-prognosis women are defined here as younger than age 35 with extra embryos available to set aside by choice for future cycles.

Note that in rare cases a single embryo may divide and thus produce multiple-infant births. For this reason, small percentages of twins and triplets or more resulted from a single embryo transfer, and a small percentage of triplets or more resulted when two embryos were transferred.

Figure 30
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births and Distribution of Number of Infants Born Among Good-Prognosis Women, by Number of Embryos Transferred,* 2015

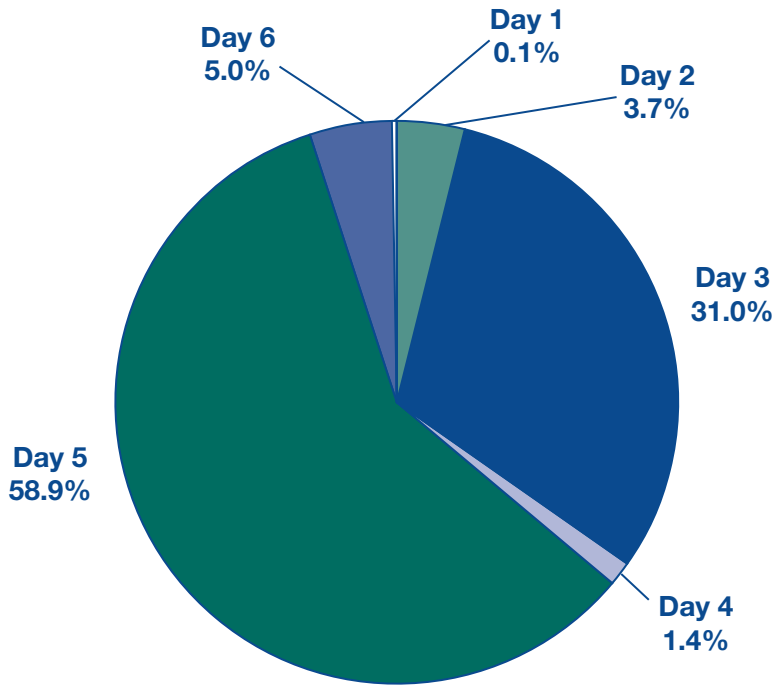


* Percentages of transfers resulting in live births are shown on top of each bar graph. Percentages of live births that were single infants, twins, and triplets or more are in parentheses.
† Total does not equal 100% due to rounding.

How long after egg retrieval did embryo transfer occur?

Once an ART cycle has progressed from egg retrieval to fertilization, the embryo(s) can be transferred into the woman's uterus anytime in the next 1 to 6 days. As seen in Figure 31, transfers 3 days after retrieval (a day 3 transfer) and transfers 5 days after retrieval (a day 5 transfer) were the most common (31% and 59%, respectively) among those embryos that progressed to the embryo transfer stage.

Figure 31
Day of Embryo Transfer* Among Transfers Using Fresh Nondonor Eggs or Embryos,†‡ 2015

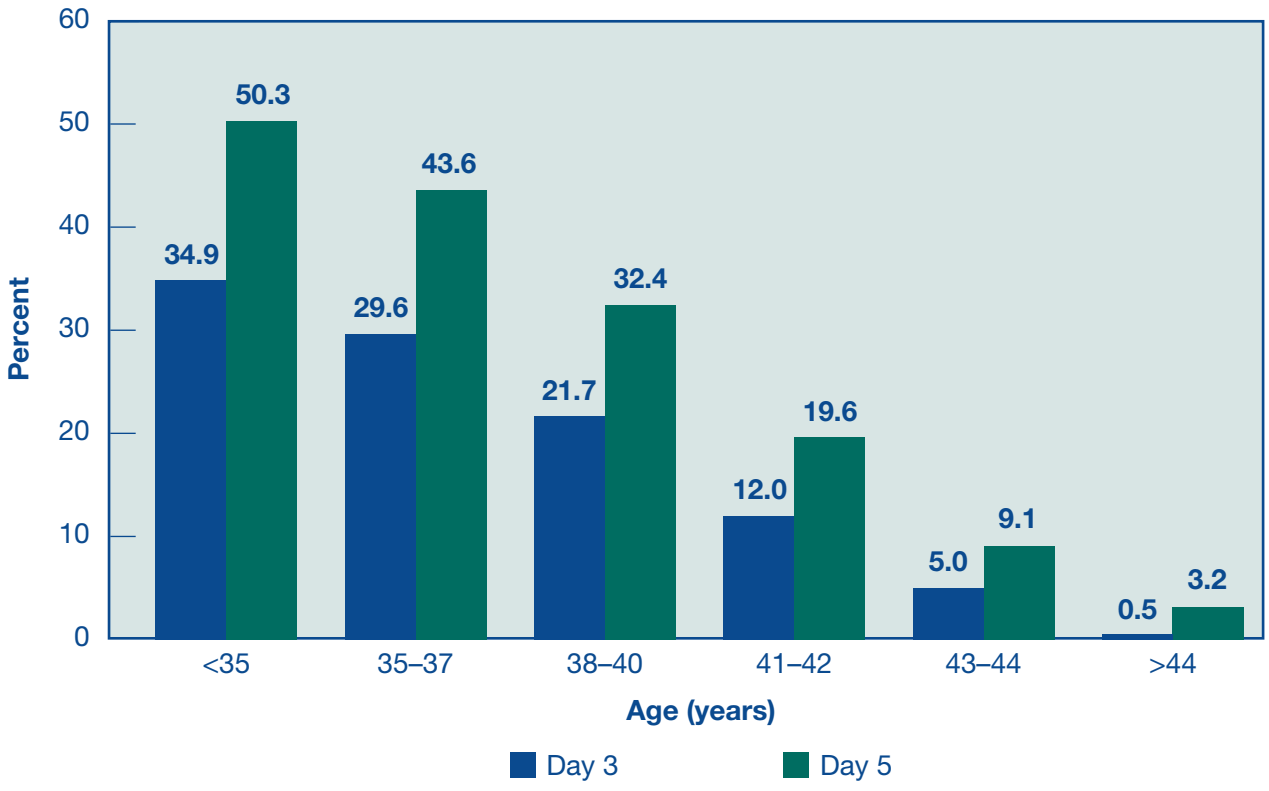


* Number of days following egg retrieval.
† Cycles using GIFT or ZIFT are excluded. Missing or implausible values for day of embryo transfer (that is, 0 or greater than 6) are not included.
‡ Total does not equal 100% due to rounding.

Was the percentage of live births higher for day 3 or day 5 transfers?

In 2015, for all age groups, live-birth percentages were higher for day 5 embryo transfers using fresh nondonor eggs or embryos than for day 3 transfers, although percentages resulting in live births decreased in all age groups for both day 3 and day 5 transfers (Figure 32). As shown in Figure 31 (page 37), the vast majority (almost 90%) of ART fresh nondonor embryo transfers were performed on day 3 or day 5. While day 5 transfers have higher live-birth percentages, not all embryos will survive until day 5 and thus, a day 5 transfer may not be an option for all embryos.

Figure 32
Percentages of Day 3 and Day 5 Embryo Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Age Group,* 2015

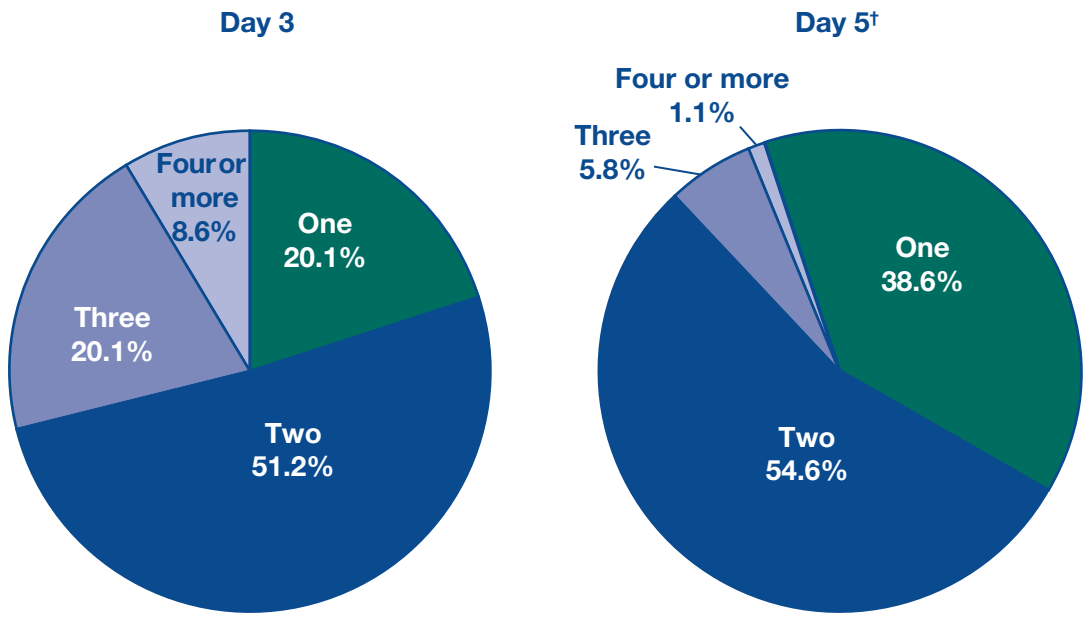


* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.

Did the number of embryos transferred differ for day 3 and day 5 transfers?

The percentage of transfers using fresh nondonor eggs or embryos that involved one and two embryos was higher on day 5 than on day 3 (Figure 33). About 7% of day 5 transfers and 29% of day 3 transfers involved three or more embryos. Transferring fewer numbers of embryos on day 5, however, did not translate into a lower percentage of multiple-infant births. See Figure 34 (page 40) for more details on the relationship between the day of transfer and multiple-infant births.

Figure 33
Numbers of Embryos Transferred on Day 3 and Day 5 Among Transfers Using Fresh Nondonor Eggs or Embryos,* 2015



* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.
† Total does not equal 100% due to rounding.

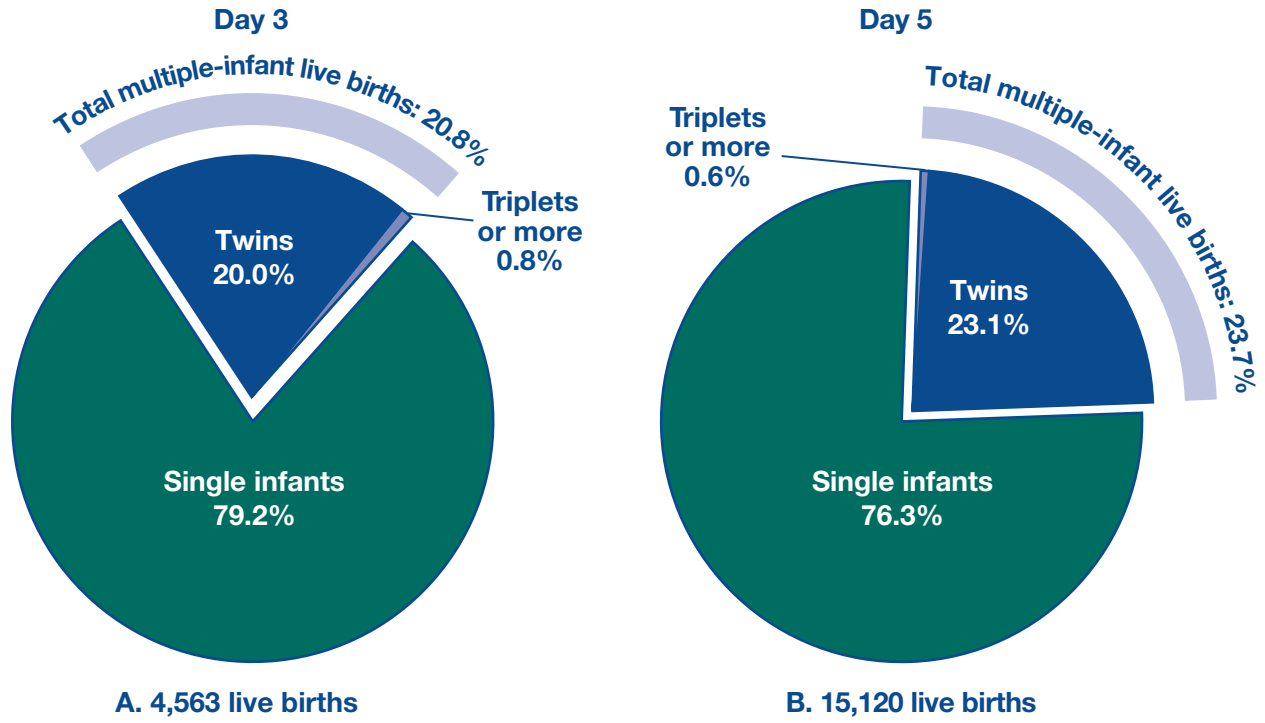
Did the percentage of multiple-infant births differ for day 3 and day 5 transfers?

The percentage of multiple-infant births was higher for day 5 transfers using fresh nondonor eggs or embryos than for day 3 transfers (Figure 34). Part A of Figure 34 shows that among the 4,563 live births that occurred following the transfer of day 3 fresh nondonor embryos, about 79% were single infants, and approximately 21% involved the birth of more than one infant (20% twins, and 1% triplets or more).

In 2015, a total of 15,120 live births occurred following the transfer of day 5 fresh nondonor embryos. Part B of Figure 34 shows that approximately 24% of these live births involved the birth of more than one infant (23% twins and 1% triplets or more).

As shown in Figure 33 (page 39), fewer embryos were transferred on day 5 than on day 3, although the majority of day 5 transfers still involved the transfer of more than one embryo. The proportion of live births resulting in twins was higher among transfers performed on day 5 than on day 3. Thus, having a multiple-infant birth was more likely for day 5 embryo transfers.

Figure 34
Distribution of Number of Infants Born Among Day 3 and Day 5 Embryo Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births,* 2015



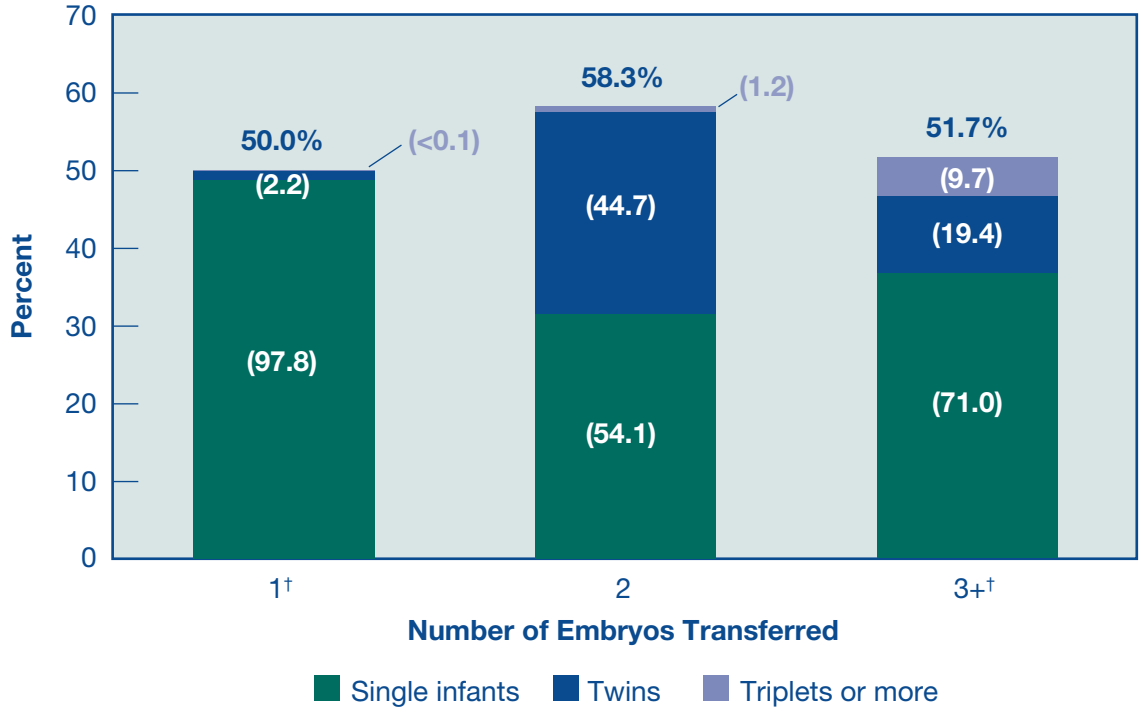
* Cycles using GIFT or ZIFT are excluded. Embryo transfers performed on days 1, 2, 4, and 6 are not included because each of these accounted for a small proportion of procedures.

Was the percentage of day 5 transfers that resulted in live births affected by the number of embryos transferred for good-prognosis women?

The percentage of day 5 transfers using fresh nondonor eggs or embryos resulting in live births was highest when two embryos were transferred among good-prognosis women (Figure 35). Good-prognosis women are defined here as women younger than age 35 with extra embryos set aside for future cycles. As shown in Figure 34 (page 40), fresh nondonor embryos transferred on day 5 resulted in a higher percentage of multiple-infant births than embryos transferred on day 3.

In 2015, the percentage of day 5 transfers resulting in live births when two embryos were transferred was 58%; however, the proportion of live births that were multiples (twins or more) was about 46%. The highest percentage of live births of a single infant (98%) resulted from the day 5 transfer of a single embryo. Note that in rare cases a single embryo may divide and thus produce multiple-infant births. For this reason, small percentages of twins and triplets or more resulted from a single embryo transfer, and a small percentage of triplets or more resulted when two embryos were transferred.

Figure 35
Percentages of Day 5 Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births and Distribution of Number of Infants Born Among Good-Prognosis Women, by Number of Embryos Transferred,* 2015

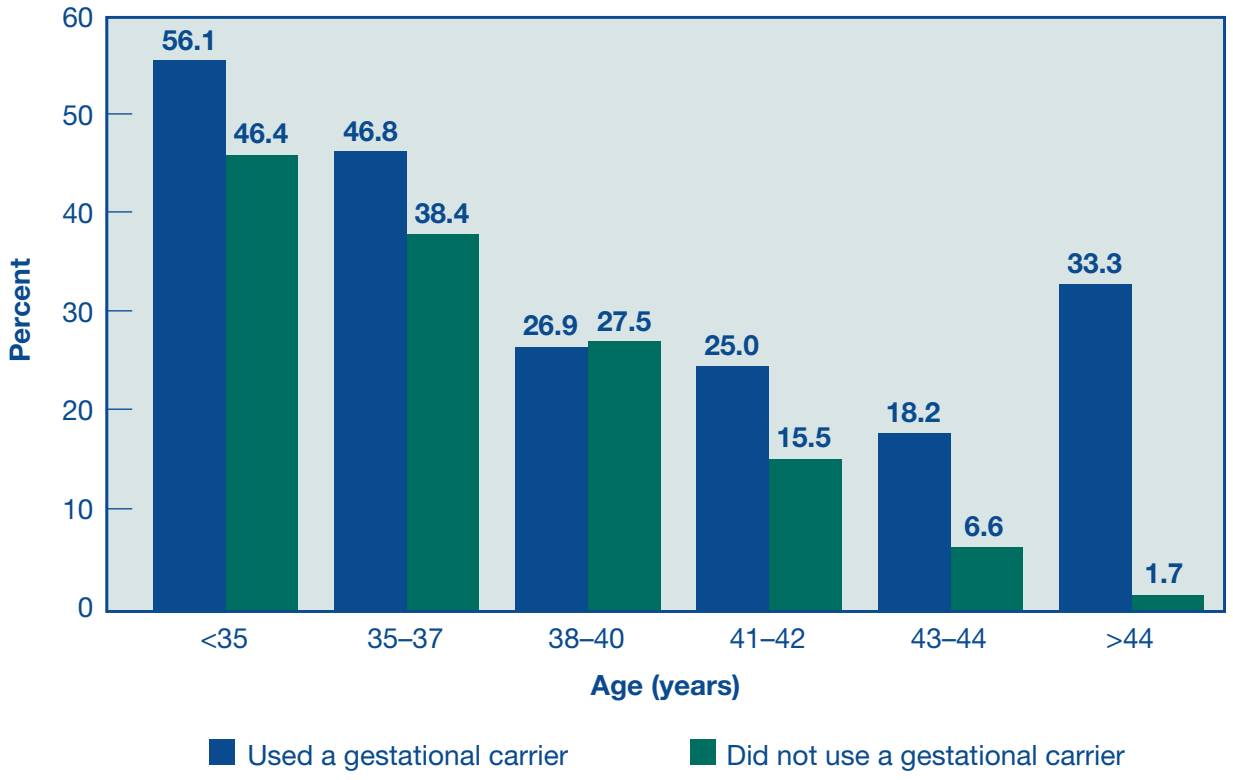


* Percentages of transfers resulting in live births are shown on top for each bar graph. Percentages of live births that were single infants, twins, and triplets or more are in parentheses.
† Totals do not equal 100% due to rounding.

Did the percentage of transfers that resulted in live births differ by gestational carrier use?

Among all age groups except those aged 38–40, the percentage of transfers using fresh nondonor eggs or embryos that resulted in live births was higher for those using gestational carriers than for those that did not use a gestational carrier (Figure 36). A gestational carrier or gestational surrogate is a woman who agrees to carry a developing embryo created from another woman's egg for others. In 2015, gestational carriers were used in about 1% of fresh nondonor cycles. While the percentage of live births generally decreased with the patient's age with or without using gestational carrier, percentages of live births when using a gestational carrier were about 8% to 12% higher among most patient age groups, and almost 32% higher among patients older than age 44.

Figure 36
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births Among ART Cycles That Used Gestational Carriers and Those That Did Not, by Age Group,* 2015



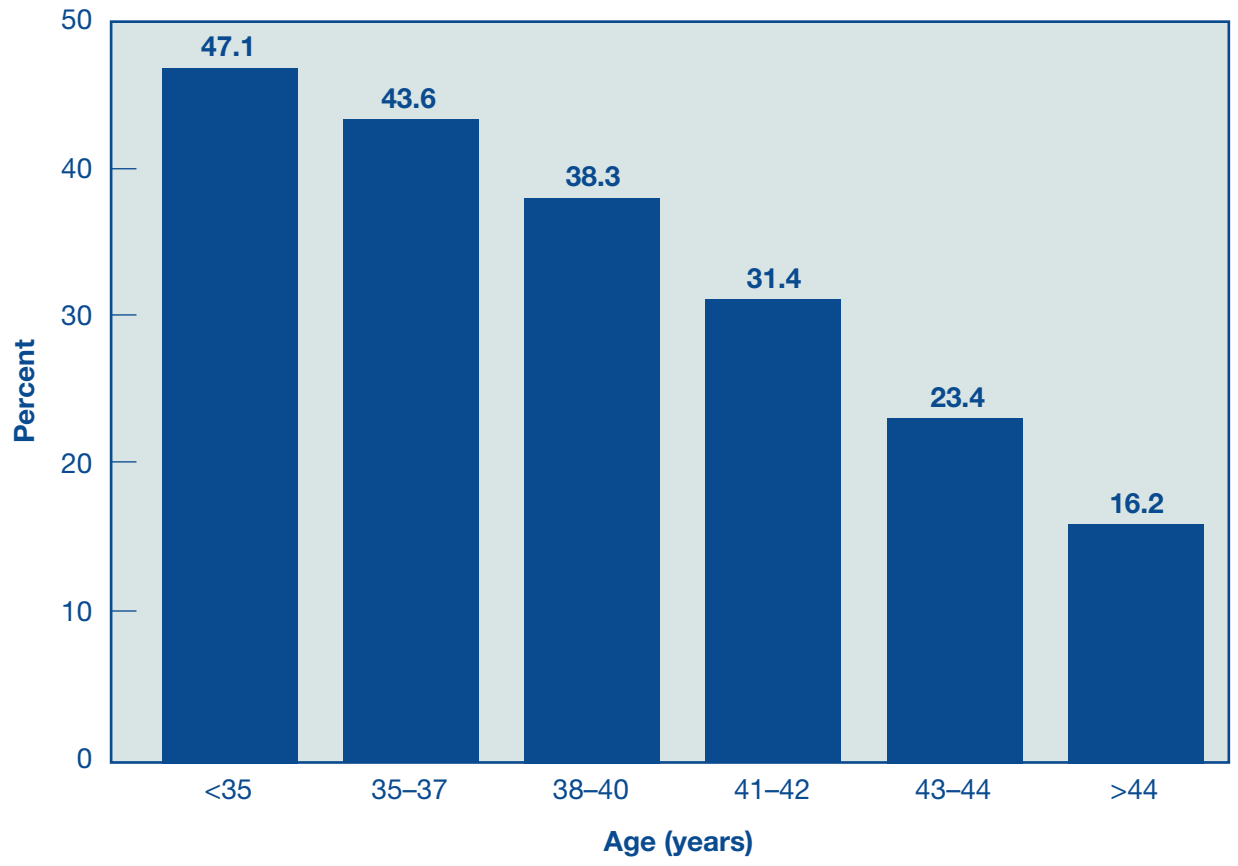
* Age groups reflect the age of the ART patient, not the age of the gestational carrier.

SECTION 3: ART CYCLES USING FROZEN NONDONOR EMBRYOS

Did the implantation rate differ by a woman's age?

The percentage of transferred frozen nondonor embryos that implanted decreased with age from about 47% among women younger than age 35 to 16% among women older than age 44 (Figure 37). Note that for frozen cycles, although not shown, the age of the woman at the time of retrieval has a larger effect on implantation rates than the age of the woman at the time of transfer.

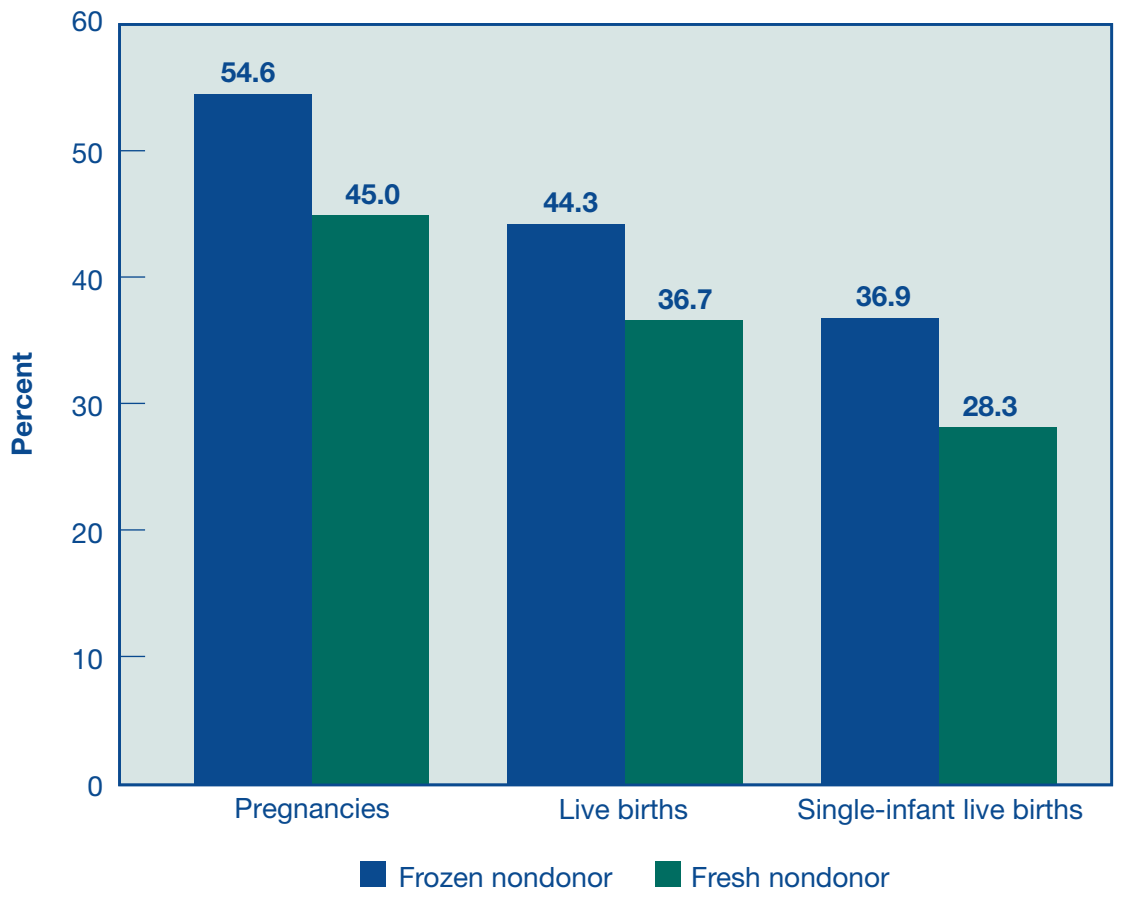
Figure 37
Percentages of Embryos Transferred That Implanted Using Frozen Nondonor Embryos, by Age Group, 2015



Was the percentage of transfers that resulted in pregnancies, live births, and single-infant live births higher for fresh or frozen nondonor embryos?

Figure 38 shows that percentages of transfers resulting in pregnancies, live births, and single-infant live births were higher for frozen nondonor embryos than for fresh nondonor embryos in 2015. Frozen nondonor embryos were used in 69,882 ART cycles performed in 2015.

Figure 38
Percentages of Transfers Using Frozen or Fresh Nondonor Embryos That Resulted in Pregnancies, Live Births, and Single-Infant Live Births, 2015



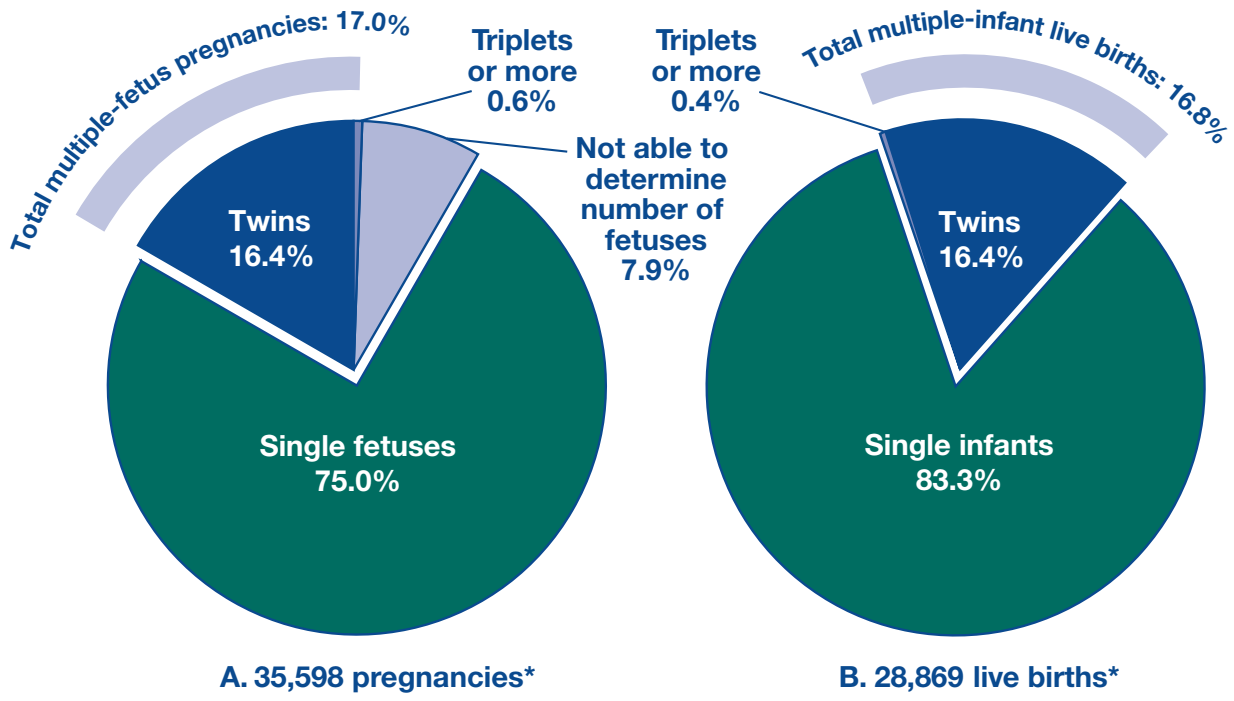
What percentage of ART cycles resulted in a multiple-fetus pregnancy or multiple-infant birth?

Part A of Figure 39 shows that among the 35,598 pregnancies that resulted from ART cycles using frozen nondonor embryos in 2015, 75% were single-fetus pregnancies and 17% were multiple-fetus pregnancies. The number of fetuses could not be accurately determined for 8% of pregnancies.

Of the 35,598 pregnancies that resulted from these ART cycles, 28,869 (81%) resulted in live births. Part B of Figure 39 shows that about 17% of these live births resulted in more than one infant (16% twins and less than 1% triplets or more).

ART pregnancies are more likely to result in multiple-infant births (twins, triplets or more) than pregnancies resulting from natural conception because more than one embryo may be transferred. Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Figure 39
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births Among ART Cycles Using Frozen Nondonor Embryos, 2015



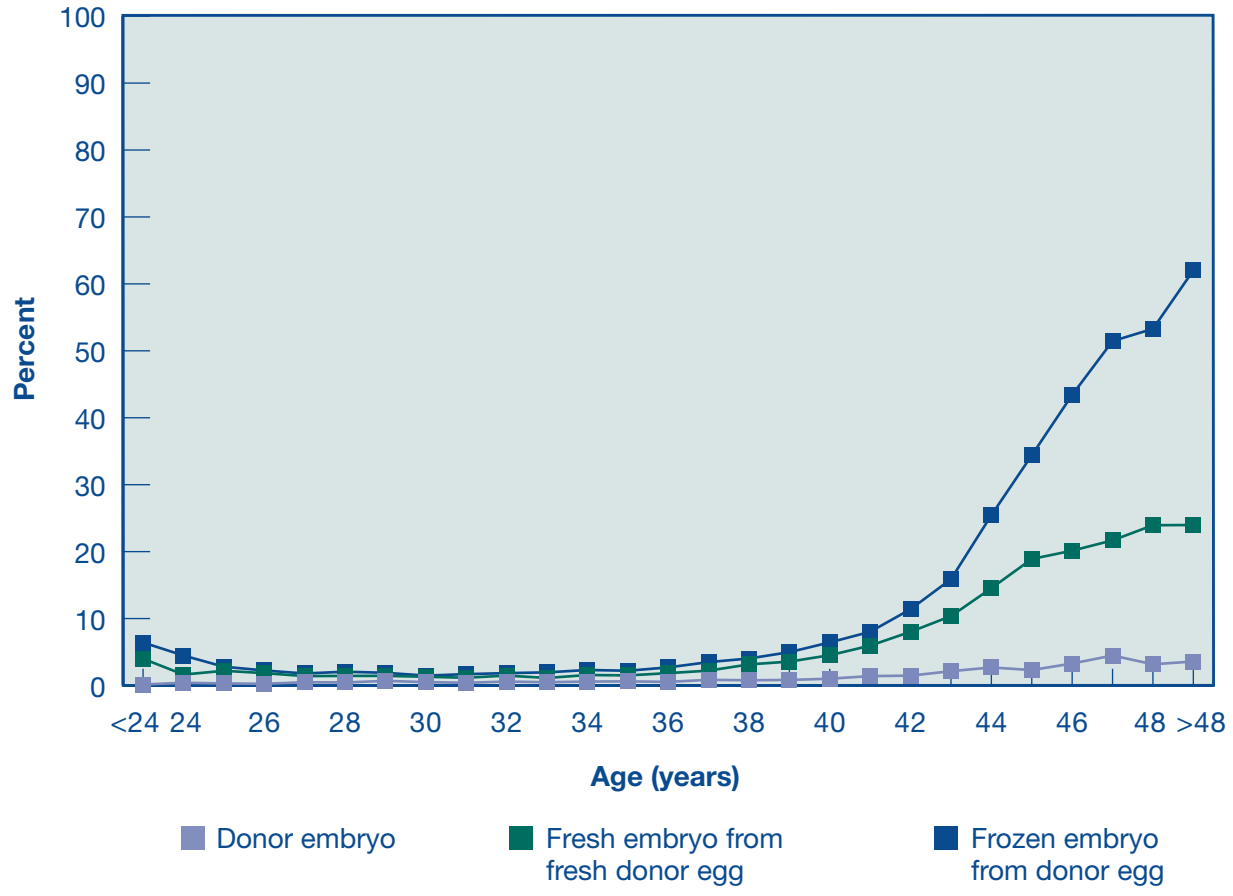
* Totals do not equal 100% due to rounding.

SECTION 4: ART CYCLES USING DONOR EGGS

Was the use of donor eggs or embryos higher among older women undergoing ART?

ART using donor eggs or embryos is much more common among older women than among younger women (Figure 40). Donor eggs or embryos were used in 21,182 ART cycles performed in 2015, of which 1,700 used donor embryos from another patient or couple's ART treatment, 7,331 used fresh embryos created from fresh donor eggs, and 12,151 used frozen embryos created from donor eggs. The percentage of cycles performed with donor eggs increased sharply after age 40. Among women older than age 48, for example, approximately 90% of all ART cycles used donor eggs, of which more than two-thirds used frozen embryos created from donor eggs. As shown in Figures 17, 27, and 37 (pages 23, 33, and 43), eggs produced by older women form embryos that are less likely to implant and more likely to result in miscarriage if they do implant.

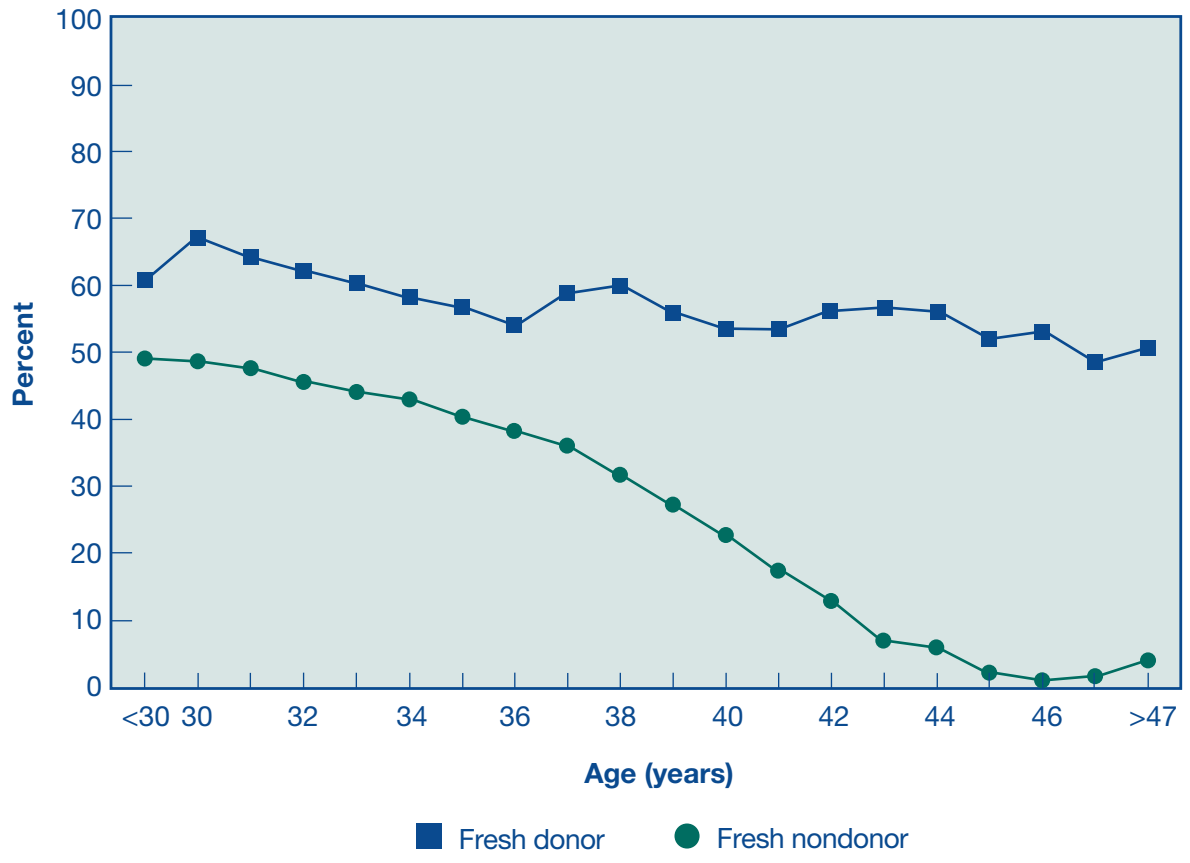
Figure 40
Percentages of ART Cycles Using Donor Eggs or Embryos, by Age of Woman, 2015



Did the percentage of ART transfers that resulted in live births differ for fresh donor and fresh nondonor eggs?

The percentage of transfers using fresh nondonor eggs or embryos resulting in live births decreased as the age of the woman increased (Figure 41). In contrast, since egg donors are typically in their 20s or early 30s, the percentage of transfers using fresh donor eggs or embryos that resulted in live births remained consistently above 50% among women of almost all ages. The likelihood of a fertilized egg implanting is related to the age of the woman who produced the egg.

Figure 41
Percentages of Transfers Using Fresh Embryos from Donor or Nondonor Eggs That Resulted in Live Births, by Age of Woman, 2015



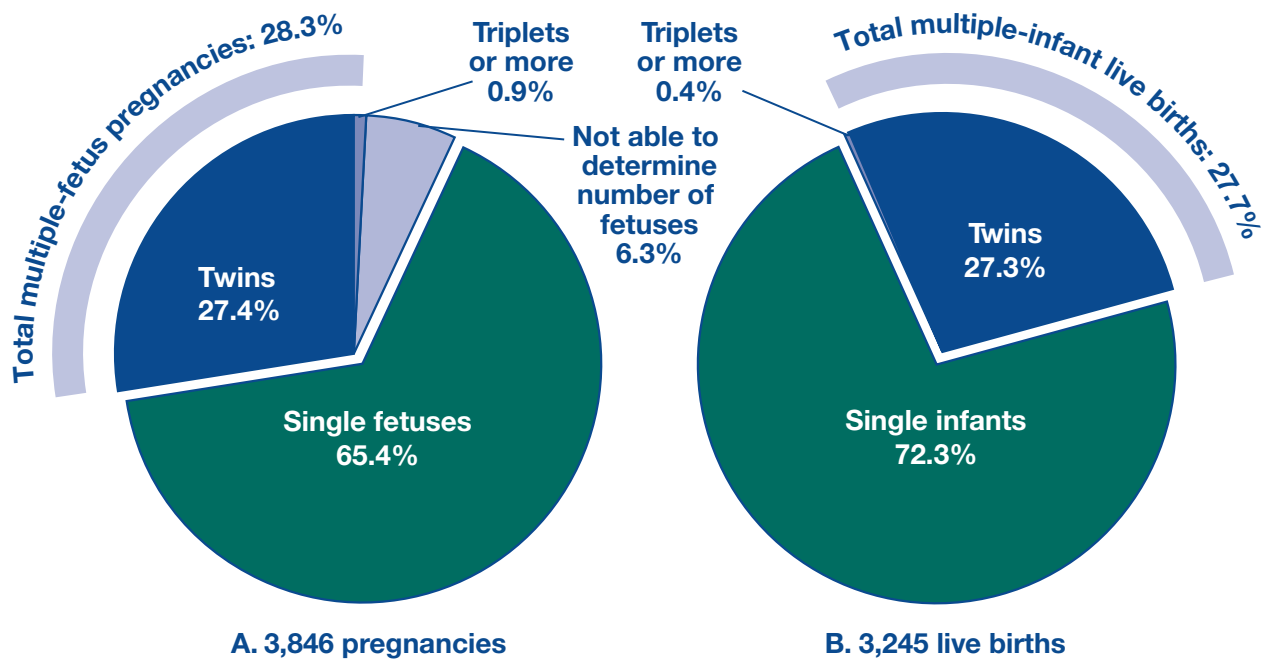
What percentage of ART cycles resulted in a multiple-fetus pregnancy or multiple-infant birth?

Part A of Figure 42 shows that among the 3,846 pregnancies that resulted from ART cycles using fresh donor eggs or embryos in 2015, about 65% were single-fetus pregnancies and 28% were multiple-fetus pregnancies. The number of fetuses could not be accurately determined for 6% of pregnancies.

Of the 3,846 pregnancies that resulted from these ART cycles, 3,245 (84%) resulted in live births. Part B of Figure 42 shows that approximately 27% of these live births resulted in twins and less than 1% resulted in triplets or more.

ART pregnancies are more likely to result in multiple-infant births (twins, triplets or more) than pregnancies resulting from natural conception because more than one embryo may be transferred. Multiple-infant births are associated with greater problems for both mothers and infants, including higher rates of caesarean section, prematurity, low birth weight, and infant disability or death.

Figure 42
Distribution of Multiple-Fetus Pregnancies and Multiple-Infant Live Births Among ART Cycles Using Fresh Embryos from Donor Eggs, 2015

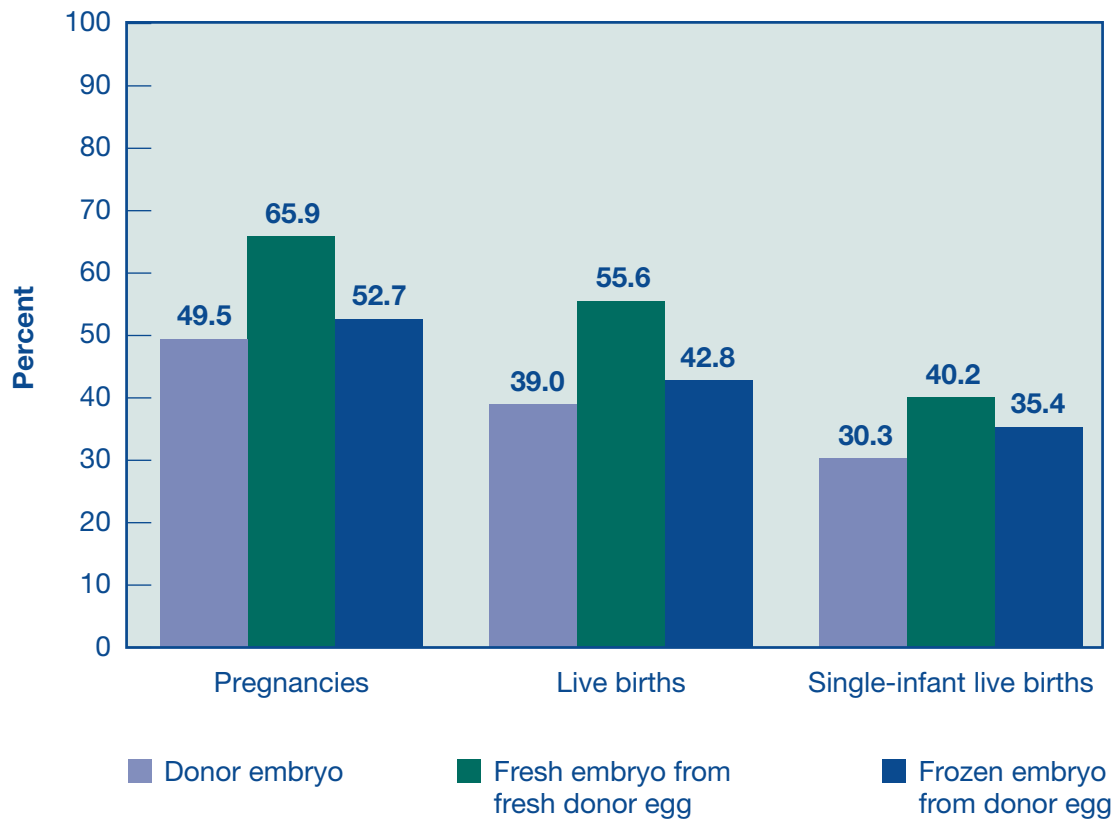


Did the percentage of transfers using donor eggs or embryos that resulted in pregnancies, live births, and single-infant live births differ by cycle type?

Figure 43 shows that in 2015, percentages of transfers resulting in pregnancies, live births, and single-infant live births were lower for patients using donor embryos from another patient or couple's ART treatment and for transfers using frozen embryos from donor eggs compared with percentages for patients using fresh embryos from fresh donor eggs.

The average number of embryos transferred in 2015 was 1.8 for transfers of donor embryos, 1.6 for transfers of fresh embryos using fresh donor eggs, and 1.5 for transfers of frozen embryos using donor eggs.

Figure 43
Percentages of Transfers Using Donor Eggs or Embryos That Resulted in Pregnancies, Live Births, and Single-Infant Live Births, 2015



SECTION 5: ART TRENDS, 2006–2015

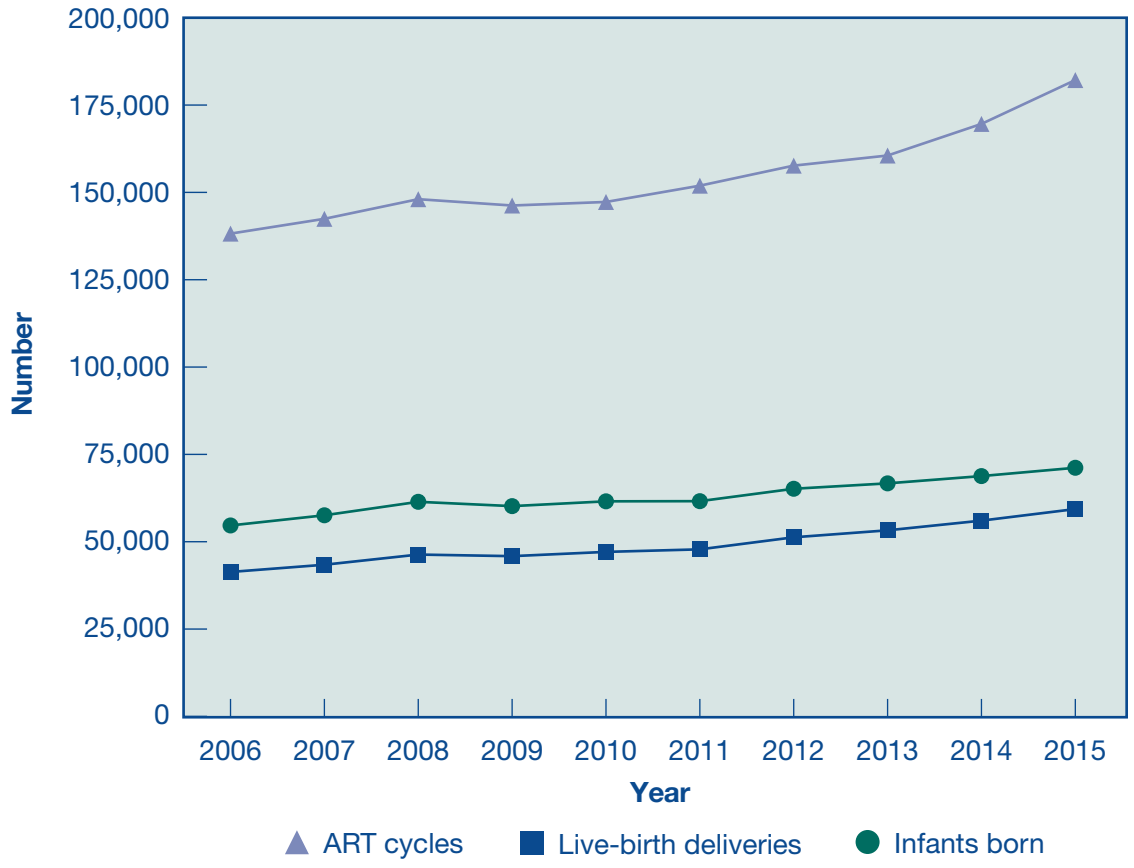
This report marks the twenty-first consecutive year that CDC has published an annual report detailing the success rates for ART clinics in the United States. Having many years of data provides us with the opportunity to examine trends in ART use and success rates over time.

This report features an examination of trends for the most recent 10-year period, 2006–2015. Statistics for earlier years are available in CDC's previous annual publications of ART success rates and national summaries.

Has the use of ART increased?

Figure 44 shows that the number of ART cycles performed in the United States has increased 32%, from 138,198 cycles in 2006 to 182,154 in 2015. The number of live-birth deliveries in 2015 (59,348) was almost one and a half times higher than in 2006 (41,343). The number of infants born who were conceived using ART increased from 54,656 in 2006 to 71,169 in 2015. Because more than one infant can be born during a live-birth delivery (for example, twins), the total number of infants born is greater than the number of live-birth deliveries.

Figure 44
Numbers of ART Cycles Performed, Live-Birth Deliveries, and Infants Born Using ART, 2006–2015

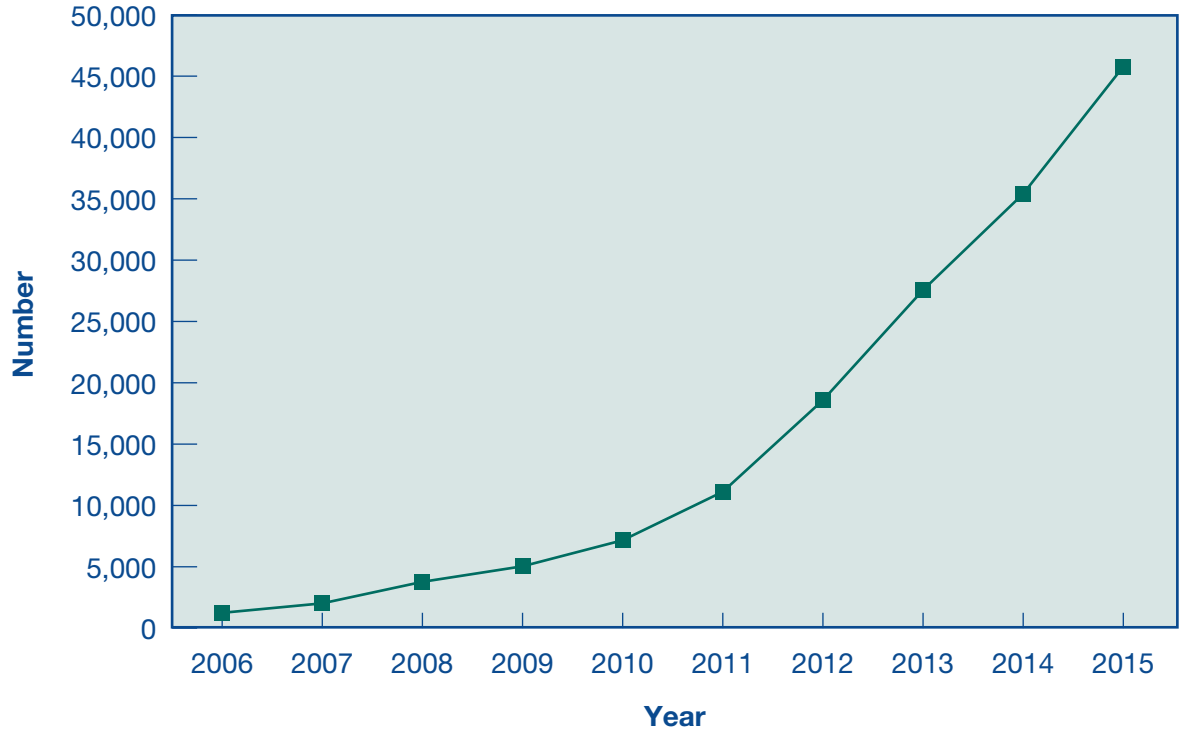


What are egg/embryo banking cycles and have they increased?

Figure 45 shows that the number of cycles performed for banking all fresh nondonor eggs or embryos increased dramatically from 2006 through 2015.

An egg/embryo banking cycle is an ART cycle started with the intention of freezing (cryopreserving) all resulting eggs or embryos for potential future use, when they may be thawed, fertilized (if eggs), and transferred. Banking cycles may be performed to avoid potentially negative effects of stimulation on conception or to the fetus, or when it is necessary to wait for results of genetic testing. Egg or embryo banking also may be used when only a small number of eggs or embryos develop during one cycle. In this case, women may undergo several banking cycles to improve availability of good-quality eggs or embryos for later transfer. In other situations, patients may choose to freeze eggs or embryos because the patient or partner needs to undergo medical treatment that may harm their future reproduction capabilities or to delay childbearing for other reasons.

Figure 45
Numbers of ART Cycles Performed for Banking All Fresh Nondonor Eggs or Embryos, 2006–2015

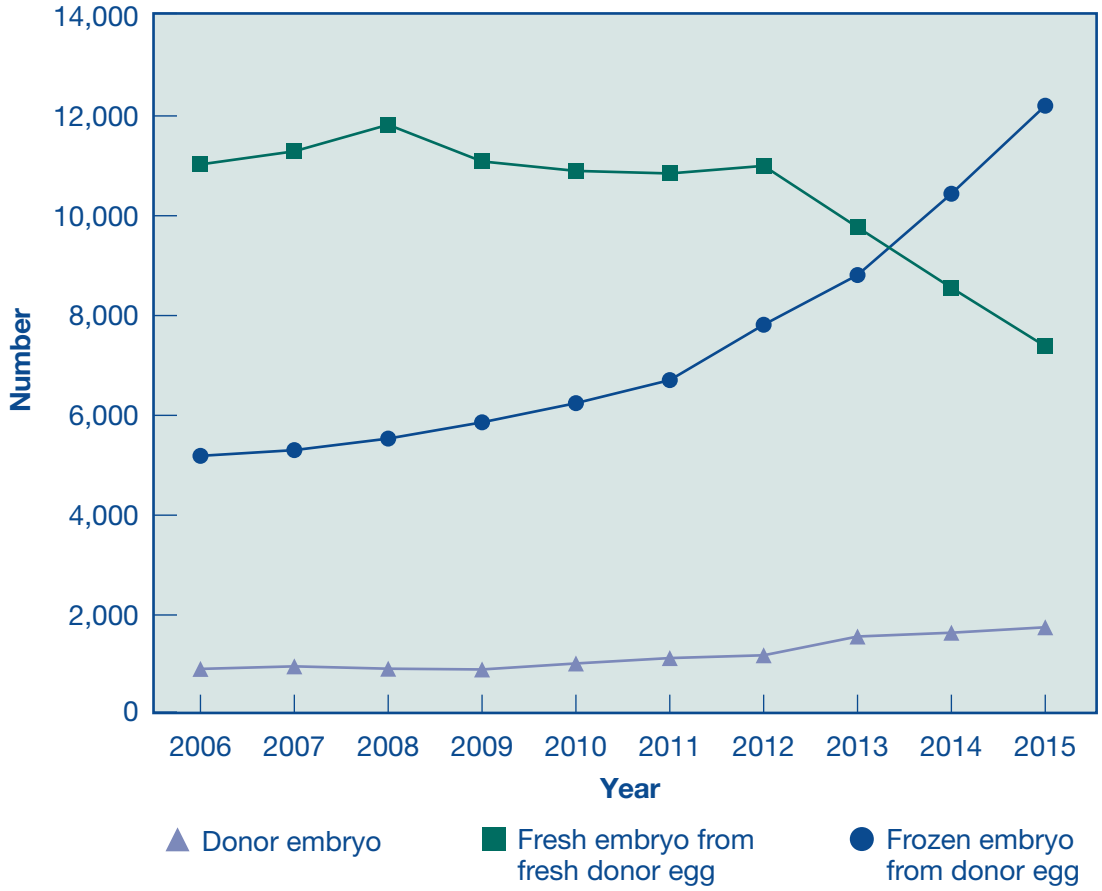


Has the number of cycles using donor eggs or embryos increased?

Figure 46 shows that the number of cycles performed using donor embryos increased from 866 in 2006 to 1,700 in 2015 and the number of cycles performed using frozen embryos from donor eggs increased from 5,135 in 2006 to 12,151 in 2015. However, the number of cycles performed using fresh embryos from fresh donor eggs decreased from 10,975 in 2006 to 7,331 in 2015.

A donor embryo cycle is a cycle in which an embryo is donated by another patient who previously used ART; neither the sperm nor egg is genetically related to the parent(s) who will raise the child. A fresh or frozen embryo cycle using a donor egg is a cycle in which an embryo is formed from the egg of one woman (the donor) and the sperm from her partner or a donor and then transferred to another woman (the recipient). Donor cycles are most commonly used by women with diminished ovarian reserve, usually as a result of advanced maternal age or premature ovarian insufficiency. Egg donors are usually younger women, which results in higher percentages of pregnancies and lower percentages of miscarriages among recipients.

Figure 46
Numbers of ART Cycles Using Donor Eggs or Embryos, 2006–2015

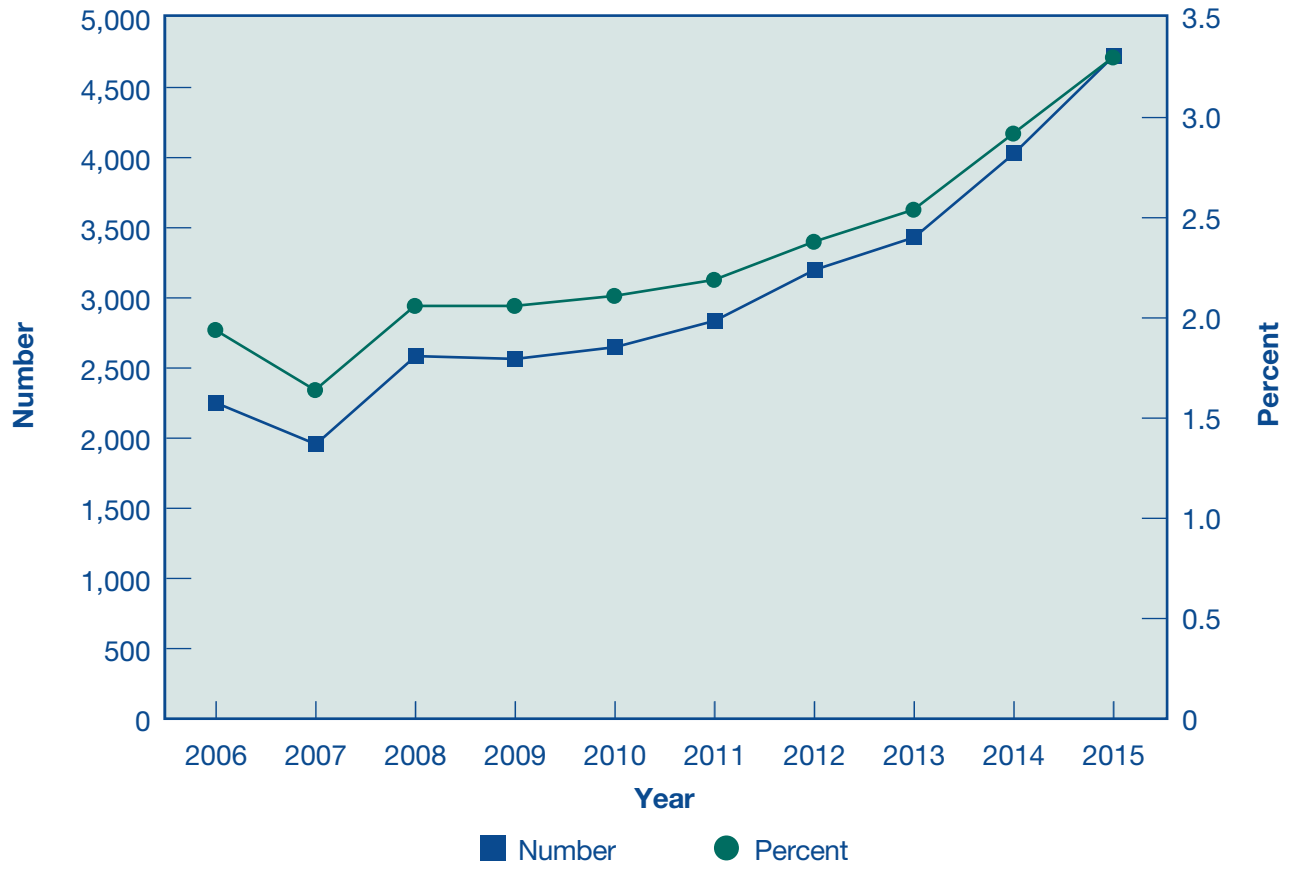


Has the number and percentage of transfers using gestational carriers increased?

Figure 47 shows that the number of transfers for ART cycles using gestational carriers more than doubled, from 2,251 in 2006 to 4,725 in 2015. The percentage of transfers using a gestational carrier among all transfers also increased, from about 2% in 2006 to more than 3% in 2015.

A gestational carrier (also called a gestational surrogate) is a woman who agrees to carry a developing embryo created from another woman's egg for others.

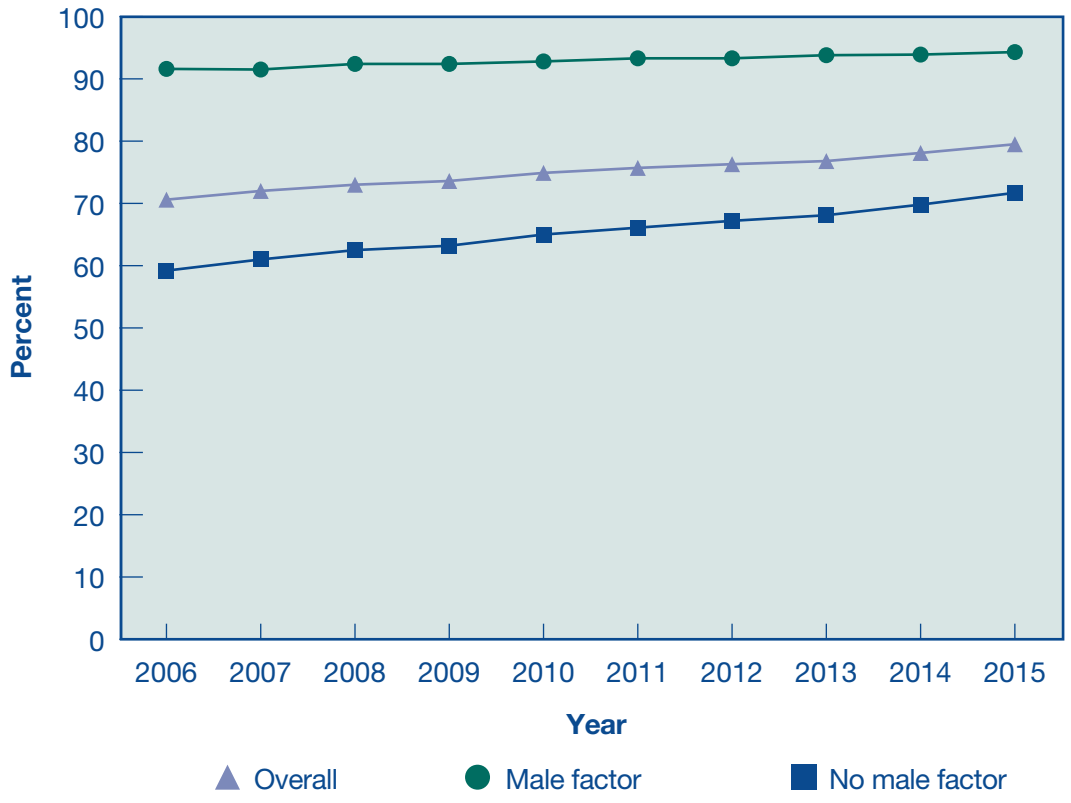
Figure 47
Numbers and Percentages of Transfers Using Gestational Carriers, 2006–2015



Has ICSI use changed over time?

Figure 48 shows that the percentage of retrievals using ICSI increased over time from 71% in 2006 to 79% in 2015. The increase in use was larger for patients with no diagnosis of male factor infertility than for those patients with a diagnosis of male factor infertility, where ICSI use has remained consistently high over the last ten years.

Figure 48
Percentages of Retrievals Using Fresh Nondonor or Donor Eggs or Embryos That Used ICSI,* 2006–2015



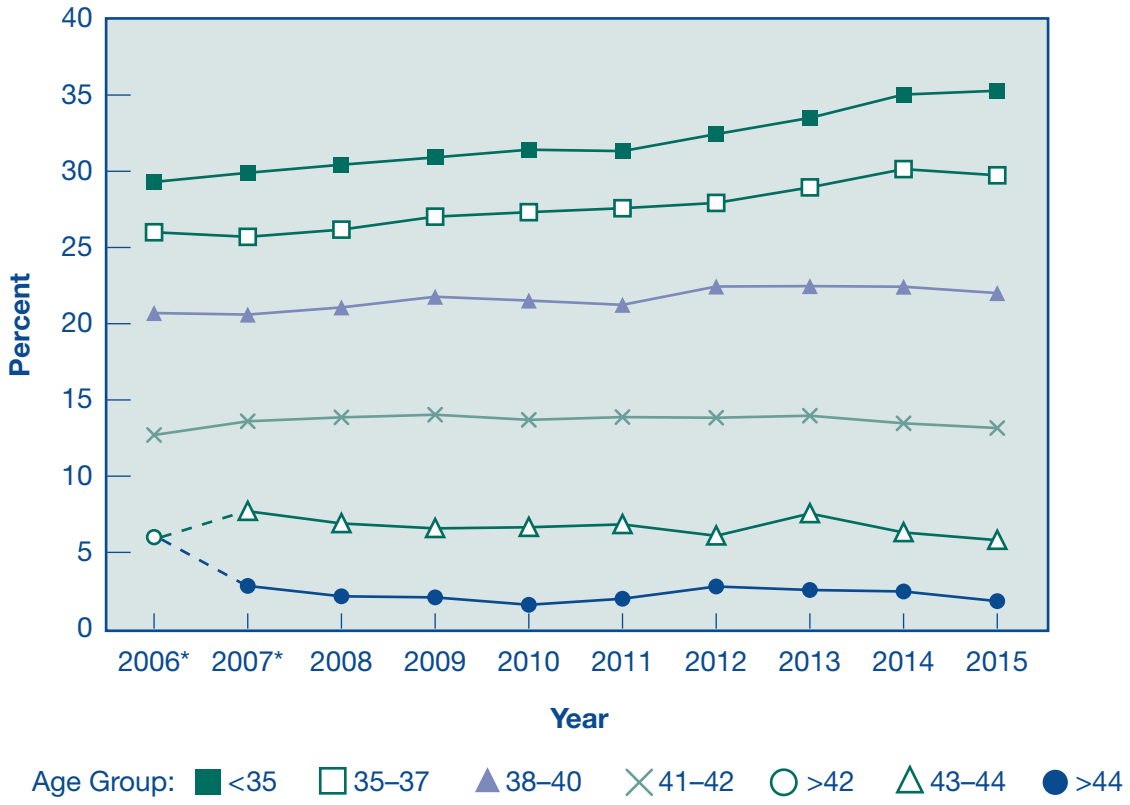
* Cycles using GIFT are excluded.

Has the percentage of transfers that resulted in single-infant live births changed?

From 2006 through 2015, the percentage of transfers using fresh nondonor eggs or embryos that resulted in single-infant live births increased from 29% in 2006 to 35% in 2015 for women younger than age 35, from 26% to 30% for women aged 35–37, and from 21% to 22% for women aged 38–40 (Figure 49).

Single-infant births have a lower risk than multiple-infant births for poor infant health outcomes, including prematurity, low birth weight, disability, and death.

Figure 49
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Single-Infant Live Births, by Age Group, 2006–2015

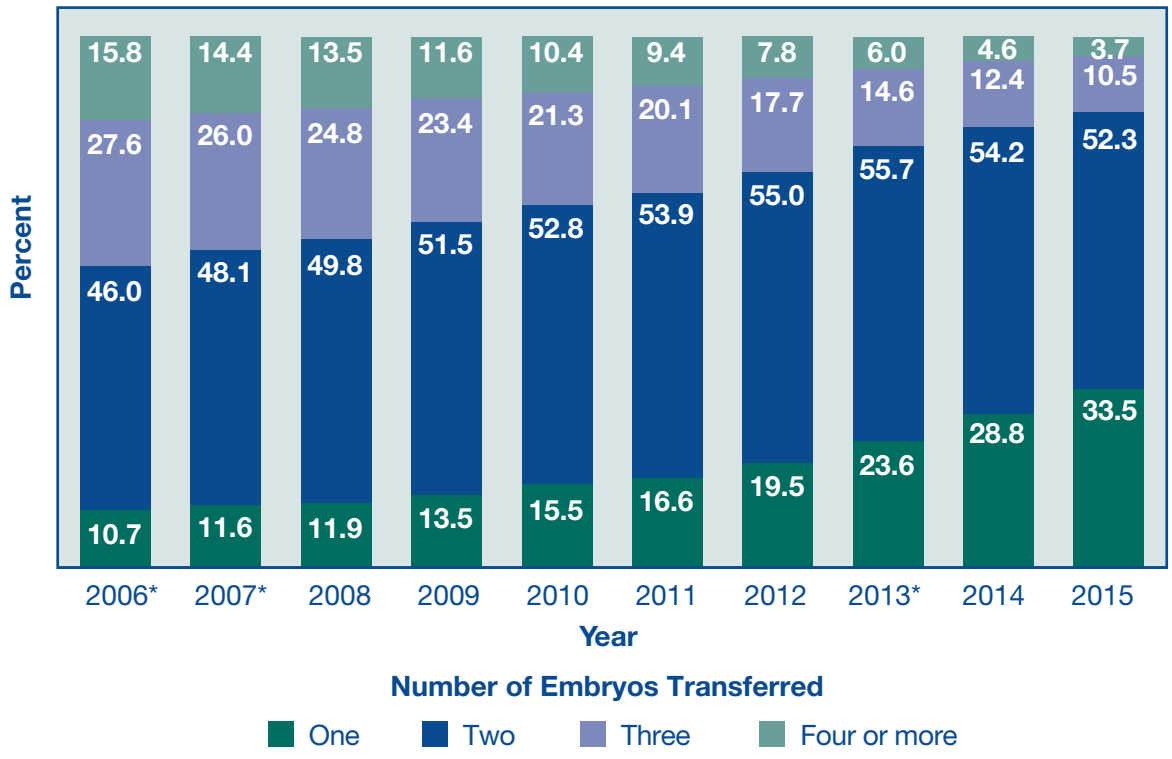


* Through 2006, data for women older than age 42 were combined. Starting in 2007, data for women older than age 42 were reported as women aged 43–44 and women older than age 44.

Has the number of embryos transferred changed?

From 2006 through 2015, transfers of one embryo tripled from 11% to 34%, and transfers of two embryos increased from 46% to approximately 52% for all fresh nondonor cycles that resulted in transfer (Figure 50). During the same time period, transfers of three embryos decreased from about 28% to 11%, and transfers of four or more embryos decreased from approximately 16% to 4%.

Figure 50
Percentages of Fresh Nondonor Transfers of One, Two, Three, or Four or More Embryos, 2006–2015



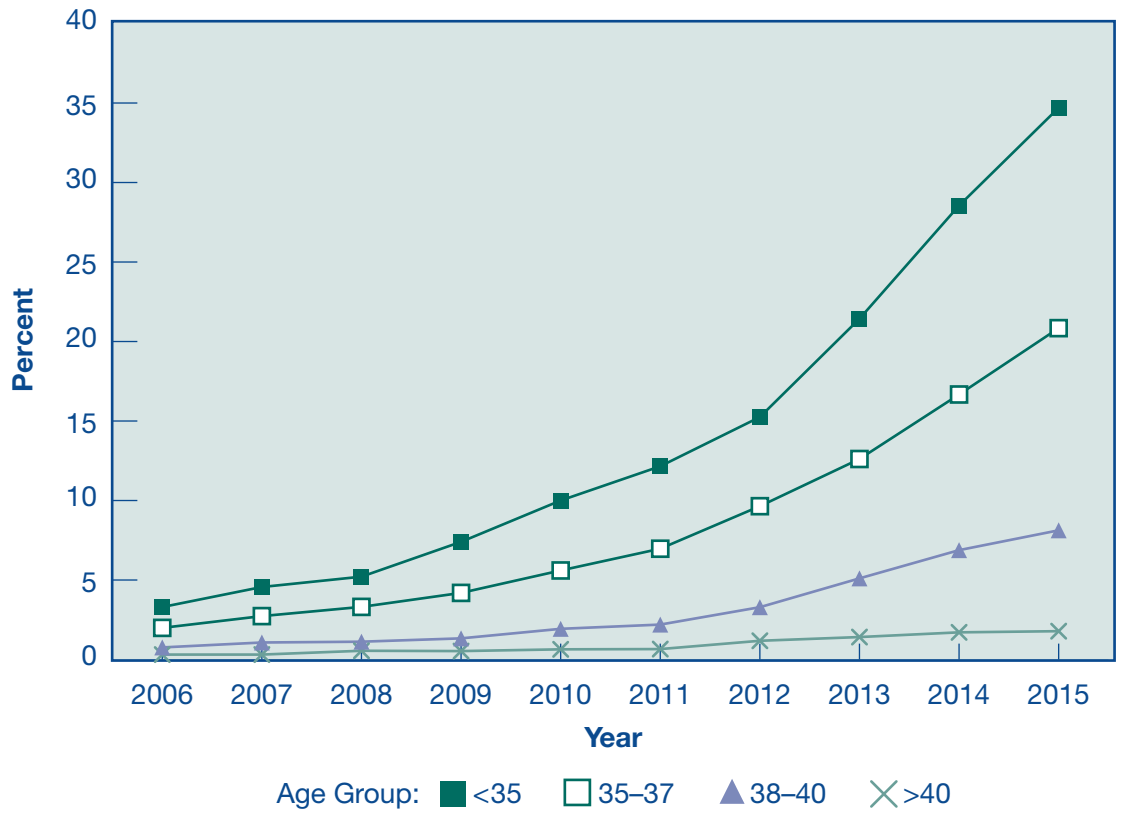
* Totals do not equal 100% due to rounding.

Has the percentage of elective single embryo transfers increased?

From 2006 through 2015, the percentage of transfers using elective single embryo transfer (eSET) increased dramatically from about 3% to 35% for women younger than age 35 and from approximately 2% to almost 21% for women aged 35–37 (Figure 51).

The percentage of eSET transfers is the percentage of all transfers in which at least two embryos are available for transfer but only one embryo is transferred. It does not include cycles in which only one embryo is available. The use of eSET is the most effective way to avoid a multiple-fetus pregnancy and to reduce the risk for poor infant health outcomes such as prematurity and low birth weight.

Figure 51
Percentages of Elective Single Embryo Transfer (eSET) Among All Transfers Using Fresh Nondonor Eggs or Embryos, by Age Group,* 2006–2015



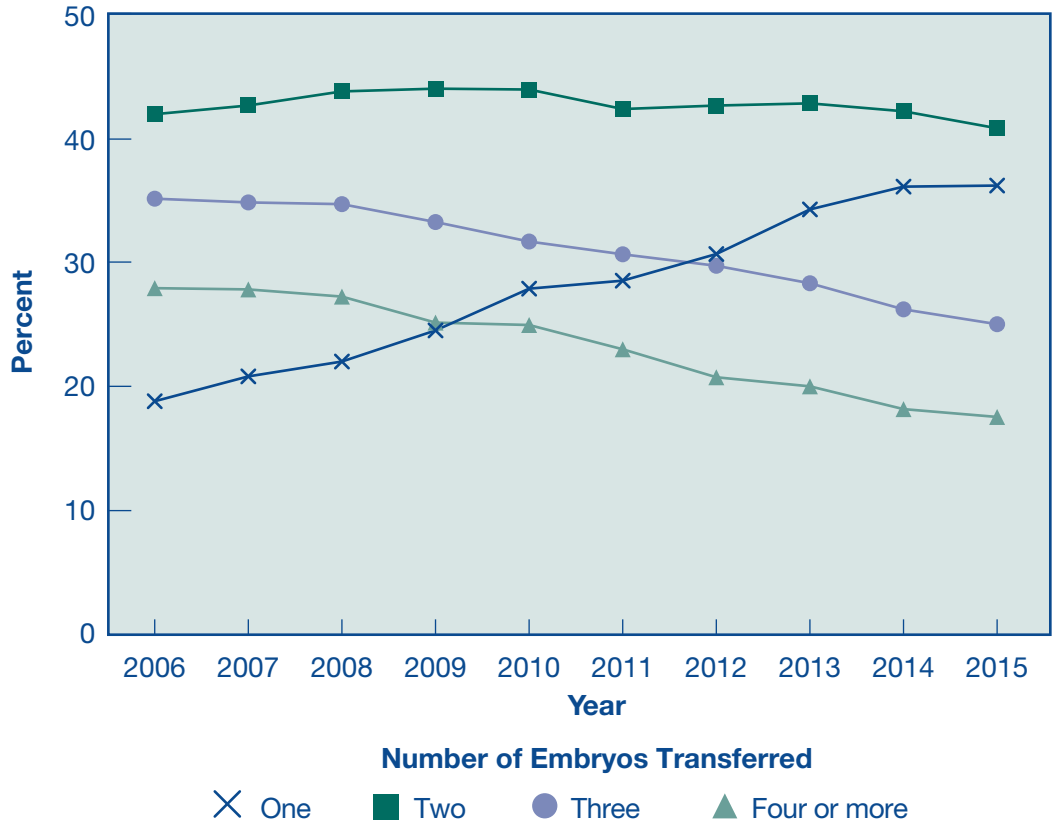
* All ages older than 40 years are reported together due to the small number of transfers performed with eSET.

Has the relationship between number of embryos transferred and the percentage of transfers that resulted in live births changed?

The percentage of transfers using fresh nondonor eggs or embryos that resulted in live births almost doubled from 19% in 2006 to 36% in 2015 for the transfer of one embryo (Figure 52). During the same period, the percentage of transfers that resulted in live births decreased overall from 42% to 41% for the transfer of two embryos, from 35% to 25% for the transfer of three embryos and from 28% to 18% for the transfer of four or more embryos.

Interpretation of the relationship between the number of embryos transferred and the percentage of live births over time is affected by several factors, such as the woman's age and embryo quality. The increase in the percentage of live births among transfers of one embryo is likely due in part to a shift toward eSET among good-prognosis patients and overall improvements in ART practice.

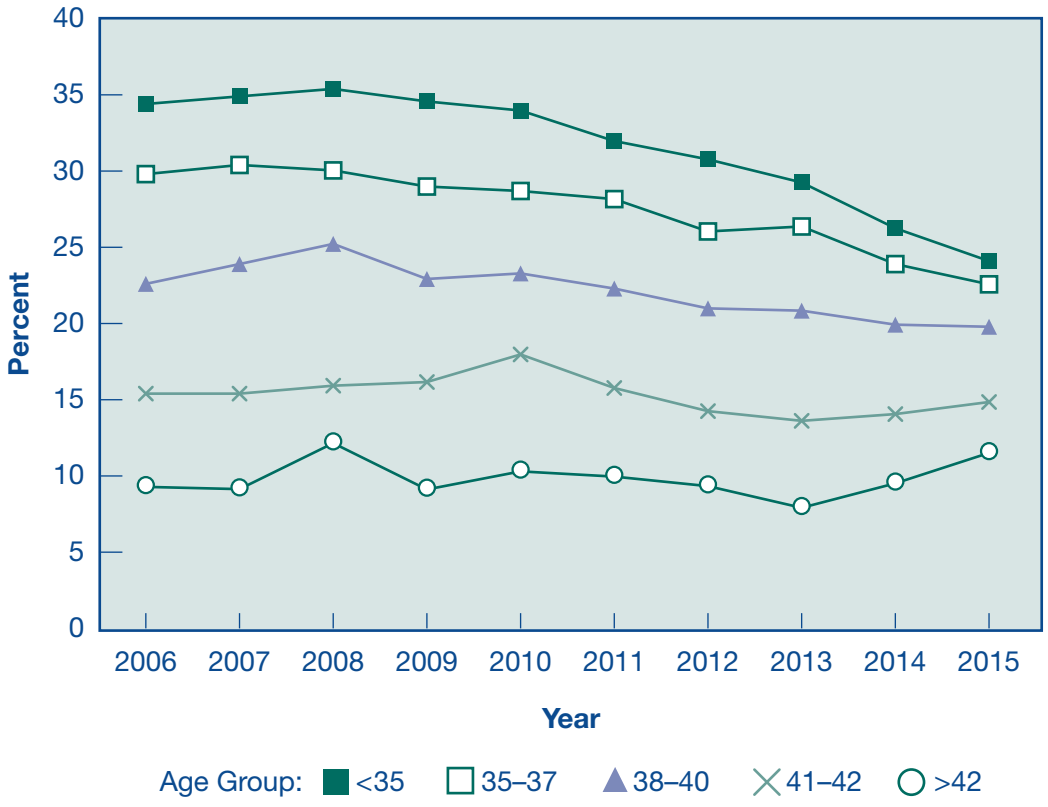
Figure 52
Percentages of Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, by Number of Embryos Transferred, 2006–2015



Has the percentage of multiple-infant live births changed?

Figure 53 shows that the percentage of live births that resulted in multiple infants born decreased over time in younger age groups among cycles using fresh nondonor eggs or embryos. From 2006 through 2015, the percentage of multiple-infant live births decreased from 34% to 24% for women younger than age 35, from 30% to 23% for women aged 35–37, and from 23% to 20% for women aged 38–40. During the same time period, the percentage of multiple-infant live births ranged from approximately 14% to 18% for women aged 41–42 and from 8% to 12% for women older than age 42.

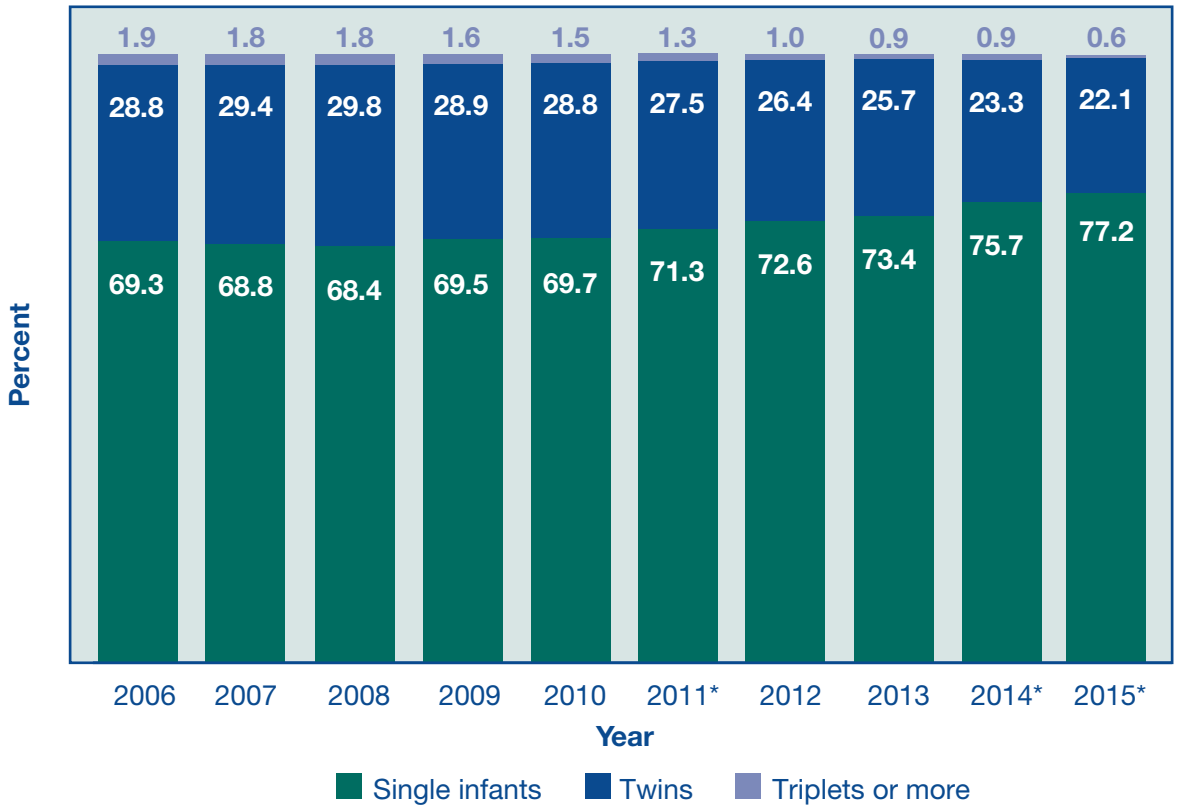
Figure 53
Percentages of Live Births Using Fresh Nondonor Eggs or Embryos That Resulted in Multiple Infants Born, by Age Group, 2006–2015



Has the percentage of single infants, twins, and triplets or more changed for transfers that resulted in live births?

During the past 10 years, the percentage of transfers using fresh nondonor eggs or embryos that resulted in single-infant live births increased from about 69% to 77%; twin births decreased from approximately 29% to 22%; and triplets or more births decreased from about 2% to less than 1% (Figure 54). Infants born from multiple-infant births, including twins, are at greater risk of poor outcomes, including low birth weight, preterm birth, neurological impairments such as cerebral palsy, and death, compared with infants born from single-infant births.

Figure 54
Percentages of Single Infants, Twins, and Triplets or More Among ART Transfers Using Fresh Nondonor Eggs or Embryos That Resulted in Live Births, 2006–2015



* Totals do not equal 100% due to rounding.

2015

Appendix A

Glossary of Terms

APPENDIX A: GLOSSARY OF TERMS

American Society for Reproductive Medicine (ASRM). Professional society whose affiliate organization, the Society for Assisted Reproductive Technology (SART), is composed of clinics and programs that provide ART.

ART (assisted reproductive technology). All treatments or procedures that include the handling of human eggs or embryos to help a woman become pregnant. ART includes but is not limited to in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), zygote intrafallopian transfer (ZIFT), tubal embryo transfer, egg and embryo cryopreservation, egg and embryo donation, and gestational surrogacy.

ART cycle. An ART cycle starts when a woman begins taking fertility drugs or having her ovaries monitored for follicle production. If eggs are produced, the cycle progresses to egg retrieval. Retrieved eggs are combined with sperm to create embryos. If fertilization is successful, at least one embryo is selected for transfer. If implantation occurs, the cycle may progress to clinical pregnancy and possibly live birth. ART cycles include any process in which (1) an ART procedure is performed, (2) a woman has undergone ovarian stimulation or monitoring with the intent of having an ART procedure, or (3) frozen embryos have been thawed with the intent of transferring them to a woman.

Canceled cycle. An ART cycle in which ovarian stimulation was performed but the cycle was stopped before eggs were retrieved or, in the case of frozen embryo cycles, before embryos were transferred. Cycles are canceled for many reasons: eggs may not develop, the patient may become ill, or the patient may choose to stop treatment.

Cryopreservation. The practice of freezing eggs or embryos from a patient's ART cycle for potential future use.

Diminished ovarian reserve. This diagnosis means that the ability of the ovary to produce eggs is reduced. Reasons include congenital, medical, or surgical causes or advanced age.

Donor egg cycle. An ART cycle in which an embryo is formed from the egg of one woman (the donor) and then transferred to another woman (the recipient). Sperm from either the recipient's partner or a donor may be used.

Donor embryo cycle. An ART cycle in which an embryo that is donated by a patient or couple who previously underwent ART treatment and had extra embryos available is transferred to another woman (the recipient).

Ectopic pregnancy. A pregnancy in which the fertilized egg implants in a location outside of the uterus—usually in the fallopian tube, the ovary, or the abdominal cavity. Ectopic pregnancy is a dangerous condition that must receive prompt medical treatment.

Egg. A female reproductive cell, also called an oocyte or ovum.

Egg/Embryo banking cycle. An ART cycle started with the intention of freezing (cryopreserving) all resulting eggs or embryos for potential future use.

Egg retrieval (also called oocyte retrieval). A procedure to collect the eggs contained in the ovarian follicles.

Egg transfer (also called oocyte transfer). The transfer of retrieved eggs into a woman's fallopian tubes through laparoscopy. This procedure is used only in GIFT.

Embryo. An egg that has been fertilized by a sperm and has then undergone one or more cell divisions.

Embryo transfer. Placement of embryos into a woman's uterus through the cervix after IVF: in ZIFT, zygotes are placed in a woman's fallopian tube.

Endometriosis. A medical condition that involves the presence of tissue similar to the uterine lining in abnormal locations.

eSET (elective single embryo transfer). Elective single embryo transfer is a procedure in which one embryo, selected from a larger number of available embryos, is placed in the uterus or fallopian tube. The embryo selected for eSET might be a frozen (cryopreserved) embryo from a previous IVF cycle or a fresh embryo selected from a larger number of fresh embryos yielded during the current fresh IVF cycle.

Female factor infertility. Infertility due to ovulatory disturbances, diminished ovarian reserve, pelvic abnormalities affecting the reproductive tract, or other abnormalities of the reproductive system.

Fertility Clinic Success Rate and Certification Act of 1992 (FCSRCA). Law passed by the United States Congress in 1992 requiring all clinics performing ART in the United States to annually report their success rate data to the Centers for Disease Control and Prevention.

Fertilization. The penetration of the egg by the sperm and the resulting combining of genetic material that develops into an embryo.

Fetus. The unborn offspring from the eighth week after conception to the moment of birth.

Follicle. A structure in the ovaries that contains a developing egg.

Fresh eggs, sperm, or embryos. Eggs, sperm, or embryos that have not been frozen.

Fresh embryo cycle. An ART cycle in which fresh (never frozen) embryos are transferred to the woman. The fresh embryos are conceived with fresh eggs and fresh or frozen sperm.

Frozen egg cycle. An ART cycle in which frozen (cryopreserved) eggs are thawed, fertilized, and then the resulting fresh embryo is transferred to the woman. Frozen and thawed eggs may be fertilized with either fresh or frozen sperm.

Frozen embryo cycle. An ART cycle in which frozen (cryopreserved) embryos are thawed and transferred to the woman. Frozen embryos may have been conceived using fresh or frozen eggs and fresh or frozen sperm.

Gamete. A reproductive cell, either a sperm or an egg.

Gestational age. The deviation of time from estimated last menstrual period (LMP) to birth. LMP is estimated using the date of retrieval or transfer.

Gestational carrier (also called a gestational surrogate). A woman who gestates, or carries, an embryo that was formed from the egg of another woman with the expectation of returning the infant to its intended parents.

Gestational sac. A fluid-filled structure that develops within the uterus early in pregnancy. In a normal pregnancy, a gestational sac contains a developing fetus.

GIFT (gamete intrafallopian transfer). An ART procedure that involves removing eggs from the woman's ovary and using a laparoscope to place the unfertilized eggs and sperm into the woman's fallopian tube through small incisions in her abdomen.

ICSI (intracytoplasmic sperm injection). A procedure in which a single sperm is injected directly into an egg; this procedure is commonly used to overcome male infertility problems.

Implantation rate. A measurement of ART success when the ART cycle results in an intrauterine clinical pregnancy, defined as the larger of either the number of maximum fetal hearts by ultrasound or maximum infants born, including live births and stillbirths, out of the total number of embryos transferred.

Induced or therapeutic abortion. A procedure used to end a pregnancy.

Infertility. In general, infertility refers to the inability to conceive after 12 months of unprotected intercourse. Women aged 35 and older unable to conceive after 6 months of unprotected intercourse generally are considered infertile for the purpose of initiating medical treatment.

IUI (intrauterine insemination). A medical procedure that involves placing sperm into a woman's uterus to facilitate fertilization. IUI is not considered an ART procedure because it does not involve the manipulation of eggs.

IVF (in vitro fertilization). An ART procedure that involves removing eggs from a woman's ovaries and fertilizing them outside her body. The resulting embryos are then transferred into a woman's uterus through the cervix.

Live birth. The delivery of one or more infants with any signs of life.

Male factor infertility. Any cause of infertility due to low sperm count or problems with sperm function that makes it difficult for a sperm to fertilize an egg under normal conditions.

Miscarriage (also called spontaneous abortion). A pregnancy ending in the spontaneous loss of the embryo or fetus before 20 weeks of gestation.

Multifetal pregnancy reduction. A procedure used to decrease the number of fetuses a woman carries and improve the chances that the remaining fetuses will develop into healthy infants. Multifetal reductions that occur naturally are referred to as spontaneous reductions.

Multiple factor infertility, female and male. A diagnostic category used when one or more female cause of infertility and male factor infertility are diagnosed.

Multiple factor infertility, female only. A diagnostic category used when more than one female cause of infertility but no male factor infertility is diagnosed.

Multiple-fetus pregnancy. A pregnancy with two or more fetuses, determined by the number of fetal hearts observed on an ultrasound.

Multiple-infant birth. A pregnancy that results in the birth of more than one infant.

NASS (National ART Surveillance System). Web-based data collection system used by all ART clinics to report data for each ART procedure to CDC.

Nondonor cycle. An ART cycle in which an embryo is formed from the egg of the patient and either partner or donor sperm and then transferred back to the patient.

Oocyte. The female reproductive cell, also called an egg.

Other causes of infertility. These include immunological problems, chromosomal abnormalities, cancer chemotherapy, and serious illnesses.

Ovarian hyperstimulation syndrome. A possible complication of ovarian stimulation or ovulation induction that can cause enlarged ovaries, a distended abdomen, nausea, vomiting or diarrhea, fluid in the abdominal cavity or chest, breathing difficulties, changes in blood volume or viscosity, and diminished kidney perfusion and function.

Ovarian monitoring. The use of ultrasound, or blood or urine tests to monitor follicle development and hormone production.

Ovarian stimulation. The use of drugs (oral or injected) to stimulate the ovaries to develop follicles and eggs.

Ovulatory dysfunction. A diagnostic category used when a woman's ovaries are not producing eggs normally. It is usually characterized by irregular menstrual cycles reflective of ovaries that are not producing one mature egg each month. It includes polycystic ovary syndrome and multiple ovarian cysts.

PGD/PGS (preimplantation genetic diagnosis or screening). Techniques performed on embryos prior to transfer. PGD is for detecting specific genetic conditions to reduce the risk of passing inherited diseases to children. PGS screens embryos for an abnormal number of chromosomes, which is of special value for women with advanced age, recurrent miscarriages, or prior failed IVF.

Pregnancy (clinical). A pregnancy documented by ultrasound that shows a gestational sac in the uterus. For ART data reporting purposes, pregnancy is defined as a clinical pregnancy rather than a chemical pregnancy (that is, a positive pregnancy test).

Singleton. A single infant.

Society for Assisted Reproductive Technology (SART). An affiliate of ASRM composed of clinics and programs that provide ART.

Sperm. The male reproductive cell.

Spontaneous abortion. See Miscarriage.

Stillbirth. The birth of an infant that shows no sign of life after 20 or more weeks of gestation.

Stimulated cycle. An ART cycle in which a woman receives oral or injected fertility drugs to stimulate her ovaries to develop follicles that contain mature eggs.

Thawed embryo cycle. Same as frozen embryo cycle.

Tubal factor infertility. A diagnostic category used when the woman's fallopian tubes are blocked or damaged, making it difficult for the egg to be fertilized or for an embryo to travel to the uterus.

Ultrasound. A technique used in ART for visualizing the follicles in the ovaries, the gestational sac, or the fetus.

Unknown cause of infertility. A diagnostic category used when no cause of infertility is found in either the woman or the man.

Unstimulated cycle. An ART cycle in which the woman does not receive drugs to stimulate her ovaries to produce more follicles and eggs. Instead, follicles and eggs develop naturally.

Uterine factor infertility. A structural or functional disorder of the uterus that results in reduced fertility.

ZIFT (zygote intrafallopian transfer). An ART procedure in which eggs are collected from a woman's ovary and fertilized outside her body. A laparoscope is then used to place the resulting zygote into the woman's fallopian tube through a small incision in her abdomen.

Zygote. A fertilized egg before it begins to divide.

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