Published in final edited form as:

JAMA. 2017 March 28; 317(12): 1272–1273. doi:10.1001/jama.2016.21311.

Contribution of Assisted Reproductive Technology to Overall Births by Maternal Age in the United States, 2012–2014

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Assisted reproductive technology (ART) contributes to 1.6% of births in the United States,[1] and utilization varies across several dimensions, including patient age.[2] Delayed childbearing and age-related fertility declines may be associated with increasing ART use. Also, success rates for patients using their own oocytes decline with increasing maternal age, leading to higher use of donated oocytes by older women.[2] The proportion of ART births among US multiple births by maternal age has been reported[3]; however, to our knowledge, age-specific estimates of the contribution of ART to total US births have not been previously published.

Methods |

Institutional review boards at the US Centers for Disease Control and Prevention (CDC) and Georgia Institute of Technology approved this study; a waiver of informed consent was obtained. We calculated the number of live births to US residents resulting from ART using the CDC's National ART Surveillance System (NASS)[4] and compared these results, stratified by maternal age group, with all live births in the United States, as reported by the CDC's National Vital Statistics System.[5] NASS is a federally mandated reporting system that collects cycle-level ART procedure information and was, as of 2014, estimated to include information on 98% of ART cycles in the United States.[4] Annually, 7% to 10% of

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Author Contributions: Dr Levine had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: All authors.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Levine.

Critical revision of the manuscript for important intellectual content: Boulet, Kissin.

Statistical analysis: Levine, Boulet.

Administrative, technical, or material support: Boulet, Kissin.

Supervision: Kissin.

Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the US Centers for Disease Control and Prevention.

clinics are randomly selected for data validation; discrepancy rates for most fields are low (<5%).[4] For each ART cycle that led to 1 or more live births in 2012, 2013, or 2014, we calculated maternal age at the time of birth based on the mother's date of birth and the date of delivery and categorized maternal age using 5-year intervals. We also used NASS data to classify each cycle as autologous (using the patient's oocytes) or donor (using donated oocytes or embryos), as fresh or thawed (using previously frozen embryos or oocytes) and by gestational carrier usage. The 95% CIs were calculated using the Agresti-Coull method in Microsoft Excel 2013.

Results |

Between 2012 and 2014, ART accounted for 191250 births (1.6% [95% CI, 1.6%–1.6%]) of the 11 873 098 births in the United States (Table). The percentage of births resulting from ART increased with maternal age, with ART used in 76.5% (95% CI, 74.6%–78.3%) of the 2020 births to women 50 years or older compared with 4.4% (95% CI, 4.3%–4.4%) of the 1464 939 births to women aged 35 to 39 years. Autologous ART using fresh oocytes contributed to 3.6% (95% CI, 3.5%–3.7%) of births to women aged 40 to 44 years, before declining to account for 0.8% (95% CI, 0.7%–0.9%) of births to women aged 45 to 49 years. Frozen oocytes or embryos were used in more than 70% of autologous ART births to women 45 years or older and in more than 95% of such births to women 50 years or older. The contribution of donor ART to total births increased with maternal age, and the technique accounted for more births than did autologous ART among women in the 2 oldest maternal age groups. Gestational carrier use also increased with maternal age, accounting for 20.4% (95% CI, 18.7%–22.2%) of births to women 50 years or older.

Discussion |

The contribution of ART to live births was clustered among older maternal age groups, and much of this disproportionate usage was driven by donor ART. Births following autologous ART among older maternal age groups predominately used frozen embryos, as expected given the low success rates for autologous ART using fresh embryos among older women.[2] Given the association between advanced maternal age and many obstetric complications,[6] the role of ART in enabling births to older women merits public health consideration.

The analysis may underestimate the true contribution of ART to total births because some clinics do not report to NASS and some births following ART by non–US residents may have occurred in the United States. Additional limitations include potential data entry errors and lack of information on the year in which thawed embryos or oocytes were frozen. Despite these limitations, the analysis used the best data available and may be useful to patients, clinicians, and organizations (including medical societies as well as state and federal agencies) interested in improving maternal and infant health and the practice of ART.

References

1. Sunderam S, Kissin DM, Crawford SB, et al. Assisted Reproductive Technology Surveillance—United States, 2013. MMWR Surveill Summ. 2015;64(11):1–25.

2. Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology. 2014 Assisted Reproductive Technology National Summary Report. Atlanta, GA: US Dept of Health and Human Services; 2016.
3. Reynolds MA, Schieve LA, Martin JA, Jeng G, Macaluso M. Trends in multiple births conceived using assisted reproductive technology, United States, 1997–2000. Pediatrics. 2003;111(5 Pt 2) (suppl 1):1159–1162. [PubMed: 12728130]
4. Centers for Disease Control and Prevention, American Society for Reproductive Medicine, Society for Assisted Reproductive Technology. 2014 Assisted Reproductive Technology Fertility Clinic Success Rates Report. Atlanta, GA: US Dept of Health and Human Services; 2016.
5. Centers for Disease Control and Prevention. About natality, 2007–2014.https://wonder.cdc.gov/natality-current.html. Accessed January 13, 2016.
6. Salihu HM, Shumpert MN, Slay M, Kirby RS, Alexander GR. Childbearing beyond maternal age 50 and fetal outcomes in the United States. Obstet Gynecol. 2003;102(5 pt 1):1006–1014. [PubMed: 14672478]

Table.

Contribution of Autologous and Donor ART to Total Births by Maternal Age in the United States, 2012–2014

Maternal Age, y	US Births, No.	No. of Live Births (% of All Births) [95% CI][a]							
			Autologous ART			Donor ART			
		All ART Births[b]	Fresh	Thawed	All	Fresh	Thawed	All	Gestational Carrier
≤19	837 110	5 (<0.01) [<0.01–<0.01]	NA[c]	NA[c]	5 (<0.01) [<0.01–<0.01]	0	0	0	0
20–24	2 696 123	1235 (0.05) [0.04–0.05]	870 (0.03) [0.03–0.03]	292 (0.01) [0.01–0.01]	1162 (0.04) [0.04–0.05]	47 (<0.01) [<0.01–<0.01]	26 (<0.01) [<0.01–<0.01]	73 (<0.01) [<0.01–<0.01]	31 (<0.01) [<0.01–<0.01]
25–29	3 390 069	19 450 (0.6) [0.6–0.6]	13 538 (0.4) [0.4–0.4]	5279 (0.2) [0.2–0.2]	18 817 (0.6) [0.5–0.6]	391 (0.01) [0.01–0.01]	242 (<0.01) [<0.01–<0.01]	633 (0.02) [0.02–0.02]	250 (<0.01) [<0.01–<0.01]
30–34	3 131 401	64 985 (2.1) [2.1–2.1]	42 641 (1.4) [1.3–1.4]	19 729 (0.6) [0.6–0.6]	62 370 (2.0) [2.0–2.0]	1680 (0.1) [0.1–0.1]	935 (0.03) [0.03–0.03]	2615 (0.1) [0.1–0.1]	999 (0.03) [0.03–0.03]
35–39	1 464 939	63 819 (4.4) [4.3–4.4]	38 276 (2.6) [2.6–2.6]	20 013 (1.4) [1.3–1.4]	58 289 (4.0) [3.9–4.0]	3400 (0.2) [0.2–0.2]	2130 (0.1) [0.1–0.2]	5530 (0.4) [0.4–0.4]	1426 (0.1) [0.1–0.1]
40–44	329 084	31 525 (9.6) [9.5–9.7]	11 883 (3.6) [3.5–3.7]	6996 (2.1) [2.1–2.2]	18 879 (5.7) [5.7–5.8]	7820 (2.4) [2.3–2.4]	4826 (1.5) [1.4–1.5]	12 646 (3.8) [3.8–3.9]	1243 (0.4) [0.4–0.4]
45–49	22 352	8685 (38.9) [38.2–39.5]	170 (0.8) [0.7–0.9]	427 (1.9) [1.7–2.1]	597 (2.7) [2.5–2.9]	4571 (20.5) [19.9–21.0]	3517 (15.7) [15.3–16.2]	8088 (36.2) [35.6–36.8]	681 (3.0) [2.8–3.3]
≥50	2020	1546 (76.5) [74.6–78.3]	NA[c]	NA[c]	45 (2.2) [1.7–3.0]	760 (37.6) [35.5–39.8]	741 (36.7) [34.6–38.8]	1501 (74.3) [72.4–76.2]	412 (20.4) [18.7–22.2]
Total	11 873 098	191 250 (1.6) [1.6–1.6]	107 383 (0.9) [0.9–0.9]	52 781 (0.4) [0.4–0.4]	160 164 (1.3) [1.3–1.4]	18 669 (0.2) [0.2–0.2]	12 417 (0.1) [0.1–0.1]	31 086 (0.3) [0.3–0.3]	5042 (0.04) [0.04–0.04]

Abbreviations: ART, assisted reproductive technology; NA, not applicable.

[a]The 95%CIs were calculated using the Agresti-Coull method in Microsoft Excel 2013.

[b]Excludes 5277 live births to non-US residents, 502 live births when date of birth was missing in the National ART Surveillance System, and 11 births resulting from research cycles using round spermatid injection or immature oocyte retrieval.

[c]Actual counts suppressed to protect patient confidentiality.