

# Parent Perspective on Childhood Development after Assisted Reproductive Technology: A National Survey

Karissa C. Hammer<sup>1</sup>, Zoran J. Pavlovic<sup>1</sup>, Marika R. Raff<sup>1</sup>, Danielle E. Bradley<sup>3</sup>, Christina N. Cobb<sup>3</sup>, Stephanie E. Elliot<sup>1</sup>, Louis L. Fogg<sup>1</sup>, Jennifer E. Hirshfeld-Cytron<sup>1,2</sup>

<sup>1</sup>Department of Obstetrics and Gynecology, Rush University Medical Center, <sup>2</sup>Fertility Centers of Illinois, Chicago, <sup>3</sup>Ovia Health, Boston, IL, USA

ABSTRACT

**Context:** There is limited understanding about parent perspectives of newborn development after assisted reproductive technology (ART). The use of ART is known to increase the risk of premature delivery and low birth weight. Both of these factors are associated with developmental delay. To our knowledge, no study has investigated how parents perceive their child's development after use of ART. **Aims:** To investigate how the parent perspective of childhood development after ART use compares to the parent perspective of spontaneously conceived children. **Settings and Design:** This is a digital survey collecting data on parent perspective of newborn development after ART and spontaneous conception. **Subjects and Methods:** Invitation to participate was sent via E-mail to users of a (*Ovia Health's*) mobile parenting application (*Ovia Parenting*). Surveys were collected from August 30, 2018, to September 12, 2018, and a total of 1881 surveys were collected. **Statistical Analysis Used:** Analysis was performed with Chi-square cross-tabulations and ANOVA. **Results:** Overall, 13,600 (12%) of users who were delivered the E-mail engaged with the content. Of those users, 2739 (20%) initiated the survey and 1881 (69%) completed the survey and were included in the analyses. When comparing spontaneous conception to ART, parents reported similar developmental milestones at most ages. A significant difference existed at 12 months where those who had used ART were more likely to report their child met all milestones. This difference did not persist for subsequent ages. **Conclusions:** From the parent perspective, children conceived using ART methods should be expected to meet the same age-based developmental milestones as their spontaneously conceived peers.

**KEYWORDS:** Assisted reproductive technology, childhood development, milestones, parent perspective

## INTRODUCTION

Assisted reproductive technology (ART) is an increasingly common mechanism for conception, but parents' perspectives of newborn development after ART have not been extensively studied.<sup>[1]</sup> The potential impact of ART on childhood developmental milestones is complicated by the correlation between ART and risk of prematurity and low birth weight, both of which are associated with developmental delay.<sup>[2-4]</sup> Many studies

have focused on the clinical question of whether the outcomes for children born from ART are impacted by maternal fertility factors and their disease state or the technology of assisted reproduction itself. Studies to date have conflicting evidence on the impact ART has on newborn development when compared to naturally

**Address for correspondence:** Dr. Karissa C. Hammer, Department of Obstetrics and Gynecology, Rush University Medical Center, Chicago, IL, USA. E-mail: karissa.c.hammer@gmail.com

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conceived children.<sup>[5-8]</sup> This begs the question: how do we counsel our patients and how have they been interpreting their own child's development after conception via ART? This study aims to investigate the parent perspective on childhood developmental milestones after the use of ART compared to spontaneous conception. Our results demonstrate that parents of both groups report similar developmental milestones at most ages.

## SUBJECTS AND METHODS

Using a digital survey, data were collected on parent perspectives of newborn development after ART and spontaneous conception. Invitation to participate was sent via E-mail to users of the mobile parenting application (*Ovia Parenting*). Surveys were collected from August 30, 2018, to September 12, 2018. Those who participated were offered to be entered into a random drawing to win one of the four 100-dollar gift cards to encourage participation. All surveys were collected and analyzed in a de-identifiable fashion. The questionnaire was developed using the CDC guidelines for developmental milestones and modified for a sixth-grade reading level<sup>[9]</sup> [Appendix 1]. After a sample of 1881 respondents answered the survey, data collection was discontinued.

Inclusion criteria consisted of women identifying as at least 18 years of age, who have given birth to a living child, and willing to complete the survey. Exclusion criteria included incomplete surveys and women who had not given birth to a living child. This study was IRB approved (at Rush University Medical Center, Chicago, IL). All analyses were conducted using SPSS software (IBM Corporation, Chicago, IL, USA).

Findings were compared between spontaneously conceived newborns and those conceived with ART. Analysis was performed with Chi-square cross-tabulations and ANOVA. Raw data demonstrating the total number of milestones met were also collected. We further stratified participants into three groups: (1) those who did not meet any milestones or met only one, (2) those who met a moderate number of milestones (two if there were only three milestones listed or three if four milestones were listed), and (3) those who met all milestones for a given age (maximum of four). At pediatric visits, questionnaires are used to assess these milestones from a parent perspective and missing a single milestone is used as a warning sign that further evaluation is necessary.<sup>[10]</sup> Therefore, we further categorized our findings by grouping comparisons into those who met all milestones for an age group compared to those who were perceived to have met less than all milestones listed. Recognizing that prematurity is

associated with delayed milestone attainment, a subgroup analysis was performed where prematurely delivered children were excluded, analyzing only births at or after 37 weeks gestation by parent report. Analysis regarding all milestones met was stopped at 24 months because the number of subjects ranged from 0 to 3 in the ART group; otherwise, questionnaire data are reported up to 60 months.

## RESULTS

The survey was electronically sent to 112,663 users of the mobile application. Of those users, 12% (13,600) opened the E-mail, and 24% (3321) of those clicked the survey link. A total of 2739 users initiated the survey and 69% (1881) of those fully completed the survey [Figure 1]. Among the complete respondents, 87.7% (1652) conceived spontaneously and 12.2% (229) conceived using assisted reproductive technologies.

The majority of respondents delivered vaginally at or after 37 weeks; however, preterm delivery was more common in the ART group [Table 1]. This difference was statistically significant as a greater proportion of the ART group had delivered prematurely, 11.3% versus 7.2% in the ART and spontaneous conception groups, respectively. However, patients in the subgroup analysis did not differ significantly in other demographic factors and the groups were comparable as was true in the original analysis. The newborns in both ART and spontaneous groups were within a normal percentile for growth by their first pediatric appointment, had no parent identified birth defect, went home with their mother, and did not require a NICU admission or surgery. Differences existed within maternal demographics, with the ART group being more

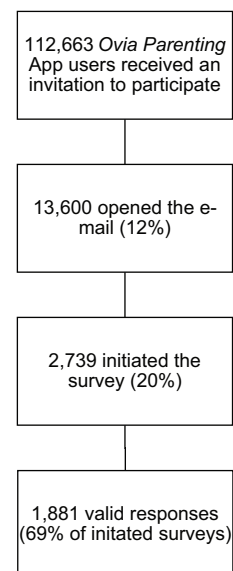
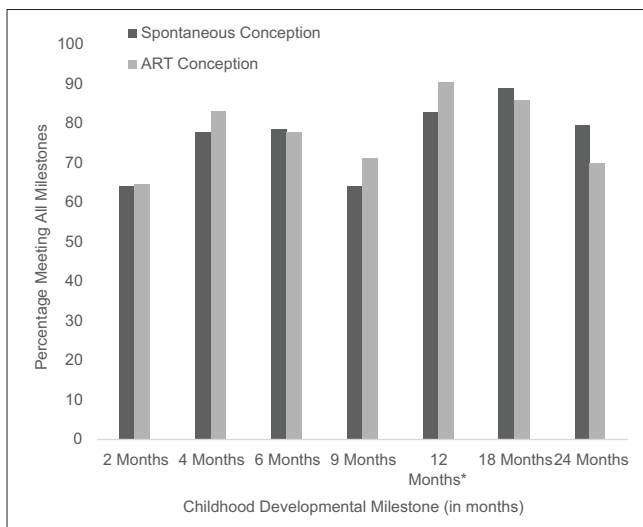


Figure 1: Electronic survey responses

likely to have a bachelor's degree, annual household income over 150,000 USD, and report partnership status as married. While the majority delivered vaginally, cesarean delivery was significantly more likely to occur in the ART group (38.0%) versus the spontaneous group (30.6%). Advanced maternal age was also more common in the ART group compared to spontaneous conception, 36.7% versus 16.2% ( $P < 0.05$ ) [Table 1].

The ART group included individuals who used a variety of methods for conception, including infertility medication (91; 39.7%), intrauterine insemination (89; 38.9%), and *in vitro* fertilization (78; 34.1%). A total of 12.2% (28) of ART respondents reported more than one method. Within this group, 59.4% (136) of respondents reported a formal diagnosis of infertility and 164 (71.6%) tried to conceive for over a year. Participants self-reported their etiology for infertility; the most common reason was "unknown" (46; 20.1%), followed by polycystic ovarian syndrome (34; 14.85%) and diminished ovarian reserve (15; 14.8%). Other less common etiologies included male factor, tubal disease, and endometriosis.

Parents overall, including those having had preterm deliveries, reported their children reaching similar developmental milestones at most ages [Table 2 and Figure 2]. A significant difference existed at 12 months, with those who had used ART being more likely to report that their child met all milestones compared to those who had spontaneously conceived ( $P < 0.05$ ). Although this was found at 12 months, the difference did not persist to later ages for developmental milestones.



**Figure 2:** Percentage of children perceived by parents to meet all milestones

**Table 1: Demographics**

Demographic	Spontaneous conception (n=1652), n (%)	ART conception (n=229), n (%)
Maturity (weeks)		
Term >37	1533 (92.80)	203 (88.65)
Preterm <37	119 (7.20)	26 (11.35)
Pregnancy risks		
Multiple gestation	19 (1.15)	15 (6.55)
Gestational diabetes	129 (7.81)	32 (13.97)
Hypertension	170 (10.29)	31 (13.54)
Preeclampsia	102 (6.17)	24 (10.48)
Abnormal placentation	35 (2.12)	10 (4.37)
None	1141 (69.07)	129 (56.33)
Delivery method		
Vaginal	1136 (68.77)	142 (62.01)
C-section	506 (30.63)	87 (37.99)
VBAC	10 (0.61)	0
Maternal age at time of delivery (years old)		
<35	1295 (78.39)	145 (63.32)
≥35	267 (16.16)	84 (36.68)
Time to conception		
≤6 months	1318 (79.78)	23 (10.04)
6 months-1 year	169 (10.23)	42 (18.34)
≥1 year	165 (9.99)	164 (71.62)
Methods used to conceive		
Fertility-tracking mobile application	933 (56.48)	160 (69.87)
I used fertility medications only	0	91 (39.74)
Medications and IUI	0	89 (38.86)
IVF	0	78 (34.06)
No, I conceived spontaneously	905 (54.78)	0
Diagnosed with infertility		
Yes	78 (4.72)	136 (53.39)
No	0	93 (40.61)
Infertility factors		
Male infertility factor	1 (0.06)	8 (3.49)
DOR or low egg supply	26 (1.57)	15 (6.55)
PCOS	26 (1.57)	34 (14.85)
Tubal disease	2 (0.12)	6 (2.62)
Endometriosis	1 (0.06)	7 (3.06)
Other/unknown	23 (1.39)	46 (20.09)
Neonatal intensive care unit admission		
Yes	209 (12.65)	33 (14.41)
No	1443 (87.35)	196 (85.59)
Birth defect		
Yes	41 (2.48)	4 (1.75)
No	1611 (97.52)	225 (98.25)
Growth percentile at first pediatric visit (percentile)		
<10	194 (11.74)	41 (17.90)
20-50	469 (28.39)	72 (31.44)

Contd...

**Table 1: Continued**

Demographic	Spontaneous conception (n=1652), n (%)	ART conception (n=229), n (%)
50-90	526 (31.84)	62 (27.07)
91+	214 (12.95)	26 (11.35)
No appointment yet	6 (0.36)	0
Not recalled	243 (14.71)	28 (12.23)

IUI=Intrauterine insemination, IVF=*In vitro* fertilization, DOR=Diminished ovarian reserve, PCOS=Polycystic ovarian syndrome, VBAC=Vaginal birth after cesarean, ART=Assisted reproductive technologies

**Table 2: Parent perspective on number of centers for disease control milestones met by their child**

Child's age (months)	Number of milestones achieved	Spontaneous, n (%)	ART, n (%)
2	0-1	55 (3.3)	10 (4.4)
	2-3	536 (32.4)	71 (31.0)
	4+	1061 (64.2)	148 (64.6)
4	0-1	28 (2.1)	3 (1.5)
	2-3	262 (20.1)	30 (15.4)
	4+	1014 (77.8)	162 (83.1)
6	0-1	11 (1.1)	1 (0.7)
	2-3	210 (20.5)	33 (21.6)
	4+	805 (78.5)	119 (77.8)
9	0-1	23 (3.2)	5 (4.2)
	2-3	235 (32.7)	30 (24.6)
	4+	460 (64.1)	87 (71.3)
12*	0-1	28 (5.6)	1 (1.2)
	2-3	58 (11.5)	7 (8.2)
	4+	418 (82.9)	77 (90.6)
18	0-1	2 (0.9)	1 (2.3)
	2-3	22 (10)	5 (11.6)
	4+	195 (89)	37 (86)
24	0-1	2 (2.7)	1 (5)
	2-3	13 (17.6)	5 (25)
	4+	59 (79.7)	14 (70)
36	0-1	1 (6.7)	2 (66.7)
	2	0	0
	3	14 (93.3)	1 (33.3)
48	0-1	0	0
	2	1 (11.1)	0
	3	8 (88.9)	1 (100)
60	0-1	0	0
	2	1 (11.1)	0
	3	8 (88.9)	0

\* $P < 0.05$ . ART=Assisted reproductive technologies

### Subgroup analysis excluding preterm infants

The subgroup analysis included only infants delivered full term, 37 weeks or greater. The demographics of the patients in the subgroup analysis was similar, including significantly more patients of advanced maternal age in the ART group versus the spontaneous group, other than there being no significant difference in the method

of delivery. This subanalysis excluded 7.2% (119) of the spontaneous conception group and 11.3% (26) of the original ART group [Table 1]. A significant difference favoring more milestones met by those who conceived by ART was noted at 4 months, 9 months, and 12 months of age ( $P < 0.05$ ) [Table 3 and Figure 3]. Differences did not persist past 12 months.

### DISCUSSION

This national survey's principal finding suggests that parents' perspective of childhood milestone achievement among those who conceived using ART and those who conceived spontaneously do not significantly differ from one another. When a significant difference was noted in milestones between the two groups, it favored those who conceived by ART, but this difference did not persist over time. Strengths of this study include the national offering of the digital survey and the large sample size. This research contributes a unique perspective to the literature, the perspective of the parent, rather than a health-care professional.

This is a retrospective study asking respondents to recall their child's developmental milestones, creating the opportunity for recall bias. In addition, the data are all self-reported and not corroborated against the perspective of a medical professional. The number of respondents who conceived by spontaneous conception outnumbers the respondents using ART. In 2015, 1.7% of the infants born in the US were conceived with ART.<sup>[11]</sup> Our ART population represented 13.9% of respondents. The higher overall ART population could be owed to a higher probability of those patients downloading the app and participating in surveys. Those infants delivered prematurely were excluded as they decreased the number of respondents with children over the age of 24 months to a degree that conclusions and/or comparisons could not be made.

As described in Table 2 and Figure 2, differences between parent perspectives of children born after ART compared to spontaneous conception became the same with increasing age of the child. A difference existed at the 12-month mark, where the ART group described their children as having met more milestones. This difference did not persist at the subsequent milestone marks. Similarly, in the full-term subanalysis, parents who conceived using ART assigned more milestone achievements to their child compared to those who spontaneously conceived. Again, these differences did not persist through consecutive time periods.

This study, analyzing the parent perspective rather than the perspective of a medical provider, is unique. Parents have been identified as highly accurate in screening for developmental delay in children.<sup>[12,13]</sup> As a result, this study suggests a similar developmental trajectory when

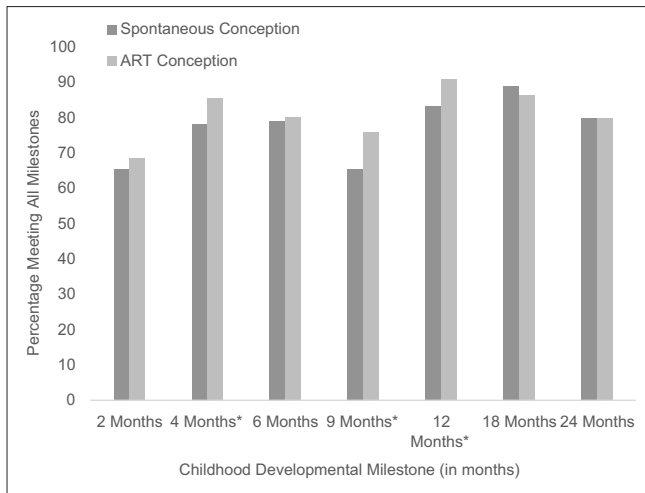


Figure 3: Subanalysis of parent perspective after term deliveries

**Table 3: Parent perspective on number of centers for disease control milestones met by their child excluding preterm deliveries**

Child's age (months)	Number of milestones achieved	Spontaneous, n (%)	ART, n (%)
2	0-1	43 (2.8)	5 (2.5)
	2-3	486 (31.7)	59 (29.0)
	4	1004 (65.5)	139 (68.5)
4*	0-1	22 (1.8)	1 (0.6)
	2-3	240 (19.8)	24 (13.8)
	4	949 (78.4)	149 (85.6)
6	0-1	10 (1.0)	0
	2-3	189 (19.7)	27 (19.7)
	4	759 (79.2)	110 (80.3)
9*	0-1	20 (3.0)	3 (2.8)
	2-3	212 (31.5)	23 (21.1)
	4	440 (65.5)	83 (76.1)
12*	0-1	24 (5.0)	1 (2.7)
	2	55 (11.6)	6 (7.8)
	3	397 (83.4)	70 (90.9)
18	0-1	2 (1.0)	1 (2.7)
	2-3	20 (10)	4 (10.8)
	4	181 (89)	32 (86.5)
24	0-1	2 (2.9)	1 (6.7)
	2-3	12 (17.1)	2 (13.3)
	4	56 (80)	12 (80)
36	0-1	1 (6.7)	2 (100)
	2	0	0
	3	14 (93.3)	0
48	0-1	0	0
	2-3	1 (11.1)	0
	4	8 (88.9)	0
60	0-1	0	0
	2-3	1 (11.1)	0
	4	8 (88.9)	0

\*P<0.05. ART=Assisted reproductive technologies

comparing spontaneously conceived children to ART conceived children, based on parental assessment.

The differences that were significant were found in the ART group; however, this finding did not persist over time. This could be that there were fewer children in the older age groups or that the difference was not medically relevant. The process of conceiving through ART can be demanding and stressful, this may also impact the parent's perception of their newborn. Based on these results, children born after ART are more likely to have their parents report that they are meeting all milestones than children born from spontaneous conception. The reason for this is not investigated in our study.

Previous investigators have found similar findings, suggesting that ART does not negatively impact childhood cognitive/behavioral development. Even when differences were noted, they seemed to equate over time. For example, one study of children ages 8-10 years old found a significant difference favoring ART conceived children's balancing skills. However, this difference in skill level resolved by age 10.<sup>[14]</sup> A 2018 review by Morin and Seli highlights that researchers to date have had similar findings, which suggest that there are not cognitive developmental differences between children conceived through ART versus spontaneous conception.<sup>[15]</sup> Further investigation and long-term follow-up is required to corroborate these findings.

In conclusion, parents who conceived spontaneously and those who used ART reported similar developmental milestones reached at most ages for their children. These findings can be used to provide improved counseling to prospective parents undergoing ART. Future steps should compare a medical perspective of childhood development after ART to the parent perspective to confirm these suggested findings.

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Fertility Centers of Illinois.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

- Centers for Disease Control and Prevention ASRM. Society for Assisted Reproductive Technology. 2016 Assisted Reproductive Technology National Summary Report. Atlanta (GA): US Dept. of Health and Human Services; 2018.
- Schieve LA, Meikle SF, Ferre C, Peterson HB, Jeng G, Wilcox LS. Low and very low birth weight in infants conceived with use of assisted reproductive technology. *N Engl J Med* 2002;346:731-7.
- Wang JX, Norman RJ, Kristiansson P. The effect of various infertility treatments on the risk of preterm birth. *Hum Reprod* 2002;17:945-9.
- Zhu JL, Basso O, Obel C, Hvidtjorn D, Olsen J. Infertility, infertility treatment and psychomotor development: The

- Danish National Birth Cohort. *Paediatr Perinat Epidemiol* 2009;23:98-106.
5. Hwang SS, Dukhovny D, Gopal D, *et al.* Health of Infants After ART-Treated, Subfertile, and Fertile Deliveries. *Pediatrics* 2018;142:e20174069.
  6. Chen M, Heilbronn LK. The health outcomes of human offspring conceived by assisted reproductive technologies (ART). *J Dev Orig Health Dis* 2017;8:388-402.
  7. Ludwig AK, Sutcliffe AG, Diedrich K, Ludwig M. Post-neonatal health and development of children born after assisted reproduction: A systematic review of controlled studies. *Eur J Obstet Gynecol Reprod Biol* 2006;127:3-25.
  8. Nakajo Y, Fukunaga N, Fuchinoue K, Yagi A, Chiba S, Takeda M, *et al.* Physical and mental development of children after *in vitro* fertilization and embryo transfer. *Reproductive medicine and biology*. *Reprod Med Biol* 2004;3:63-7.
  9. CDC's Developmental Milestones. 2018. Available from. <https://www.cdc.gov/ncbddd/actearly/milestones/index.html>. [Last accessed on 2019 Oct 11].
  10. Learn the Signs. Act Early. U.S. Department of Health and Human Services, 2019. Available from: <https://www.cdc.gov/ncbddd/actearly/index.html>. [Last accessed on 2019 Aug 19].
  11. Sunderam S, Kissin DM, Crawford SB, Folger SG, Boulet SL, Warner L, *et al.* Assisted reproductive technology surveillance-United States, 2015. *MMWR Surveill Summ* 2018;67:1-28.
  12. Glascoe FP. Parents' evaluation of developmental status: How well do parents' concerns identify children with behavioral and emotional problems? *Clin Pediatr (Phila)* 2003;42:133-8.
  13. Weitzman CC, Edmonds D, Davagnino J, Briggs-Gowan M. The association between parent worry and young children's social-emotional functioning. *J Dev Behav Pediatr* 2011;32:660-7.
  14. Leunens L, Celestin-Westreich S, Bonduelle M, Liebaers I, Ponjaert-Kristoffersen I. Follow-up of cognitive and motor development of 10-year-old singleton children born after ICSI compared with spontaneously conceived children. *Hum Reprod* 2008;23:105-11.
  15. Morin SJ, Seli E. Assisted reproductive technology and origins of disease: The clinical realities and implications. *Semin Reprod Med* 2018;36:195-203.

## APPENDIX:

### Appendix 1: Parent perspective on newborn milestone after ART

#### E-mail copy:

#### Subject:

Take our survey and enter to win one of four \$100 Amazon gift cards!

#### Teaser:

Help us better support all of our amazing users! Take our survey to be entered to win one of four \$100 Amazon gift cards!

**E-mail ID:** Rush Survey

#### User IDs:

#### Body of e-mail:

**Image text:** Help us improve Ovia! | Enter for a chance to win one of four \$100 gift cards!

**Body text:** Please take this brief survey to help us improve the information and services Ovia provides to all of our amazing users. Your feedback is anonymous and will help us continue to improve the lives of women and families!

When you complete the survey, you'll be entered to win one of four \$100 Amazon gift cards! Thank you for your time, and thank you for being an incredible Ovia user!

<Take our survey>

#### Research Question:

Does ART influence parent perspective on delivery and newborn development?

#### Specific Aims:

1. Are there differences between parent perspectives on newborn development of patients who used ART vs. patients who conceive spontaneously?
2. Are there differences in delivery outcomes reported by patients between patients who used ART vs. patients who conceive spontaneously?
3. Is the use of ART associated with higher scores on the Edinburgh Postnatal Depression Scale, compared to women who conceive spontaneously?
4. Do parents who have gone through ART and experience depressive symptoms (score at-risk or probable depression (10+) on the EPDS) perceive their infants' development differently than parents who have gone through ART but are not experiencing depressive symptoms (score < 10 on the EPDS)?

#### Significance:

ART is becoming increasingly more common, but parents' perspectives of newborn development after such techniques have not been extensively studied. Because medical journals have not shown differences in newborn development between ART and spontaneous conception, we do not know if patients view their outcomes differently. We aim to investigate whether using ART changes parents' perspectives on pregnancy, delivery, and newborn outcomes.

#### Study Design:

Through Ovia Health's mobile applications, we are collecting data on patient perspectives of delivery and newborn development after ART. These reports will be compared to a control group – women who did not undergo ART to conceive.

#### Subjects:

Individuals who download the Ovia Pregnancy or Ovia Parenting application, and receive e-mail notifications

#### Inclusion Criteria:

- Women who identify age  $\geq 18$  years at sign-up

- Women who have gone through some form of ART will be included in the study arm, while those who did spontaneously conceived will be included in the control arm
- US only

**Exclusion Criteria:**

- Women who have not had children

**Ovia Parent Perspective on Newborn Development Questionnaire**

Your anonymous responses to the following survey will contribute to a research program Ovia is conducting. By continuing on, you agree to partake in this research, which will help us better understand infant and child development. If you have questions or concerns, please contact [support@oviahealth.com](mailto:support@oviahealth.com) Thank you in advance!

*Please answer the following survey with your youngest child in mind.*

**Page 1 – Pregnancy Outcomes and conception efforts**

1. Have you given birth before?
  - a. Yes
  - b. No (*exit survey*)

**Page 2**

2. At which gestational age (weeks pregnant) did you deliver your baby? Please respond with your youngest child in mind, if you have more than one.
  - a. Dropdown weeks: 23-45 weeks
3. Did any of the following risk factors apply to your pregnancy? (select all that apply)
  - a. Multiples (twins, triplets, etc.)
  - b. Gestational diabetes
  - c. Hypertension (high blood pressure)
  - d. Preeclampsia
  - e. Abnormal placenta (my placenta grew abnormally either as a “previa,” meaning laying low over the cervix OR it grew into the uterine wall – both requiring a C-section)
  - f. None of the above
  - g. Other (free text)
4. How much weight did you gain during your most recent pregnancy?
  - a. Dropdown menu: 0 – 50 + pounds
5. How did you deliver your most recent child?
  - a. Vaginal delivery
  - b. Cesarean Section (C-section)
  - c. Vaginal Birth After Cesarean (VBAC) (for 2<sup>nd</sup> + time moms)
6. How old is your youngest baby?
  - a. Dropdown menus in months, then years: Less than a month, 1-12, 1 year, 2 years, 3 years, 4, years, 5 years
7. How old were you at the time of your most recent birth?
  - a. Dropdown menu in years (18-55 yrs)
8. How long did it take you to get pregnant when you were trying to conceive your youngest child?
  - a. I wasn't trying to get pregnant when I conceived
  - b. 1 month
  - c. 2 months
  - d. 3 months
  - e. 4 months
  - f. 5 months
  - g. 6 months
  - h. 7 months



- i. 8 months
  - j. 9 months
  - k. 10 months
  - l. 11 months
  - m. 12 months (1 year)
  - n. More than 1 year
9. Did you use any of the following resources to help you conceive your youngest child? (Please select all that apply)
- a. Fertility-tracking mobile application
  - b. I used fertility medications only – no further intervention
  - c. Medications and intrauterine insemination (IUI)
  - d. *In vitro* fertilization (IVF)
  - e. No, I conceived spontaneously/through natural conception – i.e. intercourse with no medications or procedures
  - f. *Other (please specify)*
10. Do you have a history of depression or anxiety?
- a. Yes
  - b. No
11. Have you ever been diagnosed with infertility?
- a. Yes
  - b. No (skip to page 4)

**Page 3 – Reason (s) for infertility diagnosis**

2. Which of the following factors impacted your infertility diagnosis?
- a. Male infertility factor
  - b. Diminished Ovarian Reserve (DOR) or low egg supply
  - c. Polycystic Ovarian Syndrome (PCOS)
  - d. Tubal disease (tubes are blocked or not open)
  - e. Endometriosis
  - f. Unexplained (unprotected intercourse without successful conception for 12 or more months, or 6 or more months if you're 35 years or older)
  - g. Other (open text)

**Page 4 – Newborn Development:**

10. What was the birth weight of your youngest child? Please use the following format: pounds.ounces (lbs.oz) – for example, 7.14
- a. *Open text field*
11. Did your child go home with you when you were discharged from the hospital after delivery?
- a. Yes
  - b. No
12. Did your child require any time in the NICU?
- a. Yes
  - b. No
13. Does your child have a birth defect?
- a. Yes (please specify)
  - b. No
14. Was your child re-admitted to the hospital after delivery? If so, what was the reason?
- a. Yes (please specify)
  - b. No
15. Did/does your child need any kind of surgery (excluding a circumcision) after delivery? If so, what kind of surgery?
- a. Yes (please specify)

b. No

16. Does your baby sleep well at night?

- a. Rarely
- b. Sometimes
- c. Often

17. What percentile was your child on the growth chart at his or her first visit with the pediatrician?

- a. <10<sup>th</sup>%
- b. 11%–30%
- c. 31%–50%
- d. 51%–70%
- e. 71%–90%
- f. 91% +
- g. My child hasn't been to the pediatrician (doctor's office) yet
- h. I don't remember

18. Which of the following infant feeding options do/did you use?

- a. Breastmilk
- b. Formula
- c. Combination, both breastmilk and formula

Other (*please specify*)

19. Has your child received all vaccinations recommended by your pediatrician?

- a. Yes
- b. No

20. Do you believe your child is developing at the same rate as his or her peers?

- a. Yes
- b. No

21. Please share any concerns you may have about your child's development, *\*make this question not required*

- a. Open text box

**Page 5 – 1<sup>st</sup> CDC milestone question about child development (2 months):**

Source: [https://www.cdc.gov/ncbddd/actearly/pdf/checklists/all\\_checklists.pdf](https://www.cdc.gov/ncbddd/actearly/pdf/checklists/all_checklists.pdf)

While responding to the following questions please select the behaviors (milestones) that you have noticed your child has reached. Each question will have multiple options, so please select as many of the options that apply to your child's behavior. If your child is younger than the age the question is asking about, please select the option that says, "My child is not this old yet."

22. By 2 months old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Begins to smile at people; can briefly calm themselves; tries to look at a parent
- b. Coos; makes gurgling sounds; turns head toward sounds
- c. Pays attention to faces; begins to follow things with eyes and recognize people at a distance; begins to act bored, cries, or is fussy if an activity doesn't change
- d. Can hold head up and begins to push up when lying on tummy; makes smooth movements with arms and legs
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 6 – 2<sup>nd</sup> CDC milestone question about child (4 months)**

23. By 4 months old, my child was doing the following things:(select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Smiles spontaneously; likes to play with people and might cry when playing stops; copies some movements and facial expressions; like smiling and frowning
- b. Begins to babble; babbles with expression and copies sounds heard; cries in different ways to show hunger, pain, or being tired
- c. Responds to affection; reaches for toy with one hand; follows moving things with eyes from side to side; watches people's faces closely; recognizes familiar people or things at a distance
- d. Holds head steady when unsupported; pushes feet against the ground when held in a standing position; can hold a toy and interact with it; brings hands to mouth; can push up to elbows when lying on their stomach
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 7 – 3<sup>rd</sup> CDC milestone question about child (6 months)**

24. By 6 months old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)
- a. Knows familiar faces; likes to play with others; responds to other people's emotions and often seems happy; likes to look at self in a mirror
  - b. Responds to sounds by making sounds; responds to own name; makes sounds to show joy and unhappiness; babbles with vowels ("Ah," "Eh," "Oh")
  - c. Brings things to mouth; shows curiosity; begins passing items from one hand to the other
  - d. Rolls over in both directions; begins to sit without support; rocks back and forth
  - e. My child is not this old yet (skip to page 15)
  - f. My child did not do any of these things at this age

**Page 8 – CDC milestone question about child (9 months)**

25. At 9 months, my infant was doing the following:(select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)
- a. Has a favorite toy; may be afraid of strangers; tends to cling to familiar adults
  - b. Understands when told "no"; makes different sounds like "mamamama" and "babababa"; copies sounds/gestures of others; points with finger at things
  - c. Watches the path of something as it falls; looks for things that are hidden; plays peek-a-boo; puts things in mouth; moves things smoothly from one hand to the other; can pick up small things between thumb and index finger
  - d. Stands holding on to something; sits without support; pulls to stand; crawls
  - e. My child is not this old yet (skip to page 15)
  - f. My child did not do any of these things at this age

**Page 9 – 4<sup>th</sup> CDC milestone question about child (1 year)**

26. By 12 months (1 year) old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)
- a. Is shy or nervous with strangers; cries when parent leaves; has favorite things; shows fear; plays games such as "peek-a-boo" or "pat-a-cake"; repeats sounds or actions to get attention
  - b. Responds to simple spoken requests; uses simple gesture like shaking head "no" or waving "bye-bye"; says "mama" or "dada" or sounds like "uh-oh!"; tries to say words you say
  - c. Finds hidden things easily; looks at the right picture or thing when it is named; copies gestures (like clapping or pointing); bangs two items together; follows simple directions like "pick up the toy"
  - e. My child is not this old yet (skip to page 15)
  - f. My child did not do any of these things at this age

**Page 10 – 5<sup>th</sup> CDC milestone question about child (18 months)**

27. By 18 months (1.5 years) old, my child was doing the following things: (select all answer options that list one

or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Enjoys handing things to others as play; may have temper tantrums; may be afraid of strangers; shows affection to familiar people; plays simple “pretend” such as feeding a doll; explores alone while parent is close by
- b. Says several single words; says and shakes head “no”; points to show someone what they want
- c. Knows what ordinary things are (telephone, brush, spoon); points to get the attention of others; shows interest in stuffed animal or dolls; can follow 1 step verbal command without gestures (“sit down”)
- d. Walks alone; may walk up steps or run; pulls toys while walking; can help undress themselves; drinks from a cup; eats with a spoon
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 11 – 6<sup>th</sup> CDC milestone question about child (2 years)**

28. By 2 years old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Copies others (especially adults); gets excited when with other children; shows defiant behavior; shows more independence; plays mainly beside other children
- b. Points to things or pictures when they are named; knows names of familiar people and body parts; says sentences with 2-4 words; follows simple instructions; repeats words overheard in conversation; points to things in a book
- c. Begins to sort shapes and colors; completes sentences and rhymes from familiar books; plays simple make-believe games; follows 2 step instructions (“pick up your shoes and put them in the closet”) names items in a picture book like “cat,” “bird,” or “dog”
- d. Stands on tiptoes; kicks a ball; begins to run
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 12 – 7<sup>th</sup> CDC milestone question about child (3 years)**

29. By 3 years old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Copies adults and friends; shows affection for friends without prompting; takes turns in games; shows concern for a crying friend; understands idea of “mine” and “his/hers”; shows a wide range of emotions; dresses and undresses self
- b. Follows instruction with 2-3 steps; can name most familiar things; says first name, age, or sex (“boy” or “girl”); can name their friends; talks well enough for strangers to understand; can have a conversation using 2-3 sentences at a time
- c. Can use toys that have buttons, levers or moving parts; plays make-believe; does puzzles with 3-4 pieces; begins to understand numbers; copies a circle with pencil or crayon; turns book pages one at a time; screws and unscrews jar lids; turns door handle
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 13 – 7<sup>th</sup> CDC milestone question about child (4 years)**

30. By 4 years old, my child was doing the following things: (select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)

- a. Enjoys doing new things; plays games like “mom” and “dad”; would rather play with other children than by him or herself; cooperates with other children; talks about likes dislikes, and interests;
- b. Sings a song or says a poem from memory; tells stories; can say first and last name; knows some basic rules of grammar (uses “he/she” when speaking)
- c. Names some colors and some numbers; understands counting; remembers parts of a story; draws a person with

- 2-4 body parts; uses scissors; plays board or card games; tells you what they think is going to happen next in a book
- d. Hops and stands on one foot up to 2 seconds; catches a bounced ball most of the time
- e. My child is not this old yet (skip to page 15)
- f. My child did not do any of these things at this age

**Page 14 – 8<sup>th</sup> CDC milestone question about child (5 years)**

31. By 5 years old, my child was doing the following things:(select all answer options that list one or more of the behaviors your child has done. For example, you can select an option, even if your child has only done one of the two or three behaviors listed)
- a. Wants to be liked by friends; likes to sing, dance, or act; can tell what is real and what is make believe
- b. Speaks very clearly; tells a simple story using full sentences; can use future tense (“Grandma will be here”)
- c. Counts to 10 or more; can draw a person with at least 6 body parts; can write some letters or numbers; copies a triangle and other shapes; knows about things used everyday like money and food
- d. Can stand on one foot for 10 seconds or longer; hops or somersaults; uses a fork and spoon when eating; can use the toilet on their own; swings and climbs
- e. My child is not this old yet
- f. My child did not do any of these things at this age

**Page 15 – Demographics and fertility questions:**

1. Which of the following best describes your ethnicity? Please select all that apply:
- a. Native American/Native Alaskan
- b. Asian
- c. Black/African American
- d. Native Hawaiian/Other Pacific Islander
- e. Hispanic/Latina/Spanish
- f. Middle Eastern/North African
- g. White
- h. Decline to respond
2. What best describes your use of the English language?
- a. Native (first and primary language)
- b. Fluent
- c. Proficient
- d. Conversational
- e. Basic
3. What is your annual household income?
- a. Less than \$19,999 per year
- b. \$20-29,999
- c. \$30-39,999
- d. \$40-49,999
- e. \$50-74,999
- f. \$75-99,999
- g. \$100-149,999
- h. \$150,000 or more
- i. Decline to respond
4. What is your marital status?
- a. Single, never married
- b. Married or Domestic partnership
- c. Divorced
- d. Widowed
- e. Separated

5. What environment best identifies where you live?
  - a. Urban
  - b. Small city
  - c. Suburban
  - d. Rural
6. What is your height? Please enter your height in feet and inches (for example: 5.4)
7. What is your weight? Please enter your weight in pounds (for example: 125)
8. How many children do you have?
  - a. 1
  - b. 2
  - c. 3+
9. What is your highest level of completed education?
  - a. Less than high school
  - b. High school diploma or equivalent
  - c. Associated degree (AA, AS, etc.)
  - d. Bachelor's degree (BA, BS, etc.)
  - e. Master's degree (MS, MA, MBA, MEd, etc.)
  - f. Professional degree (MD, JD, etc.)
  - g. Doctorate degree (PhD, EdD, PsyD, etc.)
  - h. Decline to respond
1. Thank you for completing the survey! Please enter your e-mail address for a chance to win one of four \$100 gift cards!

Primary Null Hypothesis:

Patients who have used ART for pregnancy have no difference in perception of newborn development when compared to those who did not use ART for pregnancy.

**References:**

PMID: 11206432 -- **In vitro fertilization and the family: quality of parenting, family functioning, and child psychosocial adjustment.**

PMID: 18163998-- **Growth and development of children born after *in vitro* fertilization.**

PMID: 18825610-- **The association of *in vitro* fertilization and perinatal morbidity.**

PMID: 23708014-- **IVF raises risk of developmental problems in premature infants, finds study.**

PMID: 19700399-- **In vitro fertilization and use of ovulation enhancers may both influence childhood height in very low birthweight infants.**

PMID: 11870121-- **Neonatal data on a cohort of 2889 infants born after ICSI (1991-1999) and of 2995 infants born after IVF (1983-1999).**\

PMID: 19606451 -- **Psychometric testing of the Perception of Pregnancy Risk Questionnaire.**