

Racial and ethnic disparities in assisted reproductive technology outcomes in the United States

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Objective: To evaluate ethnic differences in assisted reproductive technology (ART) outcomes in the United States.

Design: Historical cohort study.

Setting: Clinic-based data.

Patient(s): A total of 139,027 ART cycles from the Society for Assisted Reproductive Technology Clinic Outcome Reporting System online database for 2004–2006, limited to white, Asian, black, and Hispanic women.

Intervention(s): None.

Main Outcome Measure(s): Logistic regression was used to model the odds of pregnancy and live birth; among singletons and twins, the odds of preterm birth and fetal growth restriction. Results are presented as adjusted odds ratios, with white women as the reference group.

Result(s): The odds of pregnancy were reduced for Asians (0.86), and the odds of live birth were reduced for all groups: Asian (0.90), black (0.62), and Hispanic (0.87) women. Among singletons, moderate and severe growth restriction were increased for all infants in all three minority groups (Asians [1.78, 2.05]; blacks [1.81, 2.17]; Hispanics [1.36, 1.64]), and preterm birth was increased among black (1.79) and Hispanic women (1.22). Among twins, the odds for moderate growth restriction were increased for infants of Asian (1.30) and black women (1.97), and severe growth restriction was increased among black women (3.21). The odds of preterm birth were increased for blacks (1.64) and decreased for Asians (0.70).

Conclusion(s): There are significant disparities in ART outcomes according to ethnicity. (Fertil Steril® 2008; ■: ■–■. ©2008 by American Society for Reproductive Medicine.)

Key Words: Ethnic disparities, racial disparities, Asian, black, Hispanic, ART outcomes, IVF outcomes, IVF pregnancy rates, IVF live birth rates, prematurity, growth restriction

Patient demographics are known to influence IVF pregnancy success but have largely focused on maternal age associations (1). There is an increasing body of evidence with the acknowledgment that ethnic disparities exist in reproductive outcomes spanning the obstetrical and gynecologic populations. With respect to IVF outcomes, several studies have

found reduced pregnancy rates in infertile populations consisting of Asian and black women (2–6). The lower live birth rates in both Asian and black populations exist despite similar numbers of embryos transferred (2–5). However, other studies comparing IVF outcomes between black and white women have not shown such a disparity (7–9). Several fecundity-based studies have also demonstrated differences in ethnic groups, although these studies are confounded by potential region- and culture-specific differences in populations, independent of ethnicity (10, 11).

Recent studies support increased rates of small-for-gestational-age infants, preterm delivery, and perinatal morbidity associated with the IVF process compared with spontaneously conceived pregnancies (12–16). However, no study to date has addressed potential ethnic differences in perinatal outcomes within infertility cohorts of white, Asian, black, and Hispanic women after IVF treatment.

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In an obstetrical population, Indian and Pakistani women had higher risks of low birth weight at term compared with other subpopulations of Asian and Pacific Islander women; however, no comparisons of Asian and Pacific Islander perinatal outcomes with a white population have been published (17). Other studies have also demonstrated low birth weight in Asian populations (18–21). Further studies describing the relationship between ethnicity and birth weight differences reveal reduced birth weights in black and Hispanic populations (22–29).

Hence, we hypothesized that differences in live birth rates and perinatal outcomes would exist within three minority ethnic groups in the United States as defined by the U.S. Census Bureau (30). Using the Society for Assisted Reproductive Technology Clinic Outcome Reporting System (SART-CORS) national database, we conducted this data analysis to identify such differences.

MATERIALS AND METHODS

The data source for this study was the SART-CORS database, which contains comprehensive data from more than 90% of all reporting clinics performing more than 90% of the ART cycles in the United States and included 391 clinics in 2004, 394 in 2005, and 392 in 2006. This database contains data collected and verified by SART, which are reported to the Centers for Disease Control and Prevention in compliance with the Fertility Clinic Success Rate and Certification Act of 1992 (Public Law 102-493, October 24, 1992). The study was reviewed by the Committee for the Protection of Human Subjects at Brigham and Women's Hospital in Boston, Massachusetts, and allowed exemption from approval. This article was written in conjunction with the SART Research Committee.

The study population was limited to all ART cycles using non-donor oocytes and partner semen among women of the four major racial and ethnic groups as reported by participating clinics: white, Asian, black, and Hispanic. Because no specific instructions for SART reporting of ethnicity are given, there may be reporting biases of specific race or ethnicity that can vary from clinic to clinic and patient to patient. According to U.S. Census Bureau categorization, white, Asian, and black are considered racial groups, whereas Hispanic is considered an ethnic category of white. Dependent variables included the odds of pregnancy (presence of gestational sac on early ultrasound) as the treatment outcome, live birth as the pregnancy outcome, and, among singleton and twin live births, the odds of prematurity (<29 weeks, <32 weeks, and <37 weeks) and growth restriction (birth-weight-for-gestation z scores as moderate [<-1] or severe [<-2]), adjusting for other significant factors. White women were the reference group, and each ethnic group was compared separately. A single-ethnicity birth weight reference (Canadian live births, 1994–1996 [31]) was used to calculate birth weight z scores. Plurality-specific birth weight z scores were calculated to evaluate adequacy of weight for age (31, 32), as recommended by Land (33), and modeled as continuous and categorical variables (<-1.0 and <-2.0).

Birth weights at each gestational age are normally distributed, with a reference mean of zero and an SD of 1. A z score (or SD score) is the deviation of the value for an individual from the mean value of the reference population divided by the SD for the reference population. Z scores have a direct relationship with percentiles, with z scores from -1 to $+1$ and from -2 to $+2$ representing 68% and 95%, respectively, of the population distribution. The z score is useful to describe how far the observed birth weight for gestational age is from its expected value. For this study, we used birth weight z scores of -1 and -2 , corresponding to the 16th and 2.5th percentiles, respectively.

Maternal demographic factors, reproductive history, ART cycle-specific parameters, and ART treatment and pregnancy outcomes were compared across the four ethnic groups using the χ^2 test and analysis of variance. Logistic regression analyses were used for dichotomized outcomes. Models were adjusted for maternal age, number of embryos transferred, and the infertility diagnoses of male factor, endometriosis, polycystic ovarian syndrome, diminished ovarian reserve, tubal factors, and other factors. Models of birth weight z scores and prematurity outcomes were limited to pregnancies of ≥ 154 days (22 weeks) and >300 g. Data were analyzed using the Statistical Package for the Social Sciences, version 16.0 (SPSS, Chicago, IL).

RESULTS

The four ethnic groups differed significantly in their age distribution, with Asian and black women being older and Hispanic women younger than their white counterparts (Table 1). Asian women were more likely and black women less likely to be nulligravidas. The four groups also differed in their infertility diagnoses. Black women were less likely to be diagnosed with endometriosis, polycystic ovary syndrome, and unexplained factors and more likely to have tubal or uterine factors. Hispanic women were more likely to have tubal factors and less likely to have unexplained factors. Other demographic differences, including prior term birth, prior preterm birth, and prior spontaneous abortion, are also described in Table 1. Although data regarding sperm parameters were not available in the dataset, the relative percentages of those patients undergoing intracytoplasmic sperm injection or conventional insemination (IVF) are also listed for each racial or ethnic group in Table 1. Asian women tended to have fewer embryos transferred, whereas black and Hispanic women had more embryos transferred compared with white women (Table 1).

Treatment outcomes also varied significantly across the four groups. Black women were more likely to develop ovarian hyperstimulation syndrome (any and severe) and were less likely to achieve a clinical pregnancy; however, the absolute risk of ovarian hyperstimulation syndrome remains low. Among those who did become pregnant, black women were least likely to have a live birth (Table 2). We also examined multiple pregnancy rates by ethnicity (Table 2). Asian and black women were also less likely than white or Hispanic

TABLE 1

Characteristics and therapy of women by race and ethnicity.

Characteristic	All Groups	Racial and ethnic groups				P value
		White	Asian	Black	Hispanic	
n	139,027	107,484	13,671	8,903	8,969	
% racial or ethnic	100	77.2	9.8	6.5	6.5	
Maternal age (y), mean (SD)	35.3 (4.6)	35.3 (4.6)	35.8 (4.6)	35.9 (4.7)	35.0 (4.8)	<.0001
<30	11.2	11.5	8.6	9.9	13.6	<.0001
30–34	31.3	31.7	30.1	26.5	31.9	
35–39	37.2	37.1	38.1	38.8	35.4	
40–44	19.0	18.4	21.4	23.2	17.7	
≥45	1.3	1.2	1.8	1.6	1.3	
Nulligravida	46.8	46.9	53.2	35.4	46.5	<.0001
No prior full-term birth	55.5	54.3	64.6	58.7	52.0	<.0001
No prior preterm birth	96.5	96.6	97.5	94.9	96.2	<.0001
No prior spontaneous abortion	48.8	48.6	50.3	46.2	51.5	<.0001
Infertility diagnosis						
Male factor	38.2	38.7	36.8	34.2	38.3	<.0001
Endometriosis	14.4	15.3	12.4	7.8	12.5	<.0001
Polycystic ovary syndrome	15.2	15.7	14.2	10.6	15.0	<.0001
Diminished ovarian reserve	16.8	16.7	19.0	14.9	15.8	<.0001
All tubal factors	21.1	18.5	17.8	46.7	32.0	<.0001
Uterine factors	5.2	4.5	5.8	13.1	5.3	<.0001
Other factors	14.2	14.4	15.4	12.4	12.3	<.0001
Unexplained factors	11.7	12.2	13.5	6.3	8.5	<.0001
No. of fresh embryos transferred						
1	8.9	8.7	11.2	9.0	8.0	<.0001
2	43.7	44.4	40.2	41.9	41.7	
3	30.3	30.4	28.7	30.9	30.6	
4	11.7	11.4	13.0	12.0	13.6	
≥5	5.4	5.1	7.0	6.2	6.1	
ICSI (all or some)	70.0	70.0	70.0	67.6	71.9	<.0001
Assisted hatching (all or some)	46.8	46.1	53.1	46.6	45.7	<.0001

Note: Values are percentages unless otherwise noted. ICSI = intracytoplasmic sperm injection.

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women to become pregnant with twins, but among those who did achieve a pregnancy, their live birth rates were comparable to those for white women, without an increase in pregnancy loss. Length of gestation and birth weight by plurality also differed significantly across the four groups, as shown in Table 3. Infants of black women averaged the shortest gestations and lowest birth weights, whereas infants of Asian women averaged the longest gestations and highest birth weights within each plurality. Infants of Asian women averaged the lowest singleton birth weight z scores, and black infants the lowest twin birth weight z scores.

The results of the logistic regression models are shown in Table 4. Asian women were 14% less likely to achieve a pregnancy as the treatment outcome. All three minority groups were less likely to have a live birth as the pregnancy outcome compared with white women: 10% less for Asian, 13% less

for Hispanic, and 38% less for black women. Among women with singleton live births, black women were approximately four-, three-, and twofold as likely to deliver very early (<29 weeks), early (<32 weeks), or preterm (<37 weeks), respectively, compared with white women; Hispanic women were approximately 22% more likely to deliver preterm. Moderate and severe growth restriction were significantly more likely among the singleton infants of all three minority groups. Among women with twin births, black women were more likely and Asian women less likely to deliver preterm. Moderate growth restriction was more likely among Asian and black twin infants, and severe growth restriction among black twins.

DISCUSSION

The major findings of our study of the U.S. ART patient population are [1] the reduced clinical pregnancy rate in Asian

TABLE 2**Treatment outcomes by racial and ethnic group.**

Characteristic	All groups	Racial and ethnic groups				P value
		White	Asian	Black	Hispanic	
n	139,027	107,484	13,671	8,903	8,969	
% racial or ethnic	100	77.2	9.8	6.5	6.5	
Complications						
Any hyperstimulation	1.6	1.6	1.3	2.7	1.6	< .0001
Severe hyperstimulation	0.4	0.4	0.3	0.9	0.4	< .0001
Treatment outcome						
Not pregnant	53.8	51.9	61.8	62.2	55.9	< .0001
Biochemical	6.8	7.1	6.4	5.0	5.9	
Ectopic	0.8	0.8	0.9	0.8	0.9	
Clinical intrauterine gestation	38.5	40.1	30.9	32.0	37.3	
Heterotopic	0.1	0.0	0.1	0.0	0.0	
Fetal hearts on ultrasound						
0	5.8	5.7	6.6	6.8	5.7	< .0001
1	61.1	60.9	63.6	61.9	59.8	
2	28.7	29.0	25.7	27.6	29.6	
3	4.0	4.0	3.9	3.1	4.2	
≥4	0.4	0.4	0.3	0.6	0.7	
Pregnancy Outcome (%)						
Livebirth	83.0	83.7	81.6	75.0	82.2	< .0001
Stillbirth or fetal loss	17.0	16.3	18.4	25.0	17.8	
Plurality of liveborn						
Pregnancies (n)	44,508	36,178	3,445	2,155	2,730	< .0001
Singleton	68.1	67.7	71.6	70.9	66.8	
Twins	29.5	29.9	26.8	27.0	30.0	
Triplets	2.3	2.3	1.6	2.1	2.9	
≥ Quadruplets	0.1	0.1	0.0	0.0	0.3	

Note: Values are percentages unless otherwise noted.

Fujimoto. Racial and ethnic disparities in ART outcomes. *Fertil Steril* 2008.

women compared with white women, [2] the reduced live birth rates in all three racial and ethnic minority groups compared with white women, [3] the increased preterm delivery rate in black and Hispanic women compared with white women, and [4] the increase in fetal growth restriction seen in all three minority groups of women compared with white women. Our findings confirm that Asian and black women have reduced live birth rates after ART treatment when compared with white women and demonstrate for the first time that Hispanic women also have reduced live birth rates after ART.

The study of racial and ethnic disparities is complicated by a myriad of factors: social, cultural, nutritional, anthropometric, environmental, physical, metabolic, and genetic. No single study can address all of these factors, and any findings are limited to factors that can be measured or assessed. Although clinical pregnancy rates were similar between black, Hispanic, and white women, Asian women had a lower clinical pregnancy rate compared with white women in our study.

Black and Hispanic women had significantly higher rates of fetal loss that subsequently reduced their live birth rates significantly compared with white women. Finally, all three minority ethnic groups had higher rates of moderate and severe growth restriction at delivery compared with white women, independent of gestational age. Collectively, these data describe significant disparities in the reproductive health outcomes of minority women undergoing ART treatment in the United States.

Our confirmation of reduced clinical pregnancy rates in Asian women compared with white women confirms disparities reported in prior published work (3, 4). Our finding of a reduction in pregnancy success in Asian women is lower than previously reported by Purcell et al. (4), representing SART National data from 2001–2003, for which the odds ratio for clinical pregnancy rate in Asian women was 0.71. It is important to note that only first-cycle IVF data were analyzed by Purcell et al., whereas our dataset includes all IVF cycles generated over the 3-year reporting period (4).

TABLE 3

Length of gestation and birth weight by plurality and racial and ethnic groups.

Characteristic	All groups	Racial and ethnic groups				P value
		White	Asian	Black	Hispanic	
n	44,508	36,178	3,445	2,155	2,730	
% racial or ethnic	100	81.3	7.7	4.8	6.1	
Length of gestation						
Singletons (d), mean (SD) ^a	259 (21)	260 (21)	262 (19)	254 (26)	257 (22)	<.0001
22–28 wk (%)	1.3	1.1	0.9	4.6	1.4	<.0001
29–32 wk (%)	1.9	1.8	2.0	3.5	2.0	
33–36 wk	15.2	14.8	13.9	21.0	17.7	
≥37 wk (%)	81.6	82.3	83.1	70.9	78.9	
Twins (d), mean (SD) ^a	243 (21)	243 (21)	247 (19)	236 (26)	241 (22)	<.0001
22–28 wk (%)	5.5	5.2	3.3	12.0	7.4	<.0001
29–32 wk (%)	12.6	12.5	11.7	15.6	12.3	
33–36 wk (%)	59.0	59.4	54.6	56.3	59.7	
≥37 wk (%)	23.0	22.9	30.4	16.1	20.6	
Triplets (d), mean (SD) ^a	224 (21)	224 (20)	230 (21)	217 (21)	222 (20)	.02
22–28 wk (%)	14.3	14.4	5.6	28.6	11.7	.008
29–32 wk (%)	40.0	39.1	35.2	42.9	50.6	
33–36 wk (%)	44.5	45.5	55.6	28.6	35.1	
≥37 wk (%)	1.2	1.0	3.7	0.0	2.6	
Birth weight (g), mean (SD) ^b						
Singletons	2,900 (745)	2,966 (743)	2,906 (678)	2,735 (816)	2,861 (766)	<.0001
Twins	2,271 (603)	2,287 (599)	2,281 (545)	2,047 (685)	2,189 (618)	<.0001
Triplets	1,678 (501)	1,688 (509)	1,783 (472)	1,569 (456)	1,567 (435)	.03
Singleton birth weight z score, mean (SD) ^b						
Singleton <−1	6.9	6.2	11.0	10.9	8.0	<.0001
Singleton <−2	0.8	0.7	1.4	1.6	1.1	<.0001
Twin birth weight z score, mean (SD) ^b						
Twin <−1	7.6	7.1	9.2	13.0	8.6	<.0001
Twin <−2	1.6	1.4	1.8	4.3	2.2	<.0001

^a Limited to pregnancies of ≥154 days (22 weeks).

^b Limited to birth weights ≥300 g.

Fujimoto. Racial and ethnic disparities in ART outcomes. Fertil Steril 2008.

The higher odds ratio seen in our study may be explained by several possible etiologies: [1] reporting bias influenced by demographic differences, and [2] repeated-measure bias represented by a multiple-cycle dataset. In 2005 SART mandated the reporting of female race and ethnicity data for all IVF cycles generated by reporting clinics. It is possible that this change in reporting could have altered the ethno-demographic distribution of reporting Asian populations in the United States and thus influenced the statistical differences in pregnancy outcomes. Another possible explanation for the difference may be that Asian and white women have comparable outcomes after multiple IVF treatment cycles. The possible influence of diagnosis on Asian reproductive outcomes is demonstrated by Palep-Singh et al. (3), who reported that Asian women with polycystic ovarian syndrome

undergoing IVF had reduced clinical pregnancy and live birth outcomes compared with white women, whereas Asian women with tubal factor infertility had similar clinical pregnancy and live birth outcomes as white women (3). Various potential mechanisms could be influencing the ability of Asian women to conceive with ART. It is known that socio-cultural factors reduce health care utilization in Asian populations, which has been demonstrated in an infertility population as well (34). Although other studies have not shown differences in ovarian stimulation characteristics (4), the concept that Asian women may suffer from an acceleration in ovarian aging has been proposed to explain the disparity seen in Asian women undergoing IVF (35). Genetic differences have been demonstrated in Asian populations, which may be relevant in IVF success rates (36). Finally,

TABLE 4

Regression models on the impact of race and ethnicity on the response and outcome to ART treatment.^a

Dependent	Independent	AOR	95% CI	P Value	Singleton pregnancies ^b			Twin pregnancies ^b		
					AOR	95% CI	P Value	AOR	95% CI	P Value
Treatment outcome: pregnancy	White	1.00	Reference							
	Asian	0.86	0.80–0.93	< .0001						
	Black	1.09	0.99–1.20	.09						
	Hispanic	1.06	0.96–1.16	.25						
Pregnancy outcome: live birth	White	1.00	Reference							
	Asian	0.90	0.82–0.97	.01						
	Black	0.62	0.56–0.68	< .0001						
	Hispanic	0.87	0.79–0.96	.005						
Very early preterm birth (<29 wk)	White				1.00	Reference		1.00	Reference	
	Asian				0.77	0.48–1.25	.30	0.62	0.42–0.92	.02
	Black				4.25	3.14–5.76	< .0001	2.46	1.84–3.29	< .0001
	Hispanic				1.38	0.91–2.09	.13	1.36	1.01–1.82	.04
Early preterm birth (<32 wk)	White				1.00	Reference		1.00	Reference	
	Asian				1.01	0.78–1.31	.93	0.83	0.69–1.01	.07
	Black				2.72	2.19–3.38	< .0001	1.76	1.44–2.15	< .0001
	Hispanic				1.19	0.91–1.56	.21	1.10	0.92–1.33	.30
Preterm birth (<37 wk)	White				1.00	Reference		1.00	Reference	
	Asian				0.95	0.85–1.06	.35	0.70	0.60–0.82	< .0001
	Black				1.79	1.59–2.03	< .0001	1.64	1.29–2.08	< .0001
	Hispanic				1.22	1.08–1.37	.001	1.14	0.95–1.37	.15
Term birth (≥37 wk)	White				1.00	Reference		1.00	Reference	
	Asian				0.95	0.85–1.06	.35	0.70	0.60–0.82	< .0001
	Black				1.79	1.59–2.03	< .0001	1.64	1.29–2.08	< .0001
	Hispanic				1.22	1.08–1.37	.001	1.14	0.95–1.37	.15
Birth weight z score < -1	White				1.00	Reference		1.00	Reference	
	Asian				1.78	1.58–2.01	< .0001	1.30	1.03–1.66	.03
	Black				1.81	1.56–2.11	< .0001	1.97	1.50–2.57	< .0001
	Hispanic				1.36	1.17–1.58	< .0001	1.26	0.97–1.64	.08

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TABLE 4

Continued.

Dependent	Independent	Singleton pregnancies ^b				Twin pregnancies ^b				
		AOR	95% CI	P Value	AOR	95% CI	P Value	AOR	95% CI	P Value
Birth weight z score < -2	White	1.00	Reference		1.00	Reference		1.00	Reference	
	Asian	2.05	1.50–2.80	< .0001	1.29	0.76–2.17	.35	1.29	0.76–2.17	.35
	Black	2.17	1.47–3.19	< .0001	3.21	2.02–5.11	< .0001	3.21	2.02–5.11	< .0001
	Hispanic	1.64	1.11–2.42	.01	1.57	0.94–2.62	.08	1.57	0.94–2.62	.08

Note: AOR = adjusted odds ratio.
^a Models adjusted for maternal age, number of embryos transferred, and diagnoses of male factor, endometriosis, polycystic ovarian syndrome, diminished ovarian reserve, tubal factors, uterine factors, and other factors.
^b Pregnancy outcomes limited to gestations ≥ 154 days (22 weeks) and birth weights >300 g.
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environmental exposures may also partially contribute to the disparities seen in clinical pregnancy and live birth rates seen in Asian women (37).

Contrary to the findings of prior studies (2, 5, 6), our dataset did not demonstrate a lower clinical pregnancy rate for black women after adjusting for maternal age, number of embryos transferred, and infertility diagnoses. However, our observation of reduced live birth rates associated with black women is consistent with prior studies (2, 5, 6). Feinberg et al. (2) attributed the reduced pregnancy rate in part to the increased incidence of uterine fibroids present in the black population (2). After controlling for this factor, that study found that black women experienced a higher spontaneous miscarriage rate than white women (2). The increased fetal loss rate was confirmed in our study, with black women experiencing a 21.8% miscarriage rate, significantly higher than the rates seen in the other three racial or ethnic groups. To what extent uterine fibroids are contributing to this observation in our black population is unknown because this SART dataset did not include the presence or absence of fibroids and other contributing factors, such as the risk of aneuploidy (2). Black women also have more tubal disease, and it is well accepted that hydrosalpinges contribute to a lower IVF success rate (38, 39). The increased fetal loss rate resulted in the lowest live birth rate in the black population in our study. Although several studies have not confirmed this disparity in live birth outcomes within the black population, these studies were limited by sample size (7–9). Additionally, Asian and Hispanic live birth rates were also significantly lower than white live birth rates in our study after IVF treatment. The observation of a lower Hispanic live birth rate and higher fetal loss rate has not been previously demonstrated with IVF treatment.

There are several limitations to this study. It is important to clarify that these populations do not represent the overall reproductive-aged populations in the United States for each ethnic group, because a disproportionately higher socioeconomic status exists for each ethnicity in our patient population (40, 41). Unfortunately, specific socioeconomic data were not available for analyses within this dataset. Another limitation of this dataset is the lack of body mass indices, which have been consistently associated with pregnancy outcome disparities (42–47). Finally, we acknowledge that a significant limitation of this study is the potential variability in the reporting and classification of race and ethnicity, which may vary from clinic to clinic. Although SART requires ethnicity reporting with each registered cycle, there are no specific guidelines for the documentation of clinic-specific race and ethnicity. That said, race and ethnicity may be a proxy for some other factors that remain unmeasured in our database. The racial and ethnic minority disparities that exist within this dataset are hypothesis-generating and raise questions regarding the role of environmental and genetic susceptibility factors that may be influencing live birth rates in ART.

Our observations of increased fetal growth restriction in all three racial and ethnic minority groups, independent of

gestational number, are interesting. There is precedence for the increased growth restriction seen in Asian, black, and Hispanic infants (23). Nationally, black women have higher rates of preterm delivery and low-birth-weight births compared with white and Hispanic women. Whereas nationally, Hispanic women did not have low-birth-weight births, a study based in California found that both foreign-born and U.S.-born Hispanic women had lower-birth-weight infants compared with white women (24). In that study, it was also demonstrated that Asian women had lower-birth-weight infants compared with white women (24). The etiology of lower birth weight in minority populations after adjustment for maternal age, gestational age, and limited to singleton births is unknown. Although this study is based on an IVF population, the disparities cannot be attributed to the contributing effect of the IVF process on reduced singleton birth weight (12–16). There is increasing evidence that environmental exposures (e.g., organic solvents in the workplace) may negatively influence the birth weight of infants born to exposed women (48). It is possible that various environmental exposures may differ within race-based populations that may ultimately influence birth outcomes.

Intrauterine growth and birth weight vary with well-established maternal characteristics, including prepregnancy or first-trimester body weight, height, parity, ethnicity, and gestational weight gain, as well as by the gender of the baby (49–53). Prepregnancy weight, height, and gestational weight gain were factors not available in the SART-CORS database; also lacking were data on pregnancy complications (pre-eclampsia and gestational diabetes), which could also have influenced fetal growth and length of gestation (54). In addition, there are known racial and ethnic differences in visceral fat distribution (55, 56), as well as carbohydrate and insulin metabolism (57–63). Research has indicated an even greater level of insulin resistance within certain ethnic groups and specific infertility diagnoses (64).

Another potential limitation in our results is that we used a single-ethnicity birth weight reference (Canadian live births, 1994–1996 [31]) to calculate birth weight z scores, representing predominately white populations. The use of ethnic-specific birth weight references may have altered our findings, particularly moderate growth restriction (birth weight z scores < -1) but probably not severe growth restriction (birth weight z scores < -2). The few birth weight references that are ethnic-specific (black and white [29], Mexican American [27], Hispanic [22], and Asian [18–21]) fail to account for other important maternal characteristics, such as parity, height, and prepregnancy weight.

In summary, our findings confirm the racial and ethnic disparities seen in prior studies with respect to pregnancy rates and live birth rates resulting from ART treatment in the United States. In addition to the current concern regarding the use of ART and reduced singleton birth weight, the differences in birth weight seen in this study between the four major racial and ethnic groups further illustrates the diversity of

influences, both genetic and environmental, that may impact children born from ART treatment. This study further demonstrates the need to document racial and ethnic origins within the framework of the infertile patient evaluation for patient education purposes. More accurate and detailed recording of race and ethnicity would also provide further opportunity to understand better the ART outcome disparities of an increasingly diverse population here in the United States. Further studies are clearly needed to explore the etiologies of these disparities within all minority racial and ethnic groups described in this study.

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1 Racial and ethnic disparities in assisted reproductive technology outcomes in the United States

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Significant racial and ethnic disparities exist in rates of pregnancy, live birth, prematurity, and growth restriction after use of ART treatment in the United States.