Association between congenital uterine anomalies and placenta accreta spectrum

Savvy Benipal, M.D.,[a,b] Matthew Givens, M.D.,[a,b] Amanda A. Allshouse, M.S.,[a] Michelle Debbink, M.D., Ph.D.,[a,b] Krista Childress, M.D.,[a,c] Joseph Letourneau, M.D.,[a,d] Robert M. Silver, M.D.,[a] and Brett D. Einerson, M.D., M.P.H.[a,b]

[a] Department of Obstetrics and Gynecology, University of Utah Health, Salt Lake City, Utah; [b] Department of Obstetrics and Gynecology, Division of Maternal-Fetal Medicine, Intermountain Health, Salt Lake City, Utah; [c] Department of Obstetrics and Gynecology, Division of Pediatric and Adolescent Gynecology Primary Children's Hospital, Salt Lake City, Utah; and [d] Division of Reproductive Endocrinology and Infertility, Department of Obstetrics and Gynecology, University of Utah Health, Salt Lake City, Utah

Objective: To evaluate the association between congenital uterine anomalies (CUAs) and placenta accreta spectrum (PAS) in a large, nationally representative sample.
Design: Cross-sectional, observational study using the US National Inpatient Sample from 2017 to 2021. Logistic regression models were constructed to evaluate associations between the exposure and the outcome. Predetermined confounding variables included age, history of a cesarean delivery, and placenta previa. A sensitivity analysis was performed including only patients with a code for placenta accreta spectrum who also underwent hysterectomy. Data were weighted according to National Inpatient Sample complex sampling weights to account for year-to-year variation and to extrapolate estimates to the US population.
Subjects: Pregnant patients at ≥20 weeks' gestation with International Classification of Disease codes for congenital uterine anomalies or PAS.
Exposure: Code for at least 1 of the CUAs.
Main Outcome Measures: Code for at least 1 of the types of PAS during delivery hospitalization.
Results: The study cohort included 17,594,765 (or 3,518,955 unweighted) individuals. CUAs were present in 78,809 (0.45%, 15,259 unweighted) individuals. PAS was more frequent in patients with CUA than in those without (0.42% vs. 0.12%), with a weighted odds ratio (OR) of 3.36 (95% confidence interval [CI], 2.62–4.32; unweighted OR, 3.37 [95% CI, 2.63–4.31]). When controlling for age, prior cesarean, and placenta previa, the odds of having PAS was higher in those with a CUA than in those without (weighted adjusted OR [aOR], 2.46 [95% CI, 1.87–3.17]; unweighted aOR, 2.44 [95% CI, 1.88–3.16]). In the sensitivity analysis including only individuals with PAS who underwent a hysterectomy, CUA continued to be associated with PAS (weighted aOR, 2.26 [95% CI, 1.52–3.36]; unweighted aOR, 2.26 [95% CI, 1.55–3.31]).
Conclusion: In this population-based study, CUAs were associated with an increased odds of PAS. Patients with CUA should have careful screening for PAS at the time of routine obstetric ultrasound. (F S Rep® 2025;6:67–72. ©2025 by American Society for Reproductive Medicine.)

Key Words: Uterine anomalies, placenta, epidemiology, national inpatient sample

Placenta accreta spectrum (PAS) is a major contributor to maternal morbidity and mortality and is increasing in frequency, now affecting approximately 1 in 500 pregnancies (1). Despite this, there is a limited understanding of the etiology and pathophysiology of PAS. The most commonly accepted understanding is that PAS is a condition characterized by abnormal placental trophoblastic attachment into a damaged endometrial/myometrial layer (2). The major risk factors for PAS include prior cesarean birth and the presence of a placenta previa. Understanding other risk factors may help us better understand and detect PAS, paving the way for improved risk assessment, diagnosis, and management strategies to improve maternal outcomes.

Received October 3, 2024; revised January 9, 2025; accepted January 10, 2025.
Supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development under award number K23HD106009 (to B.D.E.).
Supported by the March of Dimes and American Board of Obstetrics and Gynecology as part of the Reproductive Scientist Development Program (to M.D.).
The participants in this study come from the National Inpatient Sample and are de-identified. Data are publicly available.
Correspondence: Brett D. Einerson, M.D., M.P.H., Department of Obstetrics and Gynecology, University of Utah Health, 30 Mario Capecchi Dr, Room 5S158, Salt Lake City, Utah 84112 (E-mail: brett.einerson@hsc.utah.edu).

F S Rep® Vol. 6, No. 1, March 2025 2666-3341

https://doi.org/10.1016/j.xfre.2025.01.006

Congenital uterine anomalies (CUAs) are developmental differences of the uterus that form during embryogenesis. The prevalence of CUA is estimated to be as high as 5.5% in the general population; however, the incidence is notably higher among those who experience infertility (8%) and recurrent miscarriages (13%) (3). The presence of CUA predisposes patients to more uterine surgeries (e.g., septum resection), in vitro fertilization (IVF) treatments, and previa placentation that may increase the risk of PAS (4). Furthermore, patients with CUA, especially those with canalization defects (e.g., septate uterus), may have embryo implantation along the septum possibly further contributing to the risk of PAS (5).

Whether individuals with CUA are at increased risk of PAS is unclear. CUAs are known to be associated with an increased risk of obstetric complications such as preterm birth, cesarean delivery, malpresentation, and fetal growth restriction; however, the association between the risk of PAS and CUA has not been sufficiently explored in studies that are either too small, imprecisely focused on PAS, or fail to account for plausible confounding (3, 6–11).

Therefore, we aimed to explore the association between CUA and PAS in a large, population-based data set. We hypothesized that CUA would be associated with PAS after controlling for confounding factors.

MATERIALS AND METHODS

We conducted a cross-sectional observational study using discharge data from the National Inpatient Sample (NIS), US Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality, from 2017 to 2021. This database is a publicly available, nationally representative sample that includes International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)/Procedure Coding System coding data from individual hospital discharges. Discharges associated with individuals aged 12–55 years who delivered at $\geq$20 weeks' gestation were included in this study. Delivery discharges were identified using the methodology described by Clapp et al. (12). International Classification of Diseases codes were used to determine weeks of gestation, exposures, and outcomes (Supplemental Appendix 1, available online). To account for changes in the hospitals included in the sample over time and allow for US population level estimates, sampling weights provided by the Healthcare Cost and Utilization Project were applied to the primary analyses. Unweighted results are also reported. The primary exposure was CUAs (Table 1). We included only uterine and cervical anomalies because vaginal anomalies are not expected to influence placental implantation.

The primary outcome was PAS, which was defined using ICD-10-CM codes O43.2xx. This set of codes incorporates diagnoses of placenta accreta, increta, and percreta. We excluded any PAS diagnosis only occurring in the first trimester (O43.2x1). Previa was defined as an ICD-10-CM code for complete or partial placenta previa in the second or third trimester when accompanied by a coexisting code for cesarean birth or hysterectomy. Although a history of cesarean birth is available to ascertain through International Classification of Diseases codes, the number of prior cesarean deliveries or type of prior cesarean (classical or low transverse) was not. Additionally, prior uterine surgeries creating a uterine scar (Z98.891) are a risk factor for PAS (13, 14); thus, this ICD-10 code was included with prior cesarean birth in the covariate "prior uterine scar."

Logistic regression models were used to derive the unadjusted and adjusted odds ratios (aORs) with associated 95% confidence intervals (CIs). Covariates included in the final model were those that were defined a priori as physiologically important (previa, prior cesarean, or prior uterine scar). Although it is an important potential confounding variable, we did not include assisted reproductive technology (ART) or IVF in the

TABLE 1

International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System codes for congenital uterine anomalies.

ICD-10 codes for congenital uterine anomalies		Appropriate synonyms
Q51.0	Agenesis of the uterus	Congenital absence of the uterus
Q51.1x	Doubling of the uterus with doubling of the cervix and vagina	
Q51.2x	Other doubling of the uterus	Didelphic uterus Uterus septate Uterus bilocularis
Q51.3	Bicornuate uterus	Bicornuate uterus Bicornuate uterus in pregnancy Bicornuate uterus complicating antenatal care, infant not yet delivered
Q51.4	Unicornuate uterus	Uterus unicornis Uterus unicornuate
Q51.5	Agenesis and aplasia of the cervix	Congenital absence of the cervix Congenital absent uterine cervix
Q51.8x	Other congenital malformations of the uterus and cervix	Arcuate uterus Hypoplasia of the uterus or cervix Cervical duplication
Q51.9	Congenital malformations of the uterus and cervix	Congenital uterine anomaly Inadequate development of the endometrium

Benipal. Uterine anomalies and placenta accreta. F S Rep 2025.

primary analytic models because ART is drastically undercoded among delivering individuals in the NIS. In this cohort, 0.11% of pregnancies were reported to be conceived by ART/IVF, compared with the 1.9% of all pregnancies estimated by the CDC (15, 16). An exploratory analysis including IVF as a covariate was performed separately. We excluded race in our model because this was not thought to impact placental implantation and rather should be viewed as a social construct (17).

A sensitivity analysis, aimed at increasing the likelihood that a code for PAS represents a true case of PAS, was performed by changing the outcome definition to only include individuals with PAS who underwent hysterectomy. This was performed to account for the possibility of overcoding of PAS in the entire cohort. PAS with hysterectomy may be more likely to represent "true" coded PAS cases.

Data analyses were completed using STATA 17.0 (StataCorp LLC, College Station, TX). This study was exempt from our institutional review board, and data sources were deidentified and publicly available. The Reporting of studies Conducted using Observational Routinely-collected Health Data modification to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines were followed for cross-sectional studies in this analysis (18). A P value of $<.05$ was considered statistically significant.

RESULTS

In this sampling-weighted analysis, 17,594,765 (unweighted n = 3,518,955) records met the inclusion criteria (Table 2). Of these, 76,294 (0.4%; n = 15,259 unweighted) had a CUA, and 21,879 (0.1%; n = 4,440 unweighted) had PAS. A single anomaly was coded in 74,134 (unweighted n = 14,827), whereas 2,115 (unweighted n = 423) had a code for 2 anomalies and 45 (unweighted n = 9) had a code for 3 anomalies. The most common uterine/cervical anomaly was a bicornuate uterus (56.3%), other doubling of the uterus (18.2%), and other congenital malformations of uterus and cervix (16.9%). Baseline characteristics were similar between those with and without CUA except for race and prior uterine scar (Table 2). Those with CUA were more likely to be white (65.0% vs. 50.4%) and, as expected, much more likely to have a prior uterine scar (33.9% vs. 17.9%).

The primary outcome, PAS, occurred more frequently in those with CUA than in those without (0.4% vs. 0.1%, $P<.001$). In the unadjusted logistic regression model, deliveries associated with individuals with a CUA were more likely to have PAS (weighted odds ratio [OR], 3.36 [95% CI, 2.62–4.32]; unweighted OR, 3.37 [95% CI, 2.63–4.31]) than those associated with individuals without a CUA (Fig. 1). In multivariable logistic regression, when controlling for age, prior uterine scar, and placenta previa, deliveries associated with individuals with a CUA had higher odds of PAS (weighted aOR, 2.43 [95% CI, 1.87–3.16]; unweighted aOR, 2.44 [95% CI, 1.88–3.16]).

PAS occurred more frequently in some but not most subtypes of CUA including bicornuate uterus and "other doubling of the uterus" (Table 3).

In the sensitivity analysis, when including only individuals with a code for PAS who underwent hysterectomy, the

TABLE 2

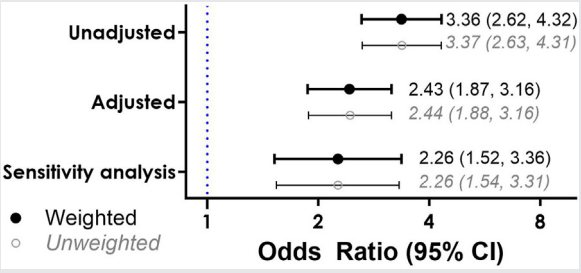
Characteristics of patients with and without congenital uterine anomalies.

Characteristic	Congenital uterine anomaly: Yes n = 76,294 (unweighted n = 15,259)	Congenital uterine anomaly: No n = 17,518,471 (unweighted n = 3,503,696)
Age, y	29.54 (5.6)	29.10 (5.8)
Weeks' gestation at delivery, mean	37.23 (3.11)	38.33 (2.24)
Race[a]		
Asian	3,914 (5.1%)	1,038,219 (5.9%)
Black	4,265 (5.6%)	2,533,744 (14.6%)
Hispanic	12,385 (16.2%)	3,582,444 (20.4%)
Native American	470 (0.6%)	123,284 (0.7%)
White	49,454 (65.0%)	8,844,700 (50.4%)
None of the above	3,020 (4.0%)	762,934 (4.4%)
Not specified	2,784 (3.6%)	633,143 (3.6%)
Chronic hypertension	2,365 (3.1%)	510,004 (2.9%)
Obesity	10,459 (13.8%)	2,205,079 (12.6%)
Tobacco use	3,660 (4.8%)	874,484 (5.0%)
Prediabetes	995 (1.3%)	212,479 (1.2%)
Assisted reproductive technology/IVF	200 (0.3%)	19,529 (0.1%)
Placenta accreta spectrum	320 (0.4%)	21,879 (0.1%)
Prior uterine scar (including prior cesarean birth)	25,844 (33.9%)	3,130,488 (17.9%)
Placenta previa	520 (0.7%)	73,919 (0.4%)

Note: Data are presented as weighted numbers (percentages) or means (standard deviations) unless otherwise noted.
IVF = in vitro fertilization.
[a] Race/ethnicity reported here to demonstrate the demographic representation of the cohort.

Benipal. Uterine anomalies and placenta accreta. F S Rep 2025.

FIGURE 1



The odds of placenta accreta spectrum in individuals with congenital uterine anomalies compared to those without, presented in an unadjusted analysis, an adjusted analysis (controlling for maternal age, prior uterine scar, and placenta previa), and a sensitivity analysis (restricted to patients with both a PAS diagnosis code and hysterectomy).

Benipal. Uterine anomalies and placenta accreta. F S Rep 2025.

association between CUAs and PAS remained (weighted aOR, 2.26 [95% CI, 1.52–3.36]; unweighted aOR, 2.26 [95% CI, 1.54–3.31]). A sensitivity analysis adding ART as a covariate in modeling showed a similar association between CUA and PAS (weighted aOR, 2.44 [95% CI, 1.87–3.17]; unweighted aOR, 2.44 [95% CI, 1.88–3.16]).

DISCUSSION

In this large, cross-sectional study, deliveries in individuals with a CUA had 2 to 3 times the odds of developing PAS compared with those in individuals without CUA. This association persisted when controlling for placenta previa, age, ART, and history of prior uterine scar (including prior cesarean birth). The association held in our sensitivity analysis when using a stricter definition of PAS to increase the likely accuracy of the ICD-10 diagnosis.

Our study bolsters and clarifies what has previously been demonstrated in a few small studies: that deliveries associated with individuals with a CUA are associated with an increased odds of PAS. One evaluation of patients in the NIS showed that unsuspected PAS at the time of vaginal delivery was strongly associated with uterine anomalies (aOR, 6.23; 95% CI, 4.20–9.26) (19). This study did not address most cases of PAS because it excluded most patients with PAS and those with previa or who underwent cesarean and only evaluated those with unsuspected PAS. Similarly, in a meta-analysis evaluating obstetric complications associated with CUAs, Panagiotopoulos et al. (11) found a modest association between CUA and placental retention (OR, 1.71; 95% CI, 1.16–2.52) and strong association between CUA and placenta previa (OR, 4.00; CI, 1.87–8.56). However, this study did not describe how placental retention was treated, if PAS was suspected or confirmed, or if patients had significant morbidity. Another evaluation of patients with CUA found 5 cases (5.4%) of placenta previa, 3 of which required hysterectomy due to PAS. This study was small (111 pregnancies) and did not address whether individuals had prior cesarean deliveries. Furthermore, the largest study to date on this topic (457 individuals with a CUA) by Wang et al. (7) found that 19.7% had placenta accreta/increta (although notably the reported incidence of accreta/increta in the control group was markedly higher than prior population studies would suggest at 11.8%).

TABLE 3

Placenta accreta spectrum in association with uterine and cervical anomaly subtypes.

	Placenta accreta spectrum		
O43.2x	**Yes n = 22,200 (unweighted n = 4,440)**	**No n = 17,572,567 (unweighted n = 3,514,515)**	***P* value**
O43.2x: CUA of any type	320 (1.4%)	75,975 (0.4%)	<.001
O43.21: Agenesis of the uterus	0 (0.0%)	30 (0.0%)	.93
O43.22: Doubling of the uterus with doubling of the cervix and vagina	0 (0.0%)	1,150 (0.0%)	.60
O43.23: Other doubling of the uterus	35 (0.2%)	13,929 (0.1%)	.02
O43.24: Bicornuate	210 (1.0%)	42,959 (0.2%)	<.001
O43.25: Unicornuate	10 (0.1%)	6,280 (0.0%)	.74
O43.26: Agenesis and aplasia of the cervix	0 (0.0%)	5 (0.0%)	.97
O43.27: Other congenital malformations of the uterus and cervix	70 (0.3%)	12,919 (0.1%)	<.001
O43.28: Congenital malformations of the uterus and cervix, unspecified	5 (0.0%)	895 (0.0%)	.10

Note: Data are presented as weighted numbers (%) unless otherwise noted. Of note, columns may not add to the total n because some individual discharges were coded with multiple CUAs. CUA = congenital uterine anomaly.

Benipal. Uterine anomalies and placenta accreta. F S Rep 2025.

The association between CUA and PAS may be mediated, in part, by the higher incidence of uterine surgery and ART in the CUA population; however, it makes sense biologically that those with CUA may be at risk of PAS regardless of prior surgery and ART. Any abnormality of the endometrial-myometrial interface, such as that that occurs in CUAs, could potentially increase the risk of PAS. For example, the endometrium covering a uterine septum has been demonstrated to have differences in histologic composition (decreased glandular cells and cilia) and decreased connective tissue in the myometrium, compared with that covering normal myometrium, potentially predisposing patients to abnormal placental attachment (20). Additionally, the shape of the cavity or thickness of the endometrium and myometrium is altered in individuals with a CUA, which may increase the chances of having abnormal placentation (10). If it is true that CUA and PAS are biologically related, this may help us gain insights into the etiology of PAS, a controversial topic (2, 21). Further investigation is needed to reveal the biologic or pathophysiological link between PAS and CUA.

These findings may have important implications for antenatal diagnosis and for better understanding the disease process of PAS. The prenatal diagnosis of PAS is imperfect, owing to relatively low predictive values of prenatal imaging and lack of a reliable biomarker resulting in both overdiagnosis and underdiagnosis (22). Population-based studies suggest that half or more of PAS goes undetected antenatally until the time of delivery (23, 24). Understanding risk factors for PAS may improve diagnosis and management; for example, patients with CUA may benefit from expert consultation and/or additional ultrasound assessment for PAS risk stratification. Our data suggest that CUA is an independent risk factor for PAS. If so, then CUA may be added to the list of the identifiable risks of PAS (alongside cesarean birth, prior uterine surgeries, and placenta previa) at the time of second-trimester ultrasound.

There are limitations of our study. First, the limitations of research using large administrative data sets are serious and should be acknowledged (25–27). Specifically, the ICD-10 codes for PAS are relatively new codes that have not been well validated (28). Many consider histopathologic confirmation of a clinical diagnosis of PAS to be the gold standard; however, this data set did not allow for this evaluation. Second, CUA was likely undercoded in this database. Prior work suggests that 3.5% of fertile women and 5.5% of all reproductive-aged women have some form of CUA. In contrast, only 0.4% of this population had a diagnostic code for CUA. This undercoding is likely because ICD-10 codes are only available from the delivery hospitalization, not from the individual's entire medical record. There exists the potential for individuals with a CUA to have that diagnosis omitted from the coding of the delivery hospitalization record. Misclassification of CUA, however, would most likely result in bias toward the null hypothesis. Furthermore, CUA was undercoded to a greater extent than PAS, and this differential coding error had unclear ramifications for the analysis. Third, there is the strong potential for unmeasured confounding. For example, prior uterine surgery may not be comprehensively coded in a delivery hospitalization encounter. Fourth, although this database is large, we are unable to adequately analyze different CUA subtypes and their association with PAS. Our exploratory analysis showed that bicornuate uterus and "other doubling of the uterus" may be associated with PAS, whereas others are not; however, data on subtypes should be interpreted with extreme caution owing to nonspecific diagnosis (e.g., "other doubling") and very small sample size within subtypes. Finally, we believe that this study was unable to sufficiently control for a higher rate of ART or IVF in the CUA group (0.3% vs. 0.1%) because this was markedly undercoded.

This study has several strengths. First, it was performed using a large, population-based data set, which allows for analysis of a greater number of individuals who have both rare disorders. Second, multiple analyses consistently demonstrate an association and magnitude similar to the primary analysis.

CONCLUSION

Our results suggest that CUA is an independent risk factor for PAS. This association may be useful both in our understanding of the disease itself and in creating better risk stratification protocols for diagnosis of PAS.

CRediT Authorship Contribution Statement

Savvy Benipal: Writing – review & editing, Writing – original draft, Validation, Investigation, Conceptualization. **Matthew Givens:** Writing – review & editing, Visualization, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Amanda A. Allshouse:** Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation. **Michelle Debbink:** Writing – review & editing, Validation, Software, Resources, Methodology, Funding acquisition, Data curation. **Krista Childress:** Writing – review & editing, Methodology, Conceptualization. **Joseph Letourneau:** Writing – review & editing, Methodology, Conceptualization. **Robert M. Silver:** Writing – review & editing, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Brett D. Einerson:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of Interests

S.B. has nothing to disclose. M.G. has nothing to disclose. A.A.A. has nothing to disclose. M.D. reports funding from the National Institute on Minority Health and Health Disparities (R21MD019175), National Institutes of Health IMPROVE (U54HD113169), and National Academy of Medicine (undirected research support); University of Utah CTSI CAPP Pilot Grant (Wahine Koa Community Pilot Grant); consulting fees from the Association of American Medical Colleges Health Equity expert review group; honoraria from George Washington University Grand Rounds, Frontier University School of Nursing Maternal Mortality Conference speaker; and travel support from the National Academy of Medicine (ABOG/Gant Fellowship attendance at NAM meetings), American College of Obstetricians and Gynecologists, Committee on Advancing Health Equity meeting attendance, and

Committee on Indigenous Health meeting attendance outside the submitted work. K.C. has nothing to disclose. J.L. has nothing to disclose. R.M.S. reports receiving support from the following organizations unrelated to this work: attending the Society for Maternal-Fetal Medicine Conference, royalties from UpToDate, salary from BJOG as a deputy editor and is a member of the data safety monitoring committee for the NIH-sponsored Apple trial which is unrelated to this work. B.D.E. reports funding from National Institute on Minority Health and Health Disparities (K23HD106009) and Board Member of the Pan American Society for Placenta Accreta Spectrum outside the submitted work.

REFERENCES

1. Jauniaux E, Bunce C, Grønbeck L, Langhoff-Roos J. Prevalence and main outcomes of placenta accreta spectrum: a systematic review and meta-analysis. Am J Obstet Gynecol 2019;221:208–18.
2. Jauniaux E, Jurkovic D, Hussein AM, Burton GJ. New insights into the etiopathology of placenta accreta spectrum. Am J Obstet Gynecol 2022;227:384–91.
3. Chan YY, Jayaprakasan K, Zamora J, Thornton JG, Raine-Fenning N, Coomarasamy A. The prevalence of congenital uterine anomalies in unselected and high-risk populations: a systematic review. Hum Reprod Update 2011;17:761–71.
4. Raga F, Bauset C, Remohi J, Bonilla-Musoles F, Simón C, Pellicer A. Reproductive impact of congenital Müllerian anomalies. Hum Reprod 1997;12:2277–81.
5. Homer HA, Li TC, Cooke ID. The septate uterus: a review of management and reproductive outcome. Fertil Steril 2000;73:1–14.
6. Akhtar MA, Saravelos SH, Li TC, Jayaprakasan K, Royal College of Obstetricians and Gynaecologists. Reproductive implications and management of congenital uterine anomalies: Scientific Impact Paper No. 62 November 2019. BJOG 2020;127:e1–13.
7. Wang S, Wang K, Hu Q, Liao H, Wang X, Yu H. Perinatal outcomes of women with Müllerian anomalies. Arch Gynecol Obstet 2023;307:1209–16.
8. Dekalo A, Feldstein O, Tal D, Friedman M, Schreiber L, Barda G, et al. The association of placental histopathological lesions and adverse obstetric outcomes in patients with Müllerian anomalies. Placenta 2022;122:23–8.
9. Bortoletto P, Romanski PA, Pfeifer SM. Müllerian anomalies: presentation, diagnosis, and counseling. Obstet Gynecol 2024;143:369–77.
10. Reichman DE, Laufer MR. Congenital uterine anomalies affecting reproduction. Best Pract Res Clin Obstet Gynaecol 2010;24:193–208.
11. Panagiotopoulos M, Tseke P, Michala L. Obstetric complications in women with congenital uterine anomalies according to the 2013 European Society of Human Reproduction and Embryology and the European Society for Gynaecological Endoscopy classification: a systematic review and meta-analysis. Obstet Gynecol 2022;139:138–48.
12. Clapp MA, James KE, Friedman AM. Identification of delivery encounters using International Classification of Diseases, Tenth Revision, diagnosis and procedure codes. Obstet Gynecol 2020;136:765–7.
13. Lin MW, Hsu HC, Hui Tan EC, Shih JC, Lee CN, Yang JH, et al. Risk of placenta accreta spectrum following myomectomy: a nationwide cohort study. Am J Obstet Gynecol 2024;231:255.e1–10.
14. You H, Wang Y, Han R, Gu J, Zeng L, Zhao Y. Risk factors for placenta accreta spectrum without prior cesarean section: a case-control study in China. Int J Gynaecol Obstet 2024;166:1092–9.
15. Centers for Disease Control and Prevention. ART success rates. Available at: https://www.cdc.gov/art/artdata/index.html. Accessed March 7, 2024.
16. Martin JA, Hamilton BE, Osterman MJK. Births in the United States, 2019. NCHS Data Brief 2020;387:1–8.
17. Headen IE, Elovitz MA, Battarbee AN, Lo JO, Debbink MP. Racism and perinatal health inequities research: where we have been and where we should go. Am J Obstet Gynecol 2022;227:560–70.
18. Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, et al. The REporting of studies Conducted using Observational Routinely collected health Data (RECORD) statement. PLOS Med 2015;12:e1001885.
19. Rau AR, Youssefzadeh AC, Matsuzaki S, Mandelbaum RS, Ouzounian JG, Matsuo K. Unsuspected placenta accreta spectrum at vaginal delivery: assessment of incidence, characteristics, and maternal morbidity. Am J Obstet Gynecol 2023;228:S82–3.
20. Rikken J, Leeuwis-Fedorovich NE, Letteboer S, Emanuel MH, Limpens J, van der Veen F, et al. The pathophysiology of the septate uterus: a systematic review. BJOG 2019;126:1192–9.
21. Shainker SA, Silver RM, Modest AM, Hacker MR, Hecht JL, Salahuddin S, et al. Placenta accreta spectrum: biomarker discovery using plasma proteomics. Am J Obstet Gynecol 2020;223:433.e1–14.
22. Einerson BD, Gilner JB, Zuckerwise LC. Placenta accreta spectrum. Obstet Gynecol 2023;142:31–50.
23. Bailit JL, Grobman W, Rice MM, et al. Morbidly adherent placenta treatments and outcomes. Obstet Gynecol 2015;125:683.
24. Fitzpatrick KE, Sellers S, Spark P, Kurinczuk JJ, Brocklehurst P, Knight M. Incidence and risk factors for placenta accreta/increta/percreta in the UK: A National Case-Control Study. PLoS One 2012;7:e52893.
25. Househ MS, Aldosari B, Alanazi A, Kushniruk AW, Borycki EM. Big data, big problems: a healthcare perspective. In: *Informatics Empowers Healthcare Transformation*. IOS Press; 2017:36–9.
26. Lyu DH, Haider A, Landman A, Raut C. The opportunities and shortcomings of using big data and national databases for sarcoma research. Cancer 2019;125:2926.
27. Silver RM, Einerson BD. ICD-10 coding for placenta accreta spectrum: An opportunity for improvement. Paediatr Perinat Epidemiol 2024;38:440–2.
28. Jotwani AR, Lyell DJ, Butwick AJ, Rwigi W, Leonard SA. Validity of ICD -10 diagnosis codes for placenta accreta spectrum disorders. Paediatr Perinat Epidemiol 2024;38:435–9.