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# Racial Disparities in Perinatal Outcomes and Pregnancy Spacing Among Women Delaying Initiation of Childbearing

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**Abstract** *Introduction* Reducing racial/ethnic disparities is a key objective of the Healthy People 2010 initiative. Unfortunately, racial disparities among women delaying initiation of childbearing have received limited attention. As more women in the US are delaying initiation of childbearing, it is important to examine racial disparities in reproductive health outcomes for this subgroup of women. *Objective* To examine racial disparities in perinatal outcomes, interpregnancy interval, and to assess the risk for adverse outcomes in subsequent pregnancy for women delaying initiation of childbearing until age 30 or older compared to those initiating childbearing at age 20–29. *Methods* We conducted a retrospective cohort study using the Missouri maternally linked cohort files 1978–1997. Final study sample included 239,930 singleton sibling pairs (Whites and African Americans). Outcome variables included first and second pregnancy outcomes (fetal death, low birth weight, preterm delivery and small-for-gestational age) and interpregnancy interval between first and second pregnancy. Independent variables included maternal age at first pregnancy and race. Analysis strategies used involved stratified analyses and multivariable unconditional logistic regression; interactions between maternal race, age and interpregnancy interval were examined in the regression models. *Results* Compared to Whites, African American mothers initiating childbearing at age 30 or older had significantly higher rates of adverse outcomes in the first and second pregnancy ($P < 0.0001$). Generally, African Americans had significantly higher rates of second pregnancy following intervals <6 months compared to Whites; however, no significant racial differences were noted in interpregnancy interval distribution pattern after controlling for maternal age at first pregnancy. African Americans delaying initiation of childbearing had significantly higher risk for adverse perinatal outcomes in the second pregnancy compared to Whites after controlling for potential confounders, however there were no significant interactions between maternal age at first pregnancy, race and short interpregnancy interval. *Conclusion* Although African Americans were less likely to delay initiation of childbearing than were White women, their risk for adverse perinatal outcomes was much greater. As health care providers strive to address racial disparities in birth outcomes, there is need to pay attention to this unique group of women as their population continues to increase.

**Keywords** Delayed childbearing · Racial disparities · Perinatal outcomes · Interpregnancy interval

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## Introduction

Addressing racial disparities is an important key objective of the *Healthy People (HP) 2010 initiative* [1]. Research has shown racial disparities in reproductive health risk factors as well as perinatal outcomes in the general population [2–4]. However, limited research has examined racial disparities for women delaying initiation of childbearing until age 30 or older.

Previous studies indicate that women delaying initiation of childbearing until age 30 or older are at increased risk for adverse perinatal outcomes, including preterm delivery (PTD), low birth weight (LBW) and fetal death (FD) [5–8]. Additionally these women have increased risk for short interpregnancy intervals of <6 months [9–11]. Unfortunately, few studies have examined racial differences in pregnancy outcomes for this subgroup of women.

Findings from previous research indicate increasing racial disparities in perinatal outcomes with increasing maternal age, with Blacks having a higher risk for adverse birth outcomes compared to Whites [12]. However, studies that have specifically examined older mothers have had mixed findings. A study that looked at mothers aged 35 years or older found no difference in risk for LBW and perinatal mortality among Blacks and Whites [13]. On the contrary, others studies have reported racial differences in LBW with increasing maternal age, with Blacks having an increased risk for LBW compared to whites [3, 4]. Another study found that older Black and Hispanic mothers have increased risk for PTD compared to Whites [14]. A study that examined racial differences in LBW among women delaying childbearing found that Blacks and Hispanics had higher risk for LBW compared to Whites [15]. A limitation of many of these studies is that they failed to account for maternal age at the initiation of childbearing, and how this may impact perinatal outcomes.

Additionally, few studies have examined racial differences in pregnancy spacing for women delaying initiation of childbearing and its influence on subsequent pregnancy outcome. General population studies show that African American (AA) mothers are more likely to have short pregnancy intervals compared to Whites [16, 17]. However, a previous study reported that older AA have longer pregnancy intervals compared to Whites [18]. Racial differences in the impact of pregnancy spacing on subsequent pregnancy outcomes are unclear. Studies have shown that the lowest rate of adverse outcomes is seen at interpregnancy interval (IPI) of 18–23 months for both Whites and AA, while the highest rate is observed at <6 months [19]. In their study Rawlings and colleagues found that AA with IPI <9 months had higher prevalence for PTD while for Whites the highest rate was seen at IPI <3 months [16]. Other studies found that IPI did not appear to increase the risk for small-for-gestational age (SGA) [17], or PTD [20], for Whites and AA. Unfortunately, none of these studies took into account maternal age at first pregnancy, a potential confounding factor.

We sought to address some of these issues by examining racial differences in this unique population of women. Our specific objectives were:

(i) To examine racial differences in first pregnancy perinatal outcomes (FD, LBW, and SGA) among women initiating childbearing at age 30 or older, in comparison to women initiating childbearing at age 20–29.
(ii) To determine racial differences in perinatal outcomes in second pregnancy among women initiating childbearing at age 30 or older, in comparison to those starting childbearing at age 20–29.
(iii) To examine racial differences in interpregnancy interval (IPI) patterns for women delaying initiation of childbearing until age 30 or older, in comparison to women initiating childbearing at age 20–29.
(iv) To determine racial differences in risk for feto-infant mortality and morbidity outcomes in second pregnancy, among women initiating childbearing at age 30 or older, and having short interpregnancy intervals (<6 months), compared to those initiating childbearing at age 20–29, after controlling for potential confounders.

We hypothesize that there are racial differences in interpregnancy interval patterns and perinatal outcomes among women initiating childbearing at age 20–29, compared to those initiating childbearing at age 30 or older. Additionally, there are racial differences in risk for adverse feto-infant mortality and morbidity outcomes between women initiating childbearing in their twenties, with short IPI, and those initiating childbearing at age 30 or older with short IPI, after controlling for potential confounders.

## Materials and Methods

We conducted a retrospective cohort study using the Missouri maternally-linked live birth/fetal death and infant death files. The database contains information on all live births, fetal and infant deaths occurring to state residents from 1978 to 1997 inclusive. The data were collected prospectively, and births to the same mother are linked together using a unique sibling identifier [21]. Cases that met the following criteria were included in the study sample; maternal age 20–50 years at first pregnancy and having two consecutive singleton pregnancies during the study period, both occurring in Missouri. A total of 242,559 sibling pairs met these inclusion criteria.

Main independent variables included maternal age at first pregnancy, maternal race and interpregnancy interval. Dependent variables included FD, LBW and subgroups, PTD and subgroups as well as SGA. Confounders examined included socio-demographic factors such as year of delivery, educational status, and marital status. Other confounders were prenatal care use (PNC), smoking, body mass index (BMI), hypertension (primary and pregnancy induced), diabetes and previous adverse pregnancy outcome in first pregnancy.

Maternal age was measured as the completed age at first pregnancy, and was categorized as 20–29 (reference group), 30–34, and 35–50. Mothers 19 years and younger, as well as those older than 50 were not included in this study as they are known to have their own set of unique perinatal risk factors [22, 23]. For purposes of this study, mothers age 30 or older at first pregnancy were considered to have delayed initiation of childbearing. Race was limited to White and AA mothers, as other race groups were too small for meaningful analysis. Interpregnancy interval was the measure for pregnancy spacing used in this study, and was calculated as the difference between date of second pregnancy outcome and date of first pregnancy outcome minus the gestational age of the second pregnancy. Initial computations were in weeks, and then converted to months. The assumption was that 13 weeks equals 3 months [24]. Interval groups were created based on the recommendation by Zhu et al. and included: 0–5, 6–11, 12–17, 18–23, 24–59, 60–119, ≥120 months [24]. Fetal death was defined as death of fetus ≥20 weeks gestation or 500 g, and was expressed as a rate per 1,000 live births plus fetal deaths. Low birth weight was defined as birth weight less than 2,500 g. The subgroups examined included; moderately low birth weight (MLBW), 1500–2499 g, very low birth weight (VLBW), 1000–1499 g and extremely low birth weight (ELBW), 500–999 g. Preterm delivery was defined as delivery at less than 37 completed weeks of gestation. The subgroups examined included moderately preterm delivery (MPTD), 32–36 weeks, very preterm delivery (VPTD), 28–31 weeks and extremely preterm delivery (EPTD), 24–27 weeks. Small-for-gestational age was defined as birth weight at or below the 10th percentile of the birth weight distribution of infants at the same gestational age based on US national growth curves [25].

Educational status was estimated from years of education completed by the first pregnancy, and maternal age, and was classified as high if the mother had completed higher than expected number of years for age, average if completed appropriate school years for age and low if mother has completed few years based on her age [26]. Prenatal care use was assessed based on the revised graduated index (R-GINDEX) measure, which takes into account timing of start of prenatal care, number of visits and gestational age at delivery. Using this measure, five categories were considered: no care, missing care, inadequate care, intermediate, adequate care and intensive care [27].

The final sample used for analysis had 239,930 maternal-infant pairs (White & African Americans). Descriptive analyses were conducted to obtain distribution of key variables for the study population. Subsequent analyses involved multivariable analysis approaches (stratified analysis and unconditional logistic regression). For bivariate analysis, the chi-square statistic was used to test for significant differences in proportions, while the Mantel-Haenszel chi square statistic was used for the stratified analyses. Several logistic regression models were constructed; the initial model looked at maternal race, maternal age at first pregnancy, and IPI. Additional models included interactions between maternal age, maternal race, and IPI as well as potential confounders. All hypothesis tests were two tailed with alpha ($\alpha$) set at $<0.05$ All analyses were performed using Statistical Analysis Software (SAS) version 9.1. Cary NC.

Approval for the study was obtained from the University of Alabama at Birmingham Institutional Review Board and from the Missouri Department of Health and Senior Services.

## Results

Over the study period, there were 221,382 first time births to White mothers, and 18,548 to AA aged 20–50 years. Significant racial differences were observed in all key socio-demographic factors and health risk factors with AA having significantly higher rates compared to Whites. The racial differences persisted even after controlling for maternal age at first pregnancy (Table 1).

In general, racial differences were observed for adverse first pregnancy outcomes, with AA having significantly higher rates of FD (8.4/1,000 vs. 4.6/1,000); LBW (11.3% vs. 5.0%); PTD (13.4% vs. 7.1%), and SGA (18.6% vs. 9.1%); ($P < 0.0001$). The rate of adverse outcomes increased with maternal age at first pregnancy for both Whites and AA. However, the increase was more pronounced for AA particularly for LBW and PTD as displayed in Fig. 1.

For the whole study population, the rates of adverse perinatal outcomes (LBW, PTD, FD and SGA) in the second pregnancy were also significantly higher for AA compared to Whites, all having $P < 0.0001$. Controlling for maternal age at first pregnancy, the racial differences persisted with AA having significantly higher rates of adverse outcomes compared to Whites. However, among mothers 35 or older at first pregnancy we found no significant racial differences for FD ($P = 0.2611$), VLBW

**Table 1** Maternal characteristics by maternal race and age at first pregnancy: Missouri resident mothers 1978–1997

| Maternal characteristics | All ages* | | | | 20–29 | | | | 30–34 | | | | 35–50 | | | | Mantel Haenszel *P*-value[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | White ($n = 221,382$) | % | AA ($n = 18,548$) | % | White ($n = 192,885$) | % | AA ($n = 17,198$) | % | White ($n = 24,905$) | % | AA ($n = 1,181$) | % | White ($n = 3,592$) | % | AA ($n = 169$) | % | |
| Marital status | | | | | | | | | | | | | | | | | |
| Single | 8.9 | | 62.2 | | 9.8 | | 64.7 | | 3.0 | | 30.6 | | 3.7 | | 29.6 | | <0.0001 |
| Education status | | | | | | | | | | | | | | | | | |
| High | 52.7 | | 46.8 | | 48.9 | | 44.8 | | 78.1 | | 71.9 | | 81.3 | | 73.8 | | |
| Average | 41.3 | | 44.1 | | 44.4 | | 45.8 | | 20.5 | | 23.4 | | 16.8 | | 20.2 | | |
| Low | 6.0 | | 9.1 | | 6.7 | | 9.4 | | 1.5 | | 4.7 | | 1.9 | | 6.0 | | <0.0001 |
| Body mass Index | | | | | | | | | | | | | | | | | |
| <18.5 | 12.4 | | 11.4 | | 13.0 | | 12.1 | | 9.6 | | 6.4 | | 7.4 | | 2.4 | | |
| 18.5–24.9 | 66.6 | | 57.1 | | 67.3 | | 58.8 | | 69.6 | | 53.0 | | 67.2 | | 62.3 | | |
| 25.0–29.9 | 11.6 | | 16.1 | | 11.7 | | 16.2 | | 11.8 | | 21.1 | | 14.1 | | 17.4 | | |
| ≥30 | 8.0 | | 13.1 | | 7.9 | | 13.0 | | 9.0 | | 19.5 | | 11.3 | | 18.0 | | <0.0001 |
| Smoking | | | | | | | | | | | | | | | | | |
| Yes | 19.6 | | 21.5 | | 20.7 | | 21.6 | | 12.4 | | 18.6 | | 11.2 | | 22.0 | | <0.0001 |
| Prenatal care use | | | | | | | | | | | | | | | | | |
| Intensive | 3.7 | | 3.5 | | 3.5 | | 3.3 | | 4.9 | | 6.5 | | 7.6 | | 5.9 | | |
| Adequate | 40.1 | | 34.7 | | 38.8 | | 33.6 | | 48.8 | | 48.4 | | 50.8 | | 56.2 | | |
| Intermediate | 48.3 | | 44.8 | | 49.4 | | 45.6 | | 41.7 | | 35.3 | | 36.4 | | 27.2 | | |
| Inadequate | 3.6 | | 9.8 | | 4.0 | | 10.2 | | 1.4 | | 4.0 | | 1.7 | | 5.9 | | <0.0001 |

[a] Mantel-Haenszel for trend

* *P*-values for all variables were <0.0001

AA = African American

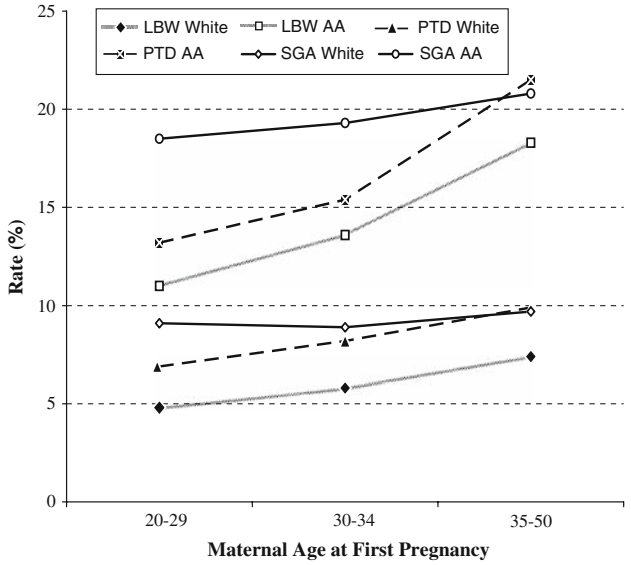


**Fig. 1** Proportion of adverse first pregnancy outcomes by maternal race and age at first pregnancy: Missouri resident mothers 1978–1997

($P = 0.2980$), ELBW ($P = 0.0960$) and VPTD ($P = 0.3680$) (Table 2).

In general, the mean IPI was significantly longer for AA mothers compared to that of Whites mothers (35.3 ± 30.2 vs. 29.5 ± 22.9); $P < 0.0001$. The mean IPI decreased with increasing age at first pregnancy ($P < 0.0001$). Within maternal age specific categories, significant racial differences were noted among mothers 30–34 years at first pregnancy, with AA having significantly longer mean IPI compared to Whites (28.2 ± 22.1 vs. 25.2 ± 17.1) ($P < 0.0001$). No significant racial difference in mean IPI was observed for mothers age 35–50 at first pregnancy. Significant racial differences were seen across IPI strata, with AA generally having higher rates of IPI <6 months compared to White mothers ($P < 0.0001$). However when controlling for maternal age at first pregnancy, there were no significant racial differences in IPI distribution (Mantel-Haenszel $P = 0.9048$). Within maternal age specific categories, significant racial differences in IPI distribution were seen for mothers 20–29 and 30–34 years at first pregnancy (Table 3).

Examining the association between IPI and subsequent perinatal outcome in second pregnancy, significant racial differences were also observed. Mothers with short IPI (<6 months) and long interval (60–119 months) had higher rates of LBW, PTD and SGA, particularly for AA. For AA, the lowest rates of LBW & SGA were observed at IPI 12–17 months (Fig. 2). Within race specific categories, short intervals were significantly associated with all adverse perinatal outcomes examined for Whites, however for AA, no significant differences in the rate of adverse outcomes was observed for VLBW ($P = 0.2511$), ELBW ($P = 0.3039$), VPTD ($P = 0.3977$) and EPTD ($P = 0.1319$).

Crude logistic regression models showed that AA had significantly increased risk for adverse outcome in the second pregnancy. Mothers age 30–34 at first pregnancy also had significantly increased risk for VLBW (OR 1.26, 95% CI = 1.02–1.57), and EPTD (OR 1.59, 95% CI = 1.21–2.10) in the second pregnancy, while those age 35–50 at first pregnancy had increased risk for all outcomes with the exception of FD (OR 1.52, 95% CI = 0.98–2.34), and ELBW (OR 1.54, 95% CI = 0.92–2.57). Interpregnancy interval of <6 months was associated with increased risk for all adverse outcomes except for FD (OR 1.14, 95%

**Table 2** Rate ratios for adverse second pregnancy outcomes by maternal race and age at first pregnancy: Missouri resident mothers 1978–1997

| Second pregnancy perinatal outcome | 20–29 | | 30–34 | | 35–50 | | Mantel Haenszel *P*-value[b] |
|---|---|---|---|---|---|---|---|
| | AA/White rate ratio | *P*-value | AA/White rate ratio | *P*-value | AA/White rate ratio | *P*-value | |
| Fetal death[a] | 2.5 | <.0001 | 2.9 | <.0001 | 2.2 | 0.2611 | <.0001 |
| Small-for-gestational age | 2.3 | <.0001 | 2.2 | <.0001 | 2.3 | <.0001 | <.0001 |
| Low birth weight (<2500 g) | 2.3 | <.0001 | 2.6 | <.0001 | 2.5 | <.0001 | <.0001 |
| Extremely low birth weight (500–999 g) | 5.0 | <.0001 | 5.5 | <.0001 | 3.0 | 0.0960 | <.0001 |
| Very low birth weight (1000–1499 g) | 2.3 | <.0001 | 4.3 | <.0001 | 0.0 | 0.2980 | <.0001 |
| Moderately low birth weight (1500–2499 g) | 2.9 | <.0001 | 2.2 | <.0001 | 2.7 | <.0001 | <.0001 |
| Preterm (<37 weeks) | 2.3 | <.0001 | 2.3 | <.0001 | 2.3 | <.0001 | <.0001 |
| Extremely preterm (24–27) weeks) | 6.0 | <.0001 | 3.5 | 0.0011 | 12.0 | <.0001 | <.0001 |
| Very preterm (28– 31 weeks) | 2.0 | <.0001 | 5.5 | <.0001 | 0.0 | 0.3680 | <.0001 |
| Moderately preterm (32–36 weeks) | 2.2 | <.0001 | 2.2 | <.0001 | 2.2 | <.0001 | <.0001 |

[a] Fetal death rate/1000 live births plus fetal deaths

[b] Mantel-Haenszel for trend

**Table 3** Distribution of interpregnancy interval by maternal race and age at first pregnancy: Missouri resident mothers 1978–1997

| Interpregnancy interval (months) | 20–29* | | | 30–34* | | | 35–50** | | | Mantel Haenszel *P*-value[a] |
|---|---|---|---|---|---|---|---|---|---|---|
| | White % | AA % | RR | White % | AA % | RR | White% | AA % | RR | |
| 0–5 | 5.5 | 8.7 | 1.58 | 4.9 | 8.6 | 1.76 | 7.3 | 12.0 | 1.64 | 0.9048 |
| 6–11 | 10.7 | 11.7 | 1.09 | 12.6 | 13.4 | 1.06 | 16.6 | 12.0 | 0.72 | |
| 12–17 | 13.8 | 10.6 | 1.86 | 16.9 | 14.1 | 0.83 | 20.8 | 19.2 | 0.92 | |
| 18–23 | 12.7 | 8.8 | 0.69 | 14.3 | 11.4 | 0.80 | 13.7 | 17.4 | 1.27 | |
| 24–59 | 40.6 | 36.6 | 0.90 | 38.4 | 37.7 | 0.98 | 30.5 | 27.0 | 0.89 | |
| 60–119 | 8.8 | 15.4 | 1.75 | 4.4 | 8.8 | 2.00 | 1.7 | 1.2 | 0.71 | |
| ≥120 | 8.1 | 8.1 | 1.00 | 8.5 | 6.0 | 0.71 | 9.4 | 11.4 | 1.21 | |

AA = African American

* $P < 0.0001$

** $P = 0.1288$

[a] Mantel-Haenszel for trend

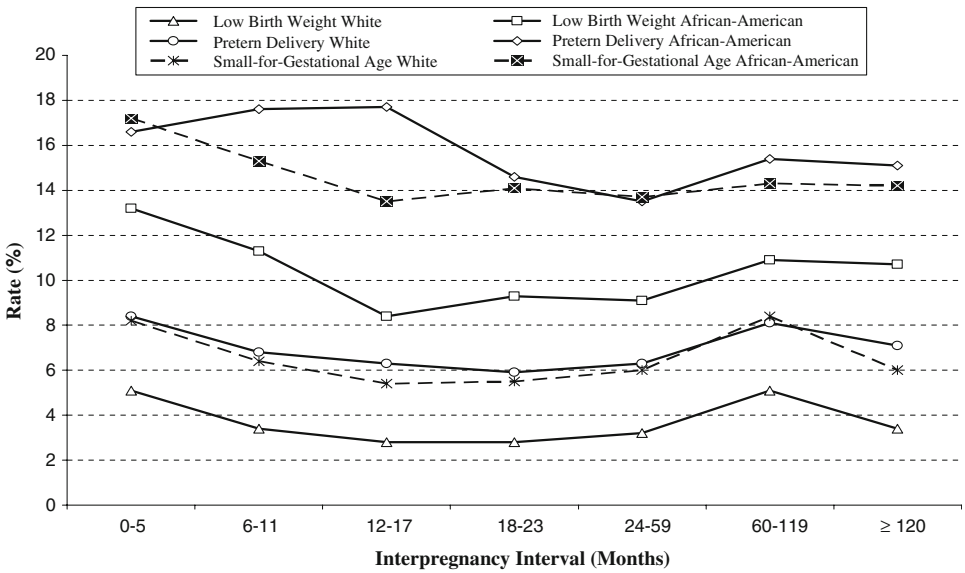


**Fig. 2** Distribution of adverse second pregnancy outcomes by maternal race and interpregnancy interval: Missouri resident mothers 1978–1997

CI = 0.86–1.51). None of the interactions tested were significant with the exception of the interaction between maternal age 30–34, short IPI, and race when modeling for SGA (OR 1.75, 95% CI = 1.07–2.82). This interaction remained significant even after controlling for other potential confounders (OR 1.91, 95% CI = 1.08–3.37). Adjusting for potential confounders, AA mothers remained at increased risk for adverse outcomes in the second pregnancy (Table 4).

## Discussion

Similar to previous general population research [3, 4, 14, 28], we found evidence of racial disparities in perinatal outcomes both in the first and second pregnancy for mothers delaying initiation of childbearing. Although the proportion of AA mothers delaying initiation of childbearing until age 30 or older was much lower than for Whites, these mothers had far higher prevalence for adverse outcomes, and the disparities increased with increasing maternal age. The reasons to explain these findings are still largely unknown even in the general population. Previous studies have suggested various theories to explain the racial disparities including among others socio-economic (SES) factors, health behavior factors [29, 30], genital infections during pregnancy [31], and maternal stress [32], as well as differences in developmental trajectories over time [33].

While these factors may explain observed racial disparities in general when looking at women delaying childbearing some of these factors may play a minimal role. For example women delaying initiation of childbearing generally have high education, and fewer health

**Table 4** Adjusted odds ratios for adverse second pregnancy perinatal outcomes: Missouri resident mothers; 1978–1997

| Adverse perinatal outcome second pregnancy | Adjusted OR (95% CI)[a] | |
|---|---|---|
| | African American[b] | Short IPI < 6 months[c] |
| Fetal death | 2.02 (1.63–2.51) | 1.06 (0.81–1.38) |
| Small-for-gestational age[d] | 1.95 (1.84–2.07) | 1.12 (1.04–1.20) |
| Low birth weight | 2.35 (2.20–2.51) | 1.21 (1.11–1.31) |
| Moderately low birth weight | 2.24 (2.08–2.41) | 1.15 (1.04–1.26) |
| Very low birth weight | 1.61 (1.29–2.01) | 1.38 (1.07–1.78) |
| Extremely low birth weight | 3.27 (2.63–4.07) | 1.43 (1.09–1.88) |
| Preterm | 1.92 (1.82–2.03) | 1.15 (1.08–1.23) |
| Moderately preterm | 1.81 (1.71–1.91) | 1.12 (1.05–1.20) |
| Very preterm | 2.75 (2.21–3.43) | 1.52 (1.17–1.98) |
| Extremely preterm | 3.02 (2.28–4.02) | 1.37 (0.97–1.95) |

[a] Model adjusted for significant interaction, and other confounders (marital status, educational status, prenatal care use, body mass index, smoking, chronic hypertension, diabetes, pregnancy induced hypertension, past adverse outcome, and year first birth)

[b] Reference age group = White

[c] Reference IPI ≥ 6 months

[d] Model included significant interaction for maternal age 30–34, IPI <6 months, and race

behavior risk factors compared to their younger counterparts [8]. Thus, SES and health behavior risk factors may not explain the racial differences observed in women delaying childbearing. Likewise, although genital infections contribute significantly to adverse perinatal outcomes, and may explain racial disparities, there is no evidence to suggest that nonwhite women delaying initiation of childbearing have higher rates of infection compared to Whites to account for the observed disparities.

On the other hand, maternal stress may explain some of the observed racial disparities. Research has associated maternal stress with adverse perinatal outcomes. It has been argued that nonwhite women experience greater stress over their life time which in turn increases their risk for adverse perinatal outcomes with advancing maternal age. This process has been termed the 'weathering' hypothesis [34–36]. Additionally, mothers delaying initiation of childbearing may have increased risk for stress and anxiety [37]. The cumulative effect of maternal stress coupled with differences in the environment [33], may play an important role in the racial disparities among women delaying childbearing. While the merits of this theory are beyond the scope of this study, further research should examine the impact of maternal stress on racial disparities in women delaying initiation of childbearing.

Interestingly, we found that AA delaying initiation of childbearing had significantly longer mean IPI compared to whites. This finding does offer some support to previous report that older AA mothers may have longer pregnancy intervals [18]. Nevertheless, we found no significant racial differences in interpregnancy interval patterns among women delaying initiation of childbearing.

In general IPI was associated with racial disparities in perinatal outcomes particularly at intervals <6 months. This finding supports previous population studies that found short IPI to be associated with racial differences in pregnancy outcomes [16, 19]. Interesting, for AA the relationship between IPI and adverse perinatal outcomes did not demonstrate the J-shaped pattern that has been previously reported in general population studies [24]. However, for white mothers a J-shape was evident; the explanation for this finding is unknown.

The effect of IPI on subsequent perinatal outcomes among women of different race groups delaying initiation of childbearing is unclear. No significant interactions were seen between maternal age at start of childbearing, race and IPI, suggesting that AA mothers delaying initiation of childbearing with short IPI do not appear to have elevated risk for adverse outcomes compared to Whites. We were unable to examine patterns of delayed childbearing and IPI among other race/ethnic groups. This is a limitation of this study as it has been reported that some nonwhite population particularly Asians tend to delay initiation of childbearing [38]. Future research using a larger and more diverse sample may reveal disparities between White women and women of other race/ethnic groups.

This study draws strength from the fact that it is among the few studies exploring racial differences in pregnancy outcomes among women delaying initiation childbearing and their pregnancy spacing patterns using a large longitudinal database. The study used a cohort design, thus enabling us to examine perinatal outcomes in the same women over time eliminating the cohort effect. Nevertheless, there were some limitations; the study used a

secondary database making it prone to missing or incorrect data, resulting in loss of information, which may reduce the effective sample size [39, 40]. Furthermore, the sample of mothers initiating childbearing at age 35 or older was relatively small especially for AA as the population of the state of Missouri is predominately White. Analysis for this age category is prone to imprecise estimates and may explain the non-significant associations as noted for pregnancy spacing patterns. We were unable to examine other variables such as fertility issues, use of ART treatment among older mothers, which may have an impact on perinatal outcomes. Further research is needed to explore if there are any differences in ART use and its role on perinatal outcomes. Finally, there are issues related to generalizability as the data used are from only one state. Having said that, the findings do provide an insight to what may be happening among the general US population.

In summary, while the number of AA women delaying initiation of childbearing is small, they demonstrate a consistent increased risk for adverse perinatal outcomes in the first and subsequent pregnancy. With the *HP-2010* objective of addressing racial disparities in birth outcomes, it is important for providers to pay attention to this unique population of women. Further research aimed at understanding risk factors associated with racial disparities may identify potential areas for intervention as health care providers strive to address racial disparities in reproductive health.

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