The Effect of Incarceration during Pregnancy on Birth Outcomes

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SYNOPSIS

Objective. This study examined the effect of incarceration during pregnancy on infant birth weight.

Methods. North Carolina prison records were matched to North Carolina birth certificates and health services records to identify 94 women who were incarcerated during one pregnancy but not incarcerated during another pregnancy. Paired analyses examined differences between the pregnancies in terms of the women's characteristics and use of health services. A generalized estimating equations analysis modeled infant birth weight as a function of the number of days that a woman was incarcerated during pregnancy, accounting for the correlation between the birth weights of two infants born to the same mother and several potentially confounding variables.

Results. Since the women were significantly more likely to have been incarcerated during the second of the pair of pregnancies, as a group they were significantly older and had more children at the time of the incarcerated pregnancy than at the time of the home pregnancy. After controlling for important covariates, a higher number of pregnancy days spent incarcerated was found to be associated with higher infant birth weight.

Conclusion. These findings suggest that aspects of the prison environment such as shelter and regular meals may enhance pregnancy outcomes among very high risk women. Health professionals should join others in efforts to assure that health-promoting resources such as adequate shelter, nutritional support, and substance abuse treatment programs are available to all pregnant women.

Since the rate of female imprisonment in the United States has dramatically increased over the past decade[1] and since approximately 6% of the women entering prison are pregnant,[2] the impact of incarceration on pregnancy outcomes is of growing concern.

The effects of incarceration on pregnancy are controversial. Some reports suggest that incarceration places pregnant women and their expected infants at increased health risk because of prison-induced stressors such as the women's separation from family and friends and the women's concerns regarding placement of the expected infant (infants are usually placed with a member of the mother's family soon after birth).[3,4] However, other reports suggest that

incarceration may promote the health of some pregnant women and may foster healthy pregnancy outcomes by supplying these often high risk women with shelter and regular meals, restricting their alcohol and illicit drug use, limiting demanding physical work, and providing appropriate prenatal health care services.[5,6]

The findings of previous investigations concerning birth outcomes of incarcerated women have been equivocal. Two exploratory, small-scale investigations of midwestern U.S. prisoners, each of which looked at fewer than 30 women, found that at least a quarter of the infants born to inmates had very poor birth outcomes—the infants required stays in neonatal units, died shortly after birth, or both.[7,8] Other findings suggest that prison may have a somewhat protective effect on birth outcomes. One study reported that fewer than 1% of the births to incarcerated women in Great Britain between 1975 and 1976 were stillborn while 3% of the births to women probationers between 1984 and 1985 were stillborn.[9] A study of roughly 100 pregnant inmates in Ohio found that women who were imprisoned for fewer than 90 days were significantly less likely to have healthy infants than women who were imprisoned for greater lengths of time.[10] A Southeastern U.S. study found that the mean birth weight of approximately 60 infants born to prison inmates was similar to that of approximately 60 infants born to health department patients.[11] A recent southern U.S. study found that after controlling for important confounding factors, infants born to women who were in prison during their pregnancies weighed essentially the same as infants born to women who had never been to prison; however, the infants born to women in prison during pregnancy weighed significantly more than infants born to women who were incarcerated at another time, either before or after the pregnancy.[12]

Previous reports of pregnancy outcomes of prison inmates vary considerably in their methodological rigor. However, one consistency among past studies is that they restricted their analyses to examination of the birth outcomes of one infant per mother. The present study extends past research by comparing the birth weights of pairs of siblings, one sib the result of a pregnancy for at least part of which occurred while the mother was incarcerated (for ease of reference, this sib will be referred to as the "prison baby") and the other sib the result of a pregnancy during which the mother was not incarcerated (the "home baby").

Methods

The North Carolina Department of Corrections records from a five year period (January 1, 1987 to December 31, 1991) were computer matched to an already linked data file containing the North Carolina birth certificates and health services records from a four year period (January 1, 1988 to December 31, 1991). This matching procedure allowed the identification of women who had been pregnant exactly twice and who had delivered exactly two infants during the four year period, with at least a portion of one of these pregnancies taking place while the woman was incarcerated and the entire other pregnancy taking place while the woman was not incarcerated. For each of the prison pregnancies, the women had entered prison after the pregnancy had begun, and all of the incarcerations had taken place at the North Carolina Correctional Institution for Women, the only maximum security women's prison in the state that houses pregnant inmates. Excluded from the matching procedure were women who were residents of a state other than North Carolina, women who had non-singleton births, and women who were either less than 16 years of age or more than 45 years of age—these last two variables being important risk factors for low birth weight babies.

The matching identified 194 liveborn infants delivered to 97 different women. Complete prison and birth certificate/health services information was available for 94 (97%) of these women. Therefore, the final sample consisted of pairs of infants born to each of the 94 women with complete study information. Identifying information was stripped from the matched data set prior to analysis.

The birth certificate/health services data file documented various characteristics of the study women (ethnicity, age, number of children, marital status, education level, and use of cigarettes and alcohol during pregnancy). These data files also included information concerning the women's use of the following health-related services during the two pregnancies: participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); adequacy of prenatal care use, defined as either "adequate" or "intermediate/inadequate" using the Kessner/Institute of Medicine Adequacy of Prenatal Care Index;[13] use of North Carolina's case management services for Medicaid-eligible pregnant women;[14] and enrollment in Medicaid. Birth certificates supplied data on infant outcomes, including the sex of each baby, the birth weight of each baby, and the birth order.

We used descriptive statistics, matched-pairs Z-tests, and chi-square analyses appropriate for paired data (McNemar's test) to examine differences between the two pregnancies in terms of the women's characteristics and use of health-related services. We used the same procedures to look at differences in infant characteristics.

We used a generalized estimating equations analysis[15] to model the continuous infant birth weight outcome as a function of the main predictor variable of interest—the number of days that a woman was incarcerated during each of her two pregnancies—and several potentially confounding variables. The potential confounders included each woman's ethnic group, age, number of children, marital status, education level, cigarette use during pregnancy, alcohol use during pregnancy, use of WIC, adequacy of prenatal care use, use of case management services, use of Medicaid, and the sex and birth order of the infants. This analysis took into account the correlation between birth weights of infants with the same mother[16] and allowed for the control

of both "pregnancy-specific" covariates (variables that could have different values between one pregnancy and the other) and other covariates.

These procedures were reviewed and approved by the Committee on Human Subjects Institutional Review Board of the School of Public Health at the University of North Carolina at Chapel Hill and by the Research and Planning Section of the North Carolina Department of Corrections.

Results

Women's characteristics. The 94 women spent an average of 61.3 (SD = 50.8) pregnancy days in prison; the median number of pregnancy days was 49.

The women were incarcerated for a variety of crimes, with 9 (10%) convicted of crimes against persons such as assault or robbery, 54 (57%) convicted of crimes against property such as larceny or burglary, 24 (26%) convicted of public order crimes (primarily drug- and alcohol-related crimes), and 7 (7%) convicted of other types of offenses.

Seventy-five of the women were African-American (80%), and 19 were white (20%).

Two sociodemographic characteristics of the women—their age and number of children—were significantly different for the home and prison pregnancies. Women were significantly younger during their home pregnancies (mean age of 22.97 years, SD=4.06) than during their prison pregnancies (mean age of 23.52 years, SD=4.08) (Z=3.021, P=0.003). Women also had significantly fewer children during the home pregnancy (a mean of 1.52 previous children, SD=1.25) than during the prison pregnancy (a mean of 1.81 previous children, SD=1.24) (Z=2.980, P=0.004).

There were no significant differences between the two pregnancies in terms of the women's marital status (with the majority of women being single [never married] in each case) or education levels (with less than half of the women having at least a high school education in each case). Neither tobacco use nor alcohol use varied significantly between the home and prison pregnancies. About a third of the women reported smoking cigarettes during both pregnancies, whereas almost half reported not smoking during either pregnancy. The majority of women reported not drinking alcohol during either pregnancy.

Women's use of health-related services. We looked at women's use of health services (WIC, prenatal care, case management, and Medicaid) during the home pregnancy and found significant associations between the use of several of these services. Ninety-six percent of the women who received case management also received WIC services, but only 69% of the women who did not receive case management received WIC services (OR=11.87, 95% CI=1.51, 93.40). There was also a significant positive association between WIC and Medicaid enrollment; 85% of the WIC women received Medicaid, compared to only 59% of the non-WIC women (OR=3.84, 95% CI=1.32, 11.14).

We found similar significant positive associations for use of these services during the initial phases of the "prison pregnancies," prior to incarceration. Eighty percent of the women who received case management services for the prison pregnancy also received WIC services, but only 50% of the women who did not receive case management services received WIC services (OR=4.00, 95% CI=1.22, 13.10). For the prison pregnancy, 85% of the WIC women were enrolled in Medicaid, but only 59% of non-WIC women were enrolled in Medicaid (OR=3.98, 95% CI=1.50, 10.57).

A comparison of health services use during the home and prison pregnancies revealed significant differences only in the use of WIC, which was more likely to be used during the home pregnancy (77%) than the prison pregnancy (57%). WIC was used by 49% of the women during both pregnancies, 28% during only the home pregnancy, 8% during only the prison pregnancy, and 16% during neither pregnancy (McNemar's $\chi^2_{(1)}$=10.93, P<.001).

Women's use of Medicaid, adequacy of prenatal care use, and use of case management did not differ significantly between the home and prison pregnancies. Seventy-nine percent of the women were enrolled in Medicaid during the home pregnancy, as were 74% during the prison pregnancy (60% were enrolled during both pregnancies, 19% during only the home pregnancy, 14% during only the prison pregnancy, and 8% during neither pregnancy).

Adequate prenatal care use was evidenced by 32% of the women during the home pregnancy and 28% during the prison pregnancy (12% during both pregnancies, 20% during only the home pregnancy, 16% during only the prison pregnancy, and 52% during neither pregnancy). Case management was used by 29% of the women during the home pregnancy and 22% during the prison pregnancy (12% during both pregnancies, 17% during only the home pregnancy, 10% during only the prison pregnancy, and 62% during neither pregnancy).

Infant outcomes. The home and prison babies did not differ significantly in terms of their sex (McNemar's $\chi^2_{(1)}$=1.089, P=.296), with 31% of the sib pairs both male, 28% of the pairs consisting of a male home baby and a female prison baby, 20% of the pairs consisting of a female home baby and a male prison baby, and 21% of the pairs both female. The birth order of the home and prison babies was significantly different, with home babies more likely to have been delivered before prison babies (among 65% of the pairs, the home baby was born before the prison baby, $\chi^2_{(1)}$=8.340, P=.002). Finally, the unadjusted mean infant birth weight of the home babies (3120 gm, SD=612) was less than the unadjusted mean infant birth weight of the prison babies (3179 gm, SD=557).

Infant birth weight as a function of the number of pregnancy days incarcerated. The Table presents the findings of the generalized estimating equations analysis, which mod-

Table. Results of the generalized estimating equations analysis of infant birth weight as a function of number of days incarcerated during pregnancy and other variables (*N*=188 infants)

Predictor variables	*Estimated coefficient*	*P*
Number of pregnancy days incarcerated	1.49	0.0316[a]
Mother's ethnicity	− 156.10	0.8816
Mother's age	25.97	0.0767
Number of liveborn children	− 70.96	0.0873
Marital status	92.93	0.5222
Education level	− 37.14	0.7114
Cigarette smoking	− 183.23	0.0444[a]
Alcohol use	− 168.74	0.2113
WIC	11.92	0.8966
Adequate prenatal care use	199.54	0.0193[a]
Case management services	184.62	0.0324[a]
Medicaid	− 92.49	0.3576
Sex of baby	− 285.97	0.0004[a]
Birth order of baby	− 82.79	0.3843

NOTE: The generalized estimating equations model took the following form:

$E(Y_{ij}) = \beta_0 + \beta_1 X_{1ij} + \gamma_1 X_{2i} + \gamma_2 X_{3ij} + \gamma_3 X_{4ij} + \gamma_4 X_{5ij} + \gamma_5 X_{6ij} + \gamma_6 X_{7ij} + \gamma_7 X_{8ij} + \gamma_8 X_{9ij} + \gamma_9 X_{10ij} + \gamma_{10} X_{11ij} + \gamma_{11} X_{12ij} + \gamma_{12} X_{13ij} + \gamma_{13} X_{14i}$, where i = 1, 2, .., 94 (indexing each of the study women) and j = 1, 2 (indexing each of the two pregnancies for woman i during the study period)

The variable coding scheme was defined as follows:

Y_{ij} = Birth weight (in grams) of the j-th child for the i-th woman;

X_{1ij} = Number of days the i-th woman was incarcerated during her j-th pregnancy;

X_{2i} = Ethnicity of the i-th woman (1 if African American, 0 otherwise);

X_{3ij} = Age in years of the i-th woman during her j-th pregnancy;

X_{4ij} = Number of children (number of liveborn infants of the i-th woman before the j-th pregnancy);

X_{5ij} = Marital status (1 if the i-th woman was single during her j-th pregnancy, 0 otherwise);

X_{6ij} = Education level (1 if the i-th woman had less than a high school graduate level of education during her j-th pregnancy, 0 otherwise);

X_{7ij} = Cigarette smoking (1 if the i-th woman smoked during her j-th pregnancy, 0 otherwise);

X_{8ij} = Alcohol use (1 if the i-th woman drank during her j-th pregnancy, 0 otherwise);

X_{9ij} = WIC (1 if the i-th woman used WIC during her j-th pregnancy, 0 otherwise);

X_{10ij} = Adequate prenatal care use (1 if the i-th woman had adequate care during her j-th pregnancy, 0 otherwise);

X_{11ij} = Case management services (1 if the i-th woman used maternity care coordination during her j-th pregnancy, 0 otherwise);

X_{12ij} = Medicaid (1 if the i-th woman received Medicaid during her j-th pregnancy, 0 otherwise);

X_{13ij} = Sex of baby (1 if the i-th woman had a female infant as a result of her j-th pregnancy, 0 otherwise); and,

X_{14i} = Birth order (1 if the i-th woman was incarcerated during the first of the pair of pregnancies, 0 otherwise).

[a]Statistically significant at the .05 level.

eled infant birth weight (in grams) as a linear function of the main predictor variable of interest (the number of days incarcerated during each pregnancy) and the potentially confounding variables (ethnicity, age, number of liveborn children, marital status, education level, cigarette use during pregnancy, alcohol use during pregnancy, WIC participation, adequacy of prenatal care use, use of case management services, Medicaid enrollment, infant sex, and birth order).

The results of the multivariable analysis show that, after controlling for all of the covariates in the model, a significant "exposure-response" relationship exists between the number of pregnancy days spent incarcerated and infant birth weight, with an increased number of pregnancy days in prison associated with increased birth weight (see Figure). After controlling for all of the covariates, each day of pregnancy spent incarcerated led to an estimated average increase of 1.49 gm in infant birth weight. The adjusted mean difference in birth weight between the home and prison babies was 61.30 gm (95% CI=7.83 gm, 174.29 gm).

Other variables in the model found to be significantly related to infant birth weight were infant sex (females weighed less than males), adequate prenatal care use (women with adequate use had higher birth weight infants), case management (women who received this service had higher birth weight infants), and cigarette smoking (smoking was negatively associated with birth weight). In addition, two associations approached statistical significance: infants of older women on average weighed more than infants of younger women, and women with more children had babies with lower birth weight.

Discussion

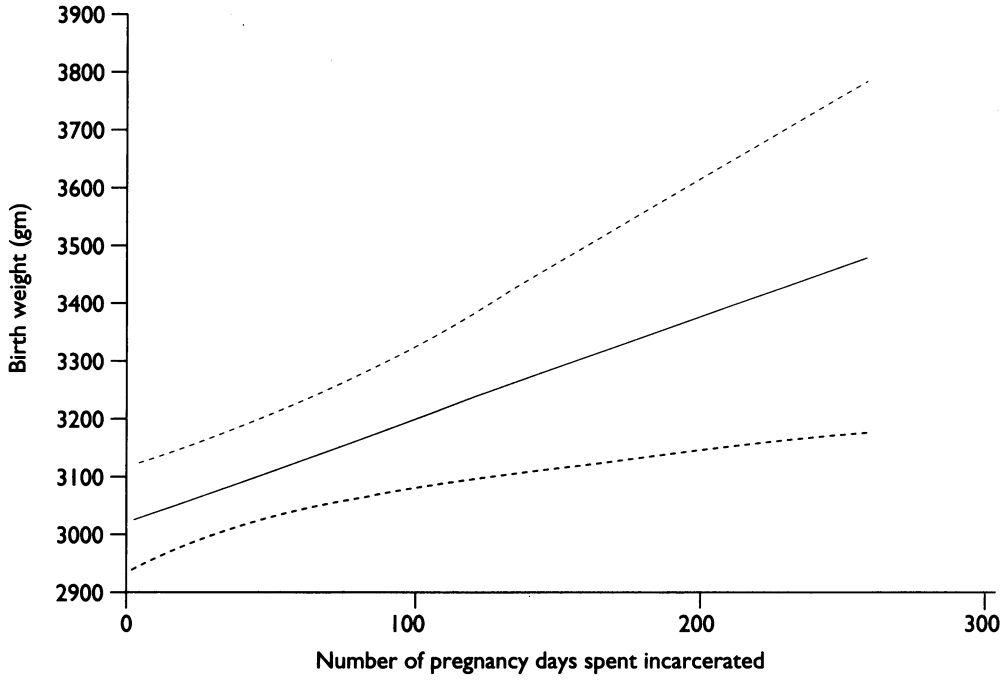
This study found that few characteristics of the women varied between their home and prison pregnancies. Among the sociodemographic variables, only age and the number of children differed significantly between the two pregnancies, with women being on average younger and having fewer children during the home pregnancy. These findings reflect the fact that 65% of the home babies were born before the prison babies.

The only significant difference found in service utilization was in the use of WIC services, with three-quarters of the women using this service during the home pregnancy compared to about half of the women during the prison pregnancy. This may be because some of the pregnant Medicaid enrolled women who were also eligible to enroll in WIC may have been sent to prison after enrolling in Medicaid but before enrolling in WIC.

The finding that women's cigarette smoking and alcohol drinking did not differ significantly between the home and prison pregnancies should be interpreted with caution. This investigation assessed women's tobacco and alcohol behavior during pregnancy using information available on the infants' birth certificates, data which indicate in a "yes/no" fashion whether the woman smoked or drank any time during the

pregnancy, regardless of the frequency or amount of consumption. However, prior research suggests that this information underreports the percentage of women who drink alcohol during pregnancy.[17] In addition, although women may have used alcohol during a particular pregnancy, information was not available on whether the women drank over the entire pregnancy. Therefore, it may be that women classified as alcohol drinkers during the prison pregnancy had access to alcohol only during the first part of that particular pregnancy before becoming incarcerated, while women classified as alcohol drinkers during the home pregnancy had access to alcohol during the entire span of the home pregnancy.

Estimated regression line and 95% confidence interval from the generalized equations analysis, relating the number of pregnancy days estimating spent incarcerated and infant birth weight (*N*=188 infants)



After taking into account the correlation between the birth weights of infants born to the same mother and the effects of potentially important confounders, we found a significant exposure-response relationship between the number of pregnancy days spent in prison and infant birth weight, with an increased number of pregnancy days in prison associated with increased infant birth weight. In addition, several other variables were found to be significantly predictive of infant birth weight; in particular, female babies weighed less than male babies, women with adequate prenatal care use had higher birth weight infants, women who used case management had higher birth weight infants, and women who smoked during pregnancy had lower birth weight infants. Furthermore, two variables showed borderline significant relationships with infant birth weight, namely, the women's age (infants of older women weighed more) and parity (women with more children tended to have lower birth weight infants).

These findings should be considered in the context of the methodological limitations of this study. Since this research was restricted to the examination of liveborn infants, the potential impact of incarceration on both spontaneous abortions and fetal deaths could not be evaluated. Also, since this study employed secondary data, information was not available concerning many factors that may have helped to explain the findings (for example, diet during each pregnancy or illicit substance use during each pregnancy). Finally, the study was restricted to pregnant women in North Carolina; therefore, these findings may not be generalizable to women living in other geographic areas.

The question remains as to why infants born to women who spent part or most of their pregnancies in prison generally had higher birth weights than their siblings. Although the data analyzed in this paper cannot adequately resolve this important question, past empirical and anecdotal evidence offer some areas for speculation.

First, prison supplies inmates with some of the basic necessities of life, such as shelter, which all too often are unavailable to the most disenfranchised members of our community. For example, it has been estimated that between 10% and 15% of the female inmates of the North Carolina Correctional Institution for Women have been homeless before incarceration (Personal communication, Dante Haywood, Medical Social Worker, North Carolina Correctional Institution for Women), and since homelessness has been associated with multiple adverse health outcomes,[18] the shelter provided during incarceration may help to promote positive outcomes among such high risk women. Although there is diversity in the living conditions provided to pregnant women by prisons and jails,[19–22] in general, prison settings may be more health-promoting than the often unsanitary and dangerous conditions faced by homeless women.

Second, prison supplies another necessity of life on a regular basis: food. It is known that poor nutrition during pregnancy may result in poor pregnancy outcomes, including low birth weight babies.[23] While all prisons and jails may not provide adequately for pregnant women's nutritional needs, in the prison in which this study was set, inmates are provided with three balanced meals each day, and pregnant prisoners also receive special protein, iron, and vitamin supplements. Thus, dietary variations may have been at least in part responsible for the difference in infant birth weight seen between the prison babies and home babies.

Third, since incarceration restricts women's interactions with their male partners and since researchers have estimated that approximately 50% of female inmates have been physically or sexually abused or both by intimate partners,[2] prison may offer a relatively safer environment for some women, thus enhancing the women's health and their pregnancy outcomes. Studies examining the association between violence during pregnancy and infant outcomes have found mixed results;[24–29] however, research has demonstrated that specific types of trauma during pregnancy (such as trauma directly to the woman's abdomen) may severely compromise the health of the woman and the fetus.[30]

Fourth, prison may enhance infant birth weight by preventing pregnant inmates from engaging in certain strenuous physical activities, for example, those required in some labor-intensive jobs. Although prisons differ in their responsiveness to pregnant inmates, in the prison in which this study was set, the pregnant inmates are relieved from physically laborious work duties during their pregnancies.

Fifth, it is possible that prison helps to foster higher birth weight babies among pregnant inmates by supplying the women with high quality prenatal care. Although this study found that the women's adequacy of prenatal care use (as assessed by the Kessner Index of Prenatal Care Adequacy) did not differ significantly between their home and prison pregnancies, this measure may have failed to capture all aspects of the quality of prenatal care relevant to infant birth weight. Specifically, the Kessner Index takes into account only the trimester in which prenatal care begins and the number of prenatal visits, without regard for the content of these visits. In the prison in which this study was set, prenatal care is provided to pregnant inmates in accordance with the guidelines of the American College of Obstetricians and Gynecologists.[31] Therefore, at least some women may have received higher quality prenatal care during their prison pregnancies than during their home pregnancies.

Finally, since past studies have found that many female inmates abuse alcohol, illicit drugs, or both prior to imprisonment,[2,32,33] differences in women's substance use patterns between the two pregnancies may have, at least in part, accounted for this study's findings. Although this study did not detect a significant difference in the percentage of women reporting alcohol use at some point during their home pregnancy compared to their prison pregnancy, it may be that prison prohibition of alcohol use resulted in women drinking alcohol for fewer days of their prison pregnancy than their home pregnancy. It is known that high levels of alcohol consumption during pregnancy can produce fetal alcohol syndrome, a condition defined by inadequate fetal growth, facial abnormalities, and impaired infant cognitive development.[34] In addition, it may be that use of illicit drugs was more common during the women's home pregnancies than during their prison pregnancies. Research has shown that cocaine use during pregnancy decreases blood flow to the fetus, which may limit fetal development, and marijuana use during pregnancy decreases oxygen availability to the fetus, which may constrain fetal growth.[35,36] Furthermore, alcohol and illicit drug abuse or dependence may be associated with appetite suppression; thus, substance abusing or dependent women may eat too little during pregnancy to achieve sufficient weight gain to maximize fetal growth.

Although certain aspects of incarceration may be viewed as health-promoting for some high risk women, we want to emphasize that prison is not the answer to the problems of high risk pregnant women, including substance abusing or dependent women. Punitive strategies—including incarceration, mandated treatment, or withdrawal of public service benefits—which at times have been advocated to force high risk pregnant women to modify their potentially risky health behaviors (such as substance abuse) in order to improve the health of the fetus, may actually "backfire" by causing high risk women to avoid health and social services that could be helpful to them. Furthermore, there are ethical and legal concerns regarding mandated interventions for pregnant women. For example, one may ask whether our legal system should treat pregnant substance users differently from non-pregnant substance users since pregnant women's behaviors place not only themselves but also the fetus at health risk. At the heart of this issue is the question of whether the fetus has rights, as a patient and a citizen, separate from those of the pregnant woman.[37–39] Regardless of one's position on this matter, there is still the worry that prison does not provide an optimal environment to promote the health and well-being of pregnant women given the often stressful prison environment (loss of privacy, proscribed clothing, structured time tables, and other stressors), the inmates' separation from supportive family and friends (loved ones are not present to help the women prepare for birth and motherhood, to attend prenatal care visits with her, or to offer other kinds of support), and the inmates' anxiety around issues of maintaining her maternal role in absentia if she places the infant with family members or in relinquishing this role to an adoptive family.[3,4]

More research is needed to firmly establish which factors in pregnant women's environments, whether in the prison setting or in the wider community, promote both the women's health and healthy birth outcomes. Such research would provide the empirical foundation for public health policy and program development to maximize the health of our nation's women and children.

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