

Poverty, Maternal Health, and Adverse Pregnancy Outcomes

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Pregnancy outcomes in the United States are generally worse than those in most developed countries. Contributing to these adverse outcomes are the relatively high levels of poverty in the United States, a characteristic that is associated with decreased utilization of appropriate prenatal care and delivery services as well as having an increased number of other risk factors. Poor women tend to be more obese, to have more medical conditions, such as hypertension and diabetes, to be more likely to be stressed or depressed, and to smoke cigarettes and use illicit drugs. We present some of the potential mechanisms that explain the association between these characteristics and adverse pregnancy outcomes—focusing on preterm birth.

Key words: pregnancy outcomes; preterm birth; poverty

Introduction

In this report we will explore some of the potential mechanisms for the relationship between poverty and adverse pregnancy outcomes. In the United States, the world's wealthiest nation by gross domestic product, 12.6% of citizens live below the official poverty line. Pregnancy outcomes, often considered a litmus test for the health of a nation, are worse in the United States than in nearly all developed nations. Poor pregnancy outcomes are influenced by a myriad of biologic, social, and environmental factors. By considering the most influential factors mediating the relationship between poverty and adverse pregnancy outcomes, we can take meaningful action to narrow the rich–poor gap seen in maternal health outcomes.

Measurement of Pregnancy Outcome

Adverse pregnancy outcomes include abortion, infant death, and perinatal mortality. In most states, abortion is defined as a pregnancy that terminates or is ter-

minated before 20 weeks' gestational age. A stillbirth is usually defined as a fetus born at 20 weeks' gestational age or more with no heartbeat or respiratory effort. Live-born infant describes an infant born at any gestational age with a heartbeat or respiratory effort. Death of a live-born infant can occur in the neonatal period, defined as the first 28 days of life, or in the postneonatal period, defined as 28 days to 1 year of age. Infant death describes the death of a live-born baby that occurs before 1 year of age, therefore including neonatal and postneonatal deaths. Perinatal mortality can be described as the sum of fetal and neonatal deaths.

Preterm birth is defined as a birth occurring before 37 weeks' gestation. A growth-restricted infant is defined as an infant born at less than the 10th percentile of birth weight for a specific gestational age. Handicap, one of many measures of long-term morbidity, often includes those children with structural anomalies, blindness, deafness, cerebral palsy, or mental retardation. Because exploring the relationship between poverty and each of these factors is beyond the scope of this report, we will focus predominantly on preterm birth. Doing so is a reasonable choice because approximately two-thirds of the neonatal mortality, about 80% of stillbirths, about 50% of the infant mortality, and much of the long-term handicap occur in preterm births.

Preterm births are classified as indicated or spontaneous. When a medical or obstetric condition threatens the life of the mother or fetus, induction of labor or cesarean delivery leads to an indicated preterm birth. Spontaneous preterm births follow the spontaneous onset of labor or preterm premature

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rupture of membranes (PPROM). Preterm labor, including those after PPROM, is now considered a syndrome most likely initiated by multiple mechanisms including infection/inflammation, uteroplacental ischemia/hemorrhage, uterine overdistension, stress, and immunologically mediated processes.¹

In the last century, a substantial improvement in many pregnancy outcome statistics, including maternal and infant mortality and stillbirth, has been observed. However, the preterm birth rate has risen substantially over the last few decades, along with the long-term childhood morbidity associated with preterm births. Much of the increase in preterm births is attributed to an increase in indicated preterm births as well as increases in multiple births resulting from various infertility treatments, but these factors do not entirely explain the rise in preterm births.

Defining Poverty

Poverty as a discrete entity has proven difficult to measure. Socioeconomic status (SES), often assessed by educational level, income, occupation, and housing conditions, is used as a surrogate measure for poverty. Lower SES is generally associated with poorer health outcomes for all causes of mortality, with particular diseases more affected by SES than others.² Recently, data from the Women's Health Initiative were examined for the relationship among SES, race/ethnicity, and lifetime morbidities in women. Higher lifetime morbidity was associated with women who were black or American Indian/Alaska Native; were poor, less educated, divorced, widowed, or separated; or were past or current smokers, obese, or on Medicaid.³ Lower SES is thus associated with increasing morbidity among women.

Racial/Ethnic Disparities

In the United States, because black race and poverty often coexist, distinguishing between their effects on pregnancy outcome can be difficult. Nevertheless, it is clear that in the United States, black women are three times more likely to die in pregnancy than are white women, twice as likely to have a stillbirth, approximately twice as likely to have a preterm birth, and three to four times as likely to have a very early preterm birth as women from most other racial or ethnic groups. Overall, black women have a prematurity rate of about 16%–18%, compared with 7%–9% for white women. East Asian women typically have low rates of preterm birth, as do most Hispanic women. Women from south Asia and especially the Indian subcontinent have high rates of low birth weight, but their preterm delivery rates do not appear to be substantially increased. Instead, they are far more likely to

have a growth-restricted infant born at term. Among all the various groups living in the United States, the high preterm birth rate in black women stands out and remains mostly unexplained to date. Although poverty clearly adds to the adverse pregnancy outcome burden in black women as well as all other women, we will try to show here that poverty is a significant risk factor for preterm delivery distinct from black race.

Poverty, Access to Health Services, and Pregnancy Outcomes

An often-cited reason for the rich–poor disparity in pregnancy outcomes is that poorer women receive less prenatal care.⁴ Although this may be so, it is not exactly clear what prenatal care accomplishes to improve outcomes. For example, prenatal care does not seem to prevent or reduce preterm delivery. On the other hand, women who receive prenatal care; are appropriately screened for conditions, such as hypertension, diabetes, anemia, Rh disease, and syphilis; and are appropriately treated have reduced rates of stillbirth and of neonatal and maternal mortality. Poor women are less connected with the obstetric care system than are wealthier women, and connection to a health care provider in case of an obstetric emergency can be crucial. Barriers to receiving prenatal care for lower-SES women may include inability to pay for otherwise available services, as well as failure to seek services because of prior negative experiences (receiving culturally inappropriate and unsatisfying services, reproach and sanctions for poor health habits), lack of transportation, and depression.⁵ In recent years, various measures of prenatal care utilization have shown a general increase. However, the increase in prenatal care use seen in the 1990s was proportionally smaller among low-income women.

Many maternal characteristics, such as comorbidities, psychiatric illness, adverse behaviors, nutritional status, intimate partner violence (IPV), previous pregnancy history, and infection, have been shown to have associations with preterm birth. The association between these factors and poverty and potential mechanisms by which they are associated with preterm birth are discussed next.

Preeclampsia

Preeclampsia is a pregnancy-related condition characterized by maternal hypertension, various vascular abnormalities, and poor placental function. It is cured only by delivery. Preeclampsia is one of the major causes of maternal death worldwide and results in poor fetal growth, stillbirth, and often an indicated preterm birth to prevent maternal and fetal mortality. Although

the etiology is unknown, major risk factors include obesity, chronic hypertension, and diabetes, all conditions seen more often in poor women. Although preeclampsia is not preventable, access to excellent prenatal and delivery care prevents most of the serious adverse outcomes associated with preeclampsia, such as stillbirth and maternal mortality. Poor women use these services less often, and the higher incidence of preeclampsia associated with the poverty-related risk factors discussed above, combined with worse outcomes when the disease occurs, accounts for an important proportion of the discrepancy in adverse pregnancy outcomes between rich and poor women.

Depression and Stress

Clinical depression during pregnancy has been reported in up to 16% of women, with up to 35% of pregnant women reporting some depressive symptoms. The literature supports a relationship between low-income status and a greater incidence of depression.^{6,7} For example, living in a “stressed” urban environment, defined by high levels of material deprivation and residential mobility, is associated with higher levels of depression.⁸ Stressed social environment, a proxy measure for poverty in the population under investigation, is associated with higher rates of depression than those in less stressed urban environments. This effect remained after age, education, marital, and visible minority status and local ethnic diversity were adjusted for. Also, risk of depression is greater in single mothers living in poverty than in married women living in poverty.⁹ These authors of the cited study conclude that although the factors that influence maternal depression in single women shift over time, financial hardship appears to have a great influence on the chronicity and occurrence of depression. Risk factors for depression also include racial or ethnic minority, young age, less than a high school education, and housing dissatisfaction.

Mothers experiencing high levels of psychological or social stress are at increased risk for preterm birth even after adjusting for the effects of sociodemographic, medical, and behavioral risk factors. Furthermore, exposure to objectively stressful conditions, such as housing instability and severe material hardship, has also been associated with preterm birth. Because depression/depressive symptoms increase the risk of behaviors, such as smoking, drug use, and alcohol use, the association between depression and preterm birth may be mediated by these behaviors as well. However, in studies that have adjusted for these behaviors, the association between depression and preterm birth persists.

Although the mechanism underlying the association between depression and preterm birth is unknown, a role for corticotropin-releasing hormone has been proposed. Women exposed to stressful conditions also have increased serum concentrations of inflammatory markers, such as C-reactive protein, an observation not accounted for by other established risk factors for inflammation. These findings indicate that systemic inflammation may be a pathway by which stress could increase the risk of preterm birth.

Use of Tobacco and Other Substances

In the United States, approximately 20%–25% of women of childbearing age smoke tobacco, and of these women, 12%–15% continue smoking throughout pregnancy. Certain groups of women are at higher risk of smoking during pregnancy, including women with lower SES, women with lower levels of education, and Medicaid recipients.¹⁰ Tobacco use increases risk for preterm birth even after adjustment for other factors. The mechanism(s) by which smoking is related to preterm birth is unclear. There are more than 3000 chemicals in cigarette smoke, and the biologic effects of most are unknown. However, both nicotine and the carbon monoxide produced by smoking are powerful vasoconstrictors and are associated with placental damage and decreased uteroplacental blood flow. Both pathways lead to fetal growth restriction and indicated preterm births. However, smoking itself is associated with a systemic inflammatory response and may increase spontaneous preterm birth through that pathway.

Alcohol consumption is not generally considered a major risk factor for preterm birth unless used in high quantities, whereas the use of substances, such as cocaine and heroin, have been associated with preterm birth in several studies. The mechanism(s) for the increase is not known. As education level and annual income decrease, the prevalence of injection drug use increases in the United States.^{11,12} Also, women who are unwed, aged 18–30 years, and have less than a high school education demonstrate a relatively higher prevalence of illicit drug use. Of pregnant women who use illicit substances, more than 50% also use tobacco and alcohol.¹³ The interaction of these behaviors and their collective effect on preterm outcomes is complex and deserves careful scrutiny to develop appropriate prevention, screening, and intervention tools to address substance use and abuse in this population.

Nutritional Status

Millions of households in the United States face food insufficiency and insecurity, the consequences of which

include hunger and malnutrition.¹⁴ These conditions disproportionately affect low-income households in the United States.¹⁵ Nutritional status during pregnancy can be described by indicators of body size, such as body mass index (BMI; measured in kilograms of body weight per square meter of body surface area), nutritional intake, and assessments for various analytes in the serum. In 1990, the Institute of Medicine defined underweight, normal weight, overweight, and obese categories by BMI.¹⁶ The relationship between maternal BMI and risk of adverse pregnancy outcomes appears to be bimodal, with an increased risk of preterm birth associated with both underweight and obese status.

The National Health and Nutrition Examination Survey data demonstrate that prevalence of obesity in women aged 20–39 years increased from 21% to 28% from 1988–1994 and 1999–2000.¹⁷ The increase in obesity and its associated morbidities has not spared any particular subgroup of women of childbearing age in the United States.¹⁸ However, the highest prevalence in obesity is seen in women with lower SES.¹⁹

Both poor and excessive weight gain are also associated with an increase in preterm birth. Women with a low BMI (<19.8 kg/m²) are at higher risk for spontaneous preterm delivery, whereas obesity may be protective against this condition but associated with other poor outcomes. Obese women are also more likely to have infants with congenital anomalies, such as neural tube defects, and these infants are more likely to be delivered preterm.

There are many potential mechanisms by which maternal nutritional status might influence preterm birth and fetal growth. Obese and morbidly obese women have an increased risk of gestational diabetes, preeclampsia, large size for gestational age and fetal macrosomia, and cesarean delivery.^{20–22} Increased fat intake is also associated with increased risk of bacterial vaginosis, an important precursor of preterm birth. For mechanisms related to maternal thinness, evidence suggests that maternal thinness is associated with decreased blood volume and less uterine blood flow, with spontaneous preterm birth occurring through this mechanism. Thin women also consume fewer vitamins and minerals. Having only low levels of these micronutrients is associated with decreased blood flow as well as increased maternal infections.

Intimate Partner Violence

IPV, most often perpetrated by a husband or partner, occurs in an estimated 4%–8% of pregnancies, exceeding the incidence of preeclampsia and gestational diabetes.^{23,24} IPV has a strong association with

poverty; it occurs with increased frequency and severity in lower-SES groups.²⁵ Also, having less than a high school education and receiving public assistance place women at a higher risk for IPV. Women may be marginalized by low SES because financial dependence may prevent women from leaving abusive relationships.²⁶ IPV is associated with multiple adverse pregnancy outcomes for both the mother and the fetus, including increased risk of preterm birth.^{27,28} The relationship between IPV and preterm delivery may be explained partially through the biologic response to chronic stress and depression. Also, sexual assault and sexually transmitted infection are present in many IPV relationships and may also contribute to the increased rates of preterm delivery.²⁷

Short Interpregnancy Interval

Pregnancies occurring soon after a previous delivery have an increased risk for preterm birth.^{29–31} Increased birth spacing is seen more commonly in communities with higher median incomes.³² In contrast, poverty and decreased educational engagement is associated with closely spaced second births in young women.³³ An interpregnancy interval less than 6 months confers a twofold-increased risk of preterm birth after adjustment for confounding variables. Furthermore, women whose first birth was preterm were far more likely to have a short interval than were women who had a term first birth, thus compounding the risk. Although the mechanism for preterm birth is not clear, one potential explanation is that the uterus requires time to return to its normal state, including resolution of the inflammatory status associated with the previous pregnancy. Maternal depletion may be another cause because pregnancy consumes maternal stores of essential vitamins, minerals, and amino acids. A short interval decreases the opportunity to replenish these nutrients.

Infectious Disease

Maternal colonization with various bacterial, fungal, protozoan, and viral organisms; their route of transmission; and their effect on pregnancy has been studied for many years. Previous reports have examined the role in adverse pregnancy outcomes (including preterm labor) of organisms, such as group B *Streptococcus*, hepatitis B virus, cytomegalovirus, and the organisms associated with bacterial vaginosis, such as the mycoplasmas, *Gardnerella vaginalis*, *Bacteroides*, and *Mobiluncus* species.

The most common infectious route of access to the uterine cavity during pregnancy is thought to be

through ascending infection from the vagina. Bacterial vaginosis and its associated intrauterine infections probably contribute far more to the overall burden of adverse pregnancy outcomes than the more classical perinatal infections such as rubella and syphilis. Diagnosed by a Nugent score of 7–10, bacterial vaginosis has been associated with a 1.5- to threefold-increased risk of preterm birth in more than 20 studies.^{34–36} In addition to bacterial vaginosis, chorioamnionitis, urinary tract infections, and periodontal disease have also been linked to increased risk of preterm birth. Earlier gestational age of preterm birth is more strongly correlated with increased frequency of maternal intrauterine infection. The proposed mechanism for intrauterine infection to contribute to preterm birth is through a pathway of inflammation leading to preterm labor or PPRM.

Bacterial vaginosis is more common among black, non-Hispanic women and Mexican American women than white women; in women living at, near, or below the federal poverty line; and in women with less than or equal to a high school education.³⁷ Also, among mothers of very-low-birth-weight infants, the risk for having chorioamnionitis is higher for black women than for white women and for women with 16 or fewer years of education.³⁸ Analysis of infection among women who had spontaneous very preterm births revealed an increasing rate of infection along an increasing gradient of social deprivation, as measured by the Index of Multiple Deprivation, which assesses SES through social, health, and economic domains.³⁹ No clear explanation exists for this disparity in infection rates in women on the basis of both race and SES.

Conclusion

Poverty or lower SES is associated with an increase in many of the medical and behavioral risk factors associated with preterm birth and other pregnancy outcomes. Although in any specific case determining the particular cause of preterm birth is often impossible, increasing numbers of risk factors—especially those that are associated with increases in systemic inflammation—are clearly often present in women who have a spontaneous preterm birth. Chronic hypertension, diabetes, and obesity—all more common in poor women, and the associated preeclampsia—are mostly responsible for the indicated preterm births. This increase of disease burden, coupled with a less timely utilization of both preventive and treatment health services, probably explains most of the discrepancy in pregnancy outcomes between poor and other women.

Conflicts of Interest

The authors declare no conflicts of interest.

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