Homelessness During Pregnancy: A Unique, Time-Dependent Risk Factor of Birth Outcomes

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Abstract Evaluate homelessness during pregnancy as a unique, time-dependent risk factor for adverse birth outcomes. 9,995 mothers of children <48 months old surveyed at emergency departments and primary care clinics in five US cities. Mothers were classified as either homeless during pregnancy with the index child, homeless only after the index child's birth, or consistently housed. Outcomes included birth weight as a continuous variable, as well as categorical outcomes of low birth weight (LBW; <2,500 g) and preterm delivery (<37 weeks). Multiple logistic regression and adjusted linear regression analyses were performed, comparing prenatal and postnatal homelessness with the referent group of consistently housed mothers, controlling for maternal demographic characteristics, smoking, and child age at interview. Prenatal homelessness was associated with higher adjusted odds of LBW (AOR 1.43, 95 % CI 1.14, 1.80, $p < 0.01$) and preterm delivery (AOR 1.24, 95 % CI 0.98, 1.56, $p = 0.08$), and a 53 g lower adjusted mean birth weight ($p = 0.08$). Postnatal homelessness was not associated with these outcomes. Prenatal homelessness is an independent risk factor for LBW, rather than merely a marker of adverse maternal and social characteristics associated with homelessness. Targeted interventions to provide housing and health care to homeless women during pregnancy may result in improved birth outcomes.

Keywords Pregnancy · Homeless · Low birth weight (LBW) · Preterm delivery · Housing · Maternal

Abbreviations

LBW	Low birth weight
PRAMS	Pregnancy Risk Assessment Monitoring System (PRAMS)
AOR	Adjusted odds ratio
CI	Confidence interval
WIC	Special Supplemental Nutrition Program for Women, Infants and Children

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Introduction

As many as 3.5 million people experience homelessness yearly [1, 2]. Children are disproportionately impacted; from 2007 to 2010 homelessness among children increased by 448,000–1.6 million children, or one in 45 US children [3]. Homeless children experience increased risk of acute illnesses, nutritional deficits, physical trauma, developmental

delays, chronic disease, emotional and behavioral problems, poor school attendance, and low academic achievement [4].

An increasing body of evidence identifies pregnancy as a uniquely vulnerable time for children's lifetime health and development [5–11]. Richards et al. [12] studied over 11,000 women in the Pregnancy Risk Assessment Monitoring System (PRAMS) from 2000 to 2007 and found that 4 % reported homelessness in the 12 months preceding the birth of their infant. Maternal homelessness the year prior to delivery was associated with a 69 g mean decrease in birth weight, a higher prevalence of low (1500–2,500 g) and very low (<1,500 g) birth weight, but no difference in gestational age, when compared to infants of housed women. Little et al. [13] reported both lower infant birth weight and a nearly threefold increased risk for preterm births in 3,895 Canadian women, homeless or "underhoused" (not further defined) during pregnancy. Homeless women are more likely than housed women to report violence exposure, substance use, low educational level, obesity or underweight, and chronic physical and mental health conditions [14–17]—all potentially compounded by decreased access to health care services [18]. Each of these conditions imposes an independent risk for poor pregnancy outcomes; frequently they occur together. Previous studies have not compared the birth outcomes of women experiencing homelessness at times other than during pregnancy, so it is not clear whether homelessness per se increases the risk of adverse birth outcomes, or whether homelessness serves as a marker of maternal and social characteristics.

The goal of the current analysis is to evaluate whether the recalled birth weight and gestational age of young low-income children whose mothers report homelessness during pregnancy differ from those recalled by mothers who have neither been homeless during the pregnancy nor within the lifetime of the child, as well as from mothers who were housed throughout pregnancy but became homeless after the child's birth, which we term postnatal homelessness. A finding that prenatal, but not postnatal, homelessness is associated with adverse birth outcomes would suggest that prenatal homelessness is unique, time-dependent risk factor, rather than a marker for other maternal and social characteristics.

Methods

This study analyzed cross-sectional data collected in Baltimore, Boston, Little Rock, Minneapolis, and Philadelphia. Interviewers elicited caregivers' verbal responses to a survey of household demographics and maternal and child health status, including respondent's recall of the index child's birth weight and gestational age. As published previously [19], subjects were caregivers (primarily mothers) of children younger than 48 months seeking medical care in emergency rooms or primary care clinics. Eligibility included English, Spanish, and (Minneapolis only) Somali speakers, state residency, and knowledge of the child's household. Caregivers of critically ill or injured children were excluded, as were those who had been interviewed previously. Institutional review board approval was obtained at each site prior to data collection and renewed annually. All research was conducted in accord with prevailing ethical principles.

Of 14,776 caregivers approached between May 2009 and December 2011, 2,254 (15.3 %) were ineligible for the study, and 1,286 (10.3 % of eligible) refused or were unable to complete the interview. To better ensure that participants had relatively similar economic backgrounds, those with private insurance were excluded (n = 1,129), as were those with missing housing variables (n = 112) leaving a final study sample of 9,995 caregiver/child pairs (Fig. 1).

Measures

Prenatal and postnatal homelessness were determined by affirmative responses to questions asking "were you ever homeless or did you live in shelter when you were pregnant with this child?" and "since your child was born has s/he ever been homeless or lived in a shelter?" Participants were further prompted that the term homeless included motel and other transitional living situations, or not having a steady place to sleep at night. Participants were categorized into three groups: (1) never homeless ("consistently housed"), the reference group; (2) homeless during pregnancy, regardless of postnatal homelessness ("prenatal homelessness"); and (3) homeless after child's birth only, not homeless prenatally ("postnatal homelessness"). Demographic variables included study site, mother's country of birth, age, race/ethnicity, marital status, education, and employment, child's gender and age. Participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), which has been associated with improved birth outcomes, was also included [20] Maternal smoking history, a recognized potential contributor to lower birth weight [21] was ascertained by asking about mother's history of cigarette use.

Birth outcomes were ascertained by maternal recall of gestational age and of birth weight. These responses were further categorized into low birth weight (LBW; <2,500 g) versus normal birth weight (≥2,500 g), and pre-term (<37 weeks) versus term or post-term gestation (≥37 weeks).

Fig. 1 Description of analytic sample selection
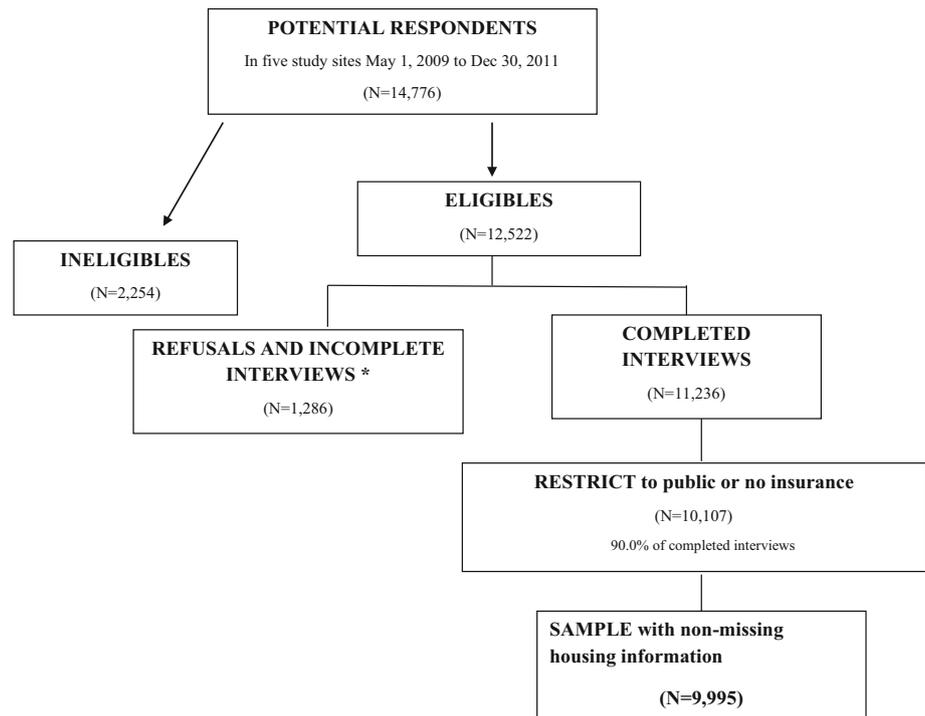
Statistical Techniques

Descriptive statistics included mothers' demographics, WIC participation, smoking history, and birth outcomes. Bivariate associations were assessed via Chi-square analyses or analysis of variance, as appropriate. To assess associations between housing status and dichotomous birth weight and preterm delivery outcomes, multiple logistic regression analyses were conducted using consistently housed mothers as the referent group. Analyses were adjusted for demographics (study site, mother's country of birth, race/ethnicity, marital status, education, employment, and the child's age at time of interview), and mother's smoking history. Linear regression analyses adjusting for the same covariates assessed associations between housing status and the continuous measure of birth weight in grams. Adjusted odds ratios (AOR) and 95 % confidence intervals are reported for logistic regression models and least square means are reported for linear regression models. All analyses were conducted using two-sided tests and a significance level of 0.05. Statistical analyses were performed using SAS software (version 9.2; SAS Institute, Cary, NC).

Results

Nine percent (n = 909) of 9,995 of these predominantly low-income mothers reported homelessness, compared to the more nationally representative PRAMs sample, where only 4 % of mothers reported homelessness. Two-thirds (n = 580) of the homeless sample were homeless prenatally (including 292 mothers that were homeless both prenatally and postnatally), and one-third (n = 329) were housed prenatally but homeless only after the birth of the index child (Table 1).

There was no difference in mean maternal age (26 years ± 6) among the three groups. Consistently housed mothers were more likely than both prenatally and postnatally homeless mothers to be married/partnered, employed and have higher levels of education. In comparison to mothers who were consistently housed, homeless mothers (particularly those homeless prenatally) were more likely to be US rather than foreign born (90 % US born). Prenatally homeless mothers were more likely than consistently housed mothers to acknowledge smoking cigarettes. WIC participation during the index pregnancy was 86 % in all three groups.

In bivariate analyses, rates of LBW were 14 % of consistently housed mothers, 15 % of the postnatally homeless, and 21 % of prenatally homeless ($p < 0.001$). Infants' mean birth weight did not differ between consistently housed and postnatally homeless mothers (3,096 vs. 3,095 g, $p = 0.98$), but birth weight was 87 g lower when infants of consistently housed mothers were compared to infants of prenatally homeless mothers (3,096 vs. 3,009 g, $p < 0.01$). Preterm deliveries were reported by 14 % of consistently housed, 17 % of postnatally homeless ($p < 0.05$), and 18 % of the prenatally homeless mothers ($p < 0.05$; Table 2).

Table 1 Sample description according to homelessness status (N = 9,995)

Variable	Overall n (%)	Consistently housed n (%)	Any prenatal homelessness n (%)	Postnatal homelessness only n (%)	p value
Total participants	9,995 (100)	9,086 (91)	580 (6)	329 (3)	
Site					
Baltimore	1,748 (17.5)	1,630 (17.9)	83 (14.3)	35 (10.6)	<0.01
Boston	1,686 (16.9)	1,280 (14.1)	240 (41.4)	166 (50.5)	
Little Rock	2,298 (23.0)	2,214 (24.4)	47 (8.1)	37 (11.2)	
Minneapolis	1,731 (17.3)	1,582 (17.4)	110 (19.0)	39 (11.9)	
Philadelphia	2,532 (25.3)	2,380 (26.2)	100 (17.2)	52 (15.8)	
Mother's place of birth (US vs. Foreign)					
US Born	7,853 (78.7)	7,066 (77.9)	521 (89.8)	266 (80.9)	<0.01
Age of child (months)					
Mean (std dev)	13.8 (11.4)	13.6 (11.4)	13.8 (11.2)	18.6 (11.2)	<0.01
Child gender					
Female	4,688 (46.9)	4,279 (47.1)	269 (46.4)	140 (42.6)	0.26
Child breastfed					
Yes	5,725 (57.3)	5,198 (57.3)	327 (56.5)	200 (60.8)	0.41
Mother's ethnicity					
Hispanic	2,883 (29.1)	2,649 (29.4)	142 (24.8)	92 (28.0)	<0.01
Black non hispanic	5,145 (52.0)	4,647 (51.7)	324 (56.5)	174 (53.0)	
White non hispanic	1,510 (15.3)	1,392 (15.5)	71 (12.4)	47 (14.3)	
Other[a]	359 (3.6)	308 (3.4)	36 (6.3)	15 (4.6)	
Marital status					
Married/partnered	4,190 (42.0)	3,978 (43.9)	140 (24.2)	72 (22.0)	<0.01
Mother's education attainment					
<High school diploma	2,800 (28.1)	2,504 (27.7)	182 (31.4)	114 (34.9)	0.02
High school	3,949 (39.7)	3,607 (39.9)	225 (38.8)	117 (35.8)	
>High school	3,208 (32.2)	2,939 (32.5)	173 (29.8)	96 (29.4)	
Mother's age					
Mean (std dev)	25.9 (5.8)	25.9 (5.8)	25.5 (5.7)	25.7 (5.7)	0.31
Mother's employment					
Employed	3,662 (36.6)	3,463 (38. 1)	131 (22.6)	68 (20.7)	<0.01
WIC[b] receipt during pregnancy					
Yes	8,381(85.6)	7,626 (85.5)	482 (86.7)	273 (85.6)	0.73
Smoking history					
Yes	2,650 (26.5)	2,259 (24.9)	267 (46.0)	124 (37.7)	<0.01

Percentages are column percents

[a] The breakdown for "other" race is Asian 98 (1 %) Native American 47 (<1 %) multiple races 214 (2.1 %)

[b] WIC stands for The Special Supplemental Nutrition Program for Women, Infants, and Children

Adjusted regression analysis demonstrated that prenatal homelessness was associated with a higher adjusted odds of LBW (AOR 1.43, 95 % CI 1.14, 1.80, $p < 0.01$) compared to infants of the referent group of housed mothers. There was no detectable difference, however, between adjusted odds of LBW for postnatally homeless mothers and consistently housed mothers (AOR 1.00, 95 % CI 0.72, 1.40, $p = 0.98$). Compared to consistently housed mothers, prenatally homeless mothers had marginally increased odds of preterm delivery (AOR 1.24, 95 % CI 0.98, 1.56, $p = 0.08$). Postnatally homeless mothers compared to consistently housed did not have significantly increased likelihood of preterm delivery (AOR 1.21, 95 % CI 0.89, 1.65, $p = 0.22$). After controlling for covariates, adjusted mean birth weight was 53 g less for babies of prenatally homeless mothers ($p = 0.08$) than for babies of consistently housed mothers, a difference of marginal statistical significance. In contrast, birth weights of infants of postnatally homeless mothers did not differ from those of consistently housed mothers (Table 3).

Table 2 Unadjusted birth outcomes of pre and postnatal homeless mothers

	Consistently housed n (%)	Any prenatal homelessness n (%)	Postnatal homelessness only n (%)	p value
Total participants	9,086 (91)	580 (6)	329 (3)	
Low birth weight[a]				
Yes < 2500 g	1,136 (13.8)	114 (20.5)	47 (14.8)	<0.01
Premature[b]				
Yes < 37 weeks	1,277 (14.1)	103 (17.8)	56 (17.2)	0.02
Birth weight in grams				
Mean (std dev)	3,096 (665)	3,009 (691)	3,095 (679)	0.01

[a] Low birth weight = <2500 g

[b] Premature = <37 weeks gestation at birth

Table 3 Adjusted birth outcomes of pre and postnatal homeless mothers

	Consistently housed	Any prenatal homelessness AOR (95 % CI)	Postnatal homelessness only AOR (95 % CI)	Overall p value
Low birth weight				
<2500 g	1.00	1.43 (1.14, 1.80)	1.0(0.72, 1.40)	0.01
		p < 0.01	2.0p = 0.98	
Premature				
<37 weeks GA	1.00	1.24 (0.98, 1.56)	1.21 (0.89, 1.63)	0.13
		p = 0.08	p = 0.22	
Birth weight in grams				
Least square mean (SEM)	3,093 (7.1)	3,040 (29.2)	3,106 (38.1)	0.19
	(ref)	p = 0.08	p = 0.73	

Adjusted for site, mother's birthplace, race/ethnicity, education, employment, marital status, child's age and mother's smoking history

AOR adjusted odds ratio, 95 % CI = 95 % confidence interval

Discussion

After controlling for many demographic and perinatal variables, we identified significantly increased adjusted odds of LBW for the infants of mothers reporting prenatal homelessness, when compared to infants of mothers consistently housed, and mothers with postnatal homelessness only. Findings of greater risk of preterm birth and a 53 g lower mean birth weight among infants of prenatally homeless mothers compared to infants of consistently housed mothers were marginally statistically significant. The measured demographic characteristics of the prenatally and postnatally homeless mothers did not differ significantly from each other, but did differ from those of consistently housed mothers. Infants born to postnatally homeless women did not differ in risk of LBW, gestational age, or mean birth weight from infants of consistently housed women. These results support the hypothesis that homelessness during pregnancy is an independent risk factor for adverse birth outcomes.

These findings are important as the face of homelessness has shifted from unemployed single men and individuals with chronic mental illness to families with children [2, 22]. While the number of homeless persons has remained relatively constant over the past 5 years [4], family homelessness is increasing rapidly in many parts of the United States [2, 23, 24] accounting for 35 % of the total homeless population [25]. Single women, many of childbearing age, comprised 27 % of the homeless surveyed in 2010 [25, 26], but more recent post-recession numbers for homelessness during pregnancy are not available nationally.

Multiple pathways, not measured in the current study, may be responsible for adverse gestational effects among pregnant women experiencing homelessness. Poor access to prenatal care and nutrition may contribute to LBW and shorter gestation among infants of prenatally homeless mothers [27]. Single women living in temporary housing are at risk of nutrient intake deficiencies such as iron deficiency anemia, a known correlate of LBW [19, 28]. Lack of appropriate foods and limited meal preparation facilities in shelter situations are recognized barriers to healthy nutritional status [29].

We acknowledge several limitations of our study. Information regarding housing situation during and after pregnancy as well as birth weight and gestational age was self-reported and retrospective, and may be subject to bias or poor recall. However, accuracy of birth weight recall has been previously validated [30, 31] and parent's recall of gestational age is believed to be accurate, based on clinical and epidemiological studies [32]. Consideration of the duration of homelessness, and the type and quality of

alternative living arrangement was beyond the scope of this work. The housing quality of mothers considered consistently housed is unknown, but may vary greatly. We did not collect information regarding maternal exposure to domestic violence, reportedly more common during pregnancy, associated with poor pregnancy outcomes [33], and consistently identified as a primary cause of homelessness for women and children in the US. Data regarding possible pregnancy-related work limitations or illegal job discrimination based on pregnancy resulting in decreased or eliminated earnings were unavailable, but may also contribute to the evolution of economic hardship and homelessness with differentiating impact on birth outcomes. We do not have information regarding maternal housing status before conception or prior to the detection of pregnancy, a period that has become the focus of increased concern and study for its impact on birth outcomes. Although questions regarding maternal depression and maternal health status are included in the survey, they are not asked specifically in relationship to the prenatal period, precluding analysis of their contribution to birth outcomes. While maternal alcohol and illicit drug use have been associated with LBW and prematurity, questions about these prenatal exposures are not part of the survey. Other studies show mothers' cigarette smoking during pregnancy is a stronger predictor of LBW than prenatal drug use [34–36]. Smoking was included in our analysis and the association of prenatal homelessness with increased odds of LBW was robust after controlling for mother's smoking.

Other unmeasured covariates may plausibly contribute to the adverse birth outcomes described here. Crowding, typical of many shelters and transient living situations, is associated with LBW [37, 38]. Limited social capital, an antecedent of homelessness [2], may indicate not only limited material resources but also lack of emotional support important to maternal self-care. Maternal stress, depression, and anxiety, reported at higher levels for homeless women [39] and associated with hypertension and increased cortisol, all have been linked to greater likelihood of LBW and preterm babies [40]. Finally, as in all studies demonstrating association, positive findings may identify risk factors that are associated with but not causal of the outcome.

The findings of this study have clinical and public policy implications. Low birth weight and prematurity are leading causes of neonatal mortality and chronic disabilities in the US [41, 42]. Although the risk of complications is greatest among the earliest and smallest babies, even those babies born late preterm at 34–37 weeks gestation are more likely than are full-term babies to experience complications [28, 29, 43]. These babies require longer hospital stays and more frequent readmission [27]; and show higher rates of developmental disabilities [29], including ADHD, as they

are followed into their school years, and lower rates of adult productivity in 20 years follow-up studies [27]. Thus exposure to homelessness in the prenatal period may have long term health and economic implications.

Potential solutions to homelessness exist, but have not expanded fast enough to keep pace with rising need. The McKinney–Vento Homeless Assistance Act [44] states that "the Federal Government has a clear responsibility and an existing capacity to fulfill a more effective and responsible role to meet the basic human needs and to engender respect for the human dignity of the homeless." In 1987, the US Interagency Council on Homelessness (USICH), an independent agency within the federal executive branch composed of 19 Cabinet secretaries and agency heads, was created to coordinate the federal response to homelessness and to develop a national partnership at every level of government to reduce and end homelessness in America [45]. More recently, the American Recovery and Reinvestment Act of 2009 allocated $1.5 billion to the Homelessness Prevention and Rapid Re-Housing Program [46]. The USICH endorses rapid re-housing, an alternative to emergency shelter and transitional housing that moves homeless individuals and households into stable housing as quickly as possible [47]. Expiration of ARRA-funded programs and budget cuts threaten the viability of these programs [48]. Moreover, urban areas, like Boston, with the highest housing costs may need additional intervention to prevent prenatal homelessness.

Conclusion

Increasing numbers of US infants are born to mothers who are homeless while pregnant. This work suggests that homelessness during pregnancy is an independent risk factor for LBW <2,500 g, with a marginally significant trend for lower average birth weight and shortened gestation. Low birth weight prevention programs will be strengthened by reducing homelessness during pregnancy. We provide evidence justifying consideration of policies providing rapid rehousing for homeless pregnant women and prioritizing measures to prevent homelessness during pregnancy by enhanced access to housing assistance, housing relocation and stabilization services. Pregnant victims of domestic violence may require specific legal protection from eviction. Homeless women of child-bearing age should also be targeted for programs of preconception care, including family planning, interventions for cessation of tobacco and other substance use, early identification of pregnancy and access to appropriate nutrition and medical care. Such measures in may facilitate more optimal birth outcomes, ultimately decreasing medical, educational, and societal costs.

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