Unconditional Prenatal Income Supplement and Birth Outcomes

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abstract

BACKGROUND AND OBJECTIVES: Perinatal outcomes have improved in developed countries but remain poor for disadvantaged populations. We examined whether an unconditional income supplement to low-income pregnant women was associated with improved birth outcomes.

METHODS: This study included all mother–newborn pairs (2003–2010) in Manitoba, Canada, where the mother received prenatal social assistance, the infant was born in the hospital, and the pair had a risk screen (N = 14 591). Low-income women who received the income supplement (Healthy Baby Prenatal Benefit [HBPB], n = 10 738) were compared with low-income women who did not receive HBPB (n = 3853) on the following factors: low birth weight, preterm, small and large for gestational age, Apgar score, breastfeeding initiation, neonatal readmission, and newborn hospital length of stay (LOS). Covariates from risk screens were used to develop propensity scores and to balance differences between groups in regression models; γ sensitivity analyses were conducted to assess sensitivity to unmeasured confounding. Population-attributable and preventable fractions were calculated.

RESULTS: HBPB was associated with reductions in low birth weight (aRR, 0.71 [95% CI, 0.63–0.81]), preterm births (aRR, 0.76 [95% CI, 0.69–0.84]) and small for gestational age births (aRR, 0.90 [95% CI, 0.81–0.99]) and increases in breastfeeding (aRR, 1.06 [95% CI, 1.03–1.09]) and large for gestational age births (aRR, 1.13 [95% CI, 1.05–1.23]). For vaginal births, HBPB was associated with shortened LOS (weighted mean, 2.86; P < .0001). Results for breastfeeding, low birth weight, preterm birth, and LOS were robust to unmeasured confounding. Reductions of 21% (95% CI, 13.6–28.3) for low birth weight births and 17.5% (95% CI, 11.2–23.8) for preterm births were associated with HBPB.

CONCLUSIONS: Receipt of an unconditional prenatal income supplement was associated with positive outcomes. Placing conditions on income supplements may not be necessary to promote prenatal and perinatal health.

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WHAT'S KNOWN ON THIS SUBJECT: Perinatal outcomes have improved in developed countries but remain poor for socioeconomically disadvantaged populations. Evaluations of conditional income supplement programs for low-income pregnant women have yielded mixed results because of methodologic challenges.

WHAT THIS STUDY ADDS: Using propensity scores to balance exposed and unexposed groups, we found that an unconditional prenatal income supplement was associated with positive perinatal results. Placing conditions on income supplements may not be necessary to promote prenatal and perinatal health.

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The prenatal period is crucial in terms of both newborn and lifelong health.[1–3] Prenatal exposure to factors (including severe stress, poor nutrition, and substance use) can lead to adverse birth outcomes such as low birth weight and preterm births, which have an impact on health and development throughout childhood and beyond.[2,4–17] Women living in poverty are more likely to be exposed to high levels of stress, have inadequate nutritional intake, and smoke and/or drink or use substances during pregnancy; they are also more likely to give birth to preterm or low birth weight infants.[18]

Considerable focus has been placed on improving outcomes for infants born to women living in poverty, through the use of prenatal interventions, in both developed and developing countries. There are several programs in Latin America, including Oportunidades in Mexico[19] and the Bolsa Familia Program in Brazil,[20] that provide money conditional on certain behaviors such as attending prenatal care.[19–21] Although many of these programs are not administered specifically during the prenatal period, they have been found to influence birth outcomes.[22] A Cochrane Review of 10 evaluations of conditional cash transfer programs concluded that although there was strong evidence of a positive impact on health service utilization and health outcomes, it was difficult to determine the role the cash incentives played in the outcomes.[21] An examination of participants in the Oportunidades program concluded that it was the cash itself that was leading to health benefits.[19]

In the United States, programs aimed at promoting prenatal health for women living in poverty have followed a different model, typically offering free services rather than conditional cash transfers. One of the best known, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), targets low-income women in the prenatal and postnatal periods and provides food supplementation, nutrition education, and access to health care services.[23] Evaluations of WIC have yielded mixed results, mainly due to challenges with identifying comparable exposed and unexposed groups.[24–29] An evaluation using propensity score matching concluded that previous positive associations between birth outcomes and WIC may have been exaggerated due to estimation methods that did not account for unmeasured confounding.[27]

In 2001, the Canadian province of Manitoba introduced the Healthy Baby Prenatal Benefit (HBPB) to improve prenatal health and birth outcomes. Within Canada's universal health care, prenatal care is already provided free of cost. HBPB provides prenatal income support (up to Can$81.41 monthly) to low-income women during the second and third trimesters. HBPB is unique in that the income supplement is provided without any conditions. Although pamphlets about the importance of good prenatal nutrition and information about breastfeeding and healthy infant development accompany the mailed monthly payment, women can spend the money as they see fit. The objective of the present study was to determine whether an unconditional income supplement to low-income pregnant women was associated with improved birth outcomes.

METHODS

Population and Data Source

This study was conducted at the Manitoba Centre for Health Policy, as part of the PATHS Equity for Children program of research,[30] and received approval from the University of Manitoba's Health Research Ethics Board. Data came from the PATHS Data Resource, which collects population-wide, de-identified health and social services data for children registered for the universal health care program in Manitoba (population, 1.2 million).[30–33] The databases used in this study included HBPB program data, newborn risk screen data, hospital discharge abstracts, social assistance (ie, welfare), physician visit records, prescription medication records, a population health registry, and the Canadian census.

All low-income pregnant women are eligible to apply for HBPB, and those applicants with documented annual incomes below Can$32 000 whose pregnancy has been confirmed by a physician are enrolled. The Healthy Child Manitoba Office, which administers HBPB, maintains administrative data on all applicants and recipients. They also maintain a database of information about families with newborns from a universal risk screen that is administered shortly after birth by public health nurses.[34] This screen provides information about prenatal health and health behaviors as well as social risk factors. Both these databases are linkable at the individual level to the population-wide information on health and social service use, using a scrambled identifier. The ability to combine program participation information with information on family risk factors and service use presented an exceptional opportunity to evaluate the impact of HBPB by enabling us to ensure comparability between those exposed and not exposed. The validity of data in the PATHS Data Resource has been well documented.[32,35–40]

The initial study population included all mother–infant pairs for Manitoba women who had a live hospital birth from January 1, 2003, through December 31, 2010 (Fig 1); <1% of Manitoba births occur at home.[41] A quasi-experimental retrospective cohort design was used, comparing birth outcomes for infants of women

who received (exposed) or did not receive (unexposed) HBPB. Although almost one-third of pregnant women are eligible for HBPB,[42] we selected all women receiving welfare during pregnancy (N = 16 557) to identify comparable exposed and unexposed groups; almost one-half of those eligible for HBPB receive welfare. Pregnant women receiving welfare represent a very-low-income population, requiring help to meet basic personal and family needs, and are therefore a group at risk for poor birth outcomes. Preliminary analyses found that the exposed and unexposed groups of women receiving welfare during pregnancy had comparable low mean annual incomes at Can$9941 and Can$9972, respectively; HBPB represents an almost 10% increase in their monthly income. Although all women receiving welfare during pregnancy are eligible for HBPB, not all apply. Reasons for not applying are not recorded but could affect the comparability between the exposed and unexposed groups. The newborn risk screen was developed and validated for predicting families at risk for maltreating their children.[34] Screen data are available for almost all families with newborns in the province, and they contain detailed information on factors such as health behaviors (eg, prenatal smoking, alcohol consumption), maternal mental health, and family functioning. Information from newborn risk screens was used to ensure comparability of the exposed and unexposed groups.

Measures

The exposure variable was whether the mother received HBPB. Because the preliminary analyses revealed that almost all HBPB recipients in our study (99.1%) received the maximum benefit, a dose–response effect was not examined. Information on birth outcomes was extracted from hospital discharge abstracts.

TABLE 1 Outcomes Examined for Exposed (Received HBPB) and Unexposed (Did Not Receive HBPB) Groups

Outcome	Definition
Low birth weight	<2500 g
Preterm birth	<37 wk gestational age
Small for gestational age	<10th percentile for gestational age and gender, using a Canadian standard[43]
Large for gestational age	>90th percentile for gestational age and gender, using a Canadian standard[43]
5-min Apgar score	Dichotomized into ≤7 and ≥8
Breastfeeding initiation	Exclusive or partial breastfeeding at hospital discharge
Neonatal readmission	Readmission to any Manitoba hospital within 28 d of birth
LOS, birth hospitalization	LOS at birth; continuous measures calculated separately for infants delivered vaginally and by cesarean delivery due to different stays expected for these groups

Definitions of outcomes examined are given in Table 1.

A number of covariates were available for the exposed and unexposed groups (Table 2). Most of these were taken from the newborn risk screen and were answered yes or no; where information was missing, a third category ("missing") was added. Additional confounders analyzed were: maternal diabetes, defined

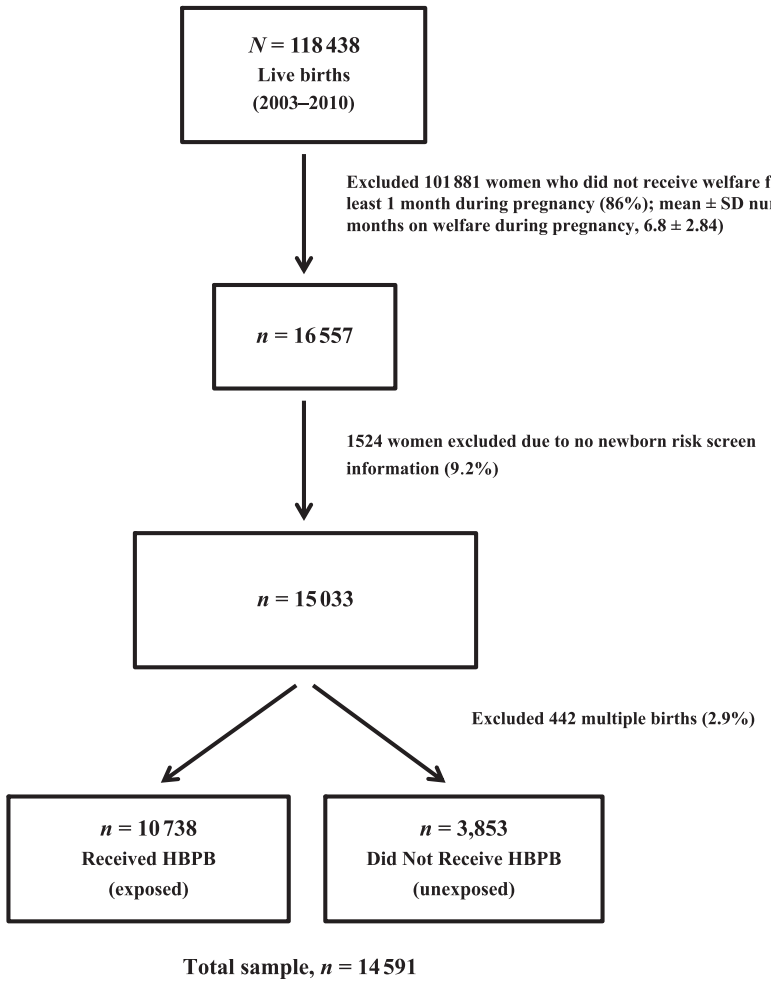

FIGURE 1
Selection of low-income groups exposed and not exposed to the HBPB.

through a combination of hospital visit, physician visit, and medication records[44,45]; mother's age at birth of first child,[46] from the population health registry; and an index of area-level socioeconomic status[47] compiled from Canada census data.

Statistical Analysis

Due to the potential for systematic differences between women on welfare who did or did not apply for HBPB, propensity scores were used to adjust for measured confounding.[48,49] A woman's propensity score is her probability of receiving HBPB, given her measurable characteristics. Adjusting for the propensity score is an efficient strategy to test for and balance observed differences between those receiving and not receiving HBPB. Propensity scores allow one to make comparisons between similar exposed and unexposed groups. Propensity scores were estimated by using multiple logistic regression, with HBPB as the dependent variable and the covariates presented in Table 2. The estimated propensity scores were used to construct inverse probability of treatment weights (IPTWs). IPTWs were applied to the data to balance differences in observed characteristics between HPBP recipients and nonrecipients. We tested whether the measured confounding covariates were balanced by using standardized differences,[50–52] set at an a priori 10% difference.[50] Once we achieved balance in measured covariates, IPTWs were applied to all outcome models to estimate the adjusted association between receipt of HBPB and the outcomes.

Outcome Models

Dichotomous outcomes were modeled by using generalized linear models with a binomial distribution. The log-link function was used to estimate the risk ratio associated with receiving HBPB for each outcome. We first modeled crude risk ratios and then modeled propensity score–adjusted risk ratios by applying the IPTWs to the dichotomous outcome models.

The 2 continuous hospital length of stay (LOS) outcomes were modeled by using generalized linear models with a negative binomial distribution. The log-link function was used to estimate the ratio in mean LOS associated with exposure to HBPB, first modeling crude mean LOS ratios and then modeling propensity score–adjusted LOS ratios by applying the IPTWs.

Sensitivity Analysis

Multiple regression and propensity score methods rest on the assumption that adjustment controls for measured and unmeasured confounding. Although this assumption cannot be directly tested, sensitivity to unmeasured confounding can be assessed.[53] We conducted a γ sensitivity analysis

TABLE 2 Characteristics of Women on Welfare During Pregnancy According to Receipt of HBPB

Characteristic	Before IPTW Applied				After IPTW Applied: Standardized Differences
	Received HBPB	Did Not Receive HBPB	*P*	Standardized Differences	
Categorical variables					
Received screen prenatally[a]	1074 (10.0)	192 (5.0)	<.001	19.15	0.14
Alcohol use during pregnancy	2378 (22.2)	789 (20.5)	.03	4.07	1.07
Drug use during pregnancy	1446 (13.5)	456 (11.8)	.01	4.91	0.37
Family history of disability	375 (3.5)	136 (3.5)	.91	0.20	0.69
Smoked during pregnancy	4954 (46.1)	1783 (46.3)	.88	0.28	0.11
Mother did not complete high school	4932 (45.9)	1628 (42.3)	<.001	7.41	0.61
Received welfare	6863 (63.9)	2001 (51.9)	<.001	24.45	0.41
Single-parent family	4722 (44.0)	1376 (35.7)	<.001	16.94	0.75
No prenatal care before 6 mo	626 (5.8)	430 (11.2)	<.001	19.21	0.14
Mother has depression	2110 (19.7)	602 (15.6)	<.001	10.58	0.31
Mother has anxiety disorder	719 (6.7)	196 (5.1)	<.001	6.84	1.17
Mother has schizophrenia	130 (1.2)	38 (1.0)	.24	2.15	0.36
Mother has a mental disability	136 (1.3)	45 (1.2)	.63	0.90	0.51
Antisocial father	402 (3.7)	95 (2.5)	<.001	7.37	0.93
Antisocial mother	182 (1.7)	55 (1.4)	.24	2.16	0.27
Current substance abuse by mother	283 (2.6)	100 (2.6)	.89	0.25	0.22
Social isolation	692 (6.4)	248 (6.4)	.99	0.03	0.19
Relationship distress	1631 (15.2)	472 (12.3)	<.001	8.55	0.46
Violence between parents	769 (7.2)	211 (5.5)	<.001	6.93	0.27
Mother abused as a child	1686 (15.7)	504 (13.1)	<.001	7.47	0.52
Maternal diabetes	268 (2.5)	62 (1.6)	<.001	6.26	0.80
Continuous variables					
Mother's age at first birth				4.21	1.00
Count	10738	3853			
Mean	19.8	19.6			
Median	19.1	19.0			
SD	3.4	3.5			
Minimum	12.0	12.2			
Maximum	42.7	43.7			
Area-level SES index (higher value = low SES)				13.40	0.70
Count	10729	3849			
Mean	0.9	0.8			
Median	0.8	0.7			
SD	0.9	0.9			
Minimum	−2.9	−2.9			
Maximum	3.9	3.9			

Data are presented as *n* (%) or %. SES, socioeconomic status.

[a] Screens are generally completed postnatally, and prenatal screens are indicative of higher risk families.

TABLE 3 Crude Rates or Means and Relative Risks or Means for Birth Outcomes and Neonatal Readmission for Exposed (Received HBPB) and Unexposed (Did Not Receive HBPB) Groups

Outcome	Crude Rates, %		Risk Ratio	95% CI	*P*	Sensitivity to Unmeasured Confounding[a]
	HBPB	No HBPB				
Breastfeeding initiation	64.2	58.9	1.06	1.03–1.09	<.0001	56.4
Low birth weight (<2500 g)	5.1	7.8	0.71	0.63–0.81	<.0001	61.8
Preterm (<37 wk gestation)	8.2	11.3	0.76	0.69–0.84	<.0001	62.9
Small for gestational age	8.3	9.6	0.90	0.81–0.99	.05	1.8
Large for gestational age	16.1	13.9	1.13	1.05–1.23	.001	38.8
Low 5-min Apgar score	3.7	4.0	0.93	0.79–1.09	.36	NS
Neonatal readmission (<29 d)	2.7	2.7	1.02	0.84–1.25	.82	NS
	Unweighted Means		Weighted Mean (95% CI)			
Birth hospital LOS	HBPB	No HBPB	HBPB	No HBPB		
Births by cesarean delivery	7.1	7.6	7.13 (6.78–7.48)	7.17 (6.79–7.55)	.87	
Vaginal births	2.9	3.1	2.86 (2.79–2.92)	3.11 (3.03–3.20)	<.0001	

[a] Analyzed by using γ sensitivity test; γ sensitivity analysis was not calculated for those findings that were not statistically significant (NS).

to answer the question: how strong would any unmeasured confounder have to be to nullify our statistically significant results? Examples of potential unmeasured confounders that might differ between our groups and be associated with newborn outcomes include whether the pregnancy was planned and self-care factors (eg, nutritional intake, stress reduction).

Population-Attributable and Population-Preventable Fractions

To quantify the impact of HBPB, population-attributable fractions (PAFs) and population-preventable fractions (PPFs) were calculated. For outcomes in which HBPB was associated with an increase, the PAF was calculated by using the formula PAF = Pe × [(RR – 1)/RR], where *Pe* is prevalence of the exposure.[54] For outcomes in which HBPB was associated with a reduction, the PPF was calculated by using the formula PPF = Pe × (1-RR). For both measures, confidence intervals (CIs) were calculated by using the SD of a bootstrapped mean PAF (or PPF) derived from 500 samples of the population.

RESULTS

There were 14 591 women who gave birth to live singletons in Manitoba between 2003 and 2010 who had received welfare during pregnancy and had risk screen information; of these, 10 738 received HBPB, and 3853 did not (Fig 1). Table 2 displays the number and percentage of women in each group for each covariate, as well as the standardized differences between the groups exposed and unexposed to HBPB, before and after applying the IPTWs. Before applying the weights, the standardized differences between the groups ranged from 0.03% to 24.5%. Many variables had standardized differences <10% even before applying the IPTWs. After applying the IPTWs, all covariates had standardized differences <1.2%. Examination of kernel density plots confirmed that propensity scores for the groups overlapped, and no trimming was necessary.

Table 3 shows the crude rates and adjusted relative risks (aRRs) for each of the birth outcomes in the exposed and unexposed groups. Receiving HBPB was associated with reductions in low birth weight, preterm and small for gestational age births, and increases in breastfeeding initiation and large for gestational age births. HBPB was not associated with 5-minute Apgar scores or neonatal hospital readmissions. Table 3 also shows the mean birth hospitalization LOS for infants born to mothers exposed or unexposed to HBPB. For infants born by cesarean delivery, there were no significant differences between groups ($P = .87$); for infants born vaginally, receipt of HBPB was associated with shorter LOS ($P < .0001$).

Sensitivity analyses found that HBPB's associations with breastfeeding initiation, low birth weight, preterm birth, and mean LOS for vaginal births were robust to unmeasured confounding (Table 3). After adjusting for the confounders included in the propensity score, there would need to be an unmeasured confounder that both perfectly predicted receipt of HBPB and accounted for ~60% of the relationship between HBPB and these 4 outcomes. The likelihood of such a confounder existing, after adjusting for covariates included in the propensity score, is very small. The findings regarding large for gestational age may be more sensitive to unmeasured confounding. Finally, the findings related to small for gestational age were very sensitive to unmeasured confounding and could potentially become nonsignificant if unmeasured confounders were included in our models.

Figure 2 illustrates the PAF for breastfeeding (4% increase) and PPF for low birth weight and preterm birth (21% and 17.5% decrease, respectively).

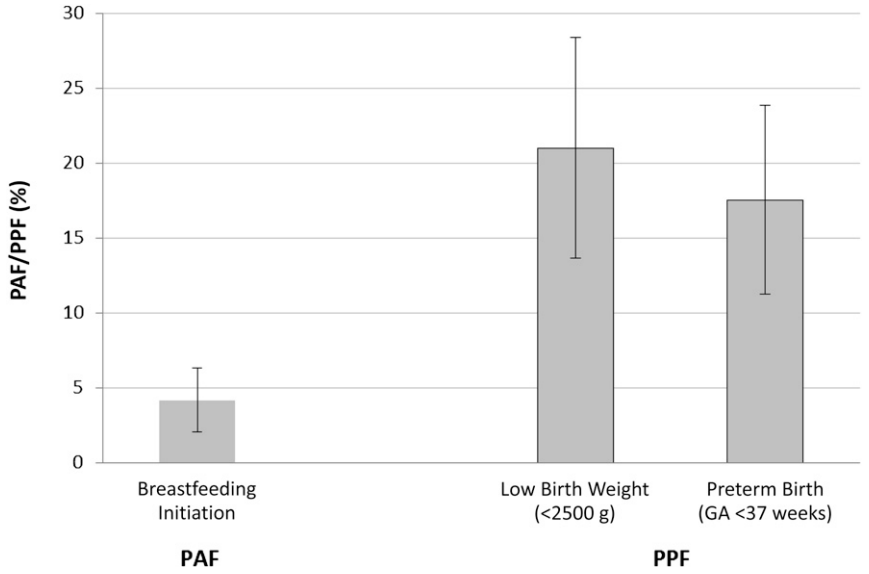

FIGURE 2
PAF and PPF associated with receipt of the HBPB. GA, gestational age.

DISCUSSION

Receipt of an unconditional prenatal income supplement by very-low-income women was associated with a number of positive outcomes: increased breastfeeding initiation; reductions in low birth weight, preterm births, and small for gestational age births; and shorter birth hospital stays for infants born vaginally. The provision of money to recipients without applying conditions differentiates this study from others in the literature. Birth outcomes improved, without requiring any specific actions from recipients to receive the income benefit or providing them with vouchers to buy specific food items.

As a society, we tend to assume that poor people cannot be trusted to make good choices. Indeed, when HBPB was first introduced in Manitoba, concerns were expressed about introducing a program for low-income women without conditions or accountability.[55] Although information about prenatal and infant health is included with the monthly payment, the Manitoba HBPB program trusts low-income women to make good choices regarding their pregnancies. There is a growing body of evidence demonstrating improvements to child outcomes associated with increased family income that warrant attention from decision-makers.[56–63]

One strength of this study was the use of administrative data to identify all those eligible for HBPB, including those receiving and not receiving the supplement. Combining population-based databases on program participation with information on family risk factors and service use avoids the problems associated with reporting and recall bias.[27] Previous evaluations of similar programs have been limited by potential underreporting of program involvement and have proposed using administrative data to overcome this bias.

A further strength of this study was the availability of an extensive array of risk factors that are rarely available in administrative data.[27,64] These factors allowed us to balance measured differences between HBPB recipients and nonrecipients and ensure that those among our population of very-low-income women who received HBPB were comparable to those who did not, based on these observed characteristics. Although we could not directly test whether the propensity score controlled for all unmeasured confounding, our analysis allowed us to assess the sensitivity of our findings.[53] We found that 4 of our 6 statistically significant associations were robust to unmeasured confounding: increased breastfeeding initiation and decreased low birth weight births, preterm births, and birth hospital LOS. Thus, based on the measured associations and the sensitivity analyses, the HBPB program seems to be improving these 4 infant health outcomes.

The benefits of breastfeeding, for both the developing infant[65–69] and the mother,[70–74] have been so clearly demonstrated that the US Surgeon General has called for action to support breastfeeding.[75] In our study, the increased breastfeeding initiation associated with HBPB was likely the result of information about the importance of breastfeeding sent with the monthly payment. The increase in breastfeeding is an important finding given that this very-low-income population is the least likely to breastfeed[76]; however, the PAF for breastfeeding was relatively small (4%), and our measure included only initiation, not duration. Research on similar programs (eg, WIC) has yielded equivocal results, with some studies actually finding reductions in breastfeeding initiation and duration associated with the program[26,77–79]; others that have more adequately controlled for confounding have found no association between WIC and breastfeeding.[80]

There is extensive literature on both the short- and long-term adverse effects of low birth weight[2,5,7, 10,81–84] and preterm births,[13,85–87] underscoring the importance of reducing these outcomes, particularly for vulnerable populations. Although reductions in low birth weight and preterm births have been found for

WIC in previous evaluations,[24,29] more sophisticated analyses suggest that previous positive findings may have more to do with selection bias than actual program effects.[27,88] Increases in birth weight were associated with WIC according to a design that exploited county-level variation in roll-out.[29] We found that the reductions in low birth weight and preterm births associated with HBPB were robust to unmeasured confounding, and they translated into the prevention of 21% of all low birth weight births and 17.5% of all preterm births for this vulnerable population.

Shorter hospital stays for uncomplicated vaginal births have medical, economic, and social benefits,[89,90] and they are indicative of better overall health of the mother and newborn.[91] We found that infants born to mothers receiving HBPB had significantly shorter birth hospital stays. Although modest, the LOS reduction associated with HBPB could translate into considerable savings in hospital days if this entire population received HBPB.

Despite the extensive array of risk factors available for propensity scores, a limitation of this study is the endogeneity bias that cannot be accounted for. The sensitivity analysis conducted attempted to address this factor; however, we cannot know for certain how unmeasured confounding influenced our findings.

Furthermore, to ensure comparability of income between our exposed and unexposed groups, we limited our evaluation to women receiving welfare rather than examining all low-income women receiving the income supplement during pregnancy. This approach limits the generalizability of our findings, although the population we examined is more comparable to the very-low-income women participating in the US WIC program, and thus the findings may be applicable to that population.

A further limitation was our inability to determine why HBPB made a difference: was the additional money used for more nutritious food? Was stress reduced because rent could be paid on time? Research on the Earned Income Tax Credit in the United States suggests that increased income to low wage earners results in better nutritional intake for women in general,[63] decreased smoking for pregnant women,[60,62,92] and more prenatal care. Findings of increased infant birth weight associated with the Food Stamp Program also suggest that prenatal nutritional intake plays a role.[93] Future research should include qualitative analyses to explore how and why the modest monthly income supplement provided through HBPB made a difference to recipients' pregnancies. It is also important to explore the barriers that prevent eligible women from receiving HBPB.

CONCLUSIONS

Using a quasi-experimental, retrospective cohort study design, we found that receipt of an unconditional income supplement by very-low-income women during pregnancy was associated with several positive outcomes: increased breastfeeding initiation, reductions in low birth weight and preterm births, and shorter mean length of birth hospital stay. Placing conditions on income supplements may not be necessary to promote prenatal and perinatal health.

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ABBREVIATIONS

aRR: adjusted relative risk
CI: confidence interval
HBPB: Healthy Baby Prenatal Benefit
IPTW: inverse probability of treatment weights
LOS: length of stay
PAF: population-attributable fraction
PPF: population-preventable fraction
WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

Mr Sarkar and Ms Taylor conducted the analyses, and reviewed and revised the manuscript; and Drs Brownell, Chartier, Nickel, Chateau, Burland, Jutte, Santos, Katz, Mr Sarkar, and Ms Taylor approved the final manuscript as submitted.

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