

Effects of Psychosocial Risk Factors and Prenatal Interventions on Birth Weight: Evidence From New Jersey's HealthStart Program

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CONTEXT: Many states developed and implemented multifaceted Medicaid prenatal care programs in the late 1980s in response to expansions in Medicaid eligibility. Although these new programs were based on the presumed relationships between psychosocial risk factors, early prenatal care, prenatal interventions and birth outcomes, research has not verified all of these linkages.

METHODS: Data were collected on 90,117 women who took part in New Jersey's comprehensive prenatal care program, HealthStart, between 1988 and 1996. The impact of psychosocial risk factors and prenatal interventions on mean birth weight and the odds of low birth weight (less than 2,500 g) was assessed using ordinary least-squares regression and logistic regression, respectively.

RESULTS: After controls were introduced for social and demographic, psychosocial and behavioral factors, as well as the woman's county of residence and the year of her baby's birth, smoking, drinking and using hard drugs (but not marijuana) during pregnancy were independently associated with reductions in mean birth weight (of 123 g, 29 g and 137 g, respectively) and with increases in the odds of low birth weight (odds ratios, 1.4, 1.2 and 1.7, respectively). However, according to the fully adjusted model, which also controlled for medical risk factors and prenatal services, the interventions designed to reduce those behaviors had no favorable effects on birth weight. In contrast, the receipt of services in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) was associated with an increase in mean birth weight of 22 g (and of 48 g among inadequately nourished women only), and with a reduction in the risk of low birth weight (odds ratio, 0.87).

CONCLUSION: Referrals to WIC services should be a key feature of prenatal care programs for poor women.

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The Medicaid expansions for pregnant women in the late 1980s focused primarily on increasing eligibility for prenatal care. However, they also allowed states to receive matching funds to enhance that care. The Consolidated Omnibus Budget Reconciliation Act of 1985 permitted states to provide case management services to Medicaid recipients on the basis of the notion that good prenatal care goes beyond providing standard medical care and encompasses identifying risk and coordinating treatment with social service agencies.

Later, the Omnibus Budget Reconciliation Act of 1989 required states to notify eligible Medicaid recipients about the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and its benefits, and to refer them to the WIC agency in their area. In response to the new laws, many local and statewide initiatives developed comprehensive prenatal care programs focused on providing multifaceted care to poor women. Many of these initiatives included features such as case coordination, treatment for alcohol and drug abuse, referrals to smoking cessation programs, counseling and psychological support, home visits and health education.

Although this new wave of multifaceted prenatal programs was based on the presumed relationships between

psychosocial risk factors, early prenatal care, prenatal interventions and birth outcomes, research has yet to verify all of these linkages. Several studies have assessed the effects of psychosocial risk factors, including maternal behaviors, on the timing of prenatal care,¹ and others have evaluated the effects of participation in enhanced programs on prenatal care use and birth outcomes.² While much research has focused on the effects of smoking and substance abuse on birth outcomes, only a few studies have assessed the effects of psychosocial risk factors other than maternal behaviors,³ and these generally have looked at a limited number of individual factors or broad measures of psychosocial stress.

Even fewer studies have evaluated the effects on birth outcomes of different psychosocial interventions within enriched prenatal care programs, mainly because few large data sets contain sufficient individual-level information. One study found that the receipt of more than 45 minutes of psychosocial services was related to a reduced rate of low birth weight, even after maternal biomedical, behavioral and psychosocial risk factors were controlled for.⁴ Another study that controlled for many important risk factors showed that providing at least one nutrition education, health education and, especially, psychosocial services ses-

sion each trimester was associated with improved birth outcomes.⁵ Our research builds on these two studies by assessing the effects of numerous psychosocial risk factors and prenatal interventions on mean birth weight and the odds of low birth weight in a large, statewide multifaceted program.

We use data from more than 90,000 women on Medicaid who took part in New Jersey's comprehensive prenatal care program, HealthStart, between 1988 and 1996. Because of the large sample size, we are able to control for numerous demographic and medical risk factors. The data are richer and appear to be more accurate than vital statistics records. (For example, a comparison of 1989–1992 HealthStart data with New Jersey birth certificate data on the same women found substantial underreporting of risk factors for poor birth outcomes on the birth certificates.⁶)

Our study expands on an evaluation of HealthStart that used linked birth records and Medicaid data from 1989–1990 to compare the birth outcomes of women enrolled in the program with similar unenrolled women on Medicaid.⁷ In that study, enrollment in HealthStart was associated with reduced rates of low birth weight among blacks, but not among whites; additionally, selection into the program generally reflected where women lived, rather than their individual decisions about where to seek care. In this article, we assess which components of this program were most effective in improving birth-weight outcomes.

DATA AND METHODS

HealthStart Program Data

Our data come from the 90,117 pregnant women who enrolled in HealthStart between 1988 and 1996 and had a live singleton birth. The program, launched in 1988 by New Jersey's Departments of Health and Human Services, consisted of a package of medical and support services that combined comprehensive prenatal care for women on Medicaid with preventive health care for their children. HealthStart was administered at the offices of Medicaid providers. To receive certification as a HealthStart prenatal provider, and thus qualify for increased reimbursement, a Medicaid physician or clinic had to provide a prescribed set of health support services, including a wide range of risk assessments, health education services and referrals. A case coordinator—a health care professional at the provider site—oversaw all aspects of care.

At a woman's initial visit, her overall level of risk for poor birth outcomes was assessed through a personal interview and physical examination; her medical, nutritional and psychosocial risks were also assessed, as was her need for health education. A plan of care was written into the woman's file, using a form that was adjusted throughout the pregnancy in response to changes in her circumstances.

The case coordinator filled out a standardized HealthStart maternity services summary data form for each woman who received any program services. This form included information on the woman's basic social and demographic characteristics, her medical or other conditions that required

intervention, the services provided, and the delivery and the infant's health. The case coordinator obtained prenatal records from previous providers whenever possible and entered any relevant information from them. The information on the form was updated at each visit.

The health department required all case coordinators to be trained in filling out the form; department staff checked the forms for accuracy and completeness, and returned them to a case coordinator for corrections and clarifications, if necessary. The data appear to be of high quality, given the case coordinators' training, the standardization of the form, the multiple data sources (maternal interviews, physical examinations and laboratory tests), the regular quality checks and updates, and the consistency of rates of prenatal behaviors with those from other studies.

Measures

We divided the independent variables into four main categories: clients' social and demographic characteristics, psychosocial risk factors, medical and obstetric risk factors, and prenatal services received. The social and demographic characteristics were specific categories of age and race or ethnicity that have been associated with significant variations in birth outcomes,⁸ whether women were born in the United States and whether English was their first language. In addition, we included employment during the first trimester, since employed women might have had a higher income, a more stable lifestyle and better pregnancy health (thanks to employer-provided health insurance) than unemployed women.

Using information from medical records and the direct questions asked during each prenatal visit, the case coordinator indicated on the form whether the client "presented with any medical or other condition requiring intervention" from a detailed list of medical, obstetric and psychosocial problems. Case managers were instructed to report pregnancy risk factors on the basis of their professional judgment of whether that problem could affect the current pregnancy; the woman was coded as having a medical, obstetric or psychosocial risk factor if it was present just prior to or during the pregnancy. (We present data on the eight most prevalent or clinically important medical and obstetric problems out of the 20 that were asked about.) The data do not contain information on risk factors by trimester.

When a given risk factor was coded as present, the woman was referred for appropriate intervention. Our data encompass both the referral to and the woman's participation in specific interventions. Large HealthStart clinics often provided the intervention on-site, whereas smaller ones that were unable to do so referred clients outside, and were required to demonstrate a working relationship with that outside program and follow up on individual clients' receipt of services.

Overall, case managers collected data on 11 psychosocial risk factors. Three of these were behavioral—prenatal smoking, drinking and drug use. We divided drug use in pregnancy into none, marijuana only, both marijuana and

hard drugs (e.g., heroin or cocaine), and hard drugs only. The wantedness of the pregnancy was another psychosocial risk factor; case managers coded a pregnancy as unwanted if the client ignored her pregnancy, delayed prenatal care, considered having an abortion or giving up her infant for adoption, or totally denied or refused to accept any aspects of the pregnancy and future responsibilities related to the care of her child. An advantage of this measure is that it was assessed as soon as care began, whereas most other research has had to rely on retrospective measures of unwantedness assessed at or after delivery.⁹ A disadvantage is that this definition of unwantedness is nontraditional, which complicates comparisons with most other studies.

The variables assessing the woman's housing situation were whether she had been threatened with eviction or was homeless (i.e., she had been told that she may have to move out of her home or had no address), and whether she lived in generally poor housing conditions (i.e., her home lacked adequate heat, electricity or running water). Another psychosocial risk factor, which we designate as being a caregiver, indicates whether the woman lived with and had some responsibility for a household member who required extensive care (because of chronic or acute illness, trauma or disability). The program also assessed whether a woman had inadequate financial resources to meet her daily needs, and whether she or another member of her household had been involved with the criminal justice system, as either the perpetrator or the victim of a crime.

The data included two risk factors indicating emotional strain—whether the client had witnessed, experienced or initiated verbal or physical (including sexual) violence or abuse in her household, and whether she had had a diagnosis of clinical depression or another mental health problem. Finally, the form had a catchall “other” category to cover risks that the coordinator was aware of but was unable to fit into any of the established categories.

Specific services that a woman received were customized to her situation and needs. Both prenatal and postpartum services were provided, but only the former are relevant here. The case coordinator recorded individual services received in four broad categories—nutrition services, social and psychological services, health education and home visits. The program required that all clients receive basic services in a timely fashion, plus specialized services as needed.

Among the services offered was referring clients at nutritional risk to a nutrition specialist and the WIC program, and monitoring their receipt of those services. The program guidelines defined nutritional risk as having inadequate or excessive weight gain, a medical condition that complicated pregnancy, a dental condition that reflected or compromised adequacy of the client's diet, or inadequate food resources. Women who were ambivalent about their pregnancy or denied it, were aged 16 or younger, or had any psychosocial risk factor received specialized counseling. Women were referred, as necessary, to specialized health education services, including childbirth education, family planning

TABLE 1. Percentage of pregnant women enrolled in New Jersey's HealthStart Program with selected characteristics and risk factors, 1988–1996

Characteristic or risk factor	% (N=90,117)
Social and demographic	
Age	
<20	20.9
20–34	73.4
≥35	5.7
Race/ethnicity	
White	27.3
Black	36.0
Hispanic	33.1
Other	3.6
Worked during first trimester	19.7
U.S.-born	70.0
English not first language	23.1
Married	24.2
City size	
<75,000	60.8
≥75,000	39.2
Psychosocial/behavioral risk factors	
Threatened with eviction/homeless	2.6
Poor housing conditions	1.7
Inadequate financial resources	34.2
Caregiver	1.0
Involved with criminal justice system	1.9
Violence/abuse in household	2.9
Depression/other mental health problem	4.9
Pregnancy unwanted	3.9
Smoked cigarettes during pregnancy	24.9
Drank alcohol during pregnancy	7.7
Drug use during pregnancy	
None	91.8
Marijuana only	2.4
Hard drugs only	4.4
Marijuana and hard drugs	1.4
Other risk factor	6.1
Medical/obstetric problems	
Anemia	15.0
Diabetes	3.8
Sexually transmitted disease	
Genital herpes	1.3
Other	12.7
Genitourinary tract infection	18.3
Pregnancy-associated hypertension	4.3
Ever had infant who was preterm/ small for gestational age	4.1
Inadequate nutrition intake	21.4

services and smoking cessation programs. Home visits were mandatory for clients deemed to be in need of these visits by HealthStart staff; the visits were conducted, as needed, by professionals (public health nurses, registered nurses or social workers with a master's degree) or paraprofessionals (home health aides or licensed practical nurses).

We also considered the timing of prenatal care and classified women by the trimester in which they initiated care at any provider (HealthStart or non-HealthStart). (The third-trimester group included 650 women who initiated care after the second trimester and went through the HealthStart intake process, but never returned for a physical examination.)

Sample Characteristics

During their pregnancy, 24% of the women who attended the HealthStart program were married (Table 1). Twenty-one percent were teenagers; 69% were black or Hispanic.

Thirty percent of the women were foreign-born, and 23% spoke a first language other than English. Twenty percent had worked during the first trimester of pregnancy.

Having inadequate financial resources was, by far, the most prevalent psychosocial risk factor (34%). Twenty-five percent of women smoked during pregnancy, and 8% drank alcohol. Overall, 8% used drugs during pregnancy; among these users, the majority took hard drugs. According to our nontraditional measure of unwantedness, 4% of these women did not want their pregnancy. (This proportion is considerably lower than the rates of 7–15% among women having a live birth in the 13 states in the 1995 Pregnancy Risk Assessment Monitoring System, which defined unwantedness as not wanting, at conception, to be pregnant at any time.¹⁰) Five percent of the HealthStart mothers had received a clinical diagnosis of depression or another mental illness, while 3% had been exposed to or had perpetrated violence or abuse in their household. Overall, 66% of the women had at least one medical or obstetric problem; the three most commonly reported ones were inadequate nutrition (21%), genitourinary tract infection (18%) and anemia (15%).

All of the mothers in the program, by definition, had some prenatal care, but only 37% initiated it in the first trimester. Forty-five percent started care in the second trimester, and 18% initiated care in the third. During pregnancy, virtually all women (97–98%) received at least basic nutrition, social, psychological and health education services (Table 2). Eighty-one percent received WIC services, 13% participated in smoking cessation programs, 6% received substance abuse treatment and 19% received home visits from a health professional.

Analyses

We estimated the effects of psychosocial risk factors and prenatal interventions on birth weight (which averaged 3,248 g) and the incidence of low birth weight, defined as weighing less than 2,500 g at birth (which averaged 8%). We modeled mean birth weight in grams using ordinary least-squares regression. Low birth weight, a dichotomous measure, was coded one if the woman delivered a low-birth-weight baby and zero otherwise; we modeled this outcome variable using logistic regression and calculated odds ratios.

We ran three models for each outcome; all three controlled for the social and demographic characteristics listed in Table 1, plus the woman's county of residence and the year of her baby's birth. The first model added controls for psychosocial and behavioral risk factors. The second instead controlled for the prenatal services women received. The third, fully adjusted model combined all controls from the previous two models, plus timing of prenatal care initiation and medical and obstetric risk factors.

Two selection issues could potentially bias our results. First, unobserved variables may be associated with both maternal (risk behaviors or prenatal services) and infant (birth weight) factors. Second, simply controlling for specific risks rather than restricting the sample to at-risk women

TABLE 2. Percentage of HealthStart participants who received various prenatal services, by type of service

Service	%
Nutrition	
Basic education	98.2
Specialized education	28.5
Extensive education	4.2
WIC†	81.3
Social/psychological	
Basic assessment	97.2
Specialized assessment/counseling	28.4
Substance abuse treatment	6.3
Other extensive/specialized service	6.1
Health education	
Basic	98.2
Specialized	
Childbirth	46.8
Family planning	63.6
Smoking cessation	13.2
Other	25.6
Home visits	
Professional‡	19.1
Paraprofessional§	4.6
Both	1.1

†Special Supplemental Nutrition Program for Women, Infants and Children.

‡Public health nurse, registered nurse or social worker (with a master's degree).

§Licensed practical nurse, home health aide or other.

may make it hard to detect effects of the interventions. (For example, substance abuse treatment is unlikely to appear effective when women who did not use drugs are included in the analyses.)

We minimized the first type of potential selection bias by including a richer set of controls than has been used in most other studies. We also included county and year fixed effects, as well as city size, to control for possible unobserved characteristics of mothers or program implementation that varied by area of residence or over time. Additionally, we examined the likely direction of remaining possible biases for certain interventions.

Our ability to restrict the sample to the relevant at-risk group (to eliminate the second potential source of bias) varied by the specific intervention, and we ran separate models for each at-risk group we could identify. For smoking cessation and WIC referral, the records indicated whether a mother's smoking or inadequate nutrition warranted intervention, so we restricted the analyses to these at-risk subgroups. Similarly, to assess the effect of substance abuse treatment, we limited the sample to drug and alcohol users. For the home-visit intervention, however, we were unable to pinpoint the at-risk group for supplementary analysis.

RESULTS

Main Analyses

The effects of psychosocial and behavioral risk factors alone were generally small, and several were nonsignificant (Table 3, page 134). The important exception was substance use during pregnancy. Prenatal smoking and hard drug use had sizable effects in the expected direction on both outcomes. Babies born to smokers were 123 g lighter, on average, than

TABLE 3. Coefficients from ordinary least-squares regression analyses assessing the effects of selected measures on birth weight, and odds ratios from logistic regressions assessing the effects of those measures on the likelihood of low birth weight

Measure	Birth weight (coefficient)			Low birth weight (odds ratio)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Psychosocial/behavioral risk factors						
Threatened with eviction/homeless	-18.76	na	-9.37	1.01	na	0.96
Poor housing conditions	-22.02	na	-13.70	1.10	na	1.04
Inadequate financial resources	14.07***	na	11.33**	0.92**	na	0.94*
Caregiver	-7.05	na	6.97	0.87	na	0.78*
Involved with criminal justice system	-2.15	na	8.05	0.94	na	0.90
Violence/abuse in household	-12.34	na	-5.77	1.18*	na	1.13
Depression/other mental health problem	-2.56	na	5.44	1.07	na	1.02
Pregnancy unwanted	-26.79**	na	-15.35	1.15*	na	1.12
Smoked cigarettes during pregnancy	-122.67***	na	-107.82***	1.43***	na	1.39***
Drank alcohol during pregnancy	-28.74***	na	-19.62**	1.19***	na	1.16***
Used drugs during pregnancy						
Marijuana only	3.89	na	6.31	1.03	na	1.05
Hard drugs only	-137.44**	na	-106.03***	1.74***	na	1.58***
Marijuana and hard drugs	-83.49	na	-63.64***	1.45***	na	1.40***
Other risk factor	-4.89	na	-0.83	1.00	na	0.99
Initiation of prenatal care						
Second trimester	na	na	-14.77***	na	na	1.03
Third trimester	na	na	-13.86***	na	na	0.94*
Nutrition services						
Basic education	na	53.30***	51.48***	na	0.79**	0.78**
Specialized education	na	40.61***	35.73***	na	0.91**	0.89**
Extensive education	na	39.06***	7.34***	na	1.01	1.10
WIC	na	22.71***	21.94***	na	0.87***	0.87***
Social/psychological services						
Basic assessment	na	-5.77	-13.88	na	1.00	1.02
Specialized assessment/counseling	na	-20.31***	-7.70*	na	1.06	1.01
Other extensive/specialized services	na	1.64	-10.55	na	0.99	1.04
Substance abuse treatment	na	-102.32***	-58.33***	na	1.48***	1.19*
Health education services						
Basic	na	36.33*	28.78	na	0.92	0.95
Specialized						
Childbirth	na	39.06***	31.61***	na	0.81***	0.83***
Family planning	na	22.02***	21.36***	na	0.90***	0.89***
Smoking cessation	na	-79.00***	-21.14***	na	1.22***	1.02
Other	na	-26.00***	-25.34***	na	1.17***	1.17***
Home visits						
Professional	na	-44.12***	-28.35***	na	1.25***	1.13***
Paraprofessional	na	-14.29	-5.72	na	1.04	0.99
Both	na	-27.31	-18.26	na	1.08	1.02

*p<.05. **p<.01. ***p<.001. Notes: For drug use, reference category is none, and for prenatal care initiation, reference category is first trimester. For all other measures, reference category is not having the specific risk factor or not having received the service. All models include controls for the social and demographic variables in Table 1 (with finer breakdowns of age and race), plus county of residence and year of the birth. Model 3 also includes the medical and obstetric risk factors in Table 1 and other, less-prevalent medical risk factors. N=90,117 for all models. na=not applicable.

babies born to nonsmokers, and babies of users of hard drugs (and not marijuana) were 137 g lighter than those of mothers who did not use drugs. These estimates translate into large differences in the odds of low birth weight. Babies born to smokers had significantly elevated odds of weighing less than 2,500 g relative to those born to nonsmokers (odds ratio, 1.4); similarly, babies born to hard drug users had higher odds of being low birth weight than those born to nonusers (1.7). The significant effects of prenatal alcohol use were smaller, but in the expected direction. Consuming alcohol during pregnancy was associated with a 29 g reduction in birth weight and with increased odds of low birth weight (1.2).

Having inadequate financial resources was significantly associated with both outcomes, but its small effect was in the opposite direction from what we expected, perhaps

because we controlled for so many risk factors related to poverty and hardship in this sample of poor women. Both pregnancy unwantedness and experience with violence or abuse in the household were associated with significant increases in odds of low birth weight; in addition, unwantedness was significantly associated with a decrease in mean birth weight of 27 g.

In the second model, which controlled for prenatal services only, all four nutrition services were associated with increases in birth weight; basic and specialized nutrition education and WIC participation were related to significantly reduced odds of low birth weight. Substance abuse counseling, smoking cessation classes and professional home visits, were associated with decreases in birth weight and with increased odds of low birth weight. These findings reflect the selection of the most at-risk women into these

services, which was mandated by the program, coupled with the lack of controls for psychosocial risk factors and medical and obstetric problems.

The effects of nutritional services in the fully adjusted model are the same as those in the model controlling only for prenatal services—namely, WIC participation was independently associated with a 22 g increase in mean birth weight and with a 13% reduction in the odds of low birth weight (odds ratio, 0.87). The adverse effects of smoking cessation services on the odds of low birth weight (from the second model) disappeared entirely when we introduced controls for all risk factors, including smoking. Adverse effects of substance abuse treatment and home visits on both mean birth weight and the odds of low birth weight were still present in the fully adjusted model, but their magnitude was substantially diminished. Since it is unlikely that treatments for substance abuse or the home visits themselves had direct negative effects on birth weight, the results are probably due to sample selection.

Supplementary Analyses

To further investigate the extent to which the effects of certain services were influenced by selection bias, we reran the two models that included prenatal services, using restricted samples of at-risk women only (not shown). In the new analyses based on the subsample of 5,280 women who had used hard drugs during pregnancy, one-third of whom had received substance abuse treatment, the adverse effect of such treatment was largely explained away (i.e., associations were either rendered nonsignificant or were diminished). In the reduced-sample model with no controls for psychosocial and behavioral risk factors (including drug use), receiving treatment for substance abuse was associated with a 45 g reduction in birth weight ($p=.02$) and a nonsignificant increase in the odds of low birth weight. In the fully controlled model, substance abuse treatment was associated with a significant reduction in birth weight of 43 g ($p=.03$) and had no significant association with the odds of low birth weight.

When we restricted our sample even further to the 3,556 drug users who did not report any alcohol use during pregnancy, analyses that controlled only for social and demographic characteristics and services received found no association between substance abuse treatment and birth weight or the odds of low birth weight. In the fully controlled model, substance abuse treatment was still not associated with either outcome.

Similarly, when we conducted a separate analysis among the 22,460 smokers only, 38% of whom received cessation services, there was no association between receipt of those services and either outcome in any model. Thus, even though we were able to reduce the selection effects, none of the models we estimated showed that participation in smoking cessation or substance abuse programs had beneficial effects on birth weight. Either these interventions were ineffective or women who were treated differed from nontreated women in unobserved ways that made a worse

outcome more likely. In other words, although we may have accounted adequately in certain cases for preexisting risk, we may have been unable to control adequately for selection into the interventions of those at risk.

In contrast, the favorable WIC effects grew stronger when we restricted the sample to the 19,307 women classified as having inadequate nutrition. In the fully controlled models, WIC participation was associated with a 48 g increase in average birth weight ($p<.001$) and a reduction of 12% in the odds of low birth weight (odds ratio, 0.88; $p<.001$). These effects were virtually unchanged when we further restricted this sample of inadequately nourished women to those who initiated prenatal care in the first or second trimester (to assess, and minimize, potential gestational age bias).

To address the direction of potential selection bias in the effects of WIC participation that may remain after restricting the sample, we compared the observed risk factors of inadequately nourished women who received WIC with those of women who did not receive these services. Women in the former group were more likely to be black, less likely to have worked during the first trimester, and just as likely to be Hispanic, to have been born in the United States and to be married (results not shown).

DISCUSSION

Our results suggest that those at highest risk were the most likely to receive the appropriate interventions. Indeed, for both mean birth weight and the odds of low birth weight, the results of both models with controls for prenatal services indicate that the outcomes worsened as the interventions intensified. For example, the receipt of specialized health education services was associated with far worse outcomes than the receipt of basic health education services. Likewise, for nutrition education and home visits, the more intensive the intervention, the worse the outcome.

Unlike the effects of smoking cessation programs and substance abuse treatment, the effects of WIC participation—i.e., increases in birth weight and reductions in the odds of low birth weight—are strong and robust. Our estimates of the effects of WIC participation on mean birth weight are generally smaller, and those on low birth weight are generally larger, than estimates from studies that incorporated fewer individual-level or pregnancy-specific controls, or that were subject to potential bias from the methodologies or samples used.¹¹ These strong WIC effects on birth weight remained even among inadequately nourished women in our sample. However, as others have postulated in a discussion of the selection issues surrounding WIC participation,¹² these effects would be overestimated if women at low risk for poor outcomes were more likely than others to participate in WIC (“favorable” selection) or underestimated if high-risk women were more likely to participate in WIC (“adverse” selection), even after controls were entered for numerous risk factors, plus city size, county and year.

Observed characteristics of participants and nonparticipants in WIC in the HealthStart sample suggest adverse

selection or no selection bias. As indicated earlier, among inadequately nourished women, those who received WIC services were more likely than those who did not to be black; they were less likely to have worked during the first trimester; and they were just as likely to be Hispanic, to have been born in the United States and to be married. Although we cannot be certain that unobserved factors are not driving the effects of WIC participation on birth weight, the net effects of unobserved factors would have had to go against and outweigh those of observed characteristics. This scenario is unlikely; indeed, recent studies indicate strong adverse selection into WIC programs (i.e., high-risk women are more likely than low-risk women to participate),¹³ even among Medicaid recipients.¹⁴

Finally, we found very similar effects of WIC participation for both the sample as a whole and a restricted subsample of women who began care in the first or second trimester; this indicates either the lack of a dose-response relationship or additional evidence of adverse selection into WIC programs. It also suggests that our findings of beneficial effects of WIC participation on birth weight were not driven by a spurious correlation between gestational age and program participation, in which women who sought prenatal care sooner (at earlier gestational ages) had more opportunity to participate in the program. Taken together, the evidence suggests that any unexplained differences in our study between women who did and did not participate in WIC would work against finding program effects; thus, our favorable WIC effects on birth weight are likely to be underestimates.

CONCLUSIONS

Our findings of independent effects of psychosocial risk factors on birth-weight outcomes are consistent with those from studies that incorporated fewer control variables. Smoking, drinking and using drugs during pregnancy all had very strong, adverse effects on outcomes, even after we controlled for other psychosocial, social and demographic factors. Most of the psychosocial measures other than these three risky behaviors did not have significant effects on birth weight. The comprehensiveness of the models and the insensitivity of the results across the models suggest that the effects of substance use are real; that is, they are unlikely to be confounded by effects of unobserved characteristics.

In the absence of a randomized design, possible selection bias makes it difficult to estimate the true net effects of the HealthStart interventions. Even after we controlled for numerous factors and restricted our sample to smokers and substance users, we were unable to produce evidence that comprehensive prenatal programs with behavior modification components—i.e., smoking cessation services and substance abuse treatment—are more effective at improving birth-weight outcomes than programs that address basic nutritional needs (i.e., WIC). This does not mean that the interventions were poorly designed or unbeneficial, but given the research design, we were unable to detect any average effects.

Several reasons might explain the unexpected findings

of our study. As mentioned earlier, adverse selection into the substance-use interventions might have suppressed favorable effects. Moreover, any of these interventions might have helped individuals, even if the average effect was not significantly different from zero. Further, even if the interventions were of very high quality, nonparticipation or attrition might have prevented success, although we cannot document this potential explanation. It is also possible that the HealthStart program was not implemented as intended, but again, there is no documentation to this effect. Finally, intensive prenatal interventions such as those delivered in HealthStart might have effects other than improvements in birth weight. These could include longer-term benefits, such as improving future birth outcomes (via reductions in prenatal smoking and drug use), connecting mothers to the health care delivery system and increasing their use of pediatric care.

HealthStart was a multimillion dollar program that tried to affect birth outcomes in many ways, including psychological counseling and numerous prenatal interventions, and referrals with follow-up to WIC. Of particular policy interest is the independent association between WIC participation and a 13% reduction in the odds of low birth weight among a fairly homogeneous group of poor women on Medicaid. This finding strongly suggests that the low-cost WIC component, in which women were aggressively connected to an already existing federal program, should be a key feature of prenatal care programs for poor women.

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