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AUTHOR	Kowaleski-Jones, Lori; Duncan, Greg J.	
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ABSTRACT

This study investigated the effects of maternal participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) on the birth weight, motor and social skills, and temperament of a national sample of children born between 1990 and 1996 to women participating in the National Longitudinal Survey of Youth (NLSY). Sibling fixed effect models were used to account for persistent differences in difficult to measure characteristics of mothers that affect participation in the program. Information was obtained for 453 sibling pairs. Results indicate that prenatal WIC participation has positive effects on infant birth weight. Fixed effect, but not ordinary least squares (OLS), estimates suggest that prenatal WIC participation is associated with more positive child temperament. An appendix contains two tables focusing on logistic regression results and maternal characteristics. (Contains 7 tables and 35 references.) (SLD)

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Effects of Participation in the WIC Food Assistance Program on Children's Health and Development: Evidence from NLSY Children

Lori Kowaleski-Jones
Department of Family and Consumer Studies
University of Utah
E-mail: lori.kowaleski-jones@fcs.utah.edu

Greg J. Duncan
Institute for Policy Research
Northwestern University
E-mail: greg-duncan@nwu.edu

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Abstract

This study investigates the effects of maternal participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) on birth weight, motor and social skills, and temperament for a national sample of children born between 1990 and 1996 to women participating in the National Longitudinal Survey of Youth. Sibling fixed effect models are used to account for persistent differences in difficult to measure characteristics of mothers that affect participation in the program. Results indicate that prenatal WIC participation has positive effects on infant birth weight. Fixed effect, but not OLS, estimates suggest that prenatal WIC participation is associated with more positive child temperament.

Effects of Participation in the WIC Food Assistance Program on Children's Health and Development: Evidence from NLSY Children

INTRODUCTION

Established in 1972, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) attempts to increase the nutrition level and general well-being of children (Currie, 1995; Blank, 1997). Program expenditures for WIC have almost tripled, from 1.3 billion dollars in 1980 to 3.7 billion dollars in 1997 (U.S. General Accounting Office, 1998). Part of the popularity of WIC has been due to the fact that it is one of the most directly targeted and interventionist of the federal welfare programs.

Many of the evaluations of this program were conducted at least 10 years ago (Edozien, Switzer, and Bryan, 1979; Kennedy et al., 1982; Kotelchuck et al., 1984; Stockbauer, 1986; and Rush et al., 1986). The majority of these evaluations either relied on data from a single state or compared results across several different states (Devaney, Bilheimer, and Schore, 1991; Devaney and Schirm, 1993). In addition, these prior evaluations did not address issues of potentially unmeasured heterogeneity. More current research is needed to examine the potential benefits of WIC participation among a nationally representative sample of women and their children.

Much of the previous work on the effects of WIC has focused on infant birth weight, nutrient intakes, presence of anemia, and the propensity of mothers to breast-feed their infants. Fewer studies have focused on the potential effects of WIC participation on developmental infant measures such as motor and social functioning and temperament, largely because of limitations present in many of the data sets used for such investigations. This is unfortunate because these types of outcomes are important predictors of later childhood social and behavioral development. Indeed, the need for information about the effects of WIC on a wider range of child outcomes has been identified as an important research goal (Currie, 1996; Owen and Owen, 1997).

Previous studies of the effects of WIC participation on children's well-being have also suffered from significant selection problems. Not all eligible women take up benefits, so if WIC selects the neediest women, then studies that compare WIC participants to nonparticipants, and fail to adjust for differences in "need," may underestimate the effects of the program. In contrast, if WIC participants are more highly motivated than nonparticipants are, then studies that fail to adjust for motivation may overestimate the program's effects. Since the WIC program is locally administered, factors governing selection are also likely to vary across time and place.

This study addresses these concerns by investigating the effects of WIC participation using a nationally representative sample of children and sibling fixed effect models to account for potential unmeasured heterogeneity among the mothers of children in this sample. Specifically, we study a sample of children born between 1990 and 1996 from the National Longitudinal Survey of Youth merged mother-child data files to consider the effects of WIC participation on a variety of infant outcomes—birth weight, infant motor and social skills, and infant temperament. We use these data to compare sibling differences in outcomes to differences in maternal participation in WIC. The results from this study should provide less-biased assessments of the impacts of the WIC program on an important national sample of recently born children.

BACKGROUND OF THE WIC PROGRAM

WIC provides federal grants to states for supplemental foods, health care referrals, and nutrition education for low-income, pregnant, breast-feeding, and postpartum women; infants; and children up to age 5 who are at nutritional risk. To qualify for the program, WIC applicants must show evidence of health or nutritional risk, as verified by a health professional. In addition, participants must have incomes at or below 185 percent of the poverty level ($13,880 for a family of three in 1999). This program is primarily funded by federal appropriations, with some states supplementing their federal grants with their own funds. A concern regarding the WIC program is that some states have unspent funds at the end of the fiscal year. Recent research indicates that many of the reasons for this surplus have to do with the way in which WIC is structured. For example, many states rely exclusively on their federal grant and are so cautious to avoid overspending that they err on the side of underspending (U.S. General Accounting Office, 1997a). Directors of WIC agencies are taking steps to improve access of WIC benefits for working women in the form of scheduling appointments instead of operating on a first-come, first-served basis (General Accounting Office, 1998). Finally, states are using a variety of cost-containment initiatives that have already saved millions of dollars annually for WIC. Some of these initiatives include obtaining rebates on WIC foods and limiting the participants' food choices to lowest-cost items (General Accounting Office, 1997b). This discussion of the current issues in WIC program administration serves to highlight the fact that action taken by states pertaining to these concerns has resulted, and will continue to result, in increasing the number of individuals able to take up WIC benefits.

PRIOR RESEARCH ON THE EFFECTS OF WIC PARTICIPATION ON INFANTS AND CHILDREN

Much of the research on the effects of WIC participation on children has focused on potential benefits of increased use of prenatal care, increased Medicaid savings, infant outcomes such birth weight, likelihood of breast-feeding, and nutritional intake. Using administrative data from five states, Devaney, Bilheimer, and Schore (1992) estimate that every dollar spent on WIC prenatal programs was associated with savings from $1.77 to $3.13 in Medicaid costs during the first 60 days following birth. They also found that prenatal WIC participation was associated with higher newborn birth weights. The link between WIC participation and both decreased Medicaid spending (Schramm, 1985; Avruch and Cackley, 1995) and increased infant birth weight (Kotelchuck et al., 1984; Caan et al., 1987) has also been observed in other studies. However, some research has failed to establish a link between WIC participation and infant birth weight (Metcoff et al., 1985; Rush et al., 1986), suggesting that more research is needed to reach definitive conclusions about this linkage.

The evidence concerning a link between WIC participation and the decision to breast-feed has been mixed. Using data from the National Maternal and Infant Health Survey, Schwartz and colleagues (1995) conclude that providing breast-feeding advice to pregnant women in the WIC program significantly improves the initiation of breast-feeding. However, Beshgetoor and colleagues (1999) find that WIC employees, while supportive of breast-feeding, may not be appropriately educated about breast-feeding, and as a result may send inconsistent messages to WIC participants. Using NLSY data, Armstrong (1994) finds that receiving WIC benefits is associated with lower rates and shorter duration of breast-feeding among poor women.

The evidence on the effects of WIC on nutritional intake is limited but consistently points to positive benefits of WIC participation. In particular, Fraker (1990) found a positive effect of WIC participation on the intake of key vitamins and nutrients. Rose and colleagues (1998) also found that WIC benefits positively influence the intakes of ten key nutrients.

Fewer studies have tracked the effects of WIC participation on child adjustment and age-appropriate achievement measures. One notable exception is Hicks, Langham, and Takenaka (1982), who studied 21 sibling pairs from Louisiana and found that children who received WIC prenatally had significantly higher scores on tests of verbal ability. The paucity of research on the effects of WIC participation on child adjustment and achievement is surprising given the potential importance of such a possible linkage.

The WIC program and research into its results have come in for some recent criticism. Specifically, Besharov and Germanis (1999) argue that research on the WIC program has potentially overstated the benefits, and that at best the WIC program's effectiveness is restricted to outcomes such as infant birth weight. This criticism, in part, stems from the recognition that the designs of many of the prior studies of the WIC program have suffered from issues of potential selection bias in the results.

Singled out for criticism has been the National WIC Evaluation (Rush et al., 1986), one of the most comprehensive examinations of WIC's effects on infants. This evaluation suffered from a number of technical problems concerning the suitability of comparison groups as well as severe response rate problems for both the WIC and comparison samples. Besharov and Germanis conclude that the findings derived cannot be regarded as anything more than suggestive.

Besharov and Germanis were also critical of the U.S. General Accounting Office's (1992) conclusion that, based on a review of 17 evaluations, WIC participation was associated with an overall 25 percent reduction in low-weight births. They contended that almost all of the evaluations included in this review were statistical comparisons of WIC participants with nonparticipants, and attempts to control for other factors that influence birth outcomes varied in their success. Their criticism of the prior studies on the effects of WIC participation suggests that more research is needed that accounts for unmeasured characteristics which may affect both program participation and child outcomes.

Nutritional boosts provided by WIC may have positive effects on measures of infant well-being other than birth weight. If properly designed research is able to find evidence of a link between prenatal WIC participation and benefits in infant well-being beyond measures typically considered, then it would offer stronger support for the overall benefits of the WIC program.

ANALYTIC APPROACH

A general model for the relationship between WIC participation and infant outcomes can be expressed as

$$Y = \alpha + \beta_1 P + \beta_2 X + \varepsilon \qquad (1)$$

where Y is the infant outcome of interest; P is an indicator equal to 1 if the mother participated in WIC prior to the child's birth and 0 otherwise; X represents a vector of persistent and time-varying maternal and family characteristics that we hypothesize will affect infant outcomes; and ε is an error term that includes unobserved variables and random error. Ordinary least squares (OLS) estimation of equation 1 will yield biased estimates of program impacts (β_1) if some of the unobservable variables are correlated with both Y and P. The sibling fixed effect estimator, also known as the within estimator, removes bias from time-invariant maternal and family components of ε. To see this, we write equation 1 as

$$Y_{ij} = \alpha + \beta_1 P_{ij} + \beta_2 X_{ij} + v_j + \varepsilon_{ij} \quad (2)$$

where the subscript i denotes the individual sibling and j represents the family unit to which the sibling belongs. Note that error term is now split into two components. ε_{ij} is the part of the residual due to random variation and v_i is the portion of the residual that is family specific. Families will differ from one another but the v residual is constant for siblings in a given family.[1] If equation 2 is true for individuals, then equation 3 holds for family groups:

$$y^*_j = \alpha + \beta_1 P^*_j + \beta_2 X^*_j + v_j + \varepsilon_j \quad (3)$$

where y^*_j, X^*_j, and ε_j represent the means for all of the siblings in a given family unit. Subtracting equation 3 from equation 2 produces

$$(y_{ij} - y^*_j) = \beta_1(P_{ij} - P^*_j) + \beta_2(X_{ij} - X^*_j) + (\varepsilon_{ij} - \varepsilon^*_j)\,. \quad (4)$$

By subtracting the family averages, we net out the biasing effects of persistent family and maternal conditions, both observed and unobserved on β_1.

It is possible that unmeasured variables associated with the individual child could bias the estimated program effects from equation 4. For example, suppose that a mother who experienced a difficult pregnancy were more likely to seek out the help that a WIC program could provide. In this case, the sibling associated with WIC participation would have worse relative outcomes than if WIC participation were a random event. As a strategy to partially account for this source of potential bias, we include controls for infant birth weight and gestational length in equations predicting infant motor and social skills and infant temperament.

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[1]Family influences that vary from child to child are part of ε_{ij}.

Another important consideration is the degree to which participation in WIC and infant outcomes such as birth weight are independent across births. If mothers were systematically more likely to use WIC during a second pregnancy because they learned of the program during a difficult first pregnancy, then the results from sibling models would likely be biased such that mothers are undergoing a learning process that would disproportionately favor the younger siblings. Although this is an important issue, variation in WIC usage across time might well be more likely to occur outside the family unit. There is evidence from recent U.S. General Accounting Office reports (1997b, 1998) that states have not systematically used their federal grants effectively. For example, Texas recently introduced a new computer system in the state WIC agencies that caused the employees to spend more time learning the system than serving clients (General Accounting Office, 1997a). This suggests that pregnancy-to-pregnancy variation in WIC participation may be a result of exogenous program forces.

SAMPLE

The data are drawn from the 1996 and earlier survey waves of the National Longitudinal Survey of Youth (NLSY), a nationally representative sample of men and women. The women in our sample were 14 to 21 years old when interviewed in 1979, making them 31 to 38 in 1996. The study oversampled black, Hispanic, and economically disadvantaged white youth. These cohorts, of which the mothers of the children we study are members, have been interviewed every year since 1979. Beginning in 1986, interviewers administered an extensive set of assessment instruments to the children of all the female respondents. These assessments include information about cognitive, socioemotional, and psychological aspects of the child's development as well as about the quality of the home environment (Baker et al., 1993). These same children were interviewed again in 1988, 1990, 1992, 1994, and 1996.

Beginning in 1990, NLSY collected data on whether mothers received WIC benefits in the preceding calendar year. Accordingly our sample consists of the 1984 children born to NLSY mothers between 1990 and 1996 for whom prenatal WIC participation status has been recorded. It is important to note that our sample consists of women who gave birth between the ages of 25 and 38, making this a sample of relatively older mothers.

To conduct our sibling-based analysis, we identified 969 children who had one or more siblings who were also born between 1990 and 1996. Information about the 453 sibling pairs thus defined is presented in Table 1. Most sibling groups in this sample have just two members.

In the majority of these sibling groups (349), the mother did not participate in the WIC program prior to the birth of any of her children. Thirty-three of the sibling groups represent situations in which the mother participated in the WIC program for all of the children included in this sample. The 71 discordant sibling groups in which siblings differed in their mothers' participation in the WIC program prior to their birth are crucial for estimating the fixed effect regression sibling models. Although it would be advantageous to have a larger number of discordant sibling groups, this number is consistent with what has been used in prior research on the WIC program (Hicks, 1982) and in investigations of the Head Start program that use similar modeling techniques (Currie and Thomas, 1995), and, as shown below, provides reasonably precise estimates of β. The majority of the discordant sibling groups (49, or 74 percent) follow the pattern of the mother not participating in WIC in the first observed pregnancy, but then participating in the program prior to a subsequent birth. A sizable percentage (19 of 71, or 26 percent) of the discordant sibling groups follow the opposite pattern of WIC program participation.

MEASUREMENT

Prenatal WIC participation is measured with a dichotomous variable based on maternal report of receipt of WIC benefits in the calendar year preceding the birth. Recent research has indicated that a potentially important aspect of WIC participation is the timing, early versus late, in the mother's pregnancy (Currie, 1995). The NLSY only provides annual data on receipt of WIC benefits—a cost that is

TABLE 1
Categories of Prenatal WIC Participation among NLSY Sibling Groups Born between 1990 and 1996

	CHILD 1	CHILD 2	
Group 1	WIC	WIC	33
Group 2	WIC	NO WIC	19
Group 3	NO WIC	WIC	49
Group 4	NO WIC	NO WIC	349
Group 5	OTHER		3
	Total		453 pairs

Notes: "Group" refers to any group of at least two siblings. One of the sibling groups in the "other" category represents a situation in which the children's mother received prenatal WIC benefits for the first and third children but not for the second child. The two other sibling groups in the "other" category represent a situation in which the children's mother received prenatal WIC benefits for only the second child.

weighed against the size and representativeness of our sample. Table 2 presents weighted descriptive information about the extent of prenatal WIC participation among the children in the full and sibling sample as well as weighted descriptive information about the other variables used in this study. Some 12 percent of the children in both samples had mothers who received WIC benefits during pregnancy.

We focus on three major infant outcomes—birth weight, temperament, and motor and social development. Lower birth weight children are at increased risk of mortality and lifelong disabilities such as cerebral palsy, autism, and mental retardation (McCormick et al., 1992).[2] In both the overall sample and the smaller sibling samples, the average birth weight was approximately 120 ounces.

Infant motor skills are measured with a mother-reported scale that captures dimensions of the motor, social, and cognitive development of young children from birth through 3 years. Based on the child's age, the mother answers 15 age-appropriate items out of 48 motor and social developmental items. The items were derived from standard measures of child development that have high reliability and validity. This score has been nationally normed to provide appropriate age ranges for key developmental milestones. These items have been used successfully with both minority and nonminority samples (Baker et al., 1993).

For these analyses, we selected the earliest available score for each child. Because the child assessments are measured biannually, roughly half of the sample children are assessed in their first year of life, and half are assessed between their first and second birthday. For example, the motor and social skills of children born before the 1990 interview were measured in 1990. The motor and social skills of children born in 1991 were measured in 1992. We include controls for the child's age at assessment in the

[2]Ideally, birth weight should be adjusted for gestational age. All things being equal, a 4-pound baby born at 7 months is likely to do better than a 4-pound baby born at 9 months. This is because the baby born at 7 months was by all accounts developing normally, while the 9-month baby was not. However, the gestational age data in the NLSY seem to deviate significantly from vital statistics data such that reported gestational age peaks at 38 weeks (Currie, 1995). This reflects the problem of ambiguity concerning actual date of conception among many women. However, the birth weight data from the NLSY conform quite closely to vital statistics data.

TABLE 2
Weighted Descriptive Characteristics of Samples of NLSY Children Born between 1990 and 1996

	Total Sample (N = 1984)		Sibling Sample (N=969)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Prenatal Maternal Variables				
Prenatal WIC Participation	0.12	0.33	0.12	0.32
Prenatal Food Stamps	0.10	0.31	0.09	0.29
Total Cash Income (x 1000)	41.89	27.14	44.13	28.04
Drank during Pregnancy	0.52	0.50	0.52	0.50
Smoked during Pregnancy	0.24	0.43	0.19	0.39
Maternal Characteristics				
AFQT	74.21	19.47	76.82	18.77
Self-Esteem in 1980	1.76	0.41	1.75	.40
Deviant Behavior in 1980[1]	1.14	1.18	1.11	1.19
Prenatal Urban Residence	0.82	0.38	0.85	0.35
Prenatal Maternal Education	13.75	2.45	14.04	2.28
Maternal Early Background				
Parents' Mean Educational Level	12.06	2.91	12.46	2.87
Mother Worked at Age 14	0.51	0.50	0.47	0.50
Lack of Literary Supports[2]	0.05	0.22	0.04	0.20
Number of Siblings of Mother	3.33	2.20	3.26	2.22
Child Demographics				
Black	0.11	0.31	0.09	0.29
Hispanic	0.06	0.24	0.06	0.24
Male	0.50	0.50	0.51	0.50
Child Age at Assessment (measured in months)	8.81	6.03	8.46	5.63
Percentage with Low Birth Weight	0.08	0.26	0.07	0.25
Gestational Length (measured in months)	38.38	1.97	38.40	1.83
Outcome Variables				
Birth Weight	119.71	21.01	120.83	20.21
Motor and Social Skills	8.56	2.91	8.40	2.95
Difficult Temperament Composite Score	24.71	6.79	24.81	6.67

Notes: The "total sample" consists of all NLSY children born between 1990 and 1996 with valid information on prenatal WIC participation. The "sibling sample" consists of NLSY children born between 1990 and 1996 and who had at least one sibling born in this same time period.

[1]Maternal Deviant Behavior was developed from a series of eight dichotomous items addressed to the mothers in 1980. The items included such activities as stealing, breaking into buildings, destroying property, shoplifting, smoking marijuana, using force, assaulting someone, or lying to "con" someone else.

[2]Lack of Literary Supports equals 1 if newspapers, library books, or magazines were not present in the mother's home.

multivariate analysis. Among both samples of children, the average score on motor and social skills is approximately 8.5 out of a possible score of 15.

Temperament is related to the child's impact on family members, and is linked with the development of behavioral problems (Bates, 1980; Belsky and Eggebeen, 1991; Hannan and Luster, 1991; Menaghan and Parcel, 1988). The temperament index includes dimensions of predictability, fearfulness, positive affect, and friendliness—components thought to be precursors of personality development and social adjustment. The internal consistency for these subscales is high, generally in the range of .77 (Baker et al., 1993). As with motor and social skills, we selected the earliest temperament score for each child and included controls for the child's age at assessment in the multivariate analysis. The average difficult temperament score for both samples of children was approximately 25, and the scores ranged from 11 to 52 points. These two measures of infant development represent important dimensions potentially affected by prenatal participation in the WIC program. Specifically, we expect that WIC participation will be associated with higher motor skills and lower difficult temperament scores.

One of the strengths of the NLSY merged mother-child data is the rich longitudinal information that can be used to control for a more comprehensive set of persistent and time-varying individual and family characteristics than is typically available in other data used for research on the effects of WIC participation on infant outcomes. Persistent characteristics, controlled for in our OLS models but differenced out of our sibling models, include early maternal resources such as maternal cognitive skills, self-esteem, and early deviant behavior. We also control for a wide variety of intergenerational variables measured when the mother was an adolescent. Specifically we control for grandparents' educational level, number of siblings of the mother, whether the mother grew up in a single-parent household, and the support for literacy in the mother's home. These time-invariant variables drop out in the sibling fixed effect models.

Time-varying characteristics accounted for in both OLS and fixed effect models include mother's reports of smoking and drinking during each specific pregnancy. We also account for prenatal food stamp participation by the mother, family income (not including food stamps) in the calendar year prior to birth, maternal residence in an urban area in the year prior to birth, child gender, and ethnic identity. Past research has shown significant differences in birth weight by minority status (Cramer, 1995).

Our regression analyses of the effects of prenatal WIC participation are based on three specifications. In the first, we control just for child demographic characteristics. Second, we include a full set of prenatal variables and maternal characteristics. In the fixed effect regression equations, many of these characteristics drop out of the analyses. In the third specification, our models also control for prenatal food stamp participation. Although families that receive food stamps automatically qualify for inclusion in the WIC program, participation in the two programs is not one for one. Among the children in this sample, 7 percent of mothers who participated in WIC did not receive food stamps, while 6 percent of those receiving food stamps did not take up WIC.[3] It does, however, suggest the value of additionally controlling for food stamp participation in estimating the effects of WIC participation.[4]

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[3]We considered modeling the effects of WIC and food stamps using a set of dummies that capture those children whose mothers participated in both programs (9 percent), neither program (78 percent), just WIC (7 percent), and just food stamps (6 percent). However, it was impossible to estimate sibling models using these categories.

[4]A logistic regression analysis of prenatal WIC participation, presented in the Appendix Table 1, shows that families with higher income have lower odds of participating in the WIC program. In addition, those families that receive food stamp benefits have significantly higher odds of also participating in the WIC program.

RESULTS

Birth Weight

Table 3 presents coefficients and standard errors from OLS and fixed effect models of the square root of infant birth weight.[5] OLS models produce consistently positive and significant effects of prenatal WIC participation on infant birth weight. Results from the most complete OLS model indicate that prenatal participation in the WIC program is associated with a .24 unit increase in the square root of infant birth weight. Two of the three additional prenatal maternal variables considered in these equations have significant links with infant birth weight in the OLS regressions. Prenatal smoking and drinking are both associated with significant decrements in subsequent infant birth weight. In addition, maternal cognitive skills are also significantly linked with higher birth weights. Consistent with other research (Currie and Cole, 1993), we observe both race and gender differences in infant birth weight. Across the three specifications, OLS results indicate that African-American infants are born at significantly lower weights than are their white counterparts. On average, males are born significantly larger than females, controlling for a wide range of observable maternal characteristics.

Sibling fixed effect models also suggest a significant impact of prenatal WIC participation on infant birth weight, but only after accounting for the full set of prenatal maternal variables. In the most complete fixed effect model, prenatal WIC participation is associated with a .40 unit difference in square root of siblings' birth weight. At the 88-ounce low birth weight cutoff, this translates into an estimated program impact of 7.7 ounces. At the sample mean, this translates into an impact of 9 ounces. Devaney's (1991) review indicates that, among low-income women, increases in mean birth weight of even 1 ounce

[5]We use the square root of birth weight because many of the likely effects of prenatal WIC participation are likely to occur at the lower end of the birth weight distribution. We experimented with various functional forms that emphasize differences at the low end of the birth weight distribution and found a slightly better fit when we exponentiated birth weight by smaller factors. We chose to use the square root of birth weight because the fit did not differ appreciably across the different specifications.

TABLE 3

Birth Weight (Square Root): Results of OLS and Fixed Effect Regressions for NLSY Children Born between 1990 and 1996

	1		2		3	
Variable	OLS	FE	OLS	FE	OLS	FE
Prenatal WIC Participation	0.16 (.08)**	0.15 (.16)	0.20 (.10)*	0.38 (.19)**	0.24 (.10)**	0.40 (.19)**
Prenatal Food Stamps					-0.14 (.12)	-0.23 (.28)
Prenatal Maternal Variables						
Total Cash Income			0.00 (.001)	0.00 (.01)	0.00 (.01)	0.00 (.01)
Drank during Pregnancy			-0.15 (.07)**	-0.13 (.17)	-0.15 (.07)**	-0.12 (.17)
Smoked during Pregnancy			-0.21 (.08)***	-0.40 (.30)	-0.20 (.08)**	-0.41 (.30)
Maternal Characteristics						
AFQT			0.01 (.01)**	(dropped)	0.01 (.01)**	(dropped)
Self-Esteem in 1980			-0.08 (.09)	(dropped)	-0.08 (.09)	(dropped)
Deviant Behavior in 1980			0.00 (.03)	(dropped)	0.00 (.03)	(dropped)
Prenatal Urban Residence			0.15 (.10)	(dropped)	0.15 (.10)	(dropped)
Prenatal Maternal Education			-0.03 (.02)	(dropped)	-0.03 (.02)	(dropped)
Maternal Early Background						
Parents' Mean Education			-0.01 (.01)	(dropped)	-0.01 (.01)	(dropped)
Mother Worked at Age 14			0.00 (.07)	(dropped)	0.00 (.07)	(dropped)
Lack of Literary Supports			0.01 (.15)	(dropped)	0.01 (.15)	(dropped)
Number of Siblings of Mother			0.01 (.02)	(dropped)	0.01 (.02)	(dropped)
Child Demographics						
Black	-0.49 (.08)***	(dropped)	-0.49 (.10)***	(dropped)	-0.48 (.10)***	(dropped)
Hispanic	-0.11 (.08)	(dropped)	-0.09 (.10)	(dropped)	-0.08 (.10)	(dropped)
Male	0.15 (.05)***	0.16 (.09)*	0.16 (.06)***	0.23 (.10)**	0.16 (.06)***	0.23 (.10)**
Adjusted R^2	0.04	0.01	0.08	0.06	0.08	0.07
Number of Children	1499	1229	1083	926	1083	926

Notes: Standard errors are given in parentheses. Panel 1 includes just prenatal WIC participation and infant demographics. Panel 2 also includes the full set of explanatory variables. Panel 3 also accounts for prenatal food stamp participation. *** = $p < .01$, ** = $p < .05$, * = $p < .10$. OLS models are estimated with robust standard errors that account for the fact that observations are clustered within family units.

pay for themselves by reducing the need for costly neonatal care. Prenatal use of food stamps, controlled for in the final set of OLS equations in Table 3, is not significantly associated with infant birth weight.[6]

Temperament

Table 4 presents the results of OLS and fixed effect regressions of the effects of prenatal WIC participation on difficult temperament. Accounting for child characteristics only, OLS estimates indicate that effect of prenatal WIC participation is associated with higher (i.e., worse) scores on mother-reported negative child temperament. However, this association drops to insignificance when the full set of observed mother and child characteristics is controlled. Prenatal food stamp receipt is significantly associated with higher scores on the difficult temperament index.

The direction of the relationship between prenatal WIC participation and negative child temperament changes sign in the fixed effect regressions. Although not estimated very precisely, the results suggest that prenatal WIC participation is associated with a 3.7 point (6.79 standard deviation) decrement in difficult child temperament. The coefficient for prenatal food stamp participation remains positive but is estimated imprecisely.

Motor and Social Skills

Table 5 presents the results of corresponding OLS and fixed effect models of prenatal WIC participation and the motor and social skill index. No significant effects of prenatal participation in the WIC program are detected in either the OLS or the fixed effect analyses. A significant negative association between drinking during pregnancy and this outcome are found in OLS, but not fixed effect, models.

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[6]In additional analyses, prenatal food stamp participation was entered into both the OLS and fixed effect equations without simultaneously accounting for prenatal WIC participation. Even in these analyses, prenatal food stamp use is not significantly linked with infant birth weight in this sample of children.

TABLE 4

Difficult Temperament Composite Index: Results of OLS and Fixed Effect Regressions for NLSY Children Born between 1990 and 1996

	1		2		3	
Variable	OLS	FE	OLS	FE	OLS	FE
Prenatal WIC Participation	1.68 (.57)***	-3.06 (1.62)*	1.20 (.77)*	-3.42 (2.07)	0.36 (.87)	-3.67 (2.08)*
Prenatal Food Stamps					2.37 (.98)**	2.97 (2.77)
Prenatal Maternal Variables						
Total Cash Income			-0.01 (.01)	0.02 (.05)	0.00 (.01)	0.03 (.05)
Drank during Pregnancy			0.54 (.49)	1.42 (1.6)	0.42 (.50)	1.39 (1.60)
Smoked during Pregnancy			-0.30 (.59)	-1.42 (2.7)	-0.38 (.60)	-1.36 (2.70)
Maternal Characteristics						
AFQT			-0.01 (.02)	(dropped)	-0.01 (.02)	(dropped)
Self-Esteem in 1980			1.89 (.67)***	(dropped)	1.89 (.67)***	(dropped)
Deviant Behavior in 1980			0.31 (.22)	(dropped)	0.29 (.22)	(dropped)
Prenatal Urban Residence			-0.66 (.70)	(dropped)	-0.78 (.69)	(dropped)
Prenatal Maternal Education			0.15 (.14)	(dropped)	0.19 (.14)	(dropped)
Maternal Early Background						
Parents' Mean Education			-0.04 (.10)	(dropped)	-0.03 (.10)	(dropped)
Mother Worked at Age 14			-0.06 (.49)	(dropped)	-0.04 (.49)	(dropped)
Lack of Literary Supports			0.06 (.97)	(dropped)	0.13 (.97)	(dropped)
Number of Siblings of Mother			-0.04 (.12)	(dropped)	-0.03 (.12)	(dropped)
Child Demographics						
Black	2.77 (.52)***	(dropped)	2.79 (.77)***	(dropped)	2.58 (.78)***	(dropped)
Hispanic	1.20 (.56)**	(dropped)	1.15 (.82)	(dropped)	0.99 (.81)	(dropped)
Male	-0.98 (.4)**	0.01 (.79)	-1.06 (.46)**	-0.17 (.92)	-1.09 (.46)**	-0.33 (.93)
Child Age at Assessment	-0.42 (.04)***	-0.49 (.07)***	-0.41 (.04)***	-0.58 (.09)***	-0.42 (.04)***	-0.57 (.09)***
Low Birth Weight	1.16 (.91)	-0.06 (1.91)	1.21 (.97)	1.78 (2.69)	1.02 (.99)	1.80 (2.69)
Gestational Length	-0.05 (.13)	-0.08 (.35)	0.03 (.14)	0.20 (.43)	0.03 (.14)	0.23 (.43)
Adjusted R^2	0.18	0.28	0.2	0.36		0.37
Number of Children	1024	884	754	676		676

Notes: Standard errors are given in parentheses. Panel 1 includes just prenatal WIC participation and infant demographics. Panel 2 also includes the full set of explanatory variables. Panel 3 also accounts for prenatal food stamp participation. *** = $p < .01$, ** = $p < .05$, * = $p < .10$. OLS models are estimated with robust standard errors that account for the fact that observations are clustered within family units.

TABLE 5

Motor and Social Skills: Results of OLS and Fixed Effect Regressions for NLSY Children Born between 1990 and 1996

	1		2		3	
Variable	OLS	FE	OLS	FE	OLS	FE
Prenatal WIC Participation	-0.18 (.23)	-0.56 (.92)	-0.09 (.32)	0.10 (1.17)	-0.28 (.36)	0.21 (1.18)
Prenatal Food Stamps					0.62 (.42)	-1.72 (1.84)
Prenatal Maternal Variables						
Total Cash Income			0.01 (.01)	0.03 (.04)	0.01 (.01)	0.03 (.04)
Drank during Pregnancy			-0.67 (.23)***	0.70 (.97)	-0.71 (.23)***	0.80 (.97)
Smoked during Pregnancy			0.14 (.26)	-2.23 (1.59)	0.11 (.26)	-2.28 (1.59)
Maternal Characteristics						
AFQT			-0.01 (.01)	(dropped)	-0.01 (.01)	(dropped)
Self-Esteem in 1980			-0.49 (.29)*	(dropped)	-0.49 (.29)*	(dropped)
Deviant Behavior in 1980			0.04 (.096)	(dropped)	0.03 (.1)	(dropped)
Prenatal Urban Residence			-0.04 (.28)	(dropped)	-0.06 (.28)	(dropped)
Prenatal Maternal Education			0.00 (.07)	(dropped)	0.01 (.07)	(dropped)
Maternal Early Background						
Parents' Mean Education			0.04 (.05)	(dropped)	0.04 (.05)	(dropped)
Mother Worked at Age 14			0.16 (.21)	(dropped)	0.17 (.21)	(dropped)
Lack of Literary Supports			0.54 (.44)	(dropped)	0.55 (.44)	(dropped)
Number of Siblings of Mother			-0.02 (.05)	(dropped)	-0.02 (.05)	(dropped)
Child Demographics						
Black	0.44 (.22)**	(dropped)	0.41 (.32)	(dropped)	0.35 (.32)	(dropped)
Hispanic	-0.31 (.27)	(dropped)	-0.33 (.36)	(dropped)	-0.37 (.36)	(dropped)
Male	-0.62 (.18)***	0.25 (.48)	-0.49 (.22)**	0.44 (.58)	-0.49 (.22)**	0.49 (.58)
Child Age at Assessment	0.12 (.02)***	0.12 (.04)***	0.11 (.02)***	0.12 (.05)**	0.11 (.02)***	0.11 (.05)**
Low Birth Weight	-0.31 (.44)	-0.53 (1.17)	-0.33 (.50)	-1.40 (1.63)	-0.37 (.5)	-1.38 (1.63)
Gestational Length	0.18 (.06)	0.20 (.22)	0.19 (.07)***	0.15 (.27)	0.18 (.07)***	0.12 (.27)
Adjusted R^2	0.09	0.07	0.11	0.09	0.11	0.1
Number of Children	1032	885	759	679	759	679

Notes: Standard errors are given in parentheses. Panel 1 includes just prenatal WIC participation and infant demographics. Panel 2 also includes the full set of explanatory variables. Panel 3 also accounts for prenatal food stamp participation. *** = p < .01, ** = p <.05, * = p < .10. OLS models are estimated with robust standard errors that account for the fact that observations are clustered within family units.

ROBUSTNESS TESTING

Missing data on our independent variables produced considerable variability in sample size. To assess the importance of this, we considered setting the missing values on various variables to zero and then including a dummy variable representing those children missing on each variable. However, this strategy produced missing dummy variables that were problematic to estimate in the fixed effect regression models. Given this, we adopted the strategy for these analyses of just including the children who were nonmissing on the variables of interest. We did experiment with various strategies of retaining as many observations as possible across the three outcomes of interest. Our tests indicate that our results are reasonably robust across various missing data specifications. For infant birth weight, the coefficient for prenatal WIC participation ranged from .26 to .38. For both the motor and social skills and difficult temperament outcomes, coefficients were robust to various tests of missing data inclusion.

The major threat to our fixed effect estimates is from maternal actions, or conditions that influence both pregnancy-specific WIC participation and child outcomes. To address these concerns, we considered a variety of maternal health measures in the year prior to the birth of the child, including whether the mother reduced calories or sodium during pregnancy, took special vitamins, sought prenatal care, the month in which she first sought prenatal care, and the average weight of the mother at various stages of her pregnancy. Additionally, we formed a dichotomous variable equal to 1 if the mother had health limits on the kind or amount of work she could accomplish. Women who were not in the work force were also asked whether health limits would prevent working at a job.[7] We included these variables

[7]Some of these variables appear to be measuring almost universally adopted practices. Virtually all of the mothers (99 percent) sought prenatal care prior to the delivery of their child. On average, these mothers sought this prenatal care between the second and third month of their pregnancy. A large proportion, 95 percent, of the mothers in our sample took special vitamins during pregnancy. A smaller proportion of the mothers reduced calories (22 percent) and reduced their intake of salt (47 percent) during pregnancy. Only a small proportion (8 percent) of the mothers had a health limitation that prevented paid work in the year prior to the birth of the child. The majority of the women in this sample did not smoke or drink during their pregnancy; among those who reported either behavior, the average frequency was approximately once a month. On average, mothers in this sample gained 32 pounds (s.d. = 14.2) during their pregnancy.

as a supplemental analysis, because missing data on these variables limited their inclusion in the main analyses. Descriptive characteristics of these additional variables are presented in Appendix Table 2.

Considering the effects of these maternal prenatal health predictors on infant birth weight in both OLS and fixed effect models, only the weight of the mother just before delivery of the child had a significant positive effect, which certainly is not a surprising finding. We also observed that maternal weight just before delivery had positive effects on infant motor and social skills and reports of difficult temperament, but only in fixed effect equations. Frequency of smoking during pregnancy and whether the mother took special vitamins also had significantly positive effects on reports of difficult temperament, but again only in fixed effect equations.

We also considered a set of variables that measured various aspects of the outcome of the pregnancy and health characteristics relevant to the child's first year of life in the equations predicting infant motor and social skills and difficult temperament. These characteristics included the number of weeks after the birth that the mother began employment, whether the child was born within a week of the due date, whether the child was delivered by cesarean section, the length of the child at birth, number of days that the child and mother stayed in the hospital after delivery, and whether the child was taken to a doctor for either an illness or well care in the first year.[8]

With these variables, we were attempting to tap aspects of the pregnancy outcome that may have implications for the child's subsequent development. Our concern was that these variables might obscure the relationship between prenatal WIC participation and the three outcomes of interest. Though there were a few significant relationships, we did not detect any changes in the observed relationships between

[8]On average, 63 percent of the children were born within a week of the due date. Twenty-six percent of the children were delivered by cesarean section. A large proportion (95 percent) of the children went to a doctor for well care in the first year. Over half of the children were taken to a doctor because of an illness during the first year of life. Inclusion of these variables in the equations predicting infant motor and social skills yielded a few significant relationships. The length of the child at birth and whether the child was taken to a doctor for well care during the first year had significantly positive effects, but these relationships were not robust when considered with fixed effect regression techniques. We did not observe any significant effects on infant difficult temperament.

prenatal WIC participation and infant birth weight, motor skills, or reports of difficult temperament. This lends additional support to the overall robustness of the relationships reported in our primary analyses.

Additionally, we investigated whether the birth was the result of a twin pregnancy. Multiple gestations are typically higher-risk pregnancies, so a woman expecting twins might be more likely to take up WIC benefits. In additional analyses, we investigated the potential utility of these variables to aid in a more robust estimation of likely effects. There were 26 twin pairs in the sample. Of these, five pairs had mothers who received WIC benefits in the year prior to their birth. Four pairs of twins had mothers who did not receive prenatal WIC benefits but did receive them in the first year of life. This is consistent with a scenario in which a difficult twin pregnancy promotes the use of WIC benefits. However, there are very few twin pairs who fit this profile. We omitted the 26 twin pairs from the sample and re-estimated all of the analyses. The relationships between prenatal WIC usage and the three outcomes were not affected. We were also concerned that WIC usage might reflect a cumulative learning process by the mother about the pregnancy-related services available that increases with each pregnancy. We estimated alternative models in which we accounted for parity and found no change in the overall pattern of results.

The fixed effect analysis presented in this paper hinges on 71 discordant sibling groups for which there was a pattern of prenatal WIC usage during one of the observed children's gestation period but not in at least one of the other observed sibling's gestation period. We were concerned that these 71 discordant sibling groups may have differed in significant ways from the other respondents in the sample, so we conducted multiple comparisons of means across the four main categories depicted in Table 1 (WIC usage in at least two pregnancies, prenatal WIC participation in the first observed pregnancy but not in subsequent pregnancies, no prenatal WIC participation in earlier pregnancy but participation in a subsequent pregnancy, and no WIC participation in any of the observed sibling pregnancies). We did find that the sibling groups in the discordant categories differed from those in the no prenatal WIC usage category. It is not surprising that those receiving prenatal WIC benefits are on average more likely to be economically disadvantaged, have lower levels of maternal education, and be more likely to receive prenatal welfare benefits than those sibling groups that did not receive prenatal WIC benefits in either pregnancy. However, there were not large differences in these mean characteristics observed among sibling groups that were receiving prenatal WIC benefits in some combination of the pregnancies.

Initially, we planned to chart the effects of WIC participation in the child's first year of life on concurrent and subsequent outcomes. Over half of all WIC participants are children aged 1 to 5, making this the largest target group of the program. However, the structure of the data on WIC participation and the timing of the assessments did not permit a precise estimation of these effects. Because of this, we did not proceed with these analyses.[9]

DISCUSSION

Summarizing results for both of the developmental outcomes, we found stronger effects of prenatal WIC participation for infant difficult temperament than for motor skills. We offer a couple of preliminary suggestions for this disparity of significant linkages. First, motor and social skills constitute a multidimensional measure capturing both age-appropriate motor skills such as the ability to turn over and social skills such as the reactions of the infant to other people. It maybe possible that a multidimensional measure is not as responsive to the potential benefits of prenatal WIC participation as the more focused measure of temperament. Second, infant difficult temperament in many ways is a measure of an infant's disposition. One might argue that an infant's disposition may be especially responsive to prenatal dietary and health patterns that may have been positively affected by prenatal WIC participation. We do not view

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[9]In the NLSY data, the only available information about WIC participation is whether the mother, child, or spouse received any form of WIC benefits in the prior calendar year. Recall that we selected the earliest score for each child. Because the child assessments are measured biannually, this procedure results in half of the sample being assessed in their first year of life, and half of the sample being assessed shortly after their first birthday. We include controls for the child's age at assessment in the multivariate analysis. Given this variable time lag in when the first assessment was administered, there could be two separate scenarios regarding the effects of WIC benefits in the first year of life and infant assessments. The first scenario represents a situation in which the effects of WIC benefits in the first year of life on an assessment in the first year of life are estimated. In the second scenario, the effects of WIC participation in the first year on an assessment measured potentially just beyond the first year of life are estimated.

a lack of statistical relationships linking prenatal WIC participation and motor skills as a piece of evidence weighing negatively against the viability of WIC as a program. Rather, we view the positive findings of the effects of prenatal WIC participation on infant temperament as a piece of additional evidence for the possible advantages of the WIC program. In sum, the pattern of results for difficult child temperament illustrates the value of statistical techniques that net out the effects of persistent family and maternal conditions and reveal the potential for selection bias in traditional OLS regression techniques.

Food assistance programs such as the Special Supplemental Nutrition Program for Women, Infants, and Children were designed to improve the life chances of children by increasing birth weights. The benefits of WIC on this important outcome have not been established with recent national data. This research uses methods designed to more effectively estimate effects of prenatal WIC participation on subsequent infant birth weights.

Prior research has been based on models that may be biased by unmeasured characteristics which may affect both program participation and birth and child outcomes. Our approach has been to use fixed effect modeling techniques to difference out potentially biasing effects of unobserved family-specific characteristics. Using this approach, we find that the positive effects of prenatal WIC participation on infant birth weight do persist when the potential for biases is minimized. Given that WIC is a rapidly growing social program, and increasingly under critical scrutiny, this is an important finding. Results from this research appear to reconfirm that the WIC program does reach its stated goal of benefitting children, as measured by infant birth weights.

This research also provides key information on measures of infant development often recognized as important research goals but seldom completed. The ability to trace the effects of WIC participation on two important measures of infant adjustment represents an important contribution to the current food assistance literature. We did not observe any significant effects of prenatal WIC participation on measures of infant motor and social skills. However, we are encouraged by our findings that WIC participation is linked to decreases in negative infant temperament. That the sign of this significant finding changes, depending on whether OLS or fixed effect techniques are used, is of special interest. These results suggest that this line of research may uncover evidence that potential benefits of the WIC program are more extensive than previously documented.

APPENDIX TABLE 1
Prenatal WIC Participation: Logistic Regression Results for NLSY Children Born between 1990 and 1996 and Who Had Valid Prenatal WIC Information, N=1984

	Prenatal WIC Participation			
	1		2	
Variable	Odds Ratio		Odds Ratio	
Prenatal Food Stamps			4.40	(1.14)***
Key Maternal Prenatal Variables				
Adjusted Income	.94	(.09)***	.96	(.01)***
Urban Residence	.66	(.17)*	.61	(.16)*
Highest Grade Completed	.85	(.05)***	.91	(.06)
Drank during Pregnancy	.88	(.20)	.78	(.18)
Smoked during Pregnancy	.67	(.16)*	.60	(.16)*
Maternal Resources and Stressors				
AFQT	1.01	(.01)	1.01	(.01)
Self-Esteem in 1980	.88	(.24)	.99	(.29)
Deviant Behavior in 1980	1.23	(.11)**	1.21	(.11)**
Maternal Early Background				
Parent's Mean Educational Level	.94	(.04)	.93	(.04)
Mother Worked at Age 14	.99	(.20)	1.05	(.23)
Lack of Literary Supports	1.03	(.30)	1.04	(.32)
Number of Siblings of Mother	.99	(.04)	.97	(.04)
Infant Demographics				
Black	2.60	(.75)***	2.18	(.66)***
Hispanic	1.39	(.47)	1.19	(.42)
Adjusted R^2	.31		.34	

Notes: Panel 1 includes the full set of relevant explanatory variables. Panel 2 also accounts for prenatal food stamp participation. *** = p < .01, ** = p <.05, * = p < .10.

APPENDIX TABLE 2
Descriptive Characteristics of Additional Maternal and Child Health Indicators

Variable	Mean	Std. Dev.
Number of weeks prior to birth that the mother left employment (actual number)	57.26	125.47
Mother makes prenatal visit during pregnancy? (1 = yes)	0.99	0.09
Month of first prenatal visit (month of pregnancy)	2.43	1.78
Frequency of smoking during pregnancy (0 = never, 1 = less than once a month, 2 = about once a month, 3 = 3 or 4 days a month, 4 = 1 or 2 days a week, 5 = 3 or 4 days a week, 6 = nearly every day, 7 = every day)	0.26	0.57
Frequency of drinking during pregnancy (0 = never, 1 = less than once a month, 2 = about once a month, 3 = 3 or 4 days a month, 4 = 1 or 2 days a week, 5 = 3 or 4 days a week, 6 = nearly every day, 7 = every day)	0.51	1.10
Mother took vitamins during pregnancy (1 = yes)	0.95	0.22
Mother reduced calories during pregnancy (1 = yes)	0.22	0.41
Mother reduced salt during pregnancy (1 = yes)	0.47	0.50
Weight of mother just before delivery of child (measured in pounds)	175.35	32.75
Weight of mother just before pregnancy (measured in pounds)	143.84	31.52
Weight change in pounds during pregnancy	31.77	14.17
Mother had health limitations that prevented paid work in the year prior to birth of child (1 = yes)	0.08	0.28
Number of weeks after the birth that the mother began employment	24.62	50.39
Child born within a week of due date (1 = yes)	0.63	0.48
Child was delivered by a cesarean section (1 = yes)	0.26	0.44
Length of child at birth (measured in inches)	20.09	1.61
Child taken to doctor for illness in the first year? (1 = yes)	0.54	0.50
Child taken to doctor for well care in first year? (1 = yes)	0.95	0.22
Number of days child stayed in hospital after delivery (actual number)	2.72	4.02
Number of days mother stayed in hospital after delivery (actual number)	3.61	6.52

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