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WIC Participation and the Initiation and Duration of Breastfeeding

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Abstract

The objective of this paper is to measure the effect of participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) after the birth of a child on one important health behavior, the initiation and persistence of breastfeeding. The study is based on linked data on mothers and children from the Children of the National Longitudinal Survey of Youth. Baseline, two-stage least squares, and fixed-effects model estimates show a negative effect of WIC participation on some forms of breastfeeding. The findings demonstrate that the WIC program faces a difficult challenge in encouraging low-income mothers to breastfeed while also providing needed infant formula to formula-fed infants.

WIC Participation and the Initiation and Duration of Breastfeeding

INTRODUCTION

The goal of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is to improve health behaviors and outcomes among low-income, nutritionally vulnerable mothers, infants, and young children by providing them with supplementary food, nutritional counseling, and referrals to medical and social services. In 2000, the program served about 7.2 million participants, including 45 percent of all infants born in the United States. The WIC program has been expanding rapidly since its inception in 1972 and cost about $4 billion in 2000. Although the federal government funds and administers WIC, state WIC agencies have some flexibility in administering and designing the program.[1]

Virtually all evaluations of the WIC program rely on nonexperimental data. These studies suggest that participation in WIC during pregnancy leads to important health benefits for children, including increases in birth weight, reductions in iron deficiency anemia, and reductions in infant mortality.[2,3] Much less is known, however, about the benefits of WIC participation after pregnancy, during infancy, and during early childhood. Although research on the effectiveness of the WIC program focuses almost exclusively on participation during pregnancy, most WIC participants are not pregnant women, but rather are infants, young children, and postpartum women. As others have noted, a large proportion of WIC funds is targeted at these groups, but little is known about whether WIC improves health behaviors and outcomes for them.[4] This information is badly needed to evaluate the overall effectiveness and the cost-effectiveness of the program, as well as to better target existing funds.

The objective of this paper is to measure the effect of participation in WIC after the birth of a child on one important health behavior, the initiation and persistence of breastfeeding. In the United States, although most pediatricians recommend breastfeeding exclusively for at least 4 to 6 months, most low-income mothers do not initiate breastfeeding at all and very few breastfeed for at least 4 months.

Recognizing this problem, the United States Department of Agriculture (USDA) during the 1990s implemented many new policies intended to promote and support breastfeeding among WIC participants.[5,6] Nevertheless, despite these efforts, the program has continued to provide infant formula in food packages, which is a major incentive for mothers to participate in WIC, and which may very well work against the program's emphasis on breastfeeding.[7] The possibility that participation in WIC actually might discourage breastfeeding is troubling in light of the already low rates of breastfeeding among indigent mothers and the mounting evidence that breastfeeding is linked to reductions in illness among children. Moreover, some have argued that an increase in breastfeeding among WIC participants would lead to significant cost savings for WIC and other publicly funded programs.[8,9,10,11,12]

These arguments in no way, however, suggest that the WIC program should stop offering infant formula. About 90 percent of formula-fed infants participating in WIC receive iron-fortified formula, and the provision of this formula is thought to be one of the reasons that iron deficiency anemia rates have fallen dramatically over time in the United States.[13] For this reason, WIC faces the difficult challenge of encouraging breastfeeding while also offering valuable rations of free infant formula.

Very little, if anything, is known about the impact of WIC participation on breastfeeding practices among participants during the 1990s. This study uses a national, linked sample of mothers and children to test the hypothesis that participation in WIC leads to decreases in breastfeeding initiation and breastfeeding duration among participants. Despite the program's important efforts to increase breastfeeding rates among participants during the 1990s, it is expected that the valuable rations of infant formula provided in food packages have a stronger effect on behavior than do nutritional counseling and other efforts to support breastfeeding. To build on previous research on breastfeeding among WIC participants, this study (1) uses a large, longitudinal data set that includes children born between 1990 and 1995 (to older mothers, with a mean age of 31 years) when most of WIC's initiatives to promote breastfeeding were under way; (2) employs econometric methods to account for self-selection into the

WIC program; and (3) links mothers' breastfeeding practices to state WIC and Medicaid policies that decision-makers can control.

The results of the study suggest that WIC participation has a negative impact on initiating breastfeeding, but it is not clear that the program affects breastfeeding persistence. Baseline results, which are shown to be preferable to instrumental variables results, indicate that WIC participation has a strong, negative effect on breastfeeding initiation, but no effect on breastfeeding duration of at least 16 weeks. A heteroskedastic fixed-effects model suggests that within families, WIC participation is associated with fewer weeks of breastfeeding. It is important to note that these results are based on a sample of mothers who are older and probably more advantaged than the national WIC population. However, these findings are consistent with the limited previous work in this area, which suggests that although WIC's counseling on infant feeding has the potential to affect feeding decisions, the overall impact of the program on breastfeeding is negative.

BACKGROUND

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

The WIC program was established in 1972 to provide nutritional aid to low-income, pregnant, breastfeeding, and postpartum women, infants, and young children at nutritional risk.[14] This nutritional aid includes nutritional education and counseling and increased access to health and social services.[15] WIC recipients also receive vouchers for nutritious foods such as iron-fortified cereal and infant formula, fruit and vegetable juice, beans/peas, and tuna fish. Although federal regulations set the maximum contents of food packages, states have some flexibility in designing the packages for participants.

There are seven types of food packages that vary according to the age, dietary needs, and breastfeeding status of the participant. Infants (age 4–12 months), for example, receive the equivalent of 8 pounds of powdered, iron-fortified formula, 24 ounces of iron-fortified cereal, and 96 fluid ounces of infant juice on a monthly basis. The monthly food package for pregnant women includes up to 28 quarts

of milk, 2.5 dozen eggs, 36 ounces of iron-fortified cereal, 276 fluid ounces of juice, and 1 pound of peanut butter, dry beans, or peas.[16] The packages include practical foods and therefore probably provide a strong incentive to participate in WIC.[17] In 1996, infant monthly food packages were worth about $77–$92 (excluding rebates that WIC receives for infant formula), and monthly food packages for pregnant women were worth $34–$38.[18]

Many studies report that participation in WIC during pregnancy is associated with better birth outcomes. Moss and Carver (1998), for example, using data from the 1988 National Maternal and Infant Health Survey, find that WIC participation during pregnancy and WIC participation during infancy are associated with lower rates of infant mortality.[19] Ahluwalia et al. (1998) report that the duration of WIC participation during pregnancy is associated with lower rates of small-for-gestational-age births in Michigan.[20] Earlier analyses based on state-level data sets support these recent results—WIC participation during pregnancy is associated with reductions in low birth weight and neonatal mortality, and increases in prenatal care, gestational age, and infant growth.[21,22,23,24,25,26,27]

Despite this evidence, considerable debate continues over whether these benefits are real or whether they simply reflect unobserved characteristics of WIC participants that are associated with better birth outcomes. For example, it is possible that expectant mothers who are more motivated would be more likely both to participate in WIC and to behave in ways that would lead to a better birth outcome, such as avoiding drug use and eating nutritious foods. None of these studies account for this type of selection into the WIC program. Moreover, not all recent studies confirm these positive results. For example, Brown et al. (1996) find no effect of WIC participation during pregnancy on birth outcomes in a hospital sample of 4,713 women.[28] Although these issues are very important, the large body of observational evidence is still quite compelling, and it appears likely that prenatal WIC participation leads to important benefits for newborns.

There is much less evidence, however, that participation in WIC after pregnancy (during the postpartum period, during infancy, and during childhood) is beneficial, mainly because of a lack of well-

designed studies of this topic. Observational evidence suggests that participation in WIC during childhood may reduce iron-deficiency anemia. For example, Vazquez-Seoane et al. (1985) compare rates of iron-deficiency anemia in groups of children with similar demographic characteristics before and after the initiation of the WIC program in 1972.[29] Although the results suggest that reductions in the prevalence of anemia may be linked to WIC, the authors are unable to control for other factors that may explain the decline, such as secular trends or differences between the groups of children studied. Similarly, Sherry et al. (1997) report a large decline in childhood anemia among white WIC participants in Vermont between 1981 and 1994, but they are unable to definitively link the WIC program to this improvement in anemia rates.[30] Moreover, Rush et al. (1988), in a longitudinal study of WIC participants and nonparticipants, find that WIC participation has mixed effects on child outcomes. These authors report that current WIC participation is associated with better dietary intake among children, but they find no effects on energy intake, use of preventive health services, or breastfeeding.[4] In summary, the research on the effectiveness of WIC participation after pregnancy and during infancy and childhood is limited, particularly when compared with the much larger literature on the benefits of prenatal WIC participation.

WIC's Efforts to Promote and Support Breastfeeding

Numerous studies conclude that breastfeeding is associated with health benefits during infancy and childhood. Breastfeeding is linked to reductions in respiratory illnesses, gastrointestinal illnesses, ear infections, asthma and other allergies, sudden infant death syndrome, and childhood acute leukemia.[31,32,33,34,35] The American Academy of Pediatrics recommends that mothers breastfeed exclusively for the first 6 months, and then continue partial breastfeeding for at least a year.[36] As of 1997, however, 46 percent of 6- to 8-month-old infants in low-income families were ever breastfed, and only 20 percent were breastfed for at least 5–6 months.[37]

To improve infant feeding practices among low-income mothers, the WIC program has made numerous efforts at federal, state, and local levels to promote and support breastfeeding. In 1992, a new, enhanced food package was added specifically for exclusively breastfeeding mothers. Previously,

exclusively breastfeeding mothers received less valuable food packages than other mothers since their packages did not include infant formula. The enhanced food package, which is available only to mothers who are not using any infant formula, includes extra rations of juice (46 fluid ounces), cheese (1 pound), carrots (2 pounds), dry beans/peas/peanut butter (1 pound), and canned tuna (26 ounces) as substitutes for the infant formula included in other packages. These foods were selected because they are rich in vitamin A and because they are available year-round.[38] In 1996, the enhanced package was worth $38–$47 per month[18], but little is known about how many participants are aware of the package and whether the availability of the package encourages mothers to breastfeed.[39]

In addition to the new food package, the USDA, as well as state and local WIC programs, made many other important efforts to increase breastfeeding rates during the 1990s. In 1994, the federal government mandated that state WIC agencies designate breastfeeding coordinators, train nutrition counselors on breastfeeding management, and develop non-English breastfeeding educational materials. The USDA also has distributed breastfeeding materials to local WIC sites and sponsored pilot projects and studies designed to increase breastfeeding among WIC participants. The Healthy Meals for Healthy Americans Act of 1994 furthered these efforts by increasing WIC funding for breastfeeding support from $8 million to $20 million. Additionally, this act required state agencies to report to Congress the breastfeeding rates among the WIC participants they serve.[6] The WIC program also has always offered nutritional counseling, which includes encouragement to breastfeed.[6]

Breastfeeding Rates among WIC Participants

In a national survey of mothers of 6-month-old infants conducted in 1995, mothers who were WIC participants had much lower rates of breastfeeding initiation than nonparticipants (46.6 percent among participants versus 71.0 percent among nonparticipants) and much lower rates of breastfeeding at 6 months than nonparticipants (12.7 percent among participants versus 29.2 percent among nonparticipants).[40] The WIC Infant Feeding Practices Study (1997) documents WIC participants' experiences in choosing, continuing, and ceasing breastfeeding, and their use of supplemental foods in

feeding infants. The study is based on longitudinal interviews with 874 mothers who participated in WIC during pregnancy. Approximately half of these mothers initiated breastfeeding. African Americans had lower rates of breastfeeding than whites and Hispanics. Mothers who were younger (less than 20 years old), never-married, born in the United States, and not living with the child's father were less likely than other mothers to breastfeed their infants. On the other hand, mothers were more likely to breastfeed if they had breastfed an older child and if they knew about the enhanced WIC food package available for breastfeeding mothers.[6]

These findings are consistent with other literature on breastfeeding practices among low-income women. Researchers have noted that younger, less-educated, and American-born mothers are less likely than other mothers to breastfeed their infants.[41,42,43,44] Attitudes and beliefs about breastfeeding, previous breastfeeding experience, and social support also are important determinants of breastfeeding practices among low-income mothers.[19,44,43,41,45,46,47] Additionally, some mixed evidence indicates that provision of free infant formula, in the form of hospital discharge packs, may influence mothers' decisions about breastfeeding.[48,49,50,51]

WIC Participation and Breastfeeding

Breastfeeding among WIC participants has increased considerably in recent years, but it is not clear that this increase is linked to the efforts of the WIC program to promote breastfeeding. In 1989, 34.2 percent of WIC participants initiated breastfeeding in the hospital and 8.4 percent were still breastfeeding 6 months later. As of 1995, 46.6 percent of WIC participants initiated breastfeeding in the hospital and 12.7 percent were still breastfeeding 6 months later.[40] The timing of these increases in breastfeeding among WIC participants coincides with the period when WIC was significantly increasing its breastfeeding support and promotion activities. Nevertheless, because breastfeeding rates were increasing among nonparticipants during this time period (albeit not as dramatically), one cannot attribute this increase in breastfeeding to the efforts of the WIC program.

There is some evidence that the WIC program plays an important role in participants' decisions to breastfeed. Ahluwalia et al. (2000), in a study of WIC participants in Georgia, report higher rates of breastfeeding initiation among those who were exposed to new WIC strategies to promote breastfeeding, such as hospital-based counseling after birth, peer counseling, and breast pump loans.[52] Although WIC participants exposed to these new strategies had larger increases in breastfeeding rates between 1992 and 1996 than did participants exposed to a standard breastfeeding intervention, participants were not randomly assigned to the various interventions, and data were not available on individual characteristics such as income and education. Therefore, important observed and unobserved differences between the groups may confound the relationship between the type of intervention and breastfeeding rates.

Schwartz et al. (1995) assess the impact of WIC participation on breastfeeding using cross-sectional data from the 1988 National Maternal and Infant Health Survey. After controlling for self-selection into the WIC program, these authors find that WIC participation alone has a negative impact on breastfeeding initiation. However, WIC participation in conjunction with breastfeeding advice from WIC is associated with an increase in breastfeeding initiation among participants.[7] Similarly, Balcazar et al. (1995), using the same data set, report that mothers who were advised by WIC to use formula were less likely than other mothers to intend to breastfeed.[53] These interesting findings suggest that the WIC program's advice can have important effects on infant feeding decisions. However, the results are based on data collected in 1988, before most of WIC's recent efforts to promote breastfeeding were under way. Moreover, it does not necessarily follow from these results that the net effect of WIC participation—which includes both advice to breastfeed and free infant formula—is an increase in breastfeeding among participants.

METHODOLOGY

This paper is based on the hypothesis that despite the important efforts the WIC program has made to increase breastfeeding during the 1990s, WIC participation is still associated with lower rates of

breastfeeding because of the valuable infant formula available to participants. To test this hypothesis, the study focuses on estimating the following equation:

$$(1) \qquad BF_{ijt} = \alpha_0 + \alpha_1 W_{ijt} + \alpha_2 X_{it} + \alpha_3 X_{jt} + \alpha_4 u_i + \alpha_5 u_j + \varepsilon_{ijt}.$$

This equation is specific to the ith child of mother j at time t. Two dichotomous dependent variables (BF) are used in this analysis: (1) whether or not the mother initiated breastfeeding[54]; and (2) whether or not the mother breastfed for at least 16 weeks, which is the lower bound recommended by pediatricians. In the fixed-effects regressions, the models were estimated with the number of weeks the mother breastfed (including zeros for those mothers who did not initiate breastfeeding) as the dependent variable.[55]

The main independent variable of interest is WIC participation (W). The variable W_{ijt} is a dummy variable indicating whether or not mother j participated in WIC during the year of child i's birth. WIC participation is measured during the year of the child's birth because it is expected that WIC participation has the most potential to impact infant feeding decisions at this time (end of pregnancy, immediately after birth). It is possible that WIC participation during early pregnancy also can affect intentions to breastfeed. All of the models were estimated with a variable that included WIC participation during pregnancy or at the time of birth. These models yielded very similar results and are not presented here.

The vector X_i includes observed child-specific factors that may determine breastfeeding, such as the child's gender and health endowment at birth, as proxied by low birth weight, as well as the child's birth order and year of birth.[56] The child's year of birth is included to capture secular trends in infant feeding practices. The vector X_j includes observed mother-specific factors that may determine breastfeeding initiation and duration. These factors were selected based on previous literature and include education, age, family size, Armed Forces Qualification Test (AFQT, an aptitude test) score, marital status, employment status, and family income. These variables are measured during the year of the child's birth.

The models also include a measure of maternal smoking during pregnancy. It is not expected that maternal smoking will directly affect the decision to breastfeed, but smoking during pregnancy may proxy the mother's unobserved motivation to make investments in infant health, such as breastfeeding. Maternal smoking, along with low birth weight and some other right-hand variables, may be endogenous in the model because they may be determined simultaneously with WIC participation, and/or correlated with unobserved factors associated with both breastfeeding and WIC participation. For this reason, all of the models were also estimated with a parsimonious set of covariates (child's race, age, birth order, and mother's aptitude test score). The results were very similar to the full models presented in this paper.

Even with a rich secondary data set, there may exist important, unobserved factors that affect the outcome of interest. The vectors u_i and u_j represent these time-invariant, unobserved child and maternal factors, respectively, that affect breastfeeding. These factors may include the mother's mental and physical health, the mother's knowledge and interest in child health, and the mother's and child's temperament. It is possible that these unobserved maternal factors that affect breastfeeding are correlated with unobserved factors that determine WIC participation. To account for this possibility, our study estimates this WIC participation equation:

$$WIC_{ijt} = \beta_0 + \beta_1 P_t + \beta_2 Y_{jt} + \beta_3 u_j + \omega_{jt}. \quad (2)$$

It is expected that individual decisions about WIC participation will be determined both by individual-level characteristics and by characteristics of the program, such as the way the program and other linked programs are administered. The vector P_t represents (1) WIC eligibility and administration policies during the year of the child's birth in the state where the mother and child reside and (2) Medicaid policies during the year of the child's birth in the state where the mother and child reside. The term Y_{jt} represents the mother's and child's observed characteristics that are expected to affect WIC participation. As in equation 1, unobserved individual traits (u_j) which do not vary over time also are determinants of WIC participation.

Initially, ordinary least squares (OLS) and standard probit models are used to estimate equation 1. Estimating equation 1 by OLS or a standard probit, however, can lead to biased and inconsistent estimates if WIC participation is determined by the same unmeasured, individual-level factor (uj) that determines breastfeeding ($\alpha 5 \neq 0$ and $\beta 3 \neq 0$). For example, mothers who do not intend to breastfeed their infants might participate in WIC mainly to receive free infant formula. Because intention to breastfeed is unobserved, standard estimation of equation 1 would lead to a biased estimate of the impact of WIC on breastfeeding, since WIC participants in this scenario are more likely than nonparticipants to not intend to breastfeed. It is also possible that mothers who are interested in learning about infant health are motivated to participate in WIC and motivated to breastfeed their infants regardless of whether or not they participate in WIC. In this case, the estimated coefficient on WIC participation in equation 1 also would be biased.

This study uses three approaches to address this problem. First, observed data on maternal characteristics are used to proxy uj to the fullest extent possible. Next, the model is estimated using the two-stage least squares (2SLS) method, which purges the endogenous WIC participation measure of its correlation with the error term. Finally, the model is estimated using fixed-effects estimation techniques with the mother as the fixed effect. These fixed-effects models, which control for uj at the level of the child's family of birth, take advantage of the fact that some mothers in the sample have multiple children.

The 2SLS technique requires that at least one exogenous variable exists that is a predictor of WIC participation but is not correlated with the error term in the breastfeeding equation. The identifying instruments used in this study are the following characteristics of the state WIC program in the state where the mother and child reside: (1) whether or not the state WIC program is linked to Medicaid, Food Stamps, and AFDC; (2) whether or not the state WIC program allows participants to self-declare income to prove eligibility; (3) whether or not the state Medicaid income eligibility threshold is greater than the income eligibility threshold for WIC (185 percent of poverty); (4) whether or not the state WIC program places no restrictions on the type of milk provided in food packages; and (5) whether or not the state WIC

program places no restrictions on the cheese, eggs, and cereal provided and places no reduced-calorie restrictions on food. All of these characteristics are expected to increase participation in the WIC program. The endogeneity of WIC participation with respect to breastfeeding is tested using the Durbin-Wu-Hausman test, and all models are estimated using robust standard errors that account for clustering of observations at the state level. Additionally, the validity of the overidentifying restrictions is tested.

Theoretically, state-level Medicaid and WIC policies are likely to be excellent instruments. There is evidence that because of adjunctive eligibility with Medicaid, it is easier for mothers to enroll in WIC in states with expansive Medicaid eligibility policies, such as higher income thresholds.[57] For example, if a mother lives in a state where she is income-eligible for Medicaid, she is also income-eligible for WIC, even if her income exceeds the WIC income threshold of 185 percent of poverty. Adjunctive eligibility with Medicaid also expands WIC eligibility because Medicaid bases income thresholds on net family income, while WIC uses gross family income.[58] Moreover, these state-level Medicaid policies are unlikely to be correlated with unobserved, individual-level characteristics that affect WIC participation and breastfeeding practices.

State WIC policies also are likely to affect eligibility for WIC and mothers' interest in participating in WIC. For example, state WIC programs' restrictions on foods, such as mandating reduced-fat cheese, may discourage eligible mothers from enrolling in WIC. These examples demonstrate that state-level Medicaid and WIC policies have the potential to influence participation in WIC at the individual level. However, if these variables are not good predictors of WIC participation, the success of the 2SLS method may be seriously hindered.[59,60,61,62]

In this study, the instruments perform fairly well. Nevertheless, it is still useful to test the robustness of the results by also using fixed-effects models to account for unobserved heterogeneity. Fixed-effects models in this study take advantage of the fact that some mothers in the data have multiple children. This approach uses differences in WIC participation and differences in breastfeeding practices

within individual mothers over time. Consequently, the method relies on the existence of sufficient variation in WIC participation and breastfeeding practices within families over time.

The fixed-effects model presumes that the individual mother has an unobserved, fixed attribute that influences both breastfeeding and WIC participation. For example, the method accounts for a mother's fixed, unobserved disinclination to breastfeed, or her fixed, unobserved interest in her infant's health. However, fixed-effects models cannot account for time-varying, unobserved factors that affect both breastfeeding and WIC participation, such as a mother's changing attitudes toward breastfeeding. This problem remains a limitation of the analysis.

In this study, a Breusch-Pagan test based on a standard fixed-effects model shows evidence of heteroskedasticity in the random component of the error term. For this reason, a heteroskedastic fixed-effects model is estimated using feasible generalized least squares. This model allows for family-specific variances, but not for cross-sectional correlation within panels. A standard fixed-effects model led to similar, but much less efficient, results.

DATA

Data used in the study come from the 1996 releases of the National Longitudinal Survey of Youth (NLSY79) and the Children of the National Longitudinal Survey of Youth (CoNLSY). NLSY79 is an annual, national survey that was initiated in 1979 with a sample of 12,686 young people who at that time were aged 14–21. The original sample includes a nationally representative sample of civilian youth as well as oversamples of African Americans, Hispanics, indigent whites, and armed forces personnel. Children of NLSY79 mothers (CoNLSY respondents) are interviewed and/or assessed in a separate, linked survey. As of 1996, 7,103 CoNLSY respondents ranging in age from newborn to over 21 years old had been assessed and/or interviewed. Of these 7,103, 21 percent were Hispanic, 33 percent were African American, and 46 percent were white/other.[63]

Analysis Samples

Three samples from CoNLSY are used in this study: (1) a main analysis sample (N=1,282), which includes children born between 1991 and 1995 and for whom information is available on WIC participation, breastfeeding, and state-level Medicaid and WIC characteristics; (2) a low-income sample (N=517), which limits the main sample to those children living in families that are receiving welfare or Medicaid or are living at or below 250 percent of the federal poverty line during the year of the child's birth; (3) a sibling analysis sample (N=970), which includes children born between 1989 and 1995 who have at least one other sibling in the sample and for whom information is also available on WIC participation and breastfeeding. All the samples include families that exceed WIC's income eligibility threshold of 185 percent of poverty because in some states these families are eligible for WIC through their eligibility for Medicaid (as described previously). The low-income sample, however, is limited to children who were most likely to be eligible for WIC during the year of their birth.

The main analysis sample and the low-income sample are used to estimate baseline models, as well as 2SLS models with state Medicaid income eligibility and WIC administration policies as identifying instruments. The sibling analysis sample is used to estimate the mother-specific fixed-effects models. For children born in 1994, WIC participation during the year of the child's birth is proxied by WIC participation in the year that preceded the child's birth. This approximation is necessary because WIC participation information is not available for 1994. The samples include respondents with missing data on birth weight, education, family income, marital status, family size, AFQT score, employment status, and smoking during pregnancy. For these respondents, missing variables are replaced by sample means. To check the sensitivity of the results to this imputation, the models were reestimated after dropping respondents with missing information. The results were almost identical to those presented here.

State-Level WIC Eligibility and Administration Policies Data

To implement the 2SLS method, this study uses measures of state-level Medicaid and WIC eligibility and WIC administration policies as identifying instruments. These variables are expected to impact WIC participation, but they also are thought to be exogenous and not directly linked to breastfeeding practices. To qualify for WIC benefits, persons who are categorically eligible for WIC[64] must be at nutritional risk and must have a family income at or below 185 percent of the poverty level.[65] Currently, categorically eligible persons who participate in Temporary Assistance for Needy Families (TANF), the Food Stamp Program (FSP), or Medicaid are automatically income-eligible for WIC. Unlike TANF and the FSP, some state Medicaid programs have eligibility requirements that allow persons whose incomes exceed 185 percent of the poverty line to enroll in Medicaid and, therefore, in WIC.

Yearly state-level data on Medicaid income thresholds were collected from various issues of the *MCH Update*, a newsletter published by the National Governors' Association. These state-level policies are expected to affect Medicaid eligibility and enrollment, and, as a consequence, WIC eligibility and enrollment. In this study, a dummy variable indicated whether or not the state income threshold for Medicaid exceeded the WIC income eligibility threshold of 185 percent. It is expected that in states with Medicaid thresholds greater than 185 percent, many more mothers will be eligible for WIC and therefore WIC participation should be relatively high.

State-level WIC administration policies also may affect WIC eligibility and the WIC participation rate among low-income mothers. This study uses data from the biennial *WIC Program and Participants Characteristics* surveys to identify state-level WIC administration policies that may affect WIC participation. These surveys, conducted in 1988, 1990, 1992, 1994, and 1996, include information on how states apply federal WIC requirements and the operating characteristics of local WIC agencies.[66] Data from the 1992, 1994, and 1996 surveys were available for this study and were merged with child records according to the child's state of birth and year of birth. Children born in nonsurvey years (1991, 1993, 1995) were matched to the survey in the following year.

Previous research suggests that WIC participation among eligible individuals is affected by policies such as food brand restrictions and how easy is it to self-declare income.[67] This study uses as instruments state-level policies that affect eligibility and the ease with which participants can enroll (whether or not the WIC program is linked to TANF, Food Stamps, and Medicaid, whether or not participants can self-declare income). The study also uses two measures of restrictions on food packages that are expected to affect participants' interest in enrolling in WIC. One measure indicates whether milk is restricted (e.g., low-fat milk required). The other measure indicates whether the state places restrictions on cheese, eggs, cereal, and reduced-calorie foods (e.g., low-sucrose cereal, low-fat cheese).

The surveys offered many other important state-level characteristics of WIC programs that had the potential to serve as instruments. For example, some states require monthly issuance of food vouchers, which is expected to discourage participation since participants have to pick up the food vouchers more frequently. This variable was a good predictor of WIC participation but when it was included as an instrument, the instruments did not pass the test of overidentifying restrictions. It is possible that states require monthly food vouchers in order to change certain health behaviors such as breastfeeding. Nutritional risk criteria vary across states, as do tailoring practices for food packages (e.g., restricting sizes of food containers) and the cost of food packages. However, these factors were very poor predictors of WIC participation and therefore were not included as instruments in this study.

DESCRIPTIVE STATISTICS

Table 1 displays means and standard deviations for the three analysis samples: the main sample (N=1,282), the low-income sample (N=517), and the sibling sample (N=970). In the main sample and the sibling sample, about 27 percent of mothers report WIC participation during the year of the child's birth. In the low-income sample, this percentage is 58 percent. These high rates of WIC participation are

TABLE 1
Characteristics of Three Analysis Samples, Means and Standard Deviations

	Main Sample (N=1282)		Low-Income Sample (N=517)		Sibling Sample (N=970)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Maternal Characteristics						
Participated in WIC during year of child's birth	.273	.446	.578	.494	.279	.449
Number of years of education at year of child's birth	13.43	2.22	12.35	2.00	13.57	2.30
Married during year of child's birth	.748	.396	.523	.474	0.778	.039
Median family income during year of child's birth ($000)	54.5	—	24.0	—	50.1	—
Age during year of child's birth	31.1	2.57	30.8	2.59	30.0	2.91
Mother employed during year of child's birth	.551	.454	.371	.448	.504	.473
Total family size during year of child's birth	3.90	1.39	4.32	1.72	3.95	1.51
AFQT percentile score	42.13	28.65	26.52	23.75	45.4	29.8
Smoked during pregnancy	.250	.396	.340	.443	.241	.400
Child Characteristics						
Female	.495	.500	.520	.500	.476	.500
African American	.248	.432	.402	.491	.234	.424
Hispanic	.203	.402	.251	.434	.187	.400
Year of birth, 19--	92.79	1.48	92.59	1.43	91.7	2.0
Weighed 5.5 pounds or less at birth	.100	.274	.138	.323	.100	.280
First born	.247	.432	.108	.311	.224	.417
Child was breastfed for at least 1 week	.554	.497	.395	.489	.564	.496
Child was breastfed for at least 16 weeks	.282	.450	.190	.392	.316	.465
State Characteristics (during birth year)						
Medicaid threshold greater than 185 percent poverty	.034	.180	.029	.168		
WIC program administratively linked to Medicaid, AFDC, and Food Stamps	.901	.298	.905	.293		
WIC applicants can self-declare income	.147	.355	.184	.388		
No restrictions on milk in food packages	.377	.485	.391	.488		
No restrictions on eggs, cheese, cereal, and no calorie-reduction restrictions in food packages	.255	.436	.277	.448		

consistent with the fact that NLSY79 contains both a nationally representative sample as well as oversamples of disadvantaged populations. About 23–25 percent of the main and sibling samples are African American and 19–20 percent are of Hispanic origin. The low-income sample includes higher percentages of African Americans (40 percent) and Hispanics (25 percent).

In the main and sibling samples, about 75–78 percent of mothers are married, and in both samples more than half of the mothers are employed during the year of the child's birth. These rates are much lower in the low-income sample, where only 52 percent of mothers are married and just 37 percent are employed during the year of the child's birth. The mean maternal age in the sample is 30–31 in all three samples (maternal age ranges from 26 to 38), making the sample somewhat older and possibly more advantaged than the national WIC population.

Table 2 shows means and standard deviations by WIC participation status for the main and low-income samples. It is not surprising that there are large and important observable differences between mothers who participate in WIC and mothers who do not participate in WIC. In the main sample, WIC participants are somewhat younger and less educated, are much less likely to be married and employed, and have much lower family incomes and aptitude test scores than nonparticipants. WIC participants are also more likely than nonparticipants to smoke during pregnancy and less likely to initiate and persist in breastfeeding.

In the low-income sample, many of these differences disappear or become less striking. WIC participants and nonparticipants are similar in terms of family income, employment status, smoking during pregnancy, and low birth weight. However, even in the low-income sample, differences persist between WIC participants and nonparticipants in breastfeeding, marital status, race, and aptitude test scores. The existence of these observable differences suggests that even when the sample is limited to low-income mothers, important unobservable differences may exist between WIC participants and nonparticipants that affect WIC participation and breastfeeding decisions.

TABLE 2
Differences between WIC Participants and Nonparticipants

	Main Sample (N=1,282)		Low-Income Sample (N=517)	
	WIC Participants (N=350)	Nonparticipants (N=932)	WIC Participants (N=299)	Nonparticipants (N=218)
Number of years of education	12.21[c]	13.89	12.07[c]	12.75
	(.105)	(.070)	(.114)	(.134)
Married	.500[c]	.842	.456[c]	.616
	(.027)	(.012)	(.029)	(.033)
Family income	63,578[c]	30,507	26,834	28,158
	(3057.39)	(1077.48)	(1,117.67)	(1099.19)
Age	30.67[c]	31.28	30.57[c]	31.13
	(.138)	(.084)	(.150)	(.174)
Mother is employed	.385[c]	.614	.349	.402
	(.026)	(.016)	(.028)	(.033)
Family size	4.37[c]	3.73	4.43[a]	4.18
	(.092)	(.039)	(.104)	(.108)
AFQT percentile score	21.50[c]	49.88	21.45[c]	33.47
	(1.05)	(.906)	(1.49)	(1.81)
Smoked during pregnancy	.342[c]	.215	.360	.313
	(.025)	(.013)	(.028)	(.031)
Female child	.490	.509	.522	.518
	(.016)	(.027)	(.029)	(.034)
African American	.457[c]	.170	.472[c]	.307
	(.027)	(.012)	(.029)	(.031)
Hispanic	.294[c]	.168	.281[a]	.211
	(.024)	(.012)	(.026)	(.028)
Year of birth, 19--	92.68[a]	92.83	92.66	92.54
	(.078)	(.049)	(.095)	(.083)
Weighed 5.5 pounds or less at birth	.140[c]	.085	.156	.113
	(.019)	(.009)	(.021)	(.021)
First born	.106[c]	.300	.094	.128
	(.016)	(.015)	(.017)	(.027)
Child was breastfed for at least 1 week	.349[c]	.632	.318[c]	.500
	(.025)	(.016)	(.027)	(.034)
Child was breastfed for at least 16 weeks	.160[c]	.328	.154[b]	.239
	(.020)	(.015)	(.021)	(.029)
Medicaid threshold greater than 185 percent poverty	.040	.031	.028	.032
	(.010)	(.006)	(.009)	(.011)
WIC program administratively linked to Medicaid, AFDC, and Food Stamps	.911	.898	.913	.894
	(.015)	(.010)	(.016)	(.021)
WIC applicants can self-declare income	.217[c]	.121	.214[b]	.142
	(.022)	(.011)	(.024)	(.024)

table continues

TABLE 2, continued

	Main Sample (N=1,282)		Low-Income Sample (N=517)	
	WIC Participants (N=350)	Nonparticipants (N=932)	WIC Participants (N=299)	Nonparticipants (N=218)
No restrictions on milk in food packages	.369 (.026)	.380 (.016)	.371 (.028)	.417 (.033)
No restrictions on eggs, cheese, cereal, and no calorie-reduction restrictions in food packages	.337[c] (.025)	.224 (.013)	.156 (.021)	.113 (.021)

[a]Statistically significant at the .10 level.
[b]Statistically significant at the .05 level.
[c]Statistically significant at the .01 level.
Note: Standard deviations are in parentheses.

Tables 3 and 4 compare the samples used in this analysis to national samples of low-income mothers. Table 3 shows breastfeeding rates in the main and low-income samples along with breastfeeding rates from three relevant sources: (1) the WIC Infant Feeding Practices Study, a national survey of 874 mothers who participated in WIC while pregnant in 1994; (2) the 1997 Pediatric Nutrition Surveillance System, which includes over 8 million infant records from participants in WIC and other federally funded nutrition programs in 44 states; and (3) almost 3,000 low-income respondents from the Third National Health and Nutrition Examination Survey (NHANES III), which includes a national sample of children surveyed between 1988 and 1994. Data compilations from NHANES III were obtained from tables from the WIC General Analysis Project: Profile of WIC Children, a report prepared for the USDA by researchers at Abt Associates.

Table 3 demonstrates that breastfeeding rates in the analysis samples are similar to those in national surveys of WIC participants and low-income nonparticipants. The main exception is among nonparticipants in the main analysis sample, where the breastfeeding rates are much higher than those among low-income nonparticipants in the national surveys. Table 4 compares other characteristics of WIC participants in the analysis samples to those of WIC participants in NHANES III. Clearly, WIC participants in the analysis samples are older (mean age 31) than those in NHANES III (mean age 25). Otherwise, there is no striking evidence that the WIC participants in the analysis samples are necessarily more advantaged than the national WIC population.

As mentioned earlier, the fixed-effects models rely on sufficient variation in breastfeeding practices and WIC participation within families. Table 5A displays the number of children within each family whose mothers participated in WIC and who were breastfed. For example, the table indicates that 526 children from two-child families had neither child in the family participating in WIC. Approximately 15 percent of the sample lived in a family where there was some variation in WIC participation across siblings. Similar percentages of children lived in families in which there was some variation in breastfeeding initiation and persistence across siblings. Table 5B focuses on the 94 children living in two-

TABLE 3
Sample Breastfeeding Rates and National Rates among Low-Income Mothers

	Main Analysis Sample (N=1,282)		Low-Income Analysis Sample (N=517)		WIC Infant Feeding Practices Study, 1994–1995 (N = 874)	PedNSS, 1997 (N = approx. 8 million)	Low-Income Respondents from NHANES III, 1988–1994 (N = 2,979)	
Participation Status	WIC (N=350)	Non-WIC (N=932)	WIC (N=299)	Non-WIC (N=218)	WIC	WIC and other public programs	WIC (N=1,010)	Non-WIC (N=1,969)
Initiated breastfeeding	35%(1)	63%(1)	32%(1)	50%(1)	45%(2)	46%(3)	40%(3)	44%(3)
Breastfed for at least 4–6 months	16%(4)	33%(4)	15%(4)	24%(4)	16%(5)	20%(6)	16%(6)	18%(6)

(1) breastfed for at least one week
(2) breastfeeding at hospital discharge
(3) ever initiated breastfeeding
(4) breastfed at least 4 months
(5) breastfed at least 5 months
(6) breastfed at least 6 months

Sources: (1) NLSY79; (2) N. Baydar, M. McCann, R. Williams, and E. Vesper. Final Report: WIC Infant Feeding Practices Study, November 1997. Contract 53-3198-3-003 to the USDA; (3) U.S. DHHS, Centers for Disease Control and Prevention, Pediatric Nutrition Surveillance System, 1997 Full Report; (4) N. R. Burstein, M. K. Fox, J. B. Hiller, R. Kornfeld, K. Lam, C. Price, and D. T. Rodda . WIC General Analysis Project: Profile of WIC Children, March 2000. Prepared for the USDA (NHANES III data compilations taken from Exhibit 3.2).

TABLE 4
Comparison of NLSY Sample WIC Population and NHANES III WIC Population

	WIC Participants in Main Analysis Sample (N=350)	WIC Participants in Low-Income Analysis Sample (N=299)	WIC Participants from NHANES III (N=1,010)
African American	46%	47%	31%
Hispanic	29%	28%	23%
Married	50%	47%	55%
Over 250% of poverty line	12%	3%	8%
Mean age at birth of child	31	31	25
Smoked during pregnancy	34%	36%	29%
Low birth weight	14%	16%	12%
Food Stamps	61%	69%	60%
Welfare	63%	72%	35%

Sources: (1) NLSY79; (2) N. R. Burstein, M. K. Fox, J. B. Hiller, R. Kornfeld, K. Lam, C. Price, and D. T. Rodda. WIC General Analysis Project: Profile of WIC Children, March 2000. Prepared for the USDA (NHANES III data compilations taken from Exhibits 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 4.4, and 4.8).

TABLE 5A
Variation in WIC Participation and Breastfeeding within Families

	Families with 2 Children			Families with 3 Children			Families with 4 Children		
	WIC	Breastfed at Least 1 Week	Breastfed 16 Weeks	WIC	Breastfed at Least 1 Week	Breastfed 16 Weeks	WIC	Breastfed at Least 1 Week	Breastfed 16 Weeks
# kids		*n=770 children*			*n=159 children*			*n=36 children*	
none	526	274	460	81	57	87	12	20	24
1	94	110	142	15	12	15	12	0	0
2	150	386	168	27	15	12	0	4	8
3				36	75	45	0	8	0
4							12	4	4

Note: # kids = number of children with column characteristics (e.g., 526 children lived in two-child families where no children participated in WIC during year of birth).

TABLE 5B
WIC Participation and Changing Breastfeeding Patterns within Two-Child Families with Only One Child in WIC
N=94

	WIC	No WIC
Number of weeks mother breastfed (including zeros)	6.96 [47]	4.51 [47]
Breastfed at least 1 week	38% [18]	36% [17]
Breastfed at least 16 weeks	17% [8]	9% [4]

Note: Cell sample size in brackets (e.g., 18 of the 94 children were in WIC and were breastfed for at least 1 week).

child families where just one of the two children participated in WIC. Surprisingly, within families, WIC participation appears to be associated with longer breastfeeding duration. However, there appears to be no difference in breastfeeding initiation rates between siblings when one child participated in WIC and the other did not. These associations may be confounded by other factors, such as the birth order of the children.

REGRESSION RESULTS

Tables 6–8 present regression results for baseline models, 2SLS models, and mother-specific fixed-effects models. Table 6 presents results for breastfeeding initiation models, while Table 7 presents results for breastfeeding persistence models, which include the fixed-effects model. The models include some covariates that are potentially endogenous, such as low birth weight and smoking during pregnancy. No difference was seen in the results when these variables were excluded from the models. The results are not presented here. Table 8 shows results from the WIC participation model, which was used to generate predictions of WIC participation for the 2SLS models.

Columns 1 and 3 in Table 6 and columns 1 and 4 in Table 7 show estimated marginal effects from baseline probit models of breastfeeding initiation and breastfeeding persistence. Columns 2 and 4 in Table 6 and columns 2 and 5 in Table 7 display 2SLS estimates for breastfeeding initiation and persistence with Medicaid and WIC policies as identifying instruments. Finally, column 3 in Table 7 shows estimates from heteroskedastic fixed-effects models with the mother as the fixed effect. These fixed-effects models focus only on "within" variation in families. The fixed-effects models exclude all "between" variation, which consists of all maternal characteristics that do not vary between siblings.

Baseline Probit Results

Baseline results (presented in columns 1 and 3 of Tables 6 and columns 1 and 4 of Table 7) indicate that participation in WIC is negatively associated with initiating breastfeeding, but has no effect

TABLE 6
WIC Participation and Breastfeeding Initiation

	Main Sample		Low-Income Sample	
	(1)	(2)	(3)	(4)
	Probit (Marginal Effects)	2SLS	Probit (Marginal Effects)	2SLS
Participated in WIC	-0.087	-0.148	-0.088	-0.222
	(-2.77)	(-0.739)	(-1.96)	(-1.07)
First-born child	0.051	0.040	-0.036	-0.043
	(1.25)	(1.08)	(-0.540)	(-0.603)
Female child	0.002	0.004	0.025	0.023
	(0.060)	(0.152)	(0.550)	(0.571)
Year of child's birth	-0.021	-0.018	-0.057	-0.047
	(-2.21)	(-1.69)	(-3.35)	(-2.49)
AFQT score	0.003	0.003	0.005	0.004
	(4.24)	(3.21)	(3.31)	(3.42)
African American	-0.122	-0.103	-0.107	-0.078
	(-2.59)	(-2.16)	(-1.38)	(-1.15)
Hispanic	0.106	0.098	0.152	0.147
	(2.74)	(2.25)	(1.68)	(2.17)
Low birth weight	-0.196	-0.148	-0.245	-0.148
	(-3.39)	(-3.04)	(-2.60)	(-2.33)
Family size	-0.013	-0.008	-0.040	-0.024
	(-1.09)	(-0.647)	(-1.71)	(-1.80)
Mother's education	0.029	0.023	0.013	0.009
	(3.45)	(2.81)	(1.05)	(0.708)
Married	0.096	0.066	0.131	0.081
	(2.53)	(1.04)	(2.45)	(1.39)
Family income	-0.000	-0.000	-0.000	-0.000
	(-0.140)	(-0.260)	(-0.590)	(-0.482)
Age of mother	0.003	0.002	0.030	0.022
	(0.032)	(0.245)	(2.28)	(2.18)
Mother is employed	-0.022	-0.021	-0.020	-0.021
	(-0.760)	(-0.636)	(-0.310)	(-0.439)
Smoked during pregnancy	-0.105	-0.91	-0.101	-0.087
	(-2.21)	(-2.63)	(-1.30)	(-1.85)
F statistic on identifying instruments		11.41		15.03
Overidentification test		8.36		4.13
Hausman test		—		0.08
R^2	0.140	.165	0.182	0.197
N groups				
N observations	1282	1282	517	517

Notes: T-statistics in parentheses; intercept not shown. Standard errors adjusted for clustering by state of birth using Huber's method. For the test of the instruments, critical values of $F(5, \infty)$ are 2.21 at 5 percent and 3.04 at 1 percent. For the Hausman test, critical values of χ^2 (14) are 23.68 at 5 percent and 29.14 at 1 percent. For the overidentification test, critical values of χ^2 (4) are 9.49 at 5 percent and 13.28 at 1 percent

TABLE 7
WIC Participation and Breastfeeding Persistence
Child was breastfed for at least 16 weeks (Probit and 2SLS)
Number of weeks child was breastfed (Fixed-Effects Model)

	Main Sample			Low-Income Sample	
	(1)	(2)	(3)	(4)	(5)
	Probit (Marginal Effects)	2SLS	Heteroskedastic Fixed-Effects Model	Probit (Marginal Effects)	2SLS
Participated in WIC	-0.035	-0.155	-0.178	-0.004	-0.087
	(-0.970)	(-.834)	(-2.00)	(-0.180)	(-0.519)
First-born child	-0.015	-0.025	2.95	-0.024	-0.035
	(-0.51)	(-0.733)	(109.38)	(-0.400)	(-0.613)
Female child	0.012	0.014	1.22	0.007	0.004
	(0.480)	(0.553)	(46.40)	(0.190)	(0.134)
Year of child's birth	-0.002	-0.002	1.64	-0.025	-0.024
	(-0.230)	(-0.210)	(15.57)	(-2.15)	(1.58)
AFQT score	0.003	0.003		0.004	0.005
	(4.98)	(3.85)		(4.15)	(4.70)
African American	-0.053	-0.023		-0.064	-0.035
	(-1.65)	(-0.526)		(-1.44)	(-0.647)
Hispanic	-0.011	0.003		0.048	0.049
	(-0.290)	(0.082)		(0.940)	(0.888)
Low birth weight	-0.185	-0.114	-0.388	-0.114	-0.056
	(-2.55)	(-2.50)	(-3.06)	(-2.00)	(-1.08)
Family size	0.007	0.013	0.095	0.004	0.009
	(0.580)	(1.14)	(4.62)	(0.250)	(0.848)
Mother's education	0.025	0.024	0.233	0.012	0.011
	(3.28)	(3.08)	(6.25)	(1.16)	(1.05)
Married	0.051	0.009	-3.25	0.080	0.075
	(1.15)	(0.154)	(-16.42)	(2.14)	(1.59)
Family income	-0.000	-0.000	0.000	-0.000	-0.000
	(-1.62)	(-2.43)	(23.22)	(-2.62)	(-2.53)
Age of mother	-0.009	-0.011	-1.48	0.011	0.008
	(-1.53)	(-1.76)	(-13.83)	(1.38)	(1.01)
Mother is employed	-0.077	-0.089	-3.63	0.020	0.002
	(-2.69)	(-2.87)	(-37.01)	(0.470)	(0.055)
Smoked during pregnancy	-0.127	-0.104	2.15	-0.067	-0.081
	(-3.88)	(-3.24)	(21.63)	(-1.96)	(-2.13)
F statistic on identifying instruments		11.41			15.03
Overidentification test		7.35			3.89
Hausman test		—			0.60
Breush-Pagan statistic			948.4		
R^2	0.122	0.114		0.201	0.130
N groups			448		
N observations	1282	1282	970	517	517

Notes: T-statistics in parentheses; intercept not shown. Standard errors adjusted for clustering by state of birth using Huber's method. For the test of the instruments, critical values of F (5, ∞) are 2.21 at 5 percent and 3.04 at 1 percent. For the Hausman test, critical values of χ^2 (14) are 23.68 at 5 percent and 29.14 at 1 percent. For the overidentification test, critical values of χ^2 (4) are 9.49 at 5 percent and 13.28 at 1 percent. The p-value for the Breush-Pagan test is .00.

TABLE 8
First-Stage Results

	Participated in WIC during Year Child Was Born	
	Main Sample	Low-Income Sample
	OLS Regression	
First-born child	-0.075	-0.103
	(-3.31)	(-1.06)
Female child	0.029	0.026
	(1.30)	(0.641)
Year of child's birth	-0.003	-0.002
	(-0.250)	(-0.059)
AFQT score	-0.003	-0.002
	(-5.87)	(-1.94)
African American	0.116	0.126
	(3.53)	(2.12)
Hispanic	0.126	0.161
	(4.50)	(3.12)
Low birth weight	0.068	0.045
	(2.08)	(0.690)
Family size	0.035	0.016
	(3.26)	(0.888)
Mother's education	-0.013	-0.020
	(-2.43)	(-2.14)
Married	-0.246	-0.128
	(-6.21)	(-2.24)
Family income	0.035	0.000
	(3.26)	(0.602)
Age of mother	-0.010	-0.016
	(-1.78)	(-1.28)
Mother is employed	-0.071	-0.015
	(-2.33)	(-0.251)
Smoked during pregnancy	0.019	0.018
	(0.587)	(0.282)
WIC linked to welfare, Food Stamps, and Medicaid	0.061	0.104
	(3.18)	(2.90)
Can self-declare income	0.057	0.070
	(1.92)	(1.37)
No milk restrictions	-0.090	-0.129
	(-3.12)	(-2.41)
No reduced-calorie restrictions	0.112	0.154
	(6.03)	(4.29)
Medicaid threshold > 185% of poverty line	0.125	0.142
	(3.35)	(1.62)
N	1282	517
F statistic on identifying instruments	11.41	15.03
R^2	.367	.466

on persisting in breastfeeding for at least 16 weeks. This effect is negative in sign in all baseline models, but is statistically significant at conventional levels only in the models of breastfeeding initiation. The size of the effect is relatively large. After controlling for a full set of covariates, participation in WIC reduces the probability of initiating breastfeeding by .09, a decrease of about 16 percent in the main sample and about 22 percent in the low-income sample, when measured at the sample means. These effect sizes are similar to the estimated effect on breastfeeding of factors such as smoking during pregnancy and marital status.

Other estimated coefficients generally are consistent with previous literature on the factors associated with breastfeeding. African American mothers are less likely than other mothers to initiate and continue breastfeeding, but this effect grows smaller and becomes statistically insignificant when the sample is limited to low-income mothers. Hispanic mothers are more likely to initiate breastfeeding, but Hispanic origin had no statistically significant effect on breastfeeding persistence. Hispanic origin may be partially capturing the effects of foreign birth; previous research suggests that foreign-born mothers are more likely to breastfeed than American-born mothers. Low-birth-weight infants are much less likely than normal-birth-weight infants to be breastfed.

Socioeconomic status may influence maternal knowledge about infant health and access to information about optimal infant feeding practices. For this reason, it is not surprising that many researchers have linked low socioeconomic status to low rates of breastfeeding. This analysis confirms this relationship. Mothers who are less educated and have lower aptitude test scores are less likely to initiate and continue breastfeeding than are more-educated mothers with higher aptitude test scores. Family size is inversely related to breastfeeding initiation. Interestingly, maternal age increases breastfeeding initiation, but only among low-income mothers. Maternal age has no impact on breastfeeding in the main sample after controlling for other factors, perhaps because the sample is limited to older mothers. Married mothers are more likely than unmarried mothers to breastfeed, and maternal employment is negatively linked to breastfeeding persistence in the main sample. These effects may be

capturing socioeconomic factors, or they may reflect time constraints and other practical constraints on breastfeeding.

2SLS Results

Baseline results show a consistent, negative relationship between WIC participation and breastfeeding initiation, but this effect may be confounded by unobserved factors that affect both WIC participation and infant feeding behaviors. 2SLS estimates purge the potentially endogenous WIC participation variable of its correlation with the error term by including in the model the predicted value of WIC participation rather than the true value. In Tables 6 and 7, state Medicaid income eligibility thresholds and state WIC administration policies are used to identify the breastfeeding equations.

The 2SLS results generally support the baseline results. In all four 2SLS models (columns 2 and 4 in Table 6 and columns 2 and 5 in Table 7), the estimated coefficient on WIC participation is negative but not statistically significant. The magnitude of the effect appears large, although it is difficult to interpret the size of the estimates because the first stage of the 2SLS model was estimated as a linear probability model for computational convenience. The identifying instruments performed fairly well in these models. The first stage of the model (Table 8) has good predictive power, the *F* statistics on the identifying instruments are above 10, and the instruments pass the overidentification test in every case.

The first stage also offers interesting information about how state policies affect WIC participation. As Table 8 shows, state-level policies had a statistically significant, consistent impact on individual mothers' participation in WIC. Mothers living in states where WIC was administratively linked to welfare, Medicaid, and Food Stamps, and in states where the Medicaid income threshold exceeded the WIC threshold (in the year when the child was born), were more likely to participate in WIC than other mothers. Being able to self-declare income had a positive effect on participation in WIC, as did state policies that left most food choices unrestricted. Surprisingly, mothers living in states that did *not* restrict milk choices were less likely than other mothers to participate in WIC.

The Hausman test was used to check every model for endogeneity of the WIC participation measure with respect to breastfeeding. These tests suggest that WIC participation is *not* endogenous, making the baseline estimates the preferred estimates. Overall, then, the baseline and 2SLS models suggest that WIC participation discourages breastfeeding initiation, but has no effect on breastfeeding persistence.

Fixed-Effects Model Results

A fixed-effects model is estimated as a third method of analyzing the impact of WIC participation on breastfeeding. The dependent variable in this model is the number of weeks the mother breastfed the infant, including zeros for mothers who did not breastfeed. These models control for fixed characteristics of mothers that affect both breastfeeding and WIC participation. The fixed-effects model approach eliminates the need for good instruments, which is an advantage, but the models rely on sufficient variation within families, and they cannot control for time-varying, unobserved factors that affect both WIC participation and breastfeeding. For example, a mother may both join WIC and decide not to breastfeed a second child because the family is experiencing unobserved stresses, such as problems at work or family conflict. Nevertheless, if the fixed-effects models also show a strong relationship between WIC participation and breastfeeding, one can have more confidence in the validity of the other findings.

Fixed-effects results are consistent with baseline and 2SLS findings for breastfeeding initiation. The models show a statistically significant, negative relationship between WIC participation and the number of weeks the mother breastfed the infant. This effect appears to be small. The effects of other covariates, such as birth order and low birth weight, appear to be more important. Some of the other estimated coefficients yielded puzzling findings that are inconsistent with both the baseline models in this paper and previous research. Within families, for example, marriage appears to detract from breastfeeding while smoking appears to increase breastfeeding duration. However, there is very little variation in these variables within families, which may have led to these unexpected results. Among mothers who gave

birth to at least two children between 1990 and 1995, very few changed their smoking habits and marital status between births.

Although fixed-effects models and the other econometric methods described in this paper are useful in exploring causal pathways and in testing the robustness of associations between WIC participation and breastfeeding, the methods cannot determine causation definitively. State-level policies are assumed to be exogenous in this study, but this assumption may be faulty if unobserved state sentiment is correlated with both policies and beliefs about breastfeeding. Furthermore, the breastfeeding and WIC participation measures used in this study are based on self-reported data, which may be subject to nonrandom reporting error.[68] Finally, although the analysis samples include a diverse group of mothers, the samples do not represent a random sample of WIC participants. For these reasons, these estimates must be interpreted and generalized with caution.

DISCUSSION

Although the WIC program is committed to the promotion and support of breastfeeding, this study is based on the hypothesis that WIC participants in the 1990s were likely to be more influenced by free infant formula than by breastfeeding counseling. Therefore, WIC participants may be less likely to initiate breastfeeding and less likely to continue breastfeeding than similar women who are not WIC participants. Baseline estimates support part of this hypothesis—WIC participants appear to be less likely to initiate breastfeeding than nonparticipants, but participation does not appear to affect breastfeeding for at least 16 weeks.

Many would argue, however, that these baseline estimates of the impact of WIC participation on breastfeeding are confounded by countervailing sources of self-selection bias. It is possible that WIC participation is correlated with unobserved socioeconomic and cultural factors that are positively correlated with both WIC participation and with formula-feeding. On the other hand, mothers who have unobserved motivation to learn about infant health and feeding issues may be more likely both to

participate in WIC and to breastfeed. It is not clear a priori which source of self-selection bias will prevail in the baseline estimates.

For this reason, 2SLS and fixed-effects model estimates are expected to show that after accounting for self-selection, participation in WIC is associated with decreased initiation and duration of breastfeeding. The results presented here, however, are somewhat inconsistent. The 2SLS estimates support baseline results—WIC participation appears to discourage breastfeeding, although the effect is not statistically significant. Hausman tests suggest that OLS models are preferable to 2SLS models, which leads to the conclusion that WIC participation may have some negative effects on breastfeeding initiation but no effect on breastfeeding for 16 weeks. Fixed-effects models, on the other hand, show a negative association between WIC participation and the number of weeks of breastfeeding. In sum, the study shows suggestive evidence that WIC participation detracts from breastfeeding, although it is not clear whether the effect is limited to the initiation of breastfeeding.

The results of this study are consistent with two other papers that examined WIC and breastfeeding using data from the 1988 National Maternal and Infant Health Survey. Schwartz et al. (1995)[7] and Balcazar et al. (1995)[53] find that WIC's infant feeding advice (as reported by mothers) does affect infant feeding decisions. Like this study, Schwartz et al. finds that the overall impact of WIC participation on breastfeeding initiation is negative. Taken together, these studies imply that while the WIC program's counseling about infant feeding may be effective, at least for some mothers, many mothers still may be more influenced by the incentive of free infant formula. The net effect of the program on breastfeeding initiation therefore may still be negative, even if the counseling increases motivation to breastfeed.

To generate implications for policy, more qualitative and quantitative research is needed to confirm the results from this very small body of work. However, if these results can be replicated using other data, it appears that the WIC program has great potential to affect infant feeding practices. The program, however, faces the challenge of increasing breastfeeding rates among participants while

continuing to offer infant formula to mothers who decide not to breastfeed. Both of these goals, though difficult to obtain simultaneously, are extremely important to the health of infants living in low-income families.

Notes

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