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Special Supplemental Nutrition Program for Women, Infants, and Children Participation and Infants' Growth and Health: A Multisite Surveillance Study

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ABSTRACT. *Context.* The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is the largest food supplement program in the United States, serving almost 7 500 000 participants in 2002. Because the program is a grant program, rather than an entitlement program, Congress is not mandated to allocate funds to serve all eligible participants. Little is known about the effects of WIC on infant growth, health, and food security.

Objective. To examine associations between WIC participation and indicators of underweight, overweight, length, caregiver-perceived health, and household food security among infants ≤ 12 months of age, at 6 urban hospitals and clinics.

Design and Setting. A multisite study with cross-sectional surveys administered at urban medical centers in 5 states and Washington, DC, from August 1998 through December 2001.

Participants. A total of 5923 WIC-eligible caregivers of infants ≤ 12 months of age were interviewed at hospital clinics and emergency departments.

Main Outcome Measures. Weight-for-age, length-for-age, weight-for-length, caregiver's perception of infant's health, and household food security.

Results. Ninety-one percent of WIC-eligible families were receiving WIC assistance. Of the eligible families not receiving WIC assistance, 64% reported access problems and 36% denied a need for WIC. The weight and length of WIC assistance recipients, adjusted for age and gender, were consistent with national normative values. With control for potential confounding family variables (site, housing subsidy, employment status, education, and receipt of food stamps or Temporary Assistance for Needy Families) and infant variables (race/ethnicity, birth weight, months breastfed, and age), infants who did not receive WIC assistance because of access problems were more likely to be underweight (weight-for-age z score = -0.23 vs 0.009), short (length-for-age z score =

-0.23 vs -0.02), and perceived as having fair or poor health (adjusted odds ratio: 1.92; 95% confidence interval: 1.29–2.87), compared with WIC assistance recipients. Rates of overweight, based on weight-for-length of >95 th percentile, varied from 7% to 9% and did not differ among the 3 groups but were higher than the 5% expected from national growth charts. Rates of food insecurity were consistent with national data for minority households with children. Families that did not receive WIC assistance because of access problems had higher rates of food insecurity (28%) than did WIC participants (23%), although differences were not significant after covariate control. Caregivers who did not perceive a need for WIC services had more economic and personal resources than did WIC participants and were less likely to be food-insecure, but there were no differences in infants' weight-for-age, perceived health, or overweight between families that did not perceive a need for WIC services and those that received WIC assistance.

Conclusions. Infants ≤ 12 months of age benefit from WIC participation. Health care providers should promote WIC utilization for eligible families and advocate that WIC receive support to reduce waiting lists and eliminate barriers that interfere with access. *Pediatrics* 2004; 114:169–176; *WIC, growth, health, food security, infants.*

ABBREVIATIONS. WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; TANF, Temporary Assistance for Needy Families; USDA, United States Department of Agriculture.

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is the largest supplemental food program in the United States, providing food, nutrition counseling, and health care screening and referrals to women during pregnancy, lactation, and the postpartum period, infants, and children <5 years of age.¹ WIC is administered by the United States Department of Agriculture (USDA) through grants to the states. Program participation has increased steadily from 88 000 participants in 1974, the first year in which the program was permanently authorized, to almost 7.5 million participants in 2002, with a budget of almost \$4.5 billion.^{2,3} WIC is a federal grant program, not an entitlement program; therefore, Congress is not mandated to allocate funds to serve all eligible participants.² The most recent legislation governing WIC, the William F. Goodling Child Nutrition Reauthori-

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zation Act of 1998 (HR 3874), was signed into law on October 31, 1998 (PL 105-336).⁴ Questions about the effectiveness of WIC and concerns related to increasing costs have threatened the existing program, as well as any expansion.^{5,6}

Eligibility for WIC for infants and children is based on nutritional risk, as determined through either medical status (eg, anemia or underweight) or dietary status (eg, inadequate dietary patterns) and caregiver income (185% of the Federal Poverty Level or eligibility for Medicaid, Temporary Assistance for Needy Families [TANF], or the Food Stamp Program).^{1,2} Based on 2004 dollars, eligibility for a family of 2 is \$23 107 and for a family of 4 is \$34 873.^{2,3} Benefits vary according to the categories of the participating mother (pregnant, postpartum, or breastfeeding) and child (<1 year or between 1 and 5 years of age).^{1,2} In addition to nutritional counseling and screening for anemia, growth delays, and inadequate dietary intake, families of infants who are not breastfed receive a food package that includes formula and infant cereal, whereas mothers who are breastfeeding receive a package to enhance their nutrition.³

Evaluations conducted during pregnancy have shown that WIC participation is associated with decreases in the rates of neonatal death,⁷⁻¹³ low birth weight,⁷⁻¹³ and prematurity.⁸⁻¹³ Evaluations conducted postnatally have shown that WIC participants demonstrate faster weight gain during infancy,¹⁴ better diets (with greater intakes of iron and zinc),^{15,16} and lower rates of anemia,¹⁷ compared with nonparticipants. However, there is only 1 study relating WIC participation to weight gain¹⁴ and no evidence linking WIC participation and infants' linear growth, health status, or household food security. Concerns about the possible association of WIC participation with excessive weight gain, contributing to the epidemic of overweight among children, were expressed recently.⁶

Household food insecurity, defined as "limited or uncertain availability of adequate or safe foods,"¹⁸ has been associated with inadequate intake of important nutrients,^{19,20} behavioral and emotional problems,^{21,22} problems relating with peers,²³ physical health problems,²³ and symptoms of depression.²⁴ For low-income families with young children, who may have limited access to cash and food stamp assistance, partially because of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996,²⁵ WIC is often the only federal nutrition assistance program available.

This investigation examines the relationship of WIC participation to infant growth (including overweight), caregiver perception of infant health, and household food security among a geographically diverse sample of low-income infants recruited from urban primary health care sites in 5 states and the District of Columbia. WIC participation or nonparticipation was not a criterion for recruitment, reducing the possibility of bias. Study of these low-income infants in the developmental epoch of rapid postpartum growth provides a unique opportunity to examine the effects of WIC participation or nonparticipation.

METHODS

Setting and Instruments

The Children's Sentinel Nutritional Assessment Program conducted household-level surveys and medical record audits, between August 1998 and December 2001, at 6 central-city medical centers, including acute care and primary care clinics (Baltimore, MD; Minneapolis, MN; and Washington, DC) and hospital emergency departments (Boston, MA; Little Rock, AR; and Los Angeles, CA).²⁶ Primary adult caregivers accompanying 11 567 children ≤ 36 months of age were interviewed in private settings by trained interviewers, scheduled during times of peak patient flow. Caregivers of critically ill or injured children were not approached. Potential respondents were excluded if they did not speak English, Spanish, or Somali (Minneapolis only), if they were not knowledgeable about the child's household, if the child's caregiver had been interviewed within the previous 6 months, or if they refused consent for any reason. Institutional review board approval was obtained at each site.

The survey instrument included questions regarding household characteristics, food security, federal assistance program (including WIC) participation, changes in benefit levels, child's history of hospitalization, and child's health status. WIC participation or nonparticipation was not a criterion of enrollment and was not known at the time of recruitment. Household food security status was derived from the 18-item USDA Food Security Scale, which was scored and scaled in accordance with established procedures.^{18,27} With this measure, households were classified as food-insecure if they reported that they could not afford enough nutritious food for an active healthy life.¹⁷ The caregiver's report of the child's overall health status was elicited in standard form, as appearing in the Third National Health and Nutrition Examination Survey.²⁸ Caregivers were asked to rate the child's health as poor, fair, good, or excellent.

For a subset of the sample (subjects recruited after January 1, 2000), we included a 3-item maternal depression screen.²⁹ The instrument had a sensitivity of 100%, specificity of 88%, and positive predictive value of 66%, compared with the 8-item Rand screening instrument. The 3-item version was scored as positive if a respondent endorsed any 2 of the 3 items.

To ensure that weights and lengths were recorded in the same manner at all sites, we purchased standard equipment and conducted training sessions at each site. Each child's weight and length were obtained either by project staff members or from medical record reviews conducted on the same day as the caregiver interview. Values were converted to z scores for weight-for-age, length-for-age, and weight-for-length, by using age- and gender-specific normative values.³⁰ Weight-for-age was used to examine underweight.³¹ On the basis of recommendations from the Centers for Disease Control and Prevention, weight-for-length of ≥ 95 th percentile was used as an indicator of overweight.³² To ensure that infants did not differ with respect to dehydration status, we collected information on dehydration, as noted in the medical record at the time of the visit.

Sample Characteristics

In the complete sample of families potentially available for recruitment, 7% refused to be interviewed; an additional 15% of families were ineligible because of language factors (did not speak English, Spanish, or Somali), because the caregivers did not have knowledge of the child's household, or because the caregivers had been interviewed previously. From the interviewed sample of 11 567 children, 6610 were ≤ 12 months of age. We eliminated 120 respondents who did not answer the questions regarding WIC participation. Because we did not have data on household income, we used the absence of private insurance as a proxy for WIC income eligibility. Only 8.5% of the sample had private insurance, and those families were more likely to report no need for WIC than were families with no insurance or with public insurance ($\chi^2 = 707.78$, $P < .0001$). Therefore, we eliminated all infants whose families received private insurance (567 infants), leaving an analysis sample of 5923 infants, 5395 who received WIC assistance and 528 who did not.

Predictor Variable

Families were asked if they received WIC assistance for their child. If they indicated that they did not receive WIC assistance,

they were asked to indicate the primary reason for not receiving WIC assistance. Responses were recorded and subsequently grouped into 15 categories independently by 3 investigators. Agreement exceeded 95%. Discrepancies were resolved through discussion. The primary predictor variable in this study included 3 mutually exclusive categories, ie, WIC participant, WIC nonparticipant (access problems), and WIC nonparticipant (no perceived need).

Outcome Measures

There were 5 outcome measures. Weight-for-age and length-for-age were expressed in z scores as continuous variables. Overweight, caregiver perception of infant health status, and household food security were expressed as 2-level categorical variables. Each child's household was categorized as food-secure or food-insecure by using the USDA Food Security Scale.¹⁸

Analytical Approach

Families that were receiving WIC services were compared with those that were not receiving WIC assistance because they had access problems or did not need WIC services. To ensure that the 3 groups were statistically comparable before the effects of WIC participation were tested, we selected potentially confounding variables that might influence infant growth, health, or household food security to include in the analytical models. These variables included study site, infant's race/ethnicity, infant's birth weight, number of months the child was breastfed, infant's age, whether the household received a housing subsidy, caregiver's employment status, caregiver's education, and whether the household received other federal assistance (food stamps or TANF).

Multivariate regression models were used to examine differences in weight-for-age and length-for-age z scores, and multivariate logistic regression models were specified to model differences in the odds of overweight, caregiver reports of children's health, and food insecurity among families of infants on the basis of their WIC status. Potentially confounding factors were controlled for in all models.

RESULTS

WIC

Approximately 91% of the families of infants presumed to be eligible for WIC reported that they were receiving WIC assistance ($n = 5395$). Of the 528 eligible families that were not receiving WIC assistance, 64% ($n = 340$) reported access problems and 36% ($n = 188$) reported that they did not need WIC services. Access problems included a waiting list (45%); missed appointment, no time to pick up vouchers, or a need to reapply (24%); moved, lived in a shelter, or could not receive an appointment (13%); no identification or transportation (4%); and other reasons (14%).

Sample differences between families of infants who were receiving WIC assistance and those who were eligible but not receiving WIC assistance indicated more economic and personal resources among families that reported no need for WIC services (Table 1). Such families had the highest rates of marriage (62%), high school graduation (36%), employment (38%), and breastfeeding initiation (64%) and were least likely to be receiving subsidized housing (9%), food stamps (10%), or TANF (7%), in comparison with WIC assistance recipients and caregivers who reported problems accessing WIC. In addition, families that reported no need for WIC services were less likely to be African American or Hispanic. There were no group differences in the caregivers' responses to the depression screen. The infants dif-

TABLE 1. Characteristics of WIC-Eligible Caregivers According to WIC Participation, 1998–2001

	No WIC (Access Problems) ($N = 340$)	No WIC (No Perceived Need) ($N = 188$)	WIC ($N = 5395$)
Caregiver characteristics			
Study site, %*			
Baltimore, MD	11	5	9
Boston, MA	16	21	24
Washington, DC	6	7	8
Little Rock, AR	8	13	9
Los Angeles, CA	8	19	16
Minneapolis, MN	51	35	33
Race/ethnicity, %†			
African American	51	40	52
Hispanic	35	28	39
White	10	21	7
Other	4	11	2
Married, %*	49	62	45
Age, y, mean \pm SD‡	25.8 \pm 6.9	27.7 \pm 7.3	25.6 \pm 7.0
High school graduate, %*	31	36	35
Depressive symptoms ($N = 3110$), %	31	24	34
Caregiver employed, %†	25	38	33
Subsidized housing, %*	16	9	23
Food stamp recipient, %‡	32	10	35
TANF recipient, %*	17	7	23
Child characteristics			
Age of child, mo, mean \pm SD‡	3.2 \pm 3.5	4.6 \pm 3.7	5.0 \pm 3.5
Birth weight, g	3133.7 \pm 671.9	3296.1 \pm 696.7	3182.4 \pm 848.2
Birth weight <2500 g, %	13	9	13
Breastfeeding initiation, %†	62	64	54
Breastfed, mo, mean \pm SD	1.1 \pm 2.1	1.6 \pm 2.2	1.3 \pm 2.3
Dehydrated at visit, %	1	2	2

Group comparisons used the χ^2 test for categorical variables and t test for continuous variables.

* $P < .0001$.

† $P < .01$.

‡ $P < .001$.

ferred with respect to age; those who were receiving WIC assistance were oldest (5.0 months), and their mothers were least likely to have initiated breastfeeding (54%). There were no differences, however, in durations of breastfeeding, birth weights, rates of low birth weight, or dehydration status among the infants according to WIC participation.

Growth

The average unadjusted *z* scores for weight-for-age and length-for-age for infants receiving WIC assistance approached 0 (weight-for-age: 0.002; length-for-age: -0.006), indicating growth consistent with national normative values (Table 2). Infants whose caregivers reported no need for WIC services also had unadjusted *z* scores for growth parameters in the normal range (weight-for-age: 0.10; length-for-age: 0.30). In contrast, the average unadjusted *z* scores for infants who were not receiving WIC assistance because of access problems were below normal (weight-for-age: -0.36; length-for-age: -0.41), indicating less than expected growth, compared with national normative values for infants of the same age. In a multivariate regression analysis, adjusted for potential confounders, infants who were not receiving WIC assistance because of access problems were underweight ($P = .002$) and short ($P = .006$), compared with WIC recipients (Table 3 and Fig 1). Infants whose caregivers reported no need for WIC did not differ from WIC assistance recipients in weight-for-age, but they were taller ($P = .04$).

The unadjusted rates of overweight varied from 7% to 9% and did not differ among the 3 groups (Table 2). Group differences in rates of overweight continued to be nonsignificant after covariate control (Table 4).

Food Insecurity

The unadjusted rates of food insecurity were higher among families that did not receive WIC assistance because of access problems than among WIC participants (28% vs 23%, $P = .05$) (Table 2). However, in a multivariate analysis, the difference was no longer significant. Among caregivers who reported no need for WIC assistance, there was an 11% rate of food insecurity. In a multivariate analysis, families that reported no need for WIC assistance remained significantly less likely to be food-insecure, compared with WIC assistance recipients (Table 4).

Perceived Health Status

The unadjusted rates of perceived poor or fair health status were higher among WIC nonparticipants with access problems than among WIC participants (16% vs 11%, $P = .01$) (Table 2). The differences remained significant in a multivariate analysis adjusted for covariates. Among families that were not receiving WIC assistance because of access problems, the odds of perceiving the infant as having fair or poor health, as opposed to good or excellent health, were >1.9 times as great (adjusted odds ratio: 1.92; 95% confidence interval: 1.29–2.87), compared with families that were receiving WIC assistance (Table 4). There were no differences in the perceived health status of the infants between families that received WIC assistance and families that felt no need for WIC assistance.

Depressive Symptoms

All analyses were repeated, including depressive symptoms as a covariate, for the subset of families that completed the depression screen. There were no changes in findings when depressive symptoms were included as a covariate.

TABLE 2. Unadjusted Child Health Outcomes According to WIC Participation

Outcome Variables	No WIC (Access Problems) (N = 340)	No WIC (No Perceived Need) (N = 188)	WIC (N = 5,395)	P Value*
Weight-for-age <i>z</i> score	-0.36 ± 1.28	0.10 ± 1.37	0.002 ± 1.29	<.0001
95% CI	-0.50, -0.22	-0.08, 0.29	-0.03, 0.04	
P value†	<.0001	.29		
Length-for-age <i>z</i> score	-0.41 ± 0.09	0.30 ± 1.24	-0.006 ± 0.02	<.0001
95% CI	-0.57, -0.26	-0.09, 0.51	-0.05, 0.03	
P value†	<.0001	.005		
Overweight				
% Weight-for-length ≥95th percentile	8	7	9	.65
Odds ratio	0.84	0.79	1.00	
95% CI	0.50, 1.39	0.38, 1.64		
P value†	.49	.52		
Caregiver perception of infant health				
% Fair/poor	16	10	11	.03
Odds ratio	1.48	0.89	1.00	
95% CI	1.09, 2.01	0.55, 1.45		
P value†	.01	.65		
Household Food Security				
% Insecure	28	11	23	.0001
Odds ratio	1.29	0.40	1.00	
95% CI	1.01, 1.64	0.21, 0.77		
P value†	.05	.0002		

CI, confidence interval.

* Three-group comparison.

† Two-group comparison (each level versus reference group).

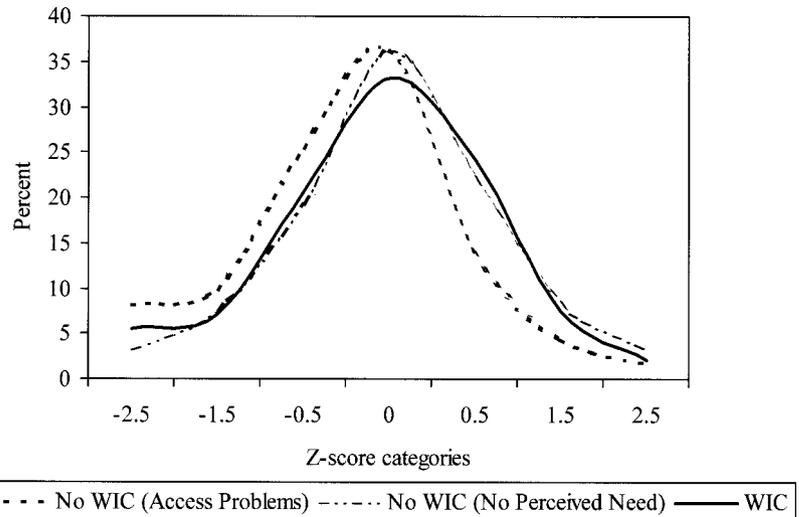
TABLE 3. Adjusted Means of Infant Growth Parameters According to WIC Participation

Outcomes	No WIC (Access Problems) (N = 340)	No WIC (No Perceived Need) (N = 188)	WIC (N = 5,395)	P Value*
Weight-for-age z score	-0.23	-0.02	0.009	.008
95% CI	-0.41, -0.10	-0.18, 0.22	-0.03, 0.04	
P value†	.002	.74		
Length-for-age z score	-0.23	.21	0.002	.003
95% CI	-0.43, -0.09	0.001, 0.45	-0.05, 0.03	
P value†	.006	.04		

Multivariate regressions are adjusted for study site, race/ethnicity of infant, infant birth weight, months breastfed, infant's age, caregiver's employment status, caregiver's education, household's receipt of housing subsidy, caregiver's receipt of public insurance, whether infant's family received TANF benefits, and whether infant's household received food stamps. CI, confidence interval.

* Three-group comparison.

† Two-group comparison (each No WIC group versus WIC group).

Fig 1. Weight-for-age z scores according to WIC participation.**TABLE 4.** Adjusted Odds Ratios of Infant Health Outcomes According to WIC Participation

Outcomes	Odds Ratio (95% CI)			P value*
	No WIC (Access Problems) (N = 340)	No WIC (No Perceived Need) (N = 188)	WIC (N = 5,395)	
Food insecurity	1.25 (0.90, 2.01) (P = .18)†	0.40 (0.21, 0.77) (P = .005)	1.00	.008
Child health fair/poor	1.92 (1.29, 2.87) (P = .0014)	0.80 (0.41, 1.57) (P = .52)	1.00	.004
Overweight	0.63 (0.29, 1.38) (P = .25)	0.72 (0.28, 1.84) (P = .49)	1.00	.42

Multivariate regressions are adjusted for study site, race/ethnicity of infant, infant birth weight, months breastfed, infant's age, caregiver's employment status, caregiver's education, household's receipt of housing subsidy, caregiver's receipt of public insurance, whether infant's family received TANF benefits, and whether infant's household received food stamps. CI, confidence interval.

* Three-group comparison.

† Two-group comparison (each No WIC group versus WIC group).

DISCUSSION

The results provide evidence that WIC participation is associated with positive infant growth and health. Infants ≤ 12 months of age who did not receive WIC services because of access problems were more likely to be underweight, short, and perceived by their caregivers to be in fair or poor health, compared with WIC assistance recipients. These findings are concerning, because there is mounting evidence that infants who experience nutritional deficiencies that are serious enough to disrupt their linear growth during infancy are at increased risk for cognitive and academic problems during school-age years.³³⁻³⁶

The weights and lengths of WIC assistance recip-

ients were consistent with national normative values, suggesting that their diets were adequate. Rates of overweight were not elevated among WIC participants, in comparison with nonparticipants, as critics have suggested.⁶ However, rates of overweight in all groups exceeded the 5% rate expected on the basis of national data.

There are several possible explanations for the positive association between WIC participation and infants' growth and perceived health. One possibility is that the infants received direct benefits from the food supplements and nutritional recommendations that their families received. The age-specific, nutrient-rich, WIC food package, including items such as

formula and infant cereal, may be beyond the food budget of low-income families. Another possibility is that the infants who participated in WIC benefited because they had better access to health care. In a recent investigation using North Carolina Medicaid records, WIC participants were more likely to use both preventive and curative health services for a wide range of health conditions, compared with non-participants.³⁷ This increased utilization is consistent with the objective of WIC, to promote preventive health care services and to provide referrals when necessary.¹

The rates of household food insecurity among the WIC assistance recipients (23%) and those who reported WIC access problems (28%) were consistent with USDA estimates of 27.8% among black and 26.4% among Hispanic households with children <18 years of age,¹⁸ indicating the vulnerability of the families and the high potential for negative consequences for infants. Although rates of food insecurity were lower among WIC assistance recipients than among families with WIC access problems, differences were not present after covariate control.

It is extremely difficult to evaluate publicly funded programs such as WIC. Investigators must rely on observational or quasi-experimental designs, rather than experimental designs. If funding is available, then it would be unethical to deny WIC services to eligible participants. When participants are compared with eligible nonparticipants, selection bias is a serious risk, because underlying differences in motivation or caregiving practices may account for differences in children's growth or health. To reduce the likelihood that the differences in the infants' growth, perceived health, and food security we observed could be attributed to selection bias, we separated those who did not receive WIC assistance into caregivers who reported access problems and caregivers who did not perceive a need for WIC services.

Caregivers who did not perceive a need for WIC services had more economic and personal resources than did WIC assistance recipients, with a rate of food insecurity lower than the national average for low-income families. Despite these differences, there were no differences in weight-for-age findings, rates of overweight, or perceived health status between WIC assistance recipients and infants whose caregivers did not perceive a need for WIC, suggesting that WIC facilitated low-income infants experiencing positive growth and improved perceived health status, similar to their slightly more privileged peers.

We also used covariate controls to reduce the possibility of bias. Because infants recruited from emergency departments may be sicker than infants recruited from primary care settings, we controlled for site. We also examined the infants' dehydration status and observed no differences according to WIC participation. We initially speculated that families that reported access problems might have been experiencing symptoms of postpartum depression and had not yet enrolled in WIC. In fact, the numbers of caregivers who reported depressive symptoms were not statistically different across the groups. When the depression screen results were included in the anal-

ysis with other covariates, infants who did not receive WIC assistance because of access problems were still more likely to be underweight, short, and perceived as being in poor or fair health, compared with infants who received WIC assistance. As we reported elsewhere,³⁸ children of mothers who reported symptoms of depression were more likely to live in food-insecure households than were children of mothers who did not report symptoms of depression. We reduced potential differences in resources and demographic characteristics by controlling for caregiver age and education, public housing, and receipt of food stamps and TANF.

Rates of breastfeeding initiation were 64% among subjects who perceived no need for WIC assistance, 62% among those who had difficulty with WIC access, and 54% among those who were receiving WIC assistance. Overall, the rates were slightly lower than the rate of 69.5% noted nationally.³⁹ The relatively poor growth of the infants whose families reported WIC access problems, despite a slightly higher rate of breastfeeding, compared with infants of WIC assistance recipients, is contrary to findings indicating that healthy breastfed infants grow more rapidly than do nonbreastfed infants in the first 2 months of life,⁴⁰ providing additional indication of the merits of WIC participation.

The coverage rates among infants in this WIC-eligible sample were very high (91%), possibly because the families were recruited from health care sites where providers were likely to encourage WIC enrollment. National data indicate that WIC serves approximately one-half of all infants born in the United States.² Access problems indicate that the demand for WIC services exceeds the availability of services. Almost one-half of the families of infants who were not receiving WIC assistance reported that they were on a waiting list. When we included those who said that they missed their appointments, did not have time to pick up the vouchers, or needed to reapply, the number increased to 69%. Most of the logistic problems reported by families that had not successfully accessed WIC could be solved by strategies that could be implemented by WIC with adequate funding, such as increasing the hours that WIC offices are open, to enhance availability to working families, or expanding services to families in shelters. For all medically indigent infants (uninsured or with public insurance), referral to WIC at the time of discharge from the newborn nursery should be routine and ongoing WIC participation should be incorporated into follow-up health maintenance visits throughout early childhood.

This investigation avoids some of the biases inherent in observational research by recruiting samples from 6 urban centers across the country and controlling for potentially confounding variables, at the level of the community (site), the family (employment, subsidized housing, public assistance, and maternal education), and the infant (race/ethnicity, age, birth weight, and months breastfed). Our sample included mostly minority subjects, and the Centers for Disease Control and Prevention growth charts include relatively small, although representative,

samples of African American and Hispanic children. We controlled for race/ethnicity, and there were no racial or ethnic differences between WIC assistance recipients and families that reported access problems, reducing the possibility that the racial/ethnic composition of the sample interfered with the interpretation of the findings. As with any cross-sectional sample, it is not possible to determine the causal direction of effect. Because many of the data are based on caregiver self-reports, they are subject to the biases that are inherent in questionnaire data. However, the outcome growth measures (weight-for-age and length-for-age z scores and overweight) are based on direct measurements collected at the time of the interview.

Caution is warranted in interpreting the findings related to overweight. Weight-for-length of ≥ 95 th percentile among infants is not necessarily a risk factor for overweight during childhood or adulthood.⁴¹ Longer-term studies that examine children's rates of growth are necessary to examine whether WIC participation is associated with excessive weight gain.

We did not have information on prenatal or lifetime WIC participation; therefore, we could examine only current WIC participation. We did not have information on income eligibility, so we used private insurance as a proxy for ineligibility; therefore, we might have eliminated some of the relatively higher-income families that were eligible for WIC assistance.

CONCLUSIONS

Among infants ≤ 12 months of age who were eligible for WIC, those who did not receive WIC assistance because of access problems were more likely to be underweight, short, and perceived as having health problems, compared with WIC assistance recipients, even after adjustment for demographic factors, breastfeeding, and birth weight. When WIC assistance recipients were compared with infants of families that perceived no need for WIC, there were no differences in weight-for-age, rate of overweight, or perceived health status, despite more favorable economic and personal resources among those who felt no need for WIC.

Evidence is accumulating that WIC protects young children from low-income families from negative health and growth consequences, not only through direct provision of age-appropriate food and nutritional advice but also through better utilization of the health care system. Our data suggest that waiting lists and logistic barriers to WIC participation should be eliminated, to ensure adequate growth and health of our nation's low-income infants.

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