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Breastfeeding and Health Outcomes among Citizen Infants of Immigrant Mothers

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ABSTRACT

Objective To examine the associations between breastfeeding and child health outcomes among citizen infants of mothers immigrant to the United States.

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Design/methods From September 1998 through June 2004, as part of the Children's Sentinel Nutrition Assessment Program, a sentinel sample of 3,592 immigrant mothers with infants aged 0 to 12 months were interviewed in emergency departments or pediatric clinics in six sites. Mothers reported breastfeeding history, child health history, household demographics, government assistance program participation, and household food security. Infants' weight and length were recorded at the time of visit. Bivariate analyses identified confounders associated with breastfeeding and outcomes, which were controlled in logistic regression. Additional logistic regressions examined whether food insecurity modified the relationship between breastfeeding and child outcomes.

Results Eighty-three percent of infants of immigrants initiated breastfeeding. Thirty-six percent of immigrant households reported household food insecurity. After controlling for potential confounding variables, breastfed infants of immigrant mothers were less likely to be reported in fair/poor health (adjusted odds ratio [AOR] 0.65, 95% confidence interval [CI] 0.50 to 0.85; $P=0.001$) and less likely to have a history of hospitalizations (AOR 0.72, CI 0.56 to 0.93, $P=0.01$), compared to nonbreastfed infants of immigrant mothers. Compared to nonbreastfed infants, the breastfed infants had significantly greater weight-for-age z scores (0.185 vs 0.024; $P=0.006$) and length-for-age z scores (0.144 vs -0.164 ; $P<0.0001$), but there was no significant difference in risk of overweight (weight-for-age >95 th percentile or weight-for-length >90 th percentile) between the two groups (AOR 0.94, CI 0.73 to 1.21; $P=0.63$). Household food insecurity modified the association between breastfeeding and child health status, such that the associations between breastfeeding and child health were strongest among food-insecure households.

Conclusions Breastfeeding is associated with improved health outcomes for infants of immigrant mothers. Breastfeeding is an optimal strategy in the first year of life to improve all infants' health and growth, especially for children of immigrants who are at greater risk for experiencing food insecurity.

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The demographic composition of families in the United States is rapidly shifting as the nation's immigrant population continues to rise. In 2005 the foreign-born population in the United States surpassed 35 million, representing 12% of the country's population (1). Nearly one fifth of all children in the United States, and one fourth of children of low-income families, are immigrants or children of immigrants (2). Immigrant families face greater socioeconomic hardship and more barriers to accessing assistance programs and health services than US-born families (2-5). As a result, children in immigrant families are at increased risk for poor health and nutrition compared to children of US-born parents (2-4).

Breastfeeding, the optimal form of infant nutrition (6), is a potential strategy for buffering vulnerable young children from poor health and nutrition. Breastfeeding has been shown to improve infants' general health and development as well as protect against a number of acute and chronic diseases (6). Because of the demonstrated health benefits of breastfeeding, national and international physician organizations recommend breastfeeding as the preferred infant feeding method (6-10). In the United States, the Surgeon General has identified increased breastfeeding as a National Objective for the year 2010 (11).

A number of epidemiologic studies have found complex ethnic, geographic and socioeconomic variation with regard to the prevalence of breastfeeding in the United States. National surveys consistently indicate lower breastfeeding initiation and duration rates among women who are non-Hispanic African American, younger in age, less educated, of lower socioeconomic status, and living in certain regions of the country (12-15). Although national surveys frequently calculate the racial/ethnic disparities in breastfeeding rates, they do not record maternal birthplace and do not consider immigration status in the analyses (16). A study of mothers in a large group practice in eastern Massachusetts found that immigration status was strongly associated with increased breastfeeding initiation; foreign-born white, foreign-born black, and foreign-born Hispanic mothers all initiated breastfeeding at rates that were greater than their US-born counterparts (17). Similarly, a study of all birth records in Massachusetts from 2002 found that US-born mothers in each racial/ethnic group were less likely to initiate breastfeeding than non-US-born mothers (16). Other smaller studies focused on immigrant populations have also found that foreign-born mothers are more likely to breastfeed their infants than US-born mothers, but breastfeeding initiation and duration rates among immigrant mothers often decrease with the amount of time spent in the United States (18-20). This has been explained by the influence of acculturation to United States social norms (20,21). However, the association between breastfeeding and acculturation varies by country of origin (22) and is not found to be statistically significant in all studies (23,24).

Overall, immigrant mothers are more likely to breastfeed than their US-born peers, yet their children as a group are at greater risk for poor health and nutrition (2-4). Few investigators have examined whether breastfeeding can potentially buffer children of impoverished

immigrants in the United States from these increased risks. Of particular concern for immigrants is their disproportionate vulnerability to household food insecurity, a concept defined by the United States Department of Agriculture as "limited or uncertain availability of adequate or safe foods" for all household members to lead a healthy life (25). Households headed by immigrants in the United States are more likely to experience food insecurity than households headed by US-born parents (26-29), leaving their children at risk for the multiple consequences of not having consistent access to nutritionally adequate and safe foods. Food insecurity is associated with poor child outcomes, including nutrient deficiencies, learning and developmental deficits, emotional and behavioral problems, and poor health (30-43).

The purpose of this research was to analyze the associations between breastfeeding and child health outcomes among a sample of immigrant mothers with infants younger than age 1 year, many of whom live in food-insecure households. The sample was recruited from six urban pediatric health care sites in five regions of the United States. Study of this immigrant sample provides an opportunity to examine the correlates of breastfeeding among vulnerable families in the United States.

METHODS

Setting

The ongoing Children's Sentinel Nutrition Assessment Program conducts household-level surveys and medical record audits at six 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). Primary adult caregivers accompanying children aged zero to 3 years seeking care are interviewed in private settings during waiting periods. Children's weight and, if possible, length are recorded at the time of the interview. The survey instrument includes questions regarding breastfeeding initiation and duration, household sociodemographic characteristics, child health status, child's history of hospitalization, federal assistance program participation, and household food security. Food security status is derived from the 18-item US Food Security Scale, which is scored and scaled in accordance with established procedures (44,45).

Potential respondents are excluded if they do not speak English, Spanish, or (in Minneapolis only) Somali. In these cases, the potential respondent's country of origin or native language is not recorded. Potential respondents are also excluded if they are not knowledgeable about the child's household, if the household lives in a different state than the one in which the interview is taking place, if they refuse consent for any reason, or if the child's caregiver has been interviewed by study staff within the previous 6 months. Caregivers who have been interviewed 7 or more months prior are interviewed again for the Children's Sentinel Nutrition Assessment Program dataset, but only the data from the first interview are included in this study sample. Caregivers of critically ill or injured children were not approached. Institutional Review Board approval was obtained at each site at the

start of the study in 1998 and has been renewed each year.

Sample

The Children's Sentinel Nutrition Assessment Program sample is a sentinel sample obtained by scheduling interviewers in the emergency departments and clinics to coincide with peak patient flow times. The sample in this analysis was drawn from the interviews conducted between August 1998 and June 2004. Of the 21,564 caregivers who were approached at the six Children's Sentinel Nutritional Assessment Program sites during this time period, 2,465 (11%) were found to be ineligible for interview. Of those ineligible, reasons for ineligibility were: language of interviewer and caregiver was different (n=1,798, 73%), the caregiver was interviewed by study staff in the previous 6 months (n=399, 16%), the caregiver was not knowledgeable about the household (n=243, 10%), or the household was from out-of-state (n=25, 1%). Among the eligible respondents, 1,449 (7%) refused consent to participate and 468 (2%) did not complete the interview.

From the interviewed sample of 17,182 children, the sample was restricted to children aged 0 to 12 months, almost all born in the United States, leaving a sample of 10,562 infants. The sample was further restricted to respondents who were birth mothers to ensure accuracy of report of breastfeeding history, leaving a sample of 8,883 infants. Finally, the analysis sample excluded any respondents whose interviews were missing information on breastfeeding history or mother's country of birth, resulting in an analysis sample of 8,800 infants. We stratified the sample by the immigrant status of the mother (determined by mother's report of her country of birth), resulting in 3,592 infants of immigrant mothers, and 5,208 infants of US-born mothers. Because the issues facing immigrants are so unique, we examined the two groups separately and focus on the findings among the immigrant sample in this report.

Predictor Variable

The primary predictor variable in this analysis is report of any breastfeeding. Two mutually exclusive groups were formed based on mothers' response to the following question: "Was your child breastfed or provided breast milk?" Breastfeeding duration was assessed by asking, "For how many months was your child breastfed or provided breast milk?" For those children still receiving breast milk at the time of the interview, duration was coded up to the day of the interview. Exclusivity of breastfeeding was not measured.

Outcome Measures

The primary outcome measures in this analysis are infant health status, history of chronic illness, hospitalization history, and growth status. Overall infant health status was elicited by caregiver response to the question, "In general, would you say (the child's) health is excellent, good, fair, or poor?" This is a standardized question, appearing in the Third National Health and Nutrition Examination Survey (46). For this study, responses to

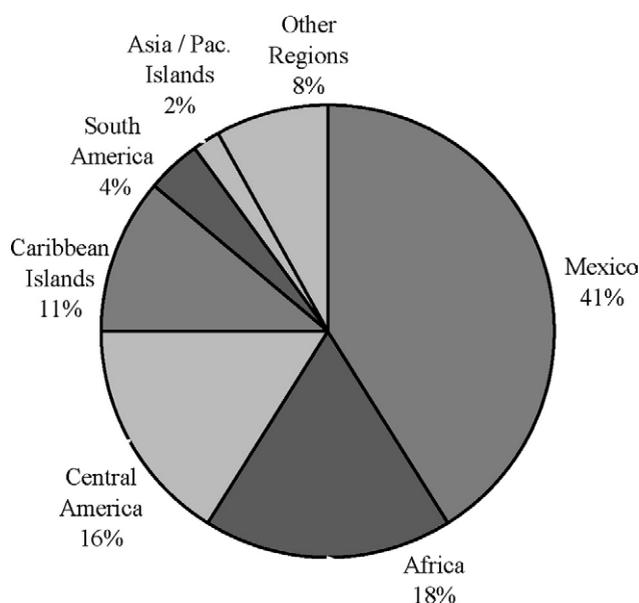


Figure. Region of origin of immigrant mothers (n=3,592) with citizen infants followed to examine the associations between breastfeeding and child health outcomes. (Information from this figure is available online at www.adajournal.org as part of a PowerPoint presentation featuring additional online-only content.)

this question were collapsed into two categories (fair/poor and good/excellent). History of chronic illness was obtained by caregiver response to the question, "Has the child ever been diagnosed with a chronic illness, such as asthma or sickle cell anemia?" If yes, the caregiver was asked to specify the illness. Hospitalization history was based on two different types of data: in all sites, the age-adjusted history of hospitalization since birth (excluding the day of the interview), as reported by the caregiver; and at the Los Angeles, Boston, and Little Rock emergency department sites only, if the child was acutely admitted on the day of interview (assessed by medical chart review). The rationale for using these two types of data was that, for those either in primary clinics or in emergency departments, a lifetime history of hospitalization can be ascertained, whereas acute admission, except in rare instances, is only likely to occur for the children who present to emergency departments. In analyzing rates of acute admissions, children in emergency departments are compared only with other children in the three study emergency department sites (Los Angeles, Boston, and Little Rock) and not with those in primary care clinics.

Each infant's weight and length were obtained either by project staff members or from medical record reviews conducted on the same day as the interview. Values were converted to z scores for weight-for-age, length-for-age, and weight-for-length, by using age- and sex-specific reference values (47). Two categorical variables were used to determine infants' risk for underweight or overweight. A composite at-risk for underweight variable was defined as weight-for-age less than the 5th percentile or weight-for-length less than the 10th percentile. A composite at-risk

Table 1. Sample characteristics by breastfeeding status among citizen infants of immigrant mothers followed to examine the associations between breastfeeding and child health outcomes^a

	Breastfed (n=2,967) (%)	Not breastfed (n=625) (%)	P	Total sample (n=3,592) (%)
Maternal characteristics				
Site			<0.0001	
Baltimore, MD	1	1		1
Boston, MA	27	22		26
Little Rock, AR	1	2		1
Los Angeles, CA	14	29		17
Minneapolis, MN	47	33		44
Washington, DC	12	14		12
Race/ethnicity			<0.0001	
Asian	2	5		2
African	32	22		30
Hispanic	65	70		66
White	2	4		2
Marital status			0.03	
Single/divorced	38	43		39
Married/partner	62	57		61
Education			0.05	
Some high school	52	56		52
High school graduate	30	30		30
College graduate	19	15		18
Mother <21 y	15	16	0.33	15
Mother employed	26	31	0.02	27
Mother's duration in United States (y)	6.7	8.7	<0.0001	7.4
Child characteristics				
Insurance status			0.02	
Public	81	77		80
Private	5	5		15
None	14	18		5
Child age			0.02	
0-6 mo	65	60		64
6-12 mo	35	40		36
Child gestational age <37 wks	8	16	<0.0001	10
Child low birth weight	8	16	<0.0001	10
Household characteristics				
Mean No. of children in house	2.3	2.5	0.001	2.3
Household food insecurity	37	31	0.01	36
Receives food stamps	22	23	0.29	22
Receives TANF ^b	16	20	0.08	17
Receives WIC ^c	89	91	0.08	89
Receives subsidized housing	14	10	0.008	13

^aGroup comparisons use χ^2 for categorical variables and *t* test for continuous variables.

^bTANF=Temporary Assistance for Needy Families.

^cWIC=Special Supplemental Nutrition Program for Women, Infants, and Children.

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for overweight variable was defined as weight-for-age greater than the 95th percentile or weight-for-length greater than the 90th percentile. Although prediction from infant growth to overweight is a controversial construct, recent studies have found that rapid weight gain during the first 4 to 6 months of life is associated with future risk of overweight (48,49). The American Academy of Pediatrics recommends that physicians identify infants with high weight-to-length percentiles to correct over-feeding if present (50).

Statistical Approach

The χ^2 test for categorical data and the *t* test for continuous data were used to determine the associations between demographic characteristics, breastfeeding status, child health, and child growth. To ensure that the group of breastfed infants and the group of nonbreastfed infants were statistically comparable, we evaluated potentially confounding demographic variables that may influence infant health or growth to include in the analytic model.

A confounding variable was defined as significantly ($P < 0.05$) related to both the predictor (breastfeeding status) and the outcome (health or growth).

Among the sample of immigrant mothers, the potential confounding variables were site of interview, race/ethnicity of the mother, child having low birth weight (<2,500 g), mother's length of time in the United States, child's insurance status, mother's marital status, child age, number of children in the household, household food security status, receipt of housing assistance benefits, and receipt of Temporary Assistance for Needy Families benefits.

Multivariate regression models were used to examine differences in weight-for-age and length-for-age z scores, and logistic regressions were performed to examine differences in the odds of poor health or poor growth on the basis of breastfeeding status, controlling for potential confounders. Additional logistic regressions were performed using interaction terms to examine whether household food insecurity modified the association between breastfeeding and child health and growth outcomes.

RESULTS

Preliminary inspection of the data showed that among the 5,208 US-born mothers in the Children's Sentinel Nutrition Assessment Program sample, breastfeeding was relatively infrequent (39% compared to 83% of the immigrant mothers) and of very brief duration (mean duration of 1 month, compared to 2.7 months in the immigrant sample). No health effects of breastfeeding were detectable in the infants of US-born mothers. Consistent with other findings on the high prevalence of food insecurity among immigrant populations (26-29), immigrant households with infants under age 1 year in this sample are disproportionately affected by food insecurity (36% compared to 14% of the US-born households). The analyses that follow are restricted to the 3,592 immigrant mothers and their infants who comprised our population of interest.

Demographic Characteristics

The Figure indicates the region of origin of the immigrant mothers: 41% of the sample were from Mexico, 18% were from Africa, 16% were from Central America, 11% were from the Caribbean Islands, 4% were from South America, 2% were from Asia/Pacific Islands, and 8% were from other regions.

Among the 3,592 infants of immigrant mothers, 83% were breastfed, for a mean duration of 2.7 months. Duration of breastfeeding was also assessed as a categorical variable: 30% of the infants were breastfed for longer than 4 months.

Table 1 depicts the sample demographics by breastfeeding status. There were several differences between the two groups. In addition to variation in site of interview (the largest portions of both the breastfed and not breastfed samples were from the Minneapolis site; $P < 0.0001$) and race/ethnicity of the mother (65% of the breastfed sample were Hispanic, compared to 70% of the nonbreastfed sample; 32% of the breastfed sample were non-Hispanic black, compared to 22% of the not breastfed sample; $P < 0.0001$), mothers who reported breastfeeding

Table 2. Unadjusted outcomes by breastfeeding status among citizen infants of immigrant mothers followed to examine the associations between breastfeeding and child health outcomes

	Breastfed (n=2,967)	Not breastfed (n=625)	P
Infant health			
Child health fair/poor (%)	12	19	<0.0001
Chronic health problems (%)	3	6	0.003
Any hospitalizations (%)	14	20	0.0002
Admitted to hospital ^a (%)	15	17	0.48
Infant growth			
At-risk for underweight ^b (%)	14	16	0.06
At-risk for overweight ^c (%)	19	17	0.49
Mean z score—weight/age	0.209	-0.088	<0.0001
Mean z score—length/age	0.160	-0.190	<0.0001

^aEmergency department sites only; n=1,533.

^bWeight-for-age <5% or weight-for-length <10%.

^cWeight-for-age >95% or weight-for-length >90%.

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their infants were more likely to be married or have a partner (62% vs 57%; $P = 0.03$), more likely to have a college degree (19% vs 15%; $P = 0.05$), less likely to be employed (26% vs 31%; $P = 0.02$) and had been living in the United States for a shorter average length of time (6.7 years vs 8.7 years; $P < 0.0001$). The sample of infants that was breastfed was younger (65% younger than age 6 months vs 60% younger than age 6 months; $P = 0.02$), more likely to receive public insurance (81% vs 77%; $P = 0.02$), less likely to have been of low birth weight (8% vs 16%; $P < 0.01$), and less likely to have been born prematurely (8% vs 16%; $P < 0.0001$) compared with infants who were not breastfed. The breastfed sample was also more likely to receive housing assistance benefits (14% vs 10%; $P = 0.008$) but slightly less likely to receive Temporary Assistance for Needy Families benefits (16% vs 20%; $P = 0.08$) and Special Supplemental Nutrition Program for Women, Infants, and Children benefits (89% vs. 91%; $P = 0.08$). Finally, the breastfed sample lived in homes with higher rates of reported household food insecurity (37% vs 31%; $P = 0.01$) and with fewer children (2.3 children vs 2.5 children; $P = 0.001$).

Unadjusted Outcomes

Table 2 shows the unadjusted outcomes for infant health and growth by breastfeeding status among the infants of immigrant mothers. The breastfed infants had significantly lower rates of fair or poor health (12% vs 19%;

Table 3. Adjusted outcomes by breastfeeding status among citizen infants of immigrant mothers followed to examine the associations between breastfeeding and child health outcomes^a

	Breastfed (n=2,967)	Not breastfed (n=625)	95% CI ^b	P
←————— AOR —————→				
Infant health				
Child health fair/poor	0.65	1.00	(0.50, 0.85)	0.001
Chronic health problems	0.66	1.00	(0.42, 1.06)	0.08
Any hospitalizations	0.72	1.00	(0.56, 0.93)	0.01
Admitted to hospital ^c	0.85	1.00	(0.58, 1.24)	0.39
Infant growth				
At-risk for underweight ^d	1.09	1.00	(0.81, 1.46)	0.57
At-risk for overweight ^e	0.94	1.00	(0.73, 1.21)	0.63
←————— z score —————→				
z score weight/age	0.185	0.024		0.006
z score length/age	0.144	-0.164		<0.0001

^aAdjusted odds ratios (AORs) and adjusted means are controlled for site, maternal race/ethnicity, low birth weight, length of time in United States, child insurance status, maternal marital status, child age, number of children in household, household food security status, receipt of housing assistance benefits, and receipt of Temporary Assistance for Needy Families benefits.

^bCI=confidence interval.

^cEmergency department sites only; n=1,533.

^dWeight-for-age <5% or weight-for-length <10%.

^eWeight-for-age >95% or weight-for-length >90%.

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$P < 0.0001$), chronic health problems (3% vs 6%; $P = 0.003$), and history of hospitalizations since birth (14% vs 20%; $P = 0.0002$). The difference in acute admission status in the reduced sample from the emergency department sites was not statistically significant (15% vs 17%; $P = 0.48$).

The breastfed infants had significantly greater weight-for-age (z score 0.209 vs -0.088 ; $P < 0.0001$) and length-for-age (z score 0.160 vs -0.190 ; $P < 0.0001$) z scores at the time of the interview than the infants who were not breastfed, in bivariate analyses. Breastfed infants also showed a trend toward significantly lower rate of at-risk for underweight based on national growth norms (14% vs 16%; $P = 0.06$). There is no significant difference in the rate of at-risk for overweight at the time of the interview between the two groups (19% vs 17% $P = 0.49$).

Adjusted Outcomes

Among the sample of immigrant mothers, the potential confounding variables correlated with both breastfeeding and outcomes were site of interview, race/ethnicity of the mother, child having low birth weight (<2,500 g), mother's length of time in the United States, child's insurance status, mother's marital status, child age, number of children in the household, household food security status, receipt of housing assistance benefits, and receipt of Temporary Assistance for Needy Families benefits. Although Special Supplemental Nutrition Program for Women, Infants, and Children participation was marginally higher among the nonbreastfed sample, this variable was not correlated with the outcomes and was not included as a covariate in the adjusted analyses.

Table 3 depicts the multivariate results as adjusted odds ratios (AORs) and adjusted means, controlled for these potential confounding variables. The adjusted re-

sults for infant health are consistent with the unadjusted findings. The infants who were breastfed were less likely to be reported in fair/poor health (AOR 0.65, 95% confidence interval [CI] 0.50 to 0.85; $P = 0.001$), less likely to have a history of hospitalizations since birth (AOR 0.72, 95% CI 0.56 to 0.93; $P = 0.01$), and showed a trend toward being less likely to have a chronic health problem (AOR 0.66, 95% CI 0.42 to 1.06; $P = 0.08$). There was no significant difference in acute admission status between the two groups (AOR 0.85, 95% CI 0.58 to 1.24; $P = 0.39$).

Also consistent with the unadjusted results, the breastfed infants had significantly higher weight-for-age (z score 0.185 vs 0.024; $P = 0.006$) and length-for-age (z score 0.144 vs -0.164 ; $P < 0.0001$) z scores, but there was no significant difference between the two groups in being at-risk for underweight (AOR 1.09, 95% CI 0.81 to 1.46; $P = 0.57$) or at-risk for overweight (AOR 0.94, 95% CI 0.73 to 1.21; $P = 0.63$) at the time of the interview, based on national norms.

Test of Food Insecurity as an Effect Modifier

Among the sample of infants of immigrant mothers, overall 36% reported household food insecurity. Thirty-seven percent of mothers who breastfed their infants reported household food insecurity, whereas 31% of mothers who did not breastfeed reported household food insecurity. In our analyses, household food insecurity was included as a covariate in the analytic model. In additional multivariate analyses, separate models with interaction terms were estimated to test whether household food insecurity modifies the effect of breastfeeding on child outcomes among the infants of immigrants.

A significant interaction between household food insecurity and breastfeeding was found for the variables of

Table 4. Secondary analyses: Adjusted child health outcomes stratified by food security status among citizen infants of immigrant mothers followed to examine the associations between breastfeeding and child health outcomes^a

	Breastfed (n=2,967)	Not breastfed (n=625)	95% CI ^c	P	Interaction term: breastfed/food security (P)
	←———— AOR ^b —————→				
Child health fair/poor					0.05
Not stratified	0.65	1.00	(0.50, 0.85)	0.001	
Food secure	0.82	1.00	(0.57, 1.16)	0.26	
Food insecure	0.47	1.00	(0.31, 0.71)	0.0003	
Admitted to hospital^d					0.04
Not stratified	0.85	1.00	(0.58, 1.24)	0.39	
Food secure	1.01	1.00	(0.64, 1.59)	0.96	
Food insecure	0.44	1.00	(0.20, 0.96)	0.04	
Weight/age	←———— z score —————→				0.09
Not stratified	0.185	0.024		0.006	
Food secure	0.171	0.074		0.17	
Food insecure	0.206	-0.059		0.01	

^aStratified analyses are shown only for the outcomes whose interaction between household food insecurity and breastfeeding was significant or showed a trend toward significance. The interaction between breastfeeding and food insecurity was not significant for the outcomes of hospitalizations since birth, chronic health problems, being at risk for underweight, being at risk for overweight, and length-for-age z score.

^bAOR=adjusted odds ratio.

^cCI=confidence interval.

^dEmergency sites only; n=1,533.

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child health fair/poor vs excellent/good ($P=0.05$) and acute admission to the hospital among the subsample of infants seen at the emergency department sites ($P=0.04$). The interaction between household food insecurity and breastfeeding showed a trend toward significance for the weight-for-age z score variable ($P=0.09$). The interaction between breastfeeding and food insecurity was not significant for the outcomes of hospitalizations since birth, chronic health problems, being at risk for underweight, being at risk for overweight, and length-for-age z score.

Table 4 shows the results of secondary analyses stratified by food security status for the three outcomes whose interaction between household food insecurity and breastfeeding was significant or showed a trend toward significance. For the outcome of child health, the infants of immigrants in food-insecure households who were breastfed were significantly less likely to be reported in fair/poor health than those who were not breastfed (AOR 0.47, 95% CI 0.31 to 0.71; $P=0.0003$), but the association did not reach significance for infants of immigrants in food-secure households (AOR 0.82, 95% CI 0.57 to 1.16; $P=0.26$). For the outcome of acute admission to the hospital, the infants of immigrants in food-insecure households who were breastfed were significantly less likely to be urgently admitted to the hospital on the day of the visit (AOR 0.44, 95% CI 0.20 to 0.96; $P=0.04$), but the association was not significant for infants of immigrants in food-secure households (AOR 1.01, 95% CI 0.64 to 1.59; $P=0.96$). A similar pattern existed for the weight-for-age z score outcome, with the infants of immigrants in food-insecure households who were breastfed having greater weight-for-age z scores than those who were not breastfed (z score 0.206 vs -0.059 ; $P=0.01$), but the association was

not significant for the infants of immigrants in food-secure households (z score 0.171 vs 0.074; $P=0.17$).

DISCUSSION

The findings presented here indicate that breastfeeding is associated with improved infant health and growth outcomes in this immigrant sample, especially for infants in food-insecure households. After controlling for potentially confounding variables, infants in immigrant families who received any amount of breast milk were less likely to be reported in fair or poor health, less likely to have a history of hospitalizations, and showed a trend toward being less likely to have a chronic health problem, compared with infants who were not breastfed. Breastfed infants of immigrant mothers also weighed more and were longer than nonbreastfed infants of immigrants, which is consistent with other epidemiologic findings indicating that breastfed babies develop on a different growth curve than formula-fed babies (51,52). There was no difference in risk for overweight among infants who were breastfed compared with those who were not breastfed.

Consistent with other findings on the high prevalence of food insecurity among immigrant populations (26-29), immigrants in this sample are disproportionately affected by food insecurity. Household food insecurity puts children at risk for health consequences resulting from lack of access to enough nutritionally adequate foods (30-43). Secondary analyses of the interaction between breastfeeding and food insecurity in this immigrant sample indicate that the influence of breastfeeding on child health status is strongest among the food-insecure families. Furthermore, although the association between

breastfeeding and acute hospital admission was not significant in the total immigrant sample, when the sample was stratified by food security status the association within the food-insecure group reached significance. To our knowledge, no other studies have examined how breastfeeding and household food insecurity interact to affect child health among immigrant or nonimmigrant populations. Breastfeeding may help to buffer children of immigrants from health consequences in infancy associated with household food insecurity. The immunoprotective effect of breast milk may decrease the infectious complications of malnutrition. Furthermore, breast milk provides optimal nutrition at no cost and does not strain the cash resources of food insecure families. Further research is needed to clarify these associations.

This study's findings of improved health and lower odds of hospitalizations among breastfed infants of immigrants are biologically plausible, given the strong medical evidence that human milk feeding decreases the incidence and/or prevalence of a wide range of infectious diseases (6). An analysis of the hospitalization and diagnosis data for all children under age 1 year in the Children's Sentinel Nutrition Assessment Program sample shows that the majority of hospitalizations for this age group are due to infections. In the Children's Sentinel Nutrition Assessment Program sample of children younger than age 1 year, among the 15.1% who have ever been hospitalized, the most common diagnoses for hospitalizations are other infections (24.3%), lower respiratory infection (18.7%), gastroenteritis (10%), neonatal (6%), asthma (5.6%), central nervous system (5.2%), urinary tract infections (5.2%), and upper respiratory infections (5.2%). Other research has shown that breastfeeding has the potential to significantly reduce annual health care costs in the United States (53,54). In a time of rising health care costs, policies and practices that promote breastfeeding among all families are critical to ensure the health of young children.

Among the 3,592 infants of immigrant mothers, 83% were breastfed for a mean duration of 2.7 months. Among the 5,208 infants of US-born mothers in the Children's Sentinel Nutrition Assessment Program sample, only 39% were breastfed, with mean duration of 1.0 month. Thus, consistent with other findings (17-20), immigrant mothers in the Children's Sentinel Nutrition Assessment Program sample reported much higher rates of initiation and duration of breastfeeding than US-born mothers in the Children's Sentinel Nutrition Assessment Program sample. In addition, length of time in the United States was inversely associated with breastfeeding among immigrant mothers in bivariate analyses, perhaps reflecting the influence of acculturation to US social norms, as others have reported (20,21).

Although national studies have concluded that non-Hispanic African-American mothers in the United States have the lowest rates of breastfeeding (12-15), this trend may differ when accounting for maternal birthplace and looking specifically at foreign-born mothers, as in this study. Table 1 indicates the racial/ethnic distribution within the breastfed and nonbreastfed groups. We also looked at the distribution of breastfeeding within each immigrant racial/ethnic group: the highest rate of breastfeeding, 87%, was reported by mothers in the immigrant

non-Hispanic black population. Eighty-one percent of mothers within the immigrant Hispanic group reported breastfeeding, whereas 68% of immigrant Asian mothers and 67% of immigrant white mothers reported breastfeeding. Further research with larger cell sizes for each immigrant group is needed to explore within-group variation in rates of breastfeeding initiation and duration.

The limitations of the Children's Sentinel Nutrition Assessment Program study design must be acknowledged. Some immigrants were excluded because their language was different from that of the interviewer. Overall we excluded about 10% of potential interviewees due to language differences, but the race, ethnicity, or country of origin of these families were not recorded. Also, the Children's Sentinel Nutrition Assessment Program interview does not include a question about the exclusivity of breastfeeding. Any infant in whom breastfeeding was initiated, regardless of duration, was considered breastfed and it is unknown whether the breastfed infants in this sample were exclusively breastfed, or receiving formula in addition to breast milk. Thus, it is not possible to measure any dose response, as amount of breast milk received is unknown. Caregivers of the sickest children were not approached for an interview; thus, the exclusion of the most severely ill or injured cases may have biased the results of the analysis. As with any cross-sectional sample, it is not possible to determine the causal direction of effect in these findings. Mothers may have chosen not to breastfeed if they perceived their child as being in poor health. We do not know if knowledge of the infant's breastfeeding status influenced health providers' decisions whether or not to hospitalize the child, leading to lower lifetime hospitalizations among breastfed infants. Because emergency department providers are unlikely to know a family's food security status, this limitation would not explain the interaction between breastfeeding and food insecurity in reducing acute admissions. Finally, the Children's Sentinel Nutrition Assessment Program sample is a sentinel surveillance sample of young, high-risk, low-income children and is neither random nor nationally representative, so the extent to which the findings can be generalized to more privileged populations is limited.

CONCLUSIONS

With few exceptions, breastfeeding is the optimal nutrition strategy in the first year of life to improve infants' health and growth. As other researchers have noted, as the foreign-born population continues to grow, national public health strategies designed to promote the health and well-being of all children in the United States must consider the unique needs and circumstances of the millions of children living in immigrant families (2-4). To promote the health of young children in immigrant families, breastfeeding promotion strategies and policies must account for the cultural context and feeding practices of foreign-born mothers' country of origin. Breastfeeding promotion strategies for immigrant mothers should encourage women to retain their traditional feeding practices rather than adopt formula-feeding practices common in North American culture. Sustaining high rates of breastfeeding among foreign-born families will protect the health, growth, and nutrition of infants grow-

ing up in vulnerable immigrant households, especially those challenged by food insecurity.

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References

1. United States Census Bureau. 2005 American Community Survey. Selected characteristics of the native and foreign-born populations. Available at: http://factfinder.census.gov/servlet/STTable?_bm=y&geo_id=01000US&-qr_name=ACS_2005_EST_G00_S0602&-ds_name=ACS_2005_EST_G00_-redLog=false. Accessed October 21, 2006.
2. Greenberg M, Rahmanou H. Four commentaries: Looking to the future. *The Future of Children*. 2004;14:139-145.
3. Capps R, Fix M, Ost J, Reardon-Anderson J, Passel J. The health and well-being of young children of immigrants. Available at: http://www.urban.org/UploadedPDF/311139_ChildrenImmigrants.pdf. Accessed August 27, 2005.
4. Takanishi R. Leveling the playing field: Supporting immigrant children from birth to eight. *The Future of Children*. 2004;14:139-145.
5. Capps R, Fix M, Reardon-Anderson J. 2003. Children of immigrants show slight reductions in poverty, hardship. Snapshots of America's Families, No. 13. Available at: http://www.urban.org/UploadedPDF/310887_snapshots3_no13.pdf. Accessed October 11, 2004.
6. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, Eidelman AI; American Academy of Pediatrics Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2005;115:496-506.
7. American College of Obstetrics and Gynecology. Breastfeeding: Maternal and infant aspects. *Educ Bull*. 2000;258:1-16.
8. American Academy of Family Physicians. Breastfeeding Position Paper. Available at: <http://www.aafp.org/x6633.xml>. Accessed October 26, 2004.
9. Academy of Breastfeeding Medicine. *ABM Mission Statement*. Princeton Junction, NJ: Academy of Breastfeeding Medicine; 1995.
10. World Health Organization, United Nations Children's Fund. Protecting, promoting and supporting breastfeeding: The special role of maternity services (A joint WHO/UNICEF statement). *Int J Gynecol Obstet*. 1990;31(suppl 1):171-183.
11. *Healthy People 2010: Understanding and Improving Health*. 2nd ed. Washington, DC: US Government Printing Office; 2000.
12. Ryan AS, Wenjun Z, Acosta A. Breastfeeding continues to increase into the new millennium. *Pediatrics*. 2002;110:1103-1109.
13. Li R, Zhao Z, Mokdad A, Barker L, Grummer-Strawn L. Prevalence of breastfeeding in the United States: The 2001 National Immunization Survey. *Pediatrics*. 2003;111:1198-1201.
14. Li R, Grummer-Strawn L. Racial and ethnic disparities in breastfeeding among the United States infants: Third National Health and Nutrition Examination Survey, 1998-2004. *Birth*. 2002;29:251-257.
15. Forste R, Weiss J, Lippincott E. The decision to breastfeed in the United States: Does race matter? *Pediatrics*. 2001;108:291-296.
16. Merewood A, Brooks D, Bauchner H, MacAuley L, Mehta SD. Maternal birthplace and breastfeeding initiation among term and preterm infants: A statewide assessment for Massachusetts. *Pediatrics*. 2006;118:1048-1054.
17. Celi AC, Rich-Edwards J, Richardson M, Kleinman K, Gilman M. Immigration, race/ethnicity, and social and economic factors as predictors of breastfeeding initiation. *Arch Pediatr Adolesc Med*. 2005;159:255-260.
18. Bevan ML, Mosley D, Solimano GR. Factors influencing breastfeeding in an urban WIC program. *J Am Diet Assoc*. 1984;5:563-567.
19. Pachon H, Olson C. Retrospective analysis of exclusive breastfeeding practices among four Hispanic subgroups in New York's EFNEP. *J Nutr Educ*. 1999;31:39-46.
20. Romero-Gwynn E. Breast-feeding pattern among Indochinese immigrants in northern California. *Am J Dis Child*. 1989;143:804-808.
21. Rassin DK, Markides KS, Baranowski T, Richardson CJ, Mikrut WD, Bee DE. Acculturation and the initiation of breastfeeding. *J Clin Epidemiol*. 1994;47:739-746.
22. Knapp RB, Houghton MD. Breast-feeding practices of WIC Participants from the former USSR. *J Am Diet Assoc*. 1999;99:1269-1271.
23. Meftuh AB, Tapsoba LP, Lamounier JA. Breastfeeding practices in Ethiopian women in southern California. *Ind J Pediatr*. 1991;58:349-356.
24. Wiemann CM, DuBois JC, Berenson AB. Racial/ethnic differences in the decision to breastfeed among adolescent mothers. *Pediatrics*. 1998;101:11-18.
25. Nord M, Andrews M, Carlson S. *Household Food Security in the United States, 2003*. Washington, DC: US Department of Agriculture, Economic Research Service; 2004. Food Assistance and Nutrition Research Report No. FANRR42.
26. Kasper J, Gupta SK, Tran P, Cook JT, Meyers AF. Hunger in legal immigrants in California, Texas and Illinois. *Am J Public Health*. 2000;90:1629-1633.
27. Quandt SA, Shoaf JJ, Tapia J, Hernandez-Pelletier M, Clark HM, Arcury TA. Experiences of Latino immigrant families in North Carolina help explain elevated levels of food insecurity and hunger. *J Nutr*. 2006;136:2638-2644.
28. Quandt SA, Arcury TA, Early J, Tapia J, Davis JD. Household food insecurity among migrant and seasonal Latino farmworkers in North Carolina. *Public Health Rep*. 2004;119:568-576.
29. Borjas GJ. Food insecurity and public assistance. *J Public Econ*. 2004;88:1421-1443.
30. Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food insufficient low-income families: Prevalence, health and nutrition status. *Arch Pediatr Adolesc Med*. 2001;155:508-514.
31. Olson CM. Nutrition and health outcomes associated with food insecurity and hunger in the US. *J Nutr*. 1999;129(suppl):S175-S205.
32. Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *J Nutr*. 1999;129(suppl):S215-S245.
33. Rose D, Oliveira V. Nutrient intakes of individuals from food-insufficient households in the United States. *Am J Public Health*. 1997;87:1956-1961.
34. Murphy JM, Wehler CA, Pagano ME, Little M, Kleinman RE, Jellinek MS. Relationship between hunger and psychosocial functioning in low-income American children. *J Am Acad Child Adolesc Psychiatr*. 1998;37:163-170.
35. Alaimo K, Olson CM, Frongillo EA Jr. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*. 2001;107:44-56.
36. Alaimo K, Olson CM, Frongillo EA, Briefel RR. Food insufficiency, family income, and health in US preschool and school-age children. *Am J Public Health*. 2001;91:781.
37. Weinreb L, Wehler C, Perloff J, Scott R, Hosmer D, Sagor L, Gundersen C. Hunger: Its impact on children's health and mental health. *Pediatrics*. 2002;110:41.
38. Matheson DM, Varady J, Varady A, Killen JD. Household food security and nutritional status of Hispanic children in the fifth grade. *Am J Clin Nutr*. 2002;76:210-217.
39. Kaiser LL, Melgar-Quinonez HR, Lamp CL, Johns MC, Sutherlin JM, Harwood JO. Food security and nutritional outcomes of preschool-age Mexican-American children. *J Am Diet Assoc*. 2002;102:924-929.
40. Cook JT, Frank DA, Berkowitz C, Black MM, Casey PH, Cutts DB, Meyers AF, Zaldivar N, Skalicky A, Levenson S, Heeren T, Nord M. Food insecurity is associated with adverse health outcomes among human infants and toddlers. *J Nutr*. 2004;134:1432-1438.
41. Casey PH, Szeto KL, Robbins JM, Stuff JE, Connell C, Gossett JM, Simpson P. Child health-related quality of life and household food insecurity. *Arch Pediatr Adolesc Med*. 2005;159:51-56.
42. Jyoti DF, Frongillo A, Jones SJ. Food insecurity affects school children's academic performance, weight gain, and social skills. *J Nutr*. 2005;135:2831-2839.
43. Cook JT, Frank DA, Levenson SM, Neault NB, Heeren TC, Black MM, Berkowitz C, Casey PH, Meyers AF, Cutts DB, Chilton M. Child food insecurity increases risks posed by household food insecurity to young children's health. *J Nutr*. 2006;136:1073-1076.
44. Carlson SJ, Andrews MS, Bickel GW. Measuring food insecurity and hunger in the United States: Measure and prevalence estimates. *J Nutr*. 1999;129(suppl):510S-516S.
45. Bickel G, Nord M, Price C, Hamilton W, Cook JT. *Measuring Food*

- Security in the United States: Guide to Measuring Household Food Security*. Revised ed. Alexandria, VA: US Department of Agriculture, Food and Nutrition Service, Office of Analysis and Evaluation; 2000.
46. National Center for Health Statistics, Centers for Disease Control and Prevention. *National Health and Nutrition Examination Survey III Data Collection Forms*. Hyattsville, MD: US Department of Health and Human Services; 1991.
 47. National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention. Overview of the CDC growth charts. Available at: <http://www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/mondule2/text/page1a.htm>. Accessed April 30, 2005.
 48. Stettler N, Zemel BS, Kumanyika S, Stallings VA. Infant weight gain and childhood overweight status in a multicenter, cohort study. *Pediatrics*. 2002;109:194-199.
 49. Dennison BA, Edmunds LE, Stratton H, Pruzek R. Rapid infant weight gain predicts childhood overweight. *Obes Res*. 2006;14:491-499.
 50. American Heart Association, Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH, Rattay TK, Steinberger J, Stettler N, Van Horn L. Dietary recommendations for children and adolescents: A guide for practitioners. *Pediatrics*. 2006;117:544-559.
 51. Fry T. The new "Breast From Birth" growth charts. An updated version of the paper given at the primary care conference and exhibition. *J Family Health Care*. 2003;13:124-126.
 52. Dewey KG, Peerson JM, Brown KH, Krebs NF, Michaelsen KF, Persson LA, Salmenpera L, Whitehead RG, Yeung DL. Growth of breast-fed infants deviates from current reference data: A pooled analysis of US, Canadian, and European data sets. World Health Organization Working Group on Infant Growth. *Pediatrics*. 1995;96:495-503.
 53. Weimer J. The economic benefits of breastfeeding: A review and analysis. Washington, DC: US Department of Agriculture, Food and Rural Economics Division, Economic Research Service; 2001. Food Assistance and Nutrition Research Report No. 13.
 54. Ball TM, Wright AL. Health care costs of formula-feeding in the first year of life. *Pediatrics*. 1999;103:870-876.