

Multivariate Analysis of State Variation in Breastfeeding Rates in the United States

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Exclusive breastfeeding for 6 months—without supplementation from other sources such as water, glucose water, or formula—has been recommended by organizations such as the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, and the World Health Organization.^{1–3} Numerous studies have indicated the benefits of increased duration and exclusivity of breastfeeding, including decreases in respiratory tract infections and decreases in gross motor, language, and developmental delays.^{4–7}

It is known that breastfeeding rates vary by demographic and socioeconomic factors and that these factors may impact differently on initiation, defined as whether the child was ever breastfed or fed breast milk, and duration.⁸ Studies have indicated that characteristics such as increasing maternal age, education, and income, as well as non-Hispanic White race, being foreign born, and being a nonsmoker are associated with higher rates of breastfeeding.^{9–13} Additionally, 2 sources of state-level data, the Ross Laboratories Mothers Survey and the National Immunization Survey, have indicated fairly wide variations in breastfeeding rates among states and regions.^{10,14,15} However, neither survey has examined whether these state variations are diminished after multivariate adjustment, although Ryan et al. examined regional variations and found that after they adjusted for sociodemographic characteristics women in the western region of the United States were most likely to breastfeed in the hospital and for at least 6 months.¹⁶

A multivariate examination of geographic variation is important for different reasons. Gaining further understanding of the large geographic variations in breastfeeding rates could lead to more effective interventions that might reduce the disparities. The best-performing states can serve as benchmarks for what can be achieved. The information for all states can help guide state health departments

Objectives. We sought to determine the impact of sociodemographic and behavioral factors and state legislation on breastfeeding initiation (child ever fed breastmilk) and duration.

Methods. We used data from a nationally representative study of children aged 6 to 71 months (N=33 121); we calculated unadjusted and adjusted state estimates for breastfeeding initiation and duration. We used logistic regression models to examine factors associated with never breastfeeding or breastfeeding less than 6 months. We conducted a multilevel analysis of state legislation's role.

Results. There were wide state variations in breastfeeding initiation and duration. The western and northwestern states had the highest rates. Covariate adjustment accounted for 25% to 30% of the disparity. Multivariate analysis showed that the adjusted odds of not being breastfed were 2.5- to 5.15-times greater in southern states compared with Oregon (reference). Children in states without breastfeeding legislation had higher odds of not being breastfed.

Conclusions. Sociodemographic and maternal factors do not account for most breastfeeding rate variation. The association with breastfeeding legislation should be explored and may reflect cultural norms. (*Am J Public Health.* 2008; 98:1872–1880. doi:10.2105/AJPH.2007.127118)

and policymakers in targeting resources and assessing the need for the development of breastfeeding promotion strategies.

We sought to examine variations in breastfeeding initiation and duration across the 50 states and the District of Columbia (DC) and to determine the extent to which selected sociodemographic and behavioral factors account for such variation. We also examined the legislation on breastfeeding in each state and DC at the time of the study to determine its possible influence on breastfeeding practices.

METHODS

Data

The data for this study were drawn from the National Survey of Children's Health (NSCH), a nationally representative cross-sectional study of 102 353 children aged from birth to 18 years, conducted from January 2003 through July 2004. The NSCH was funded by the Health Resources and Services Administration's Maternal and Child Health Bureau

and carried out by the Centers for Disease Control and Prevention's National Center for Health Statistics. The NSCH was conducted to provide estimates at both the national and state level for a variety of physical, emotional, and behavioral child health indicators. The survey was carried out in all 50 states and DC, with a target population of 2000 interviews in each state. It is the first survey of the overall health of the child population in the United States that permits analyses at the state level.

Data were obtained through random-digit dialing. To increase efficiency and to lower costs, the NSCH shared the sampling frame of the National Immunization Survey. All interviews were conducted with computer-assisted telephone interviewing. Households were screened to identify the presence of children younger than 18 years. In eligible households, 1 child younger than 18 years was randomly selected to be the subject of the interview. The respondent was the adult most knowledgeable about the child. Seventy-nine percent of interviews were conducted with the child's mother,

17% with the father, and 3% with a grandparent.¹⁷ Although most interviews were completed in English, 5.9% were conducted in Spanish. The NSCH contained a “core” set of questions asked about all children, but there were also separate, age-specific modules for children aged 0 to 5 years, 6 to 11 years, and 12 to 17 years. The sample for this study was limited to children aged 6 to 71 months, leaving an effective sample size of 33 121 children. The detailed survey and questionnaire are available online.¹⁸

Outcome Measures

We examined 2 outcome measures of breastfeeding: whether the child was ever breastfed, and whether the child was breastfed for at least 6 months. The primary independent variable was state of residence. The covariates used in the analyses were the family’s poverty level (<100% of the 2003 federal poverty level, 100%–199%, 200%–299%, and ≥300%),¹⁹ child’s race/ethnicity (Hispanic, non-Hispanic African American, non-Hispanic White, non-Hispanic multiple race, and non-Hispanic other race), child’s gender, family structure (2-parent biological or adoptive family, 2-parent step-family, single mother, or other), primary language spoken in the home (Spanish, English, or other language), nativity status (child was US born and at least 1 parent was foreign born, child and parents were foreign born, child and parents were US born), smoker in the household, maternal self-rated general health status and mental health status (excellent, very good, or good; fair or poor), and maternal exercise behaviors. (Household education level was not included because of its high correlation with family poverty level.)

We also examined legislation that supports and protects breastfeeding in each state and DC.²⁰ We divided the states into 4 categories: (1) there was no legislation supporting breastfeeding in 2003 (Alabama, Arizona, Arkansas, Colorado, DC, Kansas, Kentucky, Massachusetts, Mississippi, Nebraska, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, West Virginia); (2) the first legislation supporting breastfeeding was passed between 1999 and 2003, during the lifespan of this group of children (Georgia, Hawaii, Indiana, Louisiana, Maine, Maryland, Missouri, Montana, New Hampshire, New Mexico, Oregon,

TABLE 1—Observed and Adjusted Estimates of Children Aged 6 to 71 Months (N = 33 121) Having Been Ever Breastfed and Breastfed for 6 or More Months, by State: National Survey of Children’s Health, 2003

State	Ever Breastfed		Breastfed ≥ 6 Months	
	Observed Estimates, % (SE)	Adjusted Estimates, ^a % (SE)	Observed Estimates, % (SE)	Adjusted Estimates, ^a % (SE)
United States	72.33 (0.42)		37.57 (0.49)	
Alabama	57.46 (2.40)	61.81 (2.30)	22.94 (2.01)	25.62 (2.14)
Alaska	84.47 (1.99)	85.84 (2.10)	46.98 (2.65)	50.84 (2.89)
Arizona	78.17 (1.99)	75.08 (2.13)	42.68 (2.38)	42.25 (2.35)
Arkansas	54.75 (2.44)	59.15 (2.42)	22.87 (1.97)	26.49 (2.14)
California	86.48 (1.41)	84.26 (1.65)	50.64 (2.33)	49.78 (2.41)
Colorado	85.17 (1.59)	81.78 (1.86)	50.11 (2.40)	47.46 (2.36)
Connecticut	70.61 (2.18)	66.05 (2.26)	39.82 (2.29)	37.10 (2.17)
Delaware	62.10 (2.26)	62.96 (2.17)	31.85 (2.09)	32.66 (2.04)
District of Columbia	64.52 (2.43)	74.11 (2.18)	33.22 (2.24)	41.37 (2.57)
Florida	72.75 (2.12)	72.45 (2.19)	37.35 (2.36)	38.01 (2.35)
Georgia	66.22 (2.46)	69.06 (2.28)	31.06 (2.18)	33.75 (2.20)
Hawaii	82.19 (2.09)	80.43 (2.37)	49.85 (2.57)	53.24 (2.96)
Idaho	84.66 (1.72)	82.20 (1.99)	54.26 (2.38)	53.69 (2.43)
Illinois	73.95 (2.03)	70.32 (2.21)	43.17 (2.29)	41.59 (2.22)
Indiana	66.55 (2.36)	65.24 (2.38)	28.49 (2.18)	29.00 (2.14)
Iowa	65.85 (2.25)	62.60 (2.31)	31.73 (2.26)	30.89 (2.19)
Kansas	73.30 (2.34)	71.85 (2.56)	34.43 (2.43)	33.98 (2.40)
Kentucky	54.95 (2.41)	56.90 (2.36)	23.47 (2.03)	24.57 (2.09)
Louisiana	45.05 (2.24)	53.66 (2.24)	17.27 (1.61)	22.03 (1.93)
Maine	73.34 (2.19)	69.85 (2.36)	37.91 (2.47)	36.37 (2.42)
Maryland	76.90 (2.07)	75.69 (2.15)	45.71 (2.45)	45.71 (2.43)
Massachusetts	71.51 (2.20)	65.50 (2.47)	34.88 (2.22)	31.94 (2.08)
Michigan	67.27 (2.17)	68.40 (2.16)	32.85 (2.18)	34.53 (2.21)
Minnesota	78.64 (1.90)	74.93 (2.19)	40.80 (2.37)	39.08 (2.35)
Mississippi	51.87 (2.57)	61.42 (2.46)	20.38 (2.09)	25.45 (2.47)
Missouri	67.32 (2.24)	68.71 (2.32)	31.39 (2.15)	32.98 (2.23)
Montana	81.73 (2.07)	80.92 (2.22)	47.69 (2.56)	46.87 (2.57)
Nebraska	72.77 (2.19)	70.66 (2.27)	36.62 (2.41)	35.20 (2.31)
Nevada	78.39 (1.84)	75.54 (2.00)	38.11 (2.23)	37.61 (2.24)
New Hampshire	73.58 (2.09)	68.62 (2.33)	40.12 (2.33)	36.92 (2.24)
New Jersey	68.79 (2.11)	64.28 (2.34)	33.15 (2.14)	31.65 (2.03)
New Mexico	76.54 (2.25)	78.96 (2.36)	39.53 (2.55)	45.74 (2.87)
New York	72.92 (2.09)	69.22 (2.34)	38.25 (2.38)	37.99 (2.36)
North Carolina	67.50 (2.16)	69.90 (2.07)	30.55 (2.05)	32.84 (2.14)
North Dakota	68.42 (2.23)	66.98 (2.43)	30.12 (2.34)	30.24 (2.40)
Ohio	65.35 (2.14)	67.05 (2.07)	31.62 (2.07)	33.98 (2.11)
Oklahoma	66.68 (2.29)	70.17 (2.33)	28.14 (2.21)	31.29 (2.40)
Oregon	87.69 (1.56)	84.17 (1.93)	55.79 (2.51)	54.00 (2.52)
Pennsylvania	61.57 (2.35)	60.77 (2.33)	34.18 (2.33)	35.29 (2.37)
Rhode Island	66.02 (2.23)	61.18 (2.27)	30.22 (2.12)	27.64 (2.00)
South Carolina	60.09 (2.34)	64.18 (2.25)	25.66 (1.91)	28.74 (2.07)
South Dakota	68.49 (2.50)	69.35 (2.46)	30.92 (2.33)	32.73 (2.37)

Continued

TABLE 1—Continued

Tennessee	63.67 (2.36)	65.60 (2.31)	28.87 (2.16)	30.68 (2.13)
Texas	73.62 (1.93)	72.38 (1.99)	35.51 (2.07)	36.36 (2.09)
Utah	84.86 (1.66)	80.79 (2.07)	54.60 (2.51)	51.23 (2.53)
Vermont	81.40 (2.13)	77.27 (2.54)	49.80 (2.83)	48.09 (2.83)
Virginia	66.74 (2.30)	68.89 (2.15)	37.26 (2.24)	39.53 (2.20)
Washington State	87.93 (1.61)	85.39 (1.93)	50.99 (2.42)	49.67 (2.45)
West Virginia	52.96 (2.29)	54.48 (2.41)	23.22 (1.93)	24.92 (2.08)
Wisconsin	72.40 (2.21)	70.72 (2.24)	39.84 (2.41)	38.90 (2.34)
Wyoming	82.40 (1.75)	81.26 (1.91)	47.67 (2.47)	48.67 (2.45)

Note. All prevalence estimates are unadjusted. Analyses indicated that 34% of the variance among states for ever breastfed was explained by the adjustment, while 19% of the variance was explained for breastfeeding at 6 months.

^aAdjusted for race/ethnicity, poverty level, gender, family structure, primary language in household, nativity status, smoker in household, maternal health status and mental health status, and whether the mother exercised regularly.

South Dakota, Tennessee, Vermont, Washington State, Wyoming); (3) a single piece of legislation was passed before 1999, almost always citing public breastfeeding as being exempt from indecency laws (Alaska, Connecticut, Delaware, Idaho, Iowa, Nevada, New Jersey, New York, North Carolina, Rhode Island, Virginia, Wisconsin); and (4) multiple aspects of breastfeeding were supported through legislation before 1999, such as exemption from public indecency laws, exemption from jury duty, provision of information about breastfeeding after birth, the right to breaks at work to breastfeed or express breastmilk, and consideration in custody cases (California, Florida, Illinois, Michigan, Minnesota, Texas, Utah). We used 1999 as the cut-off point, because the oldest children in our study were born in 1998; therefore, all children in a state's sample could theoretically have benefited from the legislation.

Analysis

All analyses were performed with SUDAAN 9.01 (Research Triangle Institute, Research Triangle Park, NC), which accounts for the complex sample design of the NSCH.²⁰ The data presentation comprises 4 sections. The first part of the analysis shows the unadjusted and adjusted estimates by state for breastfeeding initiation and being breastfed at least 6 months, as well as the percentage of variance explained by the adjustment. The adjusted estimates, calculated according to the Peters–Belson method, are the mean predicted marginals derived by the

PREDMARG option in the SUDAAN logistic regression procedure.^{21,22} The estimates were adjusted for the demographic and maternal behavioral characteristics noted previously. The adjusted estimates are measures of what the breastfeeding rates would be if all the states had the same demographics and maternal behavioral characteristics. We then estimated the reduction in the disparity after adjustment by calculating the disparity difference between the highest and lowest estimates in the states as the denominator, and the reduction in the difference as the numerator.

In the second part of the analysis, 2 weighted logistic regression models were used to examine factors associated with not breastfeeding. The first model examined the association between state of residence and likelihood of not breastfeeding. The second model examined the same association, adjusting for all the covariates. In the third part of the analysis, we used 2 weighted logistic regressions to explore the factors associated with the likelihood of not breastfeeding for at least 6 months. The results provide both the crude and adjusted odds of not breastfeeding at least 6 months by state of residence. The fourth part of the analysis incorporated the contextual-level data on breastfeeding legislation in each state. We examined the association between legislation and estimates of ever breastfeeding and breastfeeding at least 6 months. We then conducted a multilevel analysis incorporating the legislation variable into the logistic regression models. However, because the legislation

variable is a linear combination of state of residence, we could not incorporate state of residence into these analyses.

RESULTS

There was wide variation among the states, both in terms of ever breastfeeding and breastfeeding for at least 6 months (Table 1). The weighted but unadjusted state estimates for being ever breastfed ranged from 45% in Louisiana to almost 88% in both Oregon and Washington State. Generally, states in the West and Northwest had higher breastfeeding initiation estimates than did other parts of the country. Adjustment for all the covariates reduced the disparities in breastfeeding initiation between the lowest and highest state estimates by about 25% to 30%, with the largest changes coming in the southern states. For example, the adjusted estimate for Louisiana was almost 54%, whereas the adjusted estimates for Oregon and Washington State were 84% and 85%, respectively. Analyses indicated that 34% of the variance among states was explained by the adjustment.

Marked geographic disparities were also apparent in breastfeeding prevalence at 6 months, with Louisiana and Mississippi having the lowest estimates of 17% and 20%, respectively, whereas Utah (55%) and Oregon (56%) had the highest estimates. Again, adjustment for covariates narrowed the disparities, with Louisiana's adjusted prevalence increasing to 22%, and Oregon's declining slightly to 54%. The multivariate adjustment explained 19% of the variance.

Multivariate analysis indicated that even after we controlled for all the covariates, where a child lived still had a strong association with breastfeeding initiation (Table 2). The adjusted odds of not being breastfed were 2.5 to 5.15 times greater for children in most southern states than for children in the reference state of Oregon. Strong, but smaller, disparities existed for most of New England. For example, compared with children in Oregon, children in Connecticut and Massachusetts had 2.94- and 3.02-times higher odds of not being breastfed. Children in the mid-Atlantic states were similarly less likely to be breastfed than those in Oregon. Other groups associated with not

initiating breastfeeding were Hispanics, Blacks, other races/ethnicities (i.e., other than Hispanic, Black, White, or multiple race), and those most likely to be in poverty.

There were similar findings for breastfeeding for at least 6 months, although in many cases the disparities were smaller both for the unadjusted and the adjusted odds (Table 3). For example, compared with children in Oregon, children in Louisiana had 4.50-times higher odds of not being breastfed for at least 6 months, even after we adjusted for socio-demographic and maternal characteristics. Similar disparities were found for children in Mississippi, Kentucky, West Virginia, Alabama, and Arkansas.

Table 4 indicates an association between breastfeeding promotion legislation and the estimated percentage of children who were ever breastfed and who were breastfed for at least 6 months. In states in which multiple pieces of legislation had been passed supporting breastfeeding, more than 76% of the children were reported to have been ever breastfed compared with only 63.7% of children living in states in which no breastfeeding promotion legislation had been enacted by the time of the 2003 survey. Similar disparities were evident for the estimated percentage of children breastfed for at least 6 months (42.4% vs 32.1%). Multilevel analysis, including all the covariates except state of residence, indicated that children who lived in states without breastfeeding promotion legislation had 63% higher odds of not being breastfed after birth and 45% higher odds of not being breastfed for at least 6 months.

DISCUSSION

We found evidence of wide geographic variation in breastfeeding initiation and duration rates in the United States. We found that, consistent with previous research, breastfeeding rates were highest among women living in the western and northwestern regions of the country and were lowest among women living in the southern states.^{15,16} Through multivariate analysis that adjusted for social, demographic, and behavioral factors, disparities in regional breastfeeding rates were diminished by approximately 25% to 30%. To our knowledge, this is the first nationally representative

TABLE 2—Unadjusted and Adjusted Odds of Not Initiating Breastfeeding: National Survey of Children’s Health, 2003

State	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Alabama	4.95 (3.50, 7.00)	3.59 (2.49, 5.16)
Alaska	1.34 (0.88, 2.02)	0.87 (0.55, 1.39)
Arizona	1.95 (1.35, 2.82)	1.83 (1.25, 2.69)
Arkansas	5.55 (3.92, 7.86)	4.04 (2.80, 5.84)
California	1.10 (0.76, 1.60)	0.99 (0.67, 1.47)
Colorado	1.22 (0.84, 1.79)	1.20 (0.81, 1.78)
Connecticut	2.81 (1.97, 4.01)	2.94 (2.03, 4.25)
Delaware	4.09 (2.90, 5.78)	3.40 (2.37, 4.87)
District of Columbia	3.83 (2.68, 5.48)	1.94 (1.31, 2.86)
Florida	2.59 (1.81, 3.70)	2.12 (1.45, 3.10)
Georgia	3.53 (2.46, 5.06)	2.53 (1.74, 3.69)
Hawaii	1.60 (1.07, 2.39)	1.31 (0.85, 2.03)
Idaho	1.26 (0.85, 1.86)	1.16 (0.77, 1.75)
Illinois	2.48 (1.74, 3.54)	2.37 (1.63, 3.45)
Indiana	3.46 (2.43, 4.95)	3.05 (2.10, 4.43)
Iowa	3.59 (2.53, 5.09)	3.46 (2.40, 4.98)
Kansas	2.46 (1.70, 3.57)	2.19 (1.47, 3.27)
Kentucky	5.49 (3.88, 7.77)	4.47 (3.11, 6.42)
Louisiana	8.36 (5.96, 11.74)	5.15 (3.61, 7.35)
Maine	2.54 (1.77, 3.65)	2.43 (1.66, 3.56)
Maryland	2.11 (1.46, 3.05)	1.77 (1.20, 2.61)
Massachusetts	2.81 (1.96, 4.02)	3.02 (2.07, 4.41)
Michigan	3.31 (2.34, 4.68)	2.62 (1.81, 3.78)
Minnesota	1.91 (1.33, 2.75)	1.85 (1.26, 2.72)
Mississippi	6.17 (4.34, 8.78)	3.65 (2.51, 5.30)
Missouri	3.24 (2.28, 4.60)	2.58 (1.77, 3.76)
Montana	1.53 (1.03, 2.27)	1.27 (0.83, 1.94)
Nebraska	2.58 (1.79, 3.70)	2.33 (1.60, 3.41)
Nevada	1.90 (1.33, 2.72)	1.79 (1.23, 2.60)
New Hampshire	2.46 (1.72, 3.51)	2.59 (1.78, 3.77)
New Jersey	3.16 (2.23, 4.48)	3.20 (2.21, 4.63)
New Mexico	2.14 (1.46, 3.13)	1.45 (0.95, 2.21)
New York	2.63 (1.84, 3.75)	2.51 (1.72, 3.68)
North Carolina	3.24 (2.29, 4.58)	2.43 (1.68, 3.50)
North Dakota	3.22 (2.26, 4.59)	2.81 (1.93, 4.09)
Ohio	3.55 (2.52, 4.99)	2.80 (1.95, 4.01)
Oklahoma	3.37 (2.36, 4.79)	2.39 (1.64, 3.50)
Oregon (Ref)	1.00	1.00
Pennsylvania	4.30 (3.03, 6.09)	3.76 (2.61, 5.41)
Rhode Island	3.44 (2.43, 4.87)	3.69 (2.57, 5.29)
South Carolina	4.53 (3.21, 6.41)	3.21 (2.23, 4.63)
South Dakota	3.14 (2.17, 4.53)	2.50 (1.70, 3.67)
Tennessee	3.91 (2.75, 5.56)	3.00 (2.07, 4.35)
Texas	2.39 (1.69, 3.38)	2.13 (1.48, 3.07)

Continued

TABLE 2—Continued

Utah	1.25 (0.85, 1.83)	1.28 (0.85, 1.93)
Vermont	1.66 (1.11, 2.48)	1.61 (1.05, 2.47)
Virginia	3.40 (2.39, 4.84)	2.55 (1.77, 3.69)
Washington State	0.97 (0.64, 1.47)	0.91 (0.58, 1.40)
West Virginia	5.97 (4.24, 8.38)	4.97 (3.46, 7.14)
Wisconsin	2.59 (1.81, 3.72)	2.33 (1.60, 3.39)
Wyoming	1.53 (1.06, 2.23)	1.24 (0.84, 1.85)
Race/ethnicity		
Hispanic		1.47 (1.22, 1.76)
Non-Hispanic Black		2.06 (1.78, 2.39)
Non-Hispanic White (Ref)		1.00
Non-Hispanic multiple race		1.10 (0.87, 1.38)
Non-Hispanic other		1.55 (1.16, 2.07)
Poverty level ^a		
<100%		1.74 (1.49, 2.02)
100%–199%		1.60 (1.41, 1.82)
200%–299%		1.25 (1.10, 1.42)
≥300% (Ref)		1.00
Gender of child		
Boy		1.00 (0.91, 1.09)
Girl (Ref)		1.00
Family structure		
2-parent stepfamily		1.78 (1.38, 2.31)
Single mother		1.47 (1.30, 1.65)
Other		7.74 (3.87, 15.48)
2-parent biological or adopted family (Ref)		1.00
Primary language in household		
Spanish		0.83 (0.65, 1.07)
Any other language		1.00 (0.83, 1.17)
English (Ref)		1.00
Nativity status		
Child was US born and at least 1 parent was foreign born		0.47 (0.38, 0.57)
Child was foreign born		0.71 (0.50, 1.00)
Child and parents were US born (Ref)		1.00
Smoker in household		
Yes		1.57 (1.38, 1.78)
No (Ref)		1.00
Maternal health status		
Fair or poor		0.97 (0.80, 1.18)
Excellent, very good, or good (Ref)		1.00
Maternal mental health status		
Fair or poor		1.00 (0.80, 1.24)
Excellent, very good, or good (Ref)		1.00
Mother exercises regularly		
Yes (Ref)		1.00
No		1.17 (1.06, 1.28)

Notes. OR = odds ratio; CI = confidence interval.

^aBased on the US Department of Health and Human Services 2003 Poverty Guidelines.¹⁹

study to incorporate various sociodemographic, behavioral, and legislative factors into multivariate analyses to help explain state variations in breastfeeding rates.

The *Healthy People 2010* breastfeeding objectives call for 75% of all US women to initiate breastfeeding, 50% to continue breastfeeding for 6 months, and 25% to breastfeed for at least 1 year.²³ Sixteen states currently exceed the national breastfeeding initiation goals, with adjusted initiation rates of about 85%. Only 5 states (Oregon, Idaho, Hawaii, Utah, and Alaska), however, were able to achieve the national target of 50% of women continuing to breastfeed for at least 6 months.

The associations of breastfeeding with sociodemographic and behavioral characteristics have been studied extensively, in part to gain insight into ways to design effective interventions to help achieve the breastfeeding objectives set forth in *Healthy People 2010*. To this end, the literature is replete with studies indicating that maternal race/ethnicity, acculturation, education level, age, marital status, employment, poverty status, prenatal care, smoking, participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and other factors are related to how women decide to feed their children. We found that odds of not ever being breastfed and not being breastfed for at least 6 months were higher among Hispanic children compared with non-Hispanic White children, despite lower odds among households in which Spanish was the primary language (Table 3). We suspect that this may be a reflection of the effects of acculturation, as demonstrated in previous studies.^{13,24} As shown in the tables, we found that even after we controlled for these numerous individual-level variables, rates of breastfeeding differed across the United States, and we sought to further delineate the reasons why.

In a study in which disparities in breastfeeding between low-income, African American women and other groups in the United States were explored, Bentley et al. took a social-ecological approach to explore multiple levels of influence on women's feeding decisions and behaviors.²⁵ Specifically, they examined linkages and interactions between many different microlevel (e.g., demographic variables) and macrolevel (e.g., media, health care

TABLE 3—Unadjusted and Adjusted Odds of Not Breastfeeding for 6 or More Months: National Survey of Children's Health, 2003

State	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Alabama	4.24 (3.14, 5.72)	3.66 (2.68, 5.01)
Alaska	1.42 (1.07, 1.90)	1.14 (0.83, 1.58)
Arizona	1.69 (1.29, 2.23)	1.66 (1.24, 2.21)
Arkansas	4.26 (3.16, 5.72)	3.50 (2.57, 4.76)
California	1.23 (0.94, 1.61)	1.20 (0.89, 1.61)
Colorado	1.26 (0.96, 1.65)	1.32 (0.99, 1.77)
Connecticut	1.91 (1.45, 2.51)	2.08 (1.56, 2.77)
Delaware	2.70 (2.05, 3.55)	2.56 (1.92, 3.40)
District of Columbia	2.54 (1.91, 3.36)	1.72 (1.26, 2.35)
Florida	2.12 (1.60, 2.80)	2.00 (1.49, 2.68)
Georgia	2.80 (2.11, 3.71)	2.43 (1.81, 3.26)
Hawaii	1.27 (0.96, 1.69)	1.03 (0.75, 1.43)
Idaho	1.06 (0.81, 1.40)	1.01 (0.76, 1.36)
Illinois	1.66 (1.27, 2.18)	1.70 (1.28, 2.27)
Indiana	3.17 (2.37, 4.23)	3.07 (2.27, 4.14)
Iowa	2.72 (2.04, 3.61)	2.79 (2.07, 3.75)
Kansas	2.40 (1.80, 3.21)	2.40 (1.77, 3.26)
Kentucky	4.11 (3.05, 5.55)	3.88 (2.84, 5.31)
Louisiana	6.05 (4.49, 8.14)	4.50 (3.30, 6.16)
Maine	2.07 (1.55, 2.75)	2.15 (1.59, 2.91)
Maryland	1.50 (1.14, 1.98)	1.43 (1.06, 1.92)
Massachusetts	2.36 (1.79, 3.11)	2.65 (1.99, 3.52)
Michigan	2.58 (1.95, 3.41)	2.34 (1.75, 3.13)
Minnesota	1.83 (1.39, 2.42)	1.90 (1.42, 2.55)
Mississippi	4.93 (3.57, 6.80)	3.70 (2.63, 5.20)
Missouri	2.76 (2.09, 3.65)	2.52 (1.87, 3.39)
Montana	1.38 (1.04, 1.84)	1.36 (1.01, 1.83)
Nebraska	2.18 (1.64, 2.90)	2.27 (1.69, 3.06)
Nevada	2.05 (1.56, 2.69)	2.03 (1.52, 2.72)
New Hampshire	1.88 (1.43, 2.48)	2.10 (1.57, 2.80)
New Jersey	2.54 (1.93, 3.35)	2.60 (1.96, 3.45)
New Mexico	1.93 (1.45, 2.58)	1.42 (1.03, 1.96)
New York	2.04 (1.54, 2.70)	2.00 (1.48, 2.69)
North Carolina	2.87 (2.18, 3.78)	2.54 (1.89, 3.40)
North Dakota	2.93 (2.18, 3.93)	2.88 (2.10, 3.94)
Ohio	2.73 (2.07, 3.59)	2.40 (1.81, 3.20)
Oklahoma	3.22 (2.40, 4.32)	2.73 (2.00, 3.73)
Oregon (Ref)	1.00	1.00
Pennsylvania	2.43 (1.83, 3.23)	2.26 (1.67, 3.06)
Rhode Island	2.91 (2.20, 3.86)	3.29 (2.45, 4.41)
South Carolina	3.66 (2.76, 4.84)	3.11 (2.31, 4.18)
South Dakota	2.82 (2.10, 3.78)	2.55 (1.88, 3.46)
Tennessee	3.11 (2.33, 4.14)	2.82 (2.10, 3.78)
Texas	2.29 (1.76, 2.99)	2.15 (1.62, 2.85)

Continued

providers and systems, legislation) factors and ways these factors might influence cultural norms and women's decisions about how to feed their children.

To try to further discern the reasons for variation in state breastfeeding rates, we attempted to explore the macrolevel influence of breastfeeding legislation that had been enacted in each state by 2003. Breastfeeding initiation rates were highest in those states that had enacted multiple pieces of legislation supportive of breastfeeding and lowest among states with no such legislation, even when we included covariates. Similarly, rates of breastfeeding at 6 months were highest among women living in states with legislation that protects and supports breastfeeding.

Supportive breastfeeding legislation may influence breastfeeding decisions by raising the profile of breastfeeding as a public health issue, reinforcing prevailing norms, or increasing resources devoted to breastfeeding promotion and support.²⁶ However, legislation may be a proxy for a culture more favorable toward breastfeeding and, as with any multilevel analysis that uses cross-sectional data, does not imply causality. It is impossible to discern from the data whether the impetus for breastfeeding promotion legislation was driven by the prevalence of breastfeeding in a state or vice versa. Further, many states focused on exemption from public indecency laws for breastfeeding laws in their legislation. We tried to go beyond this by focusing on states that had legislation dealing with multiple aspects of breastfeeding, such as information campaigns to promote breastfeeding or accommodations for breastfeeding mothers in the workplace.

Strengths and Limitations

The study had certain limitations. Maternal age and certain acculturation-related variables, which have been shown to be associated with breastfeeding, were not available in the data file, nor were other factors associated with breastfeeding, including whether or when a woman returned to work or school, whether a family participated in the WIC program, whether a woman had access to breastfeeding support in the hospital or other location where she gave birth, and the impact of the health care sector in each state. Second, because the age range of the sample was 6 to 71 months,

TABLE 3—Continued

Utah	1.05 (0.79, 1.39)	1.13 (0.84, 1.52)
Vermont	1.27 (0.94, 1.71)	1.29 (0.94, 1.77)
Virginia	2.13 (1.62, 2.80)	1.87 (1.40, 2.48)
Washington State	1.21 (0.92, 1.60)	1.20 (0.90, 1.61)
West Virginia	4.17 (3.12, 5.58)	3.81 (2.80, 5.19)
Wisconsin	1.91 (1.44, 2.52)	1.92 (1.43, 2.57)
Wyoming	1.39 (1.05, 1.83)	1.26 (0.94, 1.68)
Race/ethnicity		
Hispanic		1.80 (1.49, 2.17)
Non-Hispanic Black		1.63 (1.37, 1.94)
Non-Hispanic White (Ref)		1.00
Non-Hispanic multiple race		1.05 (0.84, 1.32)
Non-Hispanic other		1.79 (1.26, 2.53)
Poverty level ^a		
< 100%		1.44 (1.22, 1.70)
100%–199%		1.33 (1.17, 1.51)
200%–299%		1.24 (1.10, 1.39)
≥ 300% (Ref)		1.00
Gender of child		
Boy		1.08 (0.99, 1.18)
Girl (Ref)		1.00
Family structure		
2-parent stepfamily		1.90 (1.41, 2.56)
Single mother		1.57 (1.36, 1.80)
Other		2.43 (1.13, 5.24)
2-parent biological or adopted family (Ref)		1.00
Primary language in household		
Spanish		0.72 (0.56, 0.92)
Any other language		1.05 (0.81, 1.25)
English (Ref)		1.00
Nativity status		
Child was US born and at least 1 parent was foreign born		0.66 (0.54, 0.80)
Child was foreign born		0.46 (0.32, 0.66)
Child and parents were US born (Ref)		1.00
Smoker in household		
Yes		1.95 (1.70, 2.23)
No (Ref)		1.00
Maternal health status		
Fair or poor		1.01 (0.82, 1.24)
Excellent, very good, or good (Ref)		1.00
Maternal mental health status		
Fair or poor		0.94 (0.73, 1.20)
Excellent, very good, or good (Ref)		1.00
Mother exercises regularly		
Yes (Ref)		1.00
No		1.21 (1.11, 1.33)

Notes. OR = odds ratio; CI = confidence interval.

^aBased on the US Department of Health and Human Services 2003 Poverty Guidelines.¹⁹

there may have been differential recall of breastfeeding behaviors, although Li et al. found maternal recall of breastfeeding initiation and duration to be valid and reliable when asked within 3 years.²⁷ Moreover, we were not able to discern whether these children were breastfed exclusively for the first 6 months of life.

This study had several strengths, chief among them being that this was the first study, to our knowledge, to use multivariate techniques to explore extensively the associations between state of residence and breastfeeding practices among a nationally representative sample. Not only did our study show that state breastfeeding rate disparities existed, it also revealed the influence of individual as well as macrolevel factors on breastfeeding. In addition to considering maternal demographic and behavioral characteristics, for example, we evaluated the influence of breastfeeding promotion legislation enacted by the time of the study.

Conclusions

Reasons for the large variation in breastfeeding rates across states are complex. As in other areas of research, such as studies on obesity and smoking, disparities in optimal behavior are highest among those living in the South, possibly suggesting a cohort of common macrolevel factors that remain unaddressed and which we could not measure in the current analysis. To eliminate the disparities in breastfeeding practices among women living in different regions of the United States, future research needs to move beyond exploration of associations between individual-level factors and feeding behaviors. Guidance in future breastfeeding studies may be gleaned from other areas of research that incorporate macrolevel variables. Obesity research, for example, may include assessment of the influence of school lunch nutrition and physical education legislation. Research on youths' smoking behaviors often examines the associations of tobacco use and cigarette tax laws. These and other areas of research demonstrate the importance of including macrolevel variables in behavioral analyses.

Furthermore, breastfeeding interventions and promotion efforts must also consider means by which larger cultural norms can be

TABLE 4—Prevalence and Adjusted Odds Ratios (ORs) for Association Between Breastfeeding Legislation, by State and Initiation of Breastfeeding and Breastfeeding for 6 or More Months: National Survey of Children's Health, 2003

	Initiation of Breastfeeding		Breastfeeding for ≥ 6 Months	
	Unadjusted Prevalence Estimate, % (SE)	Never Breastfeeding, Adjusted OR (95% CI)	Estimate, % (SE)	Not Breastfeeding for ≥ 6 Months, Adjusted OR (95% CI)
No law in 2003	63.7 (0.71)	1.63 (1.44, 1.82)	32.1 (0.68)	1.45 (1.30, 1.62)
First law between 1999 and 2003	69.2 (0.77)	1.27 (1.12, 1.43)	35.8 (0.72)	1.21 (1.09, 1.35)
First law before 1999	69.6 (0.90)	1.43 (1.25, 1.64)	36.5 (0.92)	1.26 (1.12, 1.42)
Multiple laws before 1999 (Ref)	76.2 (0.87)	1.00	42.4 (1.06)	1.00

Note. CI = confidence interval. All models adjusted for child's gender, race/ethnicity, family poverty level, family structure, primary language in the home, nativity status of parents and child, smoker in the household, maternal self-rated health and mental health status, and maternal exercise.

changed to provide an environment that is more supportive of breastfeeding. Legislation may facilitate institutionalization of some practices, such as establishing lactation rooms in workplaces or mandating breaks for women to express breastmilk, which may ultimately result in a shift in norms such that such provisions are expected. The results of our study suggest that legislation may have some influence on breastfeeding; however, this is only 1 macrolevel factor. Other factors, such as the percentage of babies born in Baby-Friendly Hospitals (hospitals that initiated the Ten Steps to Successful Breastfeeding Initiative),²⁸ the number of mother-to-mother support groups, or the number of lactation consultants per 1000 live births, may also play a role. More-comprehensive work is called for in this area. Further research should explore the rates of breastfeeding in a state before and after the adoption of specific components of breastfeeding legislation. Ensuring that each state has programs in place to protect and support breastfeeding is one way that disparities in breastfeeding might be reduced, helping us move toward attainment of the *Healthy People 2010* breastfeeding goals. ■

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M.D. Kogan originated the study and led the writing and analysis. G.K. Singh assisted with the analysis, interpreted findings, and provided critical reviews of the article. D.L. Dee wrote part of the article, interpreted findings, and provided critical reviews of the article. C. Belanoff interpreted findings and provided critical reviews of the article. L.M. Grummer-Strawn helped conceptualize ideas, interpreted findings, and provided critical reviews of the article.

Human Participant Protection

The National Survey of Children's Health was approved by the Centers for Disease Control and Prevention's National Center for Health Statistics' institutional review board.

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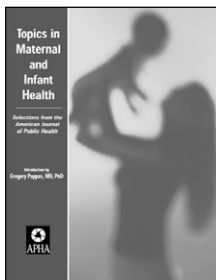
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