

VARIATIONS IN BREASTFEEDING INITIATION AND DURATION BY CHILD'S HEALTH NEEDS

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ABBREVIATIONS

ACS	American Community Survey
CAHMI	Child and Adolescent Health Measurement Initiative
CATI	Computer assisted telephone interview
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
CPS	Current Population Survey
CSHCN	Children with special health care needs
DBS	Developmental, behavioral or social
FPL	Federal poverty level
MEPS	Medical Expenditure Panel Survey
MSA	Metropolitan statistical area
NCHS	National Center for Health Statistics
NIS	National Immunization Survey
NSCH	National Survey of Children's Health
NS-CSHCN	National Survey of Children with Special Health Care Needs
OR	Odds ratio
PEDS	Parents' Evaluation of Developmental Status
SHCN	Special health care needs
SHCN/DBSD	Special health care needs or high risk of developmental, behavioral or social delays
SLAITS	State and Local Area Integrated Telephone Survey
SPSS	Statistical software

ABSTRACT

OBJECTIVE: To examine the relationship between child's health needs, as represented by having special health care needs or being at high risk of developmental, behavioral or social delay, and both breastfeeding initiation and six month duration for those who were ever breastfed among children age 0-5 years in the United States.

BACKGROUND: Breastfeeding has substantial health benefits for both infants and their mothers. Breastfed babies are less likely to be obese and to have otitis media, eczema, asthma, lower respiratory tract infections, type 2 diabetes and leukemia than non-breastfed babies.^{1,2} Studies have found that children who were never breastfed were significantly more likely to have special health care needs than children who were ever breastfed.³ Despite the extensive health benefits of breastfeeding, for babies born in 2007 less than 80% of mothers initiated breastfeeding and only 43% did so for 6 months.¹ Previously identified barriers to breastfeeding include social norms, inadequate support, infant admission into the intensive care unit (ICU), separation of infant and mother in the hospital and infant becoming sick and unable to breastfeed.^{1,4}

METHODS: This study uses data from the 2007 National Survey of Children's Health. Chi-squared tests were used to investigate the social, demographic and geographic factors that are independently associated with special health care needs or high risk of developmental, behavioral or social delays (SHCN/DBSD) and each breastfeeding outcome independently. Multivariate logistic regression was used to estimate the odds of ever breastfeeding for SHCN/DBSD compared to non-SHCN/DBSD children and the odds of six month duration of breastfeeding for SHCN/DBSD compared to non-SHCN/DBSD children among only children who were ever breastfed.

RESULTS: For children under six years living in the United States, increased health needs are negatively associated with both initiation and six month duration of breastfeeding. The multivariate-adjusted odds that children with special health care needs or at high risk of developmental, behavioral or social delays were breastfed were 18% lower than the odds for other children (95% CI: 3-30%). Of children who were ever breastfed, the multivariate-adjusted odds that those with special health care needs or high risk of delays stopped breastfeeding prior to six months of age were 26% higher than the odds for other children (95% CI: 10-40%). Other factors associated with breastfeeding initiation and continuation for at least six months after initiation were income, mother's health status, region of the United States, family structure, household tobacco use, child's birth position, mother's education and race/ethnicity.

CONCLUSION: These results show that children with increased health needs have mothers who face greater barriers in starting and continuing to breastfeed. This identifies the need for increased support for the mothers and families of these children so that infants who have or are at increased risk for special health care needs can be exposed to the proven health benefits of breast milk. Breastfeeding is also less common for children with other vulnerabilities such as living below the federal poverty level or being exposed to tobacco inside the home, indicating that in many cases children who were not breastfed optimally are also exposed to other factors that can negatively affect health.

INTRODUCTION

The importance of breastfeeding

Breast milk is well recognized as the best possible nutrition for infants and it has properties that protect against a variety of illnesses and disease for both mother and child.¹ It is promoted in the United States (U.S.) Department of Health and Human Services Strategic Plan for Fiscal Years 2010-2015, Healthy People 2020 Objectives and in January, 2011 The U.S. Surgeon General issued a call to action to support breastfeeding.^{1,5,6} Despite its well understood importance and its continued promotion, breastfeeding rates in the United States remain low.¹ The United States Department of Health and Human Services Healthy People 2020 objectives explicitly state an intention to increase the proportion of infants who are breastfed ever, at six months and at 1 year.⁶ The 2020 target for ever breastfeeding is 81.9% and for 6 months breastfeeding is 60.6%, but the U.S. rates were substantially short of these goals in 2007-09 at 74.0% and 43.5%, respectively.⁶ Additionally, breastfeeding varies greatly by state, with as many as 47.3% of children never having been breastfed in some geographic areas.⁷ Thus, there is substantial room for public health improvement in this domain.

The World Health Organization recommends that babies be exclusively breastfed for the first six months of life.⁸ However, there are disparities in breastfeeding practices by race, geographic region, income, and education level, among other factors.^{1,9,10} Hispanic and Asian women are the most likely to breastfeed and black women are the least likely.¹ Women living in the West are significantly more likely to breastfeed than those living in the South.¹⁰ Some geographical differences are related to the number of state laws in support of breastfeeding and the year they were passed in the child's state of residence, with the highest odds of breastfeeding initiation and six month duration in states where more than one law that supports breastfeeding was passed before the birth of the child.¹⁰

Breastfeeding positively affects health outcomes. Children who were never breastfed are more likely to develop otitis media, atopic dermatitis, gastroenteritis, pneumonia, childhood obesity, diabetes, asthma, and leukemia.^{4,11,12} Although the effect of breastfeeding on specific conditions is well established, there has been little research on the effect of breastfeeding on chronic conditions as a whole, especially in the United States. The studies that have assessed this association in other countries have found it to be significant. In 2009, Smith and Harvey performed a meta-analysis of existing studies on breastfeeding and chronic conditions in Australia. They found that the risk of chronic disease is 30 to 200% higher in people who were not breastfed.¹³ They also estimated that up to 24% of chronic disease could be attributable to premature weaning (prior to six months), assuming 30% of the population is weaned prematurely.¹³ The chronic diseases they identified as being associated with inadequate breastfeeding are the same as those

identified in other studies, such as diabetes, obesity, asthma and cancer.¹³ They also identified a reasonable mechanism by which infant nutrition could lead to chronic disease later in life.¹³ Akobeng and Heller performed a meta-analysis in the United Kingdom and found that of 596,122 babies born in England and Wales in 2002, 33,100 cases of asthma, 2,655 cases of celiac disease and 13,639 cases of obesity would have been prevented had every baby been breastfed.¹⁴ Bartick and Reinhold estimate that if 90% of children in the U.S. were exclusively breastfed for the first six months of life, it would save the U.S. \$13 billion and 911 deaths annually.¹⁵ The public health implications of improving breastfeeding practices are huge, yet the prevalence of breastfeeding in the United States continues to remain low and vary drastically by factors such as race, income, maternal education, household tobacco use and region of the US.

Children with Special Health Care Needs

Children with special health care needs (CSHCN) are defined by the Maternal and Child Health Bureau as “those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.”¹⁶ Nationwide, nearly one-fifth of children living in the United States have special health care needs (SHCN).¹⁷ The prevalence of CSHCN among 0-5 year-olds varies drastically across the United States, from 6.1% in Arizona to 20.2% in Arkansas.¹⁷ This suggests that there are behavioral, cultural and healthcare related practices that may influence the prevalence of CSHCN. While CSHCN represent less than 20% of children living in the United States, they account for at least 40% of the medical expenditures spent on children.¹⁸ They are a vulnerable population with increased health services use. Data from the Medical Expenditure Panel Survey (MEPS) indicate that CSHCN had over four times the number of hospitalizations and spent more than 7 times as many days in hospitals as other children in 2000.¹⁸ Children with special health care needs are more likely to have unmet health care needs and face greater health disparities than other children.¹⁹ Unmet needs and the well-being of CSHCN and their families varies by state and by sociodemographic characteristics; demographic differences explain a large portion but not all of the between-state variability in outcomes for CSHCN.²⁰

The National Survey of Children’s Health includes the CSHCN Screener (Appendix A), which efficiently and accurately identifies children with special health care needs. The CSHCN Screener was developed through a broad collaborative process and built upon over twenty-five years of work towards how to best define and identify CSHCN.²¹ The overall prevalence and demographic variations in the prevalence of CSHCN identified with the CSHCN Screener is consistent with findings from other research on CSHCN.²¹ It also has high agreement with the Questionnaire for Identifying Children with Chronic Conditions – Revised and differences between the two methods are the result of purposeful differences in instrument design.²²

It was developed to identify children meeting a wide range of functioning and health-service related consequences for standardized assessment of health system performance.²¹ Therefore, developers of the CSHCN Screener intentionally did not operationalize the “at increased risk” component of the MCHB definition of CSHCN.

The CSHCN Screener contains five items, each a sequence of two or three questions. To meet the screener criteria, a child’s parent must report that the child has an ongoing health condition that has lasted or is expected to last for at least twelve months and for which he/she experiences one or more of the following: (1) need or use of prescription medications; (2) an above routine use of medical services; (3) need or use of specialized therapies or services; (4) need or use of mental health counseling (5) a functional limitation. Most children identified experience more than one consequence. The screener is accurate and reliable in identifying children who experience at least one of these five consequences.²³ Responses to the screener have good internal psychometric properties and minimal random measurement error.²³ The CSHCN Screener is widely used and accepted as a tool for identifying children with special health care needs in a non-condition-specific manner and has been in use by researchers, policymakers and health care providers since 1998.

Among CSHCN, comorbidity of conditions is common. According to the 2005/06 National Survey of Children with Special Health Care Needs (NS-CSHCN), an estimated 42.1% of CSHCN age 0-5 years have at least two of sixteen common conditions^{i.17} Additionally, an estimated 78.8% of CSHCN age 0-5 years experience at least one of fourteen common functional difficulties^{ii.17} The prevalence, type and number of conditions and difficulties varies by age. For example, heart problems are more common among those less than one year old (13.9% of CSHCN) than they are among 5 year olds (2.8% of CSHCN).¹⁷ This means the profile of one year old CSHCN is different from the profile of five year old CSHCN and from all CSHCN. This is expected, as different conditions and difficulties develop and/or manifest differently at different ages. Some conditions are resolved with age while others appear with age. Additionally, the diagnosis of many conditions is not valid or recommended until a child reaches a certain age.

ⁱ Asthma; ADHD or ADD; autism or autism spectrum disorder; Down Syndrome; Mental retardation or developmental delay; depression, anxiety, eating disorder or other emotional problem; diabetes; heart problems; anemia or sickle cell disease; cystic fibrosis; cerebral palsy; muscular dystrophy; epilepsy or other seizure disorder; migraine or frequent headaches; arthritis or other joint problems; respiratory or food allergies

ⁱⁱ Vision difficulties even when wearing glasses or contacts; hearing difficulties even when wearing hearing aids; breathing difficulties; swallowing, digestive or metabolic difficulties; blood circulation difficulties; chronic physical pain, including headaches; difficulty with self-care activities such as eating or dressing; coordination or movement difficulties; difficulty using hands; difficulty learning, understanding or paying attention; difficulty speaking, communicating or being understood; difficulty with feeling anxious or depressed; difficulty with behavior problems, difficulty making or keeping friends

Children at high risk for developmental, behavioral or social (DBS) delay

The prevalence of children with special health care needs, as defined by the MCHB and as captured in the CSHCN Screener, increases with age.²⁴ This is due to conditions that go undiagnosed, unidentified or are not developed until later in childhood.²⁴ The CSHCN Screener identifies many children who are clinically undiagnosed, but there are young children and infants who face health consequences from current difficulties or problems but to an extent that does not meet CSHCN Screener criteria until they are older. For this analysis, we were interested in how increased child health needs impact breastfeeding practices among young children (age 0-5 years). Thus, it was important to identify children who were at increased risk of developing a diagnosis and services needs that would align with the CSHCN definition. Children at high risk of developmental, behavioral or social delay fall into this group.

The Parents' Evaluation of Developmental Status (PEDS) is validated screening tool used to identify children at risk for school problems or developmental and behavioral disabilities based on parental concerns.^{25,26,27,28} It is a clinic-based tool with sensitivity and specificity for detecting children with developmental disabilities between 70 and 80%.²⁹ Research shows that when parents' concerns are elicited, scored and interpreted correctly, they are as accurate of a developmental screening tool as quality screening tests.³⁰ Additionally, the ability for parents to raise important concerns does not vary by parental education or child-rearing experience.³⁰ Parental concern-based screening methods such as the PEDS tool can be very useful in determining the child's developmental, behavioral and referral needs.^{30,31}

Included in the 2007 NSCH are eight items derived from the PEDS that elicit specific parental concerns and one that elicits global parental concerns. The questions are asked of parents of children age 4 months through 5 years to see if parents are "a lot," "a little" or "not at all" concerned about their child's (1) general learning, development or behavior, (2) expressive language, (3) receptive language, (4) fine motor skills, (5) gross motor skills, (6) behavior, (7) socio-emotional status (8) self-help abilities and (9) preschool or school skills.³² While these are the concerns addressed, the wording used here does not reflect actual survey items (Appendix B). Items 8 and 9 are not assessed in children under 10 months of age and item 9 is not assessed in children age 10-18 months.

The PEDS scoring is based on the logic that at different ages, certain parental concerns are predictive of developmental, social or behavioral problems. Concerns are categorized into two groups depending upon the child's age: (1) concerns that, at that age, are significant predictors of developmental disabilities, called predictive concerns and (2) concerns that, at that age, are not significant predictors of developmental disabilities, called non-predictive concerns.³⁰ Questions from the 2007 NSCH can be used to group children into three groups with various levels of risk of developmental, behavioral or social (DBS) delays: (1) low or no risk, (2) moderate risk and (3) high risk. "Low or no risk" children are those whose

parents have no concerns or only non-predictive concerns, “moderate risk” children are those whose parents have exactly one predictive concern and any number of or no non-predictive concerns and “high risk” children are those whose parents have two or more predictive concerns and any number of or no non-predictive concerns. This scoring is consistent with the way the PEDS test is scored in the clinical setting, where it is recommended that children with two or more predictive concerns are referred for follow-up evaluation.³⁰ Table 1 shows which concerns are predictive (P) and which are non-predictive (N) at various ages.

Table 1: Predictive (P) and non-predictive (N) parental concerns at various ages for scoring of the Parent’s Evaluation of Developmental Status items in the 2007 NSCH

Child’s age	Global	Expressive Language	Receptive Language	Fine Motor	Gross Motor	Behavior	Socio-emotional	Self-Help	(Pre)School Skills
4-9 months	N	P	N	N	N	N	P		
10-17 mos	N	P	N	N	N	N	P	N	
18 mos – 2 yrs	N	P	P	N	N	N	N	N	N
3-4 yrs	N	P	P	N	P	N	N	N	N
5 yrs	N	P	P	P	P	N	N	N	P

The goal of this research is to examine the association between a child’s health needs and breastfeeding among children younger than six years old. Signs and symptoms of health conditions or problems may manifest as early in life but go unidentified or uncategorized until a child is older. Similarly, a condition or problem that requires above routine medical service use or functional difficulties when a child is a few years old may be present when a child is an infant or a toddler but not yet require medical intervention or cause functional difficulties. The American Academy of Pediatrics recommends that children about whom there are developmental concerns identified with a standardized developmental screening tool such as PEDS are referred for further medical evaluation and/or for intervention services.³³ Children whose parent has two or more predictive concerns, who are considered at high risk of developmental, behavioral or social delay likely exhibit behavior, conditions or problems that require more medical, parental, educational or other attention than children at no, low or moderate risk. Thus, in this analysis, children at high risk of DBS delays will be grouped with children identified as CSHCN by the CSHCN Screener. This will help to identify young children who are at risk of developing special health care needs.

Study Rationale and Objectives

Despite continued validated research supporting the importance of breastfeeding and continued public health promotion of the practice, many women face challenges or barriers that limit their ability to breastfeed. Reasons reported for breastfeeding cessation prior to 6 months include: discomfort, inability to produce milk, baby had difficulty, was not gaining enough weight or was unsatisfied with breast milk, baby

being sick, unable to breastfeed, or hospitalized and mother had too many other responsibilities or couldn't due to work or school.³⁴ Smoking during pregnancy, infant's admission to the intensive care unit, mother's employment status and Caesarean birth have been found to be negatively associated with breastfeeding.^{4,35} Meanwhile, higher maternal education, higher maternal age, mother being married and mother being of white or Hispanic race/ethnicity have been found to be positively associated with breastfeeding.³⁶ Those who have a child with increased health needs may face more barriers to breastfeeding than other mothers. If a child is in the intensive care unit or needs special medical treatment, this may mean less time that the infant is with the mother and thus less opportunity to breastfeed. Additionally, a mother of a child with special health problems or conditions may have more of her time taken up caring for her baby's health needs and less time to breastfeed or pump breast milk. These problems may be exasperated for single mothers and/or mothers with inadequate support systems.

It is feasible that mothers of children with special health care needs or high risk of delays face more barriers to breastfeeding and also that children who were not breastfed are more likely to develop conditions or problems associated with having special health care needs. This is because breastfeeding protects against a number of chronic conditions. For children who did not have increased health needs at breastfeeding age, lack of breastfeeding may heighten their risk for having increased health needs later in life. The National Survey of Children's Health is cross-sectional and temporality of events cannot be assessed and it is important to address that the temporality of this association can feasibly go either way.

No studies have previously evaluated the associations we are investigating. Most of the prior research about non-demographic barriers to breastfeeding has been based on small-scale interviews. Mothers have previously reported that admission to the intensive care unit and child becoming sick as reasons for stopping breastfeeding. However, we do not know if mothers of children who need above-routine medical services or attention generally are less able to breastfeed at all or for as long as recommended. This study represents a unique opportunity to evaluate the relationship between child health needs and breastfeeding initiation and duration while simultaneously evaluating a number of characteristics known to be associated with both. This analysis will also be generalizable to the entire population of children in the United States younger than six.

There are three objectives of this study:

Objective 1: Describe the social, demographic and geographic factors that are associated independently associated with breastfeeding initiation, six month duration of breastfeeding and children with a special health care need or at high risk of developmental, behavioral or social delays (CSHCN/DBSD).

Objective 2: Use simple logistic regression to examine the unadjusted associations between special health care needs or high risk of developmental behavioral or social delays (CSHCN/DBSD) and each measure of breastfeeding.

Objective 3: Examine this association after adjusting for various factors, including race, household language, income level, insurance status, mother's education, birth position, family structure, mother's mental and physical health, family tobacco use, and geographic location.

METHODS

2007 NSCH purpose and sampling methodology

The purpose of the National Survey of Children's Health (NSCH) is to collect information about the physical and emotional health and wellbeing of children and adolescents in the United States. The survey also assesses a variety of other factors known to affect the health and wellbeing of children as well as outcomes-related indicators. The NSCH is sponsored by the Maternal and Child Health Bureau of the Health Resources and Services Administration and has been conducted every four years starting in 2003.³⁷

There are eight topical domains in the NSCH: 1) demographics; 2) physical and mental health status; 3) health insurance; 4) health care utilization and access to health care; 5) medical home; 6) family functioning; 7) parents' health; and 8) neighborhood characteristics. Age-specific questions regarding early childhood were asked of children age 0-5 years and regarding middle childhood and adolescence of children age 6-17 years. NSCH development is lead by The Maternal and Child Health Bureau, which works in collaboration with the National Center for Health Statistics and a national technical expert panel. The Technical expert panel includes representatives from other federal agencies, state Title V leaders, family organizations and child health researchers. Where possible, previously validated questions are used in the NSCH. Additionally, most of the questions in the 2007 NSCH were also included in the 2003 NSCH and underwent pretesting. During pretesting, cognitive understanding of the questions is assessed and needed revisions are made. The NSCH was conducted using a computer assisted telephone interview (CATI) system. The system guides the interviewer by displaying the appropriate questions depending upon the subject's answers. The CATI provides automatic checks of allowable response ranges and help screens to aid the interviewer. The survey also underwent pretesting using the CATI system. Prior to the 2007 survey, 640 pretest interviews were completed and necessary changes were made to the survey based on the results of the pretest. Interviewers were trained using a mock interview certification process. Interviews were conducted in the presence of supervisory staff to ensure proper quality control.³⁸

Data collection for the 2007 NSCH took place between April 2007 and July 2008. Sampling was designed to obtain a minimum of 1,700 interviews in each state so that reasonably precise state-level estimates could be obtained. Households with children were identified from National Immunization Survey (NIS) estimation areas.^{39,40} Telephone numbers from banks were sampled and appropriately flagged for the NIS and NSCH simultaneously. Some additional NSCH-only sample was necessary in nine states. Overall, a nationwide sample of 2,806,416 telephone lines (in each of the 50 states and the District of Columbia) was selected through random-digit-dialing. A single telephone line was called up to six times on different days and at different times of the day. If no one answered during any of these attempts, the number was deemed not resolved as residential or non-residential. Nearly eighty percent of the sampled telephone lines (2.2 million) were out of scope (business, nonworking, fax or modem) or not resolved as residential or non-residential. Of the remaining households, 74,051 answered but did not complete the age eligibility section (to determine if a child under 18 years old was living in the household). The remaining lines answered, were resolved as residential and age-screened. This resulted in 380,130 households without a child in the 0-17 year old range, 43,734 with a child in the range but no interview participation, 91,642 total interviews and 90,557 completed interviews. For households with more than one child younger than 18, one child was chosen at random for the survey. After accounting for non-resolved telephone numbers, the response rate of the 2007 NSCH is 51.2%.³⁸ The survey respondent was a parent or guardian of the sample child who lived in the same household and knew about the health and health care of the child. The respondent was a mother or father for 94% of sampled children.³⁸

The majority of interviews were conducted in English, however 5.3% of completed interviews were in Spanish, which also used the CATI system. A small number (0.2%) of all completed interviews were conducted in Mandarin, Cantonese, Vietnamese or Korean. These non-English, non-Spanish interviews were conducted by a special language interviewer who spoke the respective language and used a hard copy of the questionnaire in the appropriate language and then translated the answers into the computerized English system.³⁸

2007 NSCH weighting and data management

Sample weights for the National Survey were developed by the National Center for Health Statistics. Each child received one weight value that was calculated based upon base sampling weight, adjustment for nonresolution of telephone numbers, nonresponse, subsampling of age-eligible children multiple or no telephone lines and external control totals.³⁸ Even after weighting adjustment for these factors, the estimated number of children in the NSCH is unlikely to match known population values. Therefore, two external sources were used as comparison for raking adjustment: the 2006 and 2007

American Community Survey (ACS) and the 2005-2007 Current Population Survey. Raking is a process that adjusts prior weights to match key socio-demographic population values from an external source. The 2007 ACS was used as the reference for the total counts of children by state on July 1, 2007, which was used as the reference time point for all states for the NSCH. The ACS was used as the external source for raking according to gender, household income, race and ethnicity, highest level of household education and number of children living in the household. The Current Population Survey was used as the external source for adjusting by the number of children living in metropolitan statistical areas (MSAs) and non-MSAs. The raking process leads to substantial variance in sample weights and some extremely large weights. Extremely large weights can cause a small number of cases to have a substantial impact on estimates. Therefore, extreme weights were truncated and the weights were re-raked. This process was repeated until no extreme weights persisted. Weighting formulas developed by the statistician were compared to those constructed by the statistical programmer for quality control purposes. The final sampling weights for all 91,642 cases in the survey range from 0.52 to 34724.43. These sampling weights are necessary to make reasonably accurate national and state-level estimates from the data.³⁸

Data was de-identified and recoded to remove characteristics that may make a child easily identifiable prior to public release. This included coding variables like race and family structure only into categories with larger sample sizes and combining more unique characteristics into an “other” category. It also including top of bottom coding variables such as weight and number of children in the household. Some data perturbations were made to avoid scenarios where a certain combination of characteristics had the potential to make a child identifiable. Income information was missing for 8.5% of households and a nonresponse analysis performed by the National Center for Health Statistics showed that these missing values were related to variables relating to important sample characteristics. To reduce the non-response bias that this introduced, multiple imputation of income and household size (missing for only 394 households) was used to estimate federal poverty status for cases where it was missing.³⁸

All analysis was performed on the public release version of this dataset provided by the Maternal and Child Health Data Resource for Child & Adolescent Health. The National Center for Health Statistics requires that data from the National Survey of Children’s Health is used for statistical reporting and analysis only and that this data is not linked with any individually identifiable data from other datasets.³⁸ This study was approved by the Institutional Review Board (IRB) at Oregon Health & Science University on March 14, 2011.

Inclusion and Exclusion Criteria

A total of 91,642 interviews are included in the 2007 NSCH. 27,566 of these children were under six years old at the time of the survey. Children were included in the breastfeeding initiation analysis if they (1) were under six years old at the time of the survey, (2) had a valid (“yes” or “no”) answer to the question, “was [sample child] ever breastfed or given breast milk?” and (3) if not identified as CSHCN, had complete answers to all of the PEDS screener questions in the survey (Appendix B). They were excluded from the initiation analysis if they failed to meet any of the inclusion criteria. All children in the dataset had completed CSHCN Screener items. Children were included in the duration analysis if they (1) were under six years old at the time of the survey, (2) parent answered “yes” that the child was ever breastfed or given breast milk, and (3) if not identified as CSHCN, had complete answers to all of the PEDS screener questions in the survey (Appendix B). They were excluded from the duration analysis if they failed to meet any of the inclusion criteria.

Variables and Coding

The primary independent variable used in this analysis was a composite measure created from two composite variables that were already in the dataset. It was a binary variable with one group of children identified as having a special health care need or being at high risk of developmental, behavioral or social delay and the other group being children who did not meet either of these criterion. The questions used to identify children with special health care needs (CSHCN) are shown in Appendix A. The public use version of the 2007 NSCH contains a binary variable: 0=child does not have a special health care need and 1=child has special health care need(s). Children are in the second group if they meet at least one of the five three-part screener criteria and data on this item exists for all children in the dataset. The second component of this variable is risk of developmental, behavioral or social (DBS) delay(s). This is a composite measure in which children are classified as having no, low, moderate or high risk of DBS delay(s). Survey items used to construct this measure are shown in Appendix B. Data exist on this item for most children age 4 months through 5 years in the dataset, representing 26,174 (95.0%) of children under six years old in the dataset. We took these two composite measures and coded them into a new one: 0=non-CSHCN and no, low or moderate risk of DBS delays and 1=CSHCN and/or high risk of DBS delays. Although risk of DBS delay was not assessed for those who were younger than four months at the time of the survey, children in this age range were included in our analysis because their CSHCN status was known. We thought it was important to include these infants in this analysis because children who are identified as CSHCN at such a young age are most often those who have severe conditions that can be identified at birth or infancy and may impact breastfeeding. If a child met the criteria for CSHCN but had incomplete or missing PEDS screener questions,

he or she was included in the SHCN/DBSD group. However, if a child was identified as non-CSHCN and was had incomplete or missing PEDS screener questions, he or she was excluded from analysis.

Two separate dependent variables were used in this analysis. The first outcome of interest was if a child was ever breastfed or given breast milk. This core item was assessed by the survey respondent's answer to the question, "Was [sample child] ever breastfed or fed breast milk?" This question was only asked only of respondents for children under the age of six. Valid responses were "yes" or "no" and data on this item were available on 27,388 respondents, representing 99.4% of children age 0-5 years included the survey. This variable was used in the same form as it exists in the public use version of the 2007 NSCH and required no recoding. The second outcome of interest was duration of breastfeeding, which was based on the question, "How old was [he/she] when [he/she] completely stopped breastfeeding or being fed breast milk?" which immediately followed the item about ever breastfeeding. It was coded into a binary variable of "less than six months" and "six months or more" based on World Health Organization recommendations.⁸ Because responses to this original item are standardized to days, less than six months was defined as 179 days or less and 6 months or more was defined as 180 days or more. If a child under six months old was still breastfeeding at the time of the survey, he or she was included in the six months or more group because these children had not prematurely stopped breastfeeding. Therefore, for children under six months at the time of the survey, the six month duration analysis measured if they were or were not still breastfeeding. There were data on this item for 20,927 (99.2%) of the 21,095 children who had ever been breastfed or fed breast milk.

The two breastfeeding questions used in this analysis are standard and accepted ways of assessing breastfeeding history. Both breastfeeding questions from the National Survey of Children's Health are identical to questions used in other national surveys such as the National Health and Nutrition Examination Survey and the National Immunization Survey (NIS).^{41,42} They underwent cognitive testing and the ever breastfeeding question has been used in its current form in the NIS since 2001. The question about the age at which the child completely stopped breastfeeding or being fed breast milk was optimized to its current form in the NIS in 2006 based on the results from cognitive testing.⁴² Throughout this analysis, any referral to breastfeeding includes both breastfeeding and being fed breast milk.

Potential correlates were identified based on previous research and factors expected to be associated with one or more independent and dependent variables. Child's age was recoded into three groups: 0-24 months old, 2-3 years old and 4-5 years old. We wanted to account for regional differences in breastfeeding so we used the states codes existent in the NSCH to create a geographic location variable with four groups: West, Midwest, South and Northeast according to the way in which the United States Census defines these regions.⁴⁶

With regard to race and language, there are documented cultural differences between Spanish-speaking and English-speaking Hispanic Americans because significant associations have been identified between language and health, health behaviors and health care access.^{43,44,45} The NSCH first asks if a child is of Hispanic or Latino origin before asking any other questions about race/ethnicity. A child is coded as Hispanic if their parent answered, “yes” to the first question, regardless of how else the child is identified racially. We constructed a new variable to account for both language and race/ethnicity with the following categories: non-Hispanic white, non-Hispanic black, Spanish-speaking Hispanic, English-speaking Hispanic and non-Hispanic multi-racial or other.

To account for mother’s overall health status, a composite variable of mother’s mental and physical health as used. The Child and Adolescent Health Measurement Initiative’s Data Resource Center for Child and Adolescent Health constructs and provides composite measures from the NSCH and makes them publically available. They provide a composite measure of mother’s mental and physical health status, that has two levels: mother’s mental and physical health both very good or excellent and at least one rated good, fair or poor. In the interest of sample size, we combined the stepfamily and other family structure groups into one category for this analysis. We also combined 3rd and 4th oldest children for the birth position variable because the number of 4th oldest children was small.

Table 2 summarizes the variables used in this analysis. In some cases, the variable used in this analysis was identical to the one provided in the public-use version of the 2007 National Survey of Children’s Health. Other variables used in this analysis were already created by the Child and Adolescent Health Measurement Initiative (CAHMI), who provide versions of their dataset to the public with all original variables plus the ones they coded for display on their website (www.childhealthdata.org). Other variables were constructed for this analysis either from original NSCH variables or from those created by CAHMI.

Table 2: Summary of variables used in analysis

Variable	Type	Source	Specific Question(s) or description of variable	Possible responses*	Coding for analysis
Ever breastfed	Dependent	NSCH	Was [sample child] ever breastfed or fed breast milk?	-Yes -No	0=No 1=Yes
Duration of breastfeeding	Dependent	Recoded	How old was [he/she] when [he/she] completely stopped breastfeeding or being fed breast milk?	Continuous variable standardized to child's age in days	0=Less than 6 months 1=6 months or longer
SHCN/DBSD status	Primary independent	Recoded from two variables created by CAHMI	CSHCN status: See Appendix A Risk of DBS delays: See Appendix B	-CSHCN -non-CSHCN -No -Low -Moderate -High	0=non-CSHCN and no, low or moderate risk of DBS delays 1=CSHCN and/or high risk of DBS delays
Child's age	Potential confounder	Recoded	Please tell me the age of the child.	Age in years	0=0-24 months 1=2-3 years 2=4-5 years
Child's gender	Potential confounder	NSCH	Is [S.C.] male or female?	-Male -Female	1=Male 2=Female
Child's race and language	Potential confounder	Recoded from two variables created by CAHMI	Race: Is [S.C.] of Hispanic or Latino origin?; Now, I'm going to read a list of categories. Please choose one or more of the following categories to describe [S.C.]'s race. Is [S.C.] White, Black or African American, American Indian, Alaska Native, Asian, or Native Hawaiian or other Pacific Islander? Language ⁺ : What is the primary language spoken in your home?; Is [S.C.] of Hispanic or Latino origin?	-Hispanic -White, non-Hispanic -Black, non-Hispanic -Multi-racial or other, non-Hispanic -English -Language other than English	1=White, non-Hispanic 2=English-speaking Hispanic 3=Spanish-speaking Hispanic 4=Black, non-Hispanic 5=Multi-racial or other, non-Hispanic
Household income level	Potential confounder	CAHMI	Poverty level was computed using a household income value or range and then number of people living in the household; multiple imputation procedures were used to assign values to missing cases	Standardized by NCHS to percent of federal poverty level (FPL)	0=0-99% FPL 1=100-199% FPL 2=200-399% FPL 3=400% FPL and above

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Variable	Type	Source	Specific Question(s) or description of variable	Possible responses*	Coding for analysis
Birth position of child relative to other children in household	Potential confounder	Recoded	Derived by NCHS; should not be interpreted as birth order, as sample child's relation to other children living in the household is not determined; For 87 cases the total number of children in a household was changed by 1 and large values were top-coded to protect anonymity	-Only child -Oldest -Second oldest -3 rd oldest -4 th oldest	1=Only child 2=Oldest 3=2 nd oldest 4=3 rd or 4 th oldest
Family structure	Potential confounder	Recoded	To protect confidentiality, a single family structure (FAMSTRUCT) variable was created by the NCHS	-Two parent biological or adoptive -Two parent step family -Single mother, no father present -Other	0=Two-parent biological or adoptive 1=Single mother 2=Two parent step family or other
Household tobacco use	Potential confounder	CAHMI	Does anyone living in your household use cigarettes, cigars, or pipe tobacco?; Does anyone smoke inside [S.C.]'s home?	-No -Yes	1=None 2=At least one person living in household uses tobacco but not inside the home 3=At least one person smokes inside the home
Mother's mental and physical health status	Potential confounder	CAHMI	Would you say that, in general, ([S.C.]'s [MOTHER TYPE]/your) health is excellent, very good, good, fair, or poor? Would you say that, in general, ([S.C.]'s [MOTHER TYPE]/your) mental and emotional health is excellent, very good, good, fair, or poor?	-Excellent -Very good -Good -Fair -Poor	1=One or both not very good or excellent 2=Both very good or excellent
Mother's education level	Potential confounder	Recoded	What is the highest grade or year of school [you have / [S.C.]'s [MOTHER TYPE] has] completed?	-Less than high school -High school graduate -More than high school	0=Less than high school or high school graduate 1=More than high school

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Variable	Type	Source	Specific Question(s) or description of variable	Possible responses*	Coding for analysis
Geographic location	Potential confounder	Recoded	State of residence known from sampling scheme	Any of the 50 states or the District of Columbia, recoded into 4 regions as defined by the US Census division ⁴⁶	0=West: WA, MT, ID, OR, WY, CA, NV, UT, CO, AZ, NM, HI, AK 1=Midwest: ND, SD, NE, KS, MN, IA, MO, WI, IL, MI, IN, OH 2=Northeast: ME, NH, VT, MA, CT, RI, NJ, PA, NY 3=South: TX, OK, AR, LA, MS, TN, KY, AL, GA, SC, FL, NC, VA, WV, MD, DE, DC

*“don’t know” or “refused” are also possible responses for each question but are not listed [†]This is built upon the assumption that the primary language is Spanish when a child lives in a Hispanic household where the primary language is something other than English

Descriptive analysis and statistical significance of associations with SHCN/DBSD status

All statistical analysis was performed in SPSS version 18.0 and its complex samples add-on module.⁴⁷ Each variable of interest was examined within the study sample. To examine the demographic characteristics of the study sample, frequencies were run to obtain unweighted counts, weighted proportions and weighted 95% confidence intervals. Additionally, cross-tabulations between SHCN/DBSD status and each variable of interest were run to determine the demographic characteristics of the SHCN/DBSD group. Unweighted count, weighted prevalence and weighted 95% confidence intervals for each variable within the SHCN/DBSD group were determined. Demographic differences between SHCN/DBSD children and non-SHCN/DBSD children according to the selected variables were evaluated using Pearson’s chi-squared test of independence for weighted data. This helped to evaluate variables that may confound the relationship between breastfeeding and SHCN/DBSD status. Associations that had a Pearson’s chi-squared p-value less than or equal to 0.05 were deemed to be statistically significant.

Simple logistic regression analysis

Univariate logistic regression models were built to explore the associations between each independent variable and ever breastfeeding and breastfeeding duration for children who were ever breastfed, independently. Unadjusted odds ratios (ORs) and their 95% confidence intervals were obtained from these simple logistic regression models. The confidence interval approach to determining statistical significance was used. The 95% confidence intervals for the unadjusted ORs were determined to be statistically significant if they did not include the null value of 1.00 (indicating no association).

Multivariate logistic regression analysis

The goal of this analysis was to determine the association between SHCN/DBSD status and breastfeeding initiation and breastfeeding duration for children who were ever breastfed, independently. Therefore, as the first step in model building we built a model containing three variables for each potential confounder. Each model examined the relationship between SHCN/DBSD status and ever breastfed after adjusting for one variable at a time. For each model, the p-value corresponding to its Walf F-statistic for the potential confounder and the adjusted OR were obtained and are shown in Appendix C. To determine how much, if at all, each covariate changed the relationship of interest, a percent change from the original, unadjusted OR was calculated for each model; these results are also shown in Appendix C.

To build a model with more than three variables, covariates were added one at a time to the model with SHCN/DBSD status and ever breastfed in the order corresponding to the size of the effect they had on the relationship (those with the largest effect added first). Wald F p-values and Cox and Snell pseudo r-squared were determined for each model in this additive process and are shown in Appendix C. We continued to add variables in this fashion until all potential confounders were in the model. Variables were removed from the model if they were not statistically significant at the 0.05 level had no effect on the odds ratio for the primary variable of interest (SHCN/DBSD status) and they were deemed not to have importance to the association based on prior research.

To allow for comparison between models, the same main effects model for ever breastfeeding was also used for breastfeeding duration. This was reasonable because descriptive analysis and simple logistic regression showed that the factors associated with ever breastfeeding and six-month duration for those who started breastfeeding were similar. Plausible interactions were tested in the initiation and duration models separately. The interactions tested were between SHCN/DBSD status and age, race, geographic region and family structure. These interaction terms were tested in each model independently and simultaneously. If, in either case, they had a p-value of less than 0.10, they were retained in the model. Odds ratios were also stratified by any significant interaction terms.

Final model goodness of fit was assessed using the Hosmer and Lemeshow goodness-of-fit test for weighted data (confirmed p-value greater than 0.05 so as to not reject the hypothesis that the model is a good fit).⁴⁸ Collinearity of covariates was assessed using variance inflation factor (VIF) values (confirmed none were well above 1) and by determining the correlations of covariates (confirmed none greater than 0.50). To see how weighting may have affected the estimates, we ran the final models without weighting and obtained unweighted odds ratios for the main associations of interest only.

Missing cases

There were children who could not be included in each analysis due to invalid or missing responses to the questions needed for the analysis. Table 3 shows the number and percentage of children excluded from each portion of the analysis. For the ever breastfed analysis, the total number of children who could have been in the analysis was the total number of children under six years old in the dataset, 27,566. However, only 27,374 were eligible for the analysis because 192 children either did not have valid responses to the ever breastfeeding question or their parent did not complete the entire PEDS section of the survey (all children in the dataset had complete CSHCN Screener items). The 1,626 who were included in the simple logistic model between SHCN/DBSD status and ever breastfeeding but not in multivariate logistic regression are children who had valid responses to the main independent and dependent variables but who did not have a valid response to at least one of the covariates included in the final model. Each univariate analysis included the number of children eligible for analysis who also had a valid response to the variable being examined. Less than 5% of the eligible sample (n= 27,374) were excluded from any single univariate analysis with ever breastfeeding.

Because analyzing if breastfeeding prematurely stopped among children who were never breastfed is not meaningful, we were only interested in looking at six-month duration of breastfeeding for the 21,095 children who had ever been breastfed. 173 of these children did not have complete PEDS screener questions, which resulted in 20,922 children eligible for the six-month duration analysis. Again, less than 5% of the eligible sample was excluded from any single univariate analysis with potential confounders for 6 months breastfeeding.

Table 3: Number of children included in analysis

	Eligible for analysis	Included in final model	Missing in final model	Not Eligible for analysis	Total
Ever breastfed					
Number	27,374	25,748	1,626	192	27,566
Percent of total	99.3%	93.4%	5.9%	0.7%	-
Breastfed 6 months or more, of those who were ever breastfed only					
Number	20,922	20,071	851	173	21,095
Percent of total	99.2%	95.1%	4.0%	0.8%	-

To see how missing cases may have affected the analyses, children falling into each of the three following three groups were compared: (1) included in final model (2) included in descriptive analysis and simple logistic regression but not final model and (3) not eligible for analysis. We chose three variables for which there was complete ascertainment for comparison: age, income and geographic location. For the

ever analysis, significant differences existed between the three groups for age and income (Pearson's χ^2 p-value <0.001) but not for geographic location (Pearson's χ^2 p-value=0.191). Older children were more likely to be excluded from the initiation analysis and children living in higher income households were less likely to be excluded from the initiation analysis. For the duration analysis of children who were ever breastfed, at the alpha=0.05 significance level, there were no significant differences between groups for the three variables assessed. However, the difference between groups with regard to income and age were nearly significant (Pearson's χ^2 p-value=0.07 and 0.09, respectively). Older children were also more likely to be excluded from this analysis but income did not follow any particular trend.

RESULTS

Sample characteristics

Selected characteristics of the study population are shown in Table 4 for all children and for just children with special health care needs or at high risk of developmental, behavioral or social delays (SHCN/DBSD). There were 4,857 children in the latter category, representing an estimated 18.9% of children under six years old. There were approximately equal proportions of males and females and of children in each age group in the study sample. However, SHCN/DBSD children were more likely to be male (58.4% of compared to 48.8%) and in the 4-5 year old age group (47.3% compared to 33.9%) than children in the entire study sample. This was expected for previously discussed reasons about how many conditions and problems do not appear and/or are not diagnosed until the child reaches a certain age. Children in the SHCN/DBSD group were less likely to be white (47.9% compared to 54.3%) and more likely to be black (16.2% compared to 12.5%) than children in the entire study sample, but there were similar proportions of the other racial categories in each group. Additionally, SHCN/DBSD children were more likely to live in families with household incomes less than 400% of the federal poverty level than the entire sample (77.3% compared to 72.1%). Just under 60% of the study sample and about 45% of the SHCN/DBSD children had a mother whose parent-reported mental and physical health were both very good or excellent. Children in the SHCN/DBSD group were also less likely to live in two parent, biological or adoptive than parents in the overall sample (69.9% compared 78.3%). There were significant demographics differences between SHCN/DBSD and non-SHCN/DBSD children for age, gender, race/ethnicity, birth position, mother's education level, mother's mental and physical health, household income, household tobacco use, geographic location and family structure (Pearson's chi-squared p-value=<0.05). For each demographic characteristic, less than 5% of the study sample was missing from the denominator due to invalid (don't know or refused) responses.

Table 4: Sample child, mother and household characteristics for all children and for children with special health care needs or at high risk of developmental, behavioral or social delay, birth-5 years old, 2007 NSCH

		All Children (n=27,374)			CSHCN or children at high risk of DBS ⁺ delays (n=4,857)		
		n	%	95% CI	n	%	95% CI
CSHCN or high risk of DBS⁺ delays							
	No	22,517	81.1%	79.9-82.3	-	-	-
	Yes	4,857	18.9%	17.7-20.1	-	-	-
Age (years)*							
	0-24 months	9,594	34.6%	33.2-36.0	1,085	22.2%	19.5-25.5
	2-3 years	8,321	31.5%	30.2-32.9	1,591	30.5%	27.5-33.6
	4-5 years	9,159	33.9%	32.4-35.3	2,181	47.3%	43.9-50.8
Gender*							
	Male	14,170	51.2%	49.7-52.7	2,834	58.4%	54.9-61.7
	Female	13,186	48.8%	47.3-50.3	2,023	41.6%	38.3-45.1
Race/ethnicity*							
	White, non-Hispanic	17,524	54.3%	52.8-55.8	2,753	47.9%	44.5-51.3
	Black, non-Hispanic	2,398	12.5%	11.6-13.4	590	16.2%	13.9-18.7
	English speaking Hispanic	2,134	9.4%	8.4-10.5	430	10.1%	7.9-12.7
	Spanish speaking Hispanic	1,986	13.3%	12.0-14.7	421	14.9%	11.8-18.5
	Multi and other, non-Hispanic	2,877	10.5%	9.5-11.6	575	10.9%	8.9-13.4
Birth position relative to other children in the household*							
	Only child	11,206	24.7%	23.6-25.8	1,987	24.5%	22.2-27.0
	Oldest	3,613	14.0%	13.0-15.0	717	16.9%	14.6-19.4
	2 nd oldest	8,477	34.2%	32.8-35.6	1,491	33.7%	30.6-37.0
	3 rd or 4 th oldest	4,078	27.2%	25.7-28.8	662	24.9%	21.5-28.6
Household income*							
	<99% FPL	3,911	21.1%	19.7-22.4	944	26.6%	23.6-30.0
	100-199% FPL	4,904	22.0%	20.7-23.3	972	24.5%	21.5-27.9
	200-399% FPL	8,864	29.0%	27.8-30.3	1,455	26.1%	23.4-29.0
	>=400% FPL	9,695	27.9%	26.7-29.2	1,486	22.7%	20.2-25.5
Mother's education level*							
	High school diploma or less	6,739	36.5%	34.9-38.0	1,394	41.5%	37.9-45.2
	More than high school	19,294	63.5%	62.0-65.1	3,109	58.8%	54.8-62.1
Mother's mental and physical health*							
	Both very good or excellent	17,320	59.1%	57.5-60.7	2,373	44.4%	41.1-47.9
	At least one good, fair or poor	8,837	40.9%	39.3-42.5	2,150	55.6%	52.1-58.9
Family Structure*							
	Two parent - biological or adoptive	21,968	78.3%	77.0-79.5	3,449	69.9%	66.7-72.9
	Single mother	3,761	16.0%	14.9-17.0	927	21.9%	19.1-24.9
	2 parent step family and other	1,493	5.8%	5.1-6.5	448	8.2%	6.9-9.8
Household tobacco use*							
	None	20,972	74.2%	72.8-75.4	3,540	71.7%	68.6-74.5
	Tobacco use, not inside home	5,154	21.0%	19.8-22.3	1,009	22.2%	19.6-25.1
	Tobacco use inside the home	1,056	4.8%	4.3-5.4	266	6.1%	4.9-7.6

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	n	All Children (n=27,374)		CSHCN or children at high risk of DBS ⁺ delays (n=4,857)		
		%	95% CI	n	%	95% CI
Region*						
Northeast	4,630	16.9%	15.2-16.9	797	15.7%	13.9-17.7
Midwest	6,323	22.3%	20.6-22.3	1,078	20.8%	18.9-23.0
South	9,304	39.1%	36.5-39.1	1,913	42.0%	38.9-45.2
West	7,117	26.3%	23.2-26.3	1,069	21.5%	17.8-25.6

n is unweighted, prevalence (%) and 95% CI are weighted estimates

[†]Developmental, behavioral or social

*Significant difference in the proportion of children in each group for CSHCN/children at high risk of DBS delay versus other children (Pearson's chi-squared p-value= <0.05)

National estimates of breastfeeding initiation and duration

Table 5 shows prevalence estimates for initiation and six month duration of breastfeeding. Data from the 2007 National Survey of Children's Health estimate that 75.5% of children under 6 years old in the United States were ever breastfed and that of those, 60.4% were breastfed for six months or more. For all children, this translates into 45.5% being breastfed for six months or more, 29.9% for less than six months and 24.6%, an estimated 5.96 million children, who were never breastfed or given breast milk.

Table 5: Prevalence of ever breastfeeding and 6 months breastfeeding for children birth-5 years old, 2007 NSCH

	n	Population estimate	% (95% CI)
Ever breastfed			
Yes	21,087	18,384,887	75.5% (74.3-76.7)
No	6,287	5,956,832	24.5% (23.3-25.7)*
Breastfed 6 months or more, of those who were ever breastfed only			
Yes	12,803	11,018,742	60.4% (58.6-62.1)
No	8,119	7,229,764	39.6% (37.9-41.4)
Ever and 6 months breastfeeding for all children			
Breastfed ≥ 6 months	12,803	11,018,742	45.5% (44.0-47.0)
Breastfed <6 months	8,119	7,229,764	29.9% (28.5-31.3)
Never breastfed	6,287	5,956,832	24.6% (23.4-25.8)*

n is unweighted, all other estimates are weighted

*Percentage discrepancy due to the 165 children for which there is ever breastfeeding data but no breastfeeding duration data

Logistic regression analysis: breastfeeding initiation

Table 6 shows unadjusted and multivariate-adjusted odds ratios for ever breastfeeding. Children in the SHCN/DBSD group have unadjusted odds of ever breastfeeding or being given breast milk that are much lower than the odds for other children: unadjusted OR=0.66 (95% CI: 0.57-0.77). This relationship remained significant after adjusting for age, race/ethnicity, birth position, household income, mother's education, mother's mental and physical health, family structure, household tobacco use and geographic

region: multivariate-adjusted OR=0.82 (95% CI: 0.70-0.97). This means that the odds that a child with special health care needs or with a high risk of delays was breastfed are estimated to be 18% lower than the odds for other children. An estimated 1,426,750 children age 0-5 years in the US with a special health or high risk of delays were never breastfed. Parent report of ever breastfeeding decreased with the age of the child and all characteristics assessed had significant multivariate-adjusted associations with breastfeeding initiation except for gender and mother's mental and physical health status.

Ever breastfeeding varies drastically by race. Only about five in ten children with black mothers are breastfed while about 9 in 10 children of Spanish-speaking Hispanic are ever breastfed. Compared to children of white mothers, children of black mothers have much lower odds of having been breastfed: multivariate-adjusted OR=0.65 (95%CI: 0.52-0.79). Children of Spanish-speaking Hispanic mothers have the highest odds of being breastfed, with odds that are 3.63 times those for children of white mothers (95% CI=2.57-5.13). Meanwhile, children of white, English-speaking Hispanic, multi-racial or other racially identified mothers all have similar odds of breastfeeding. Oldest children have higher odds of ever breastfeeding than only children: multivariate-adjusted OR=1.48 (95% CI: 1.18-1.85) but that was not the case 2nd, 3rd or 4th oldest children. With regard to income, children living below the federal poverty level (FPL) have the lowest odds of ever breastfeeding or being given breast milk, they are 40% lower than the odds for children living at four times the FPL or above (95% CI: 21-54% lower). This means that children living above 400% FPL have odds of being fed breast milk that are nearly double the odds for children living below the FPL. Children living in the middle two income groups had lower unadjusted odds of ever breastfeeding than children living in the highest income group, but this association did not remain significant after controlling for confounding variables. Children of mothers with any education beyond high school have an odds of breastfeeding that are about twice the odds for children of mothers without or with only a high school diploma.

Children living in two-parent biological or adoptive families have the highest odds of ever breastfeeding or being fed breast milk. Their odds are 34% higher than the odds for children in single mother households and about double the odds for children living in two parent step families or other family types. We found that breastfeeding initiation is inversely associated with household tobacco use. Children living in households where tobacco is used inside the home have an odds of being breastfed that are only 40% of the odds that children in households where no one uses tobacco. About 4 in 10 children living in households where tobacco is used inside the home, 7 of 10 children living in a household where one or more person uses tobacco use but not inside the home, and 8 in 10 children living in households with no tobacco use are breastfed. Lastly, children living in the West have odds of breastfeeding that are double the odds for children living in any other regions of the US after controlling for confounders. This is illustrative of very

large disparities in breastfeeding initiation by race, income, maternal education, family structure, household tobacco use and region of the US.

Table 6: Summary of unadjusted and multivariate adjusted* associations between independent variables and ever breastfeeding, birth-5 years old, 2007 NSCH

	Ever Breastfed % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
CSHCN or high risk of DBS⁺ delays			
No	77.1% (17,677)	referent	referent
Yes	69.0% (3,410)	0.66 (0.57-0.77) ^S	0.82 (0.70-0.97) ^S
Age (years)			
0-24 months	79.2% (7,747)	referent	referent
2-3 years	76.0% (6,621)	0.84 (0.71-0.98) ^S	0.82 (0.68-0.99) ^S
4-5 years	71.4% (6,719)	0.66 (0.56-0.77) ^S	0.66 (0.55-0.79) ^S
Gender			
Male	75.6% (10,949)	referent	-
Female	75.4% (10,121)	0.99 (0.87-1.13)	-
Race/ethnicity			
White, non-Hispanic	76.7% (13,956)	referent	referent
Black, non-Hispanic	55.5% (1,320)	0.38 (0.32-0.45) ^S	0.65 (0.52-0.79) ^S
English speaking Hispanic	74.9% (1,571)	0.91 (0.69-1.19)	1.02 (0.72-1.41)
Spanish speaking Hispanic	87.7% (1,684)	2.17 (1.60-2.95) ^S	3.63 (2.57-5.13) ^S
Multi and other, non-Hispanic	78.0% (2,219)	1.08 (0.85-1.37)	1.10 (0.85-1.43)
Birth position relative to other children in the household			
Only child	73.3% (8,511)	referent	referent
Oldest	78.4% (2,958)	1.32 (1.09-1.61) ^S	1.48 (1.18-1.85) ^S
2 nd oldest	75.4% (6,538)	1.12 (0.96-1.30)	1.13 (0.95-1.34)
3 rd or 4 th oldest	76.3% (3,080)	1.17 (0.99-1.40)	1.18 (0.97-1.44)
Household income			
<99% FPL	65.7% (2,519)	0.39 (0.32-0.47) ^S	0.60 (0.46-0.79) ^S
100-199% FPL	72.6% (3,589)	0.53 (0.44-0.65) ^S	0.86 (0.67-1.11)
200-399% FPL	77.4% (6,919)	0.69 (0.58-0.82) ^S	0.89 (0.74-1.07)
>400% FPL	83.2% (8,060)	referent	referent
Mother's education level			
High school diploma or less	68.0% (4,423)	0.48 (0.41-0.55) ^S	0.52 (0.42-0.62) ^S
More than high school	81.6% (15,986)	referent	referent
Mother's mental and physical health			
Both very good or excellent	78.9% (13,982)	referent	referent
At least one good, fair or poor	73.5% (6,517)	0.75 (0.65-0.86) ^S	0.95 (0.82-1.12)
Family Structure			
Two parent - biological or adoptive	80.8% (17,952)	referent	referent
Single mother	60.3% (2,338)	0.36 (0.31-0.42) ^S	0.66 (0.55-0.81) ^S
2 parent step family and other	47.1% (701)	0.21 (0.16-0.28) ^S	0.48 (0.31-0.75) ^S
Household tobacco use			
None	79.7% (16,888)	referent	referent
Tobacco use, not inside home	68.4% (3,565)	0.55 (0.47-0.64) ^S	0.72 (0.60-0.86) ^S
Tobacco use inside the home	42.0% (500)	0.19 (0.14-0.24) ^S	0.40 (0.30-0.52) ^S

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Table 6, continued from previous page

		Ever Breastfed % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Region				
	Northeast	74.0% (3,617)	0.46 (0.35-0.59) ^S	0.51 (0.38-0.68) ^S
	Midwest	72.0% (4,801)	0.41 (0.32-0.52) ^S	0.50 (0.39-0.66) ^S
	South	71.2% (6,532)	0.40 (0.31-0.51) ^S	0.52 (0.40-0.69) ^S
	West	86.2% (6,137)	referent	referent

n is unweighted, all other estimates are weighted

*Developmental, behavioral or social

*Adjusted by all other factors in table except gender

^SStatistically significant odds ratio at $\alpha=0.05$ significance level

The results for the association between SHCN/DBSD status and ever breastfeeding stratified by age are shown in Table 7. The point estimates for the multivariate adjusted, age-stratified odds ratios are similar to one another and the non-stratified odds ratio (range 0.78 to 0.85). However, the age-stratified odds ratios are not statistically significant. Additionally, there is a slightly upward trend indicating a slightly bigger association among the younger age groups.

Table 7: Age-stratified unadjusted and multivariate adjusted* associations between CSHCN or high risk of DBS⁺ delays and ever breastfeeding, birth-5 years old, 2007 NSCH

		Ever breastfed % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
CSHCN or high risk of DBS ⁺ delays and age				
	0-24 months No	80.1% (6,950)	referent	referent
	0-24 months Yes	72.0% (797)	0.64 (0.47-0.87) ^S	0.78 (0.57-1.06)
	2-3 years No	77.6% (5,489)	referent	referent
	2-3 years Yes	68.7% (1,132)	0.63 (0.49-0.82) ^S	0.81 (0.61-1.07)
	4-5 years No	72.7% (5,238)	referent	referent
	4-5 years Yes	67.7% (1,481)	0.79 (0.62-1.00)	0.85 (0.66-1.11)

n is unweighted, all other estimates are weighted

*Developmental, behavioral or social

*Adjusted by race/ethnicity, birth position, household income, mother's education level, mother's mental and physical health, family structure, household tobacco use and geographic location

^SStatistically significant odds ratio at $\alpha=0.05$ significance level

Logistic regression analysis: breastfeeding duration

For children who were ever breastfed, we found that children in the SHCN/DBSD group have lower odds than non-SHCN/DBSD children of being breastfed for six months or more. This association remained significant after adjusting for multiple confounding factors: multivariate-adjusted OR=0.74 (95% CI: 0.60-0.90) for children under six years old. This means that for children age 0-5 years who were ever breastfed, children with special health care needs or high risk of delays have an odds of continuing breastfeeding for at least six months that are 26% lower than the odds for other children (95% CI: 10-40% lower); this is a large association.

There was a significant interaction between SHCN/DBSD status and age, meaning that the association between breastfeeding status and SHCN/DBSD is not consistent across age groups. Table 8 shows unadjusted and multivariate-adjusted odds ratios for the model without this interaction term and Table 9 shows the odds ratios that were obtained from the model with the interaction term. Inclusion of the interaction term had minimal impact on multivariate-adjusted ORs between breastfeeding duration and the other variables of interest (difference between odds ratio estimates less than 0.03 in all cases except birth position=4th or more for which the difference between odds ratio estimate was 0.20). Both tables are shown for comparison but because of the statistical significance of this interaction term, the results from Table 9 are discussed in more detail.

Table 8: Summary of unadjusted and multivariate adjusted* associations between independent variables and 6 months breastfeeding without interaction term, for those who were ever breastfed only, birth-5 years old, 2007 NSCH

	Breastfed >= 6 months % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
CSHCN or high risk of DBS⁺ delays			
No	61.9% (10,955)	referent	referent
Yes	53.2% (1,848)	0.70 (0.58-0.85)^s	0.74 (0.60-0.90)^s
Age (years)			
0-24 months	58.7% (4,534)	referent	referent
2-3 years	63.4% (4,118)	1.22 (1.02-1.44) ^s	1.31 (1.10-1.57) ^s
4-5 years	59.3% (4,151)	1.02 (0.86-1.22)	1.14 (0.94-1.38)
Gender			
Male	60.7% (6,525)	referent	-
Female	60.1% (6,265)	0.98 (0.85-1.13)	-
Race/ethnicity			
White, non-Hispanic	61.3% (8,643)	referent	referent
Black, non-Hispanic	53.5% (667)	0.73 (0.58-0.91) ^s	0.97 (0.75-1.24)
English speaking Hispanic	57.6% (899)	0.86 (0.64-1.14)	0.98 (0.75-1.27)
Spanish speaking Hispanic	62.6% (994)	1.06 (0.80-1.39)	1.45 (1.06-1.99) ^s
Multi and other, non-Hispanic	61.8% (1,400)	1.02 (0.78-1.34)	1.07 (0.84-1.37)
Birth position relative to other children in the household			
Only child	53.7% (4,880)	referent	referent
Oldest	57.9% (1,818)	1.19 (0.97-1.46)	1.03 (0.82-1.30)
2 nd oldest	60.3% (4,015)	1.31 (1.12-1.54) ^s	1.31 (1.11-1.55) ^s
3 rd or 4 th oldest	67.6% (2,090)	1.80 (1.46-2.23) ^s	1.68 (1.49-2.32) ^s
Household income			
<99% FPL	58.4% (1,323)	0.76 (0.60-0.95) ^s	1.11 (0.84-1.49)
100-199% FPL	55.7% (2,020)	0.68 (0.55-0.83) ^s	0.95 (0.76-1.21)
200-399% FPL	60.1% (4,256)	0.81 (0.68-0.96) ^s	0.90 (0.76-1.07)
>400% FPL	65.0% (5,204)	referent	referent
Mother's education level			
High school diploma or less	52.0% (2,199)	0.59 (0.50-0.70) ^s	0.55 (0.46-0.67) ^s
More than high school	64.8% (10,283)	Referent	referent

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Table 8, continued from previous page

	Breastfed >= 6 months % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Mother's mental and physical health			
Both very good or excellent	54.9% (3,558)	Referent	referent
At least one good, fair or poor	64.4% (8,972)	0.67 (0.58-0.79) ^s	0.75 (0.65-0.88) ^s
Family Structure			
Two parent - biological or adoptive	63.0% (11,368)	Referent	referent
Single mother	48.6% (1,075)	0.56 (0.45-0.69) ^s	0.71 (0.56-0.90) ^s
2 parent step family and other	41.7% (312)	0.42 (0.27-0.65) ^s	0.62 (0.38-1.36)
Household tobacco use			
None	64.3% (10,828)	Referent	referent
Tobacco use, not inside home	47.7% (1,703)	0.51 (0.42-0.61) ^s	0.62 (0.51-0.75) ^s
Tobacco use inside the home	38.7% (203)	0.35 (0.24-0.51) ^s	0.50 (0.32-0.77) ^s
Region			
Northeast	60.9% (2,288)	0.76 (0.60-0.96) ^s	0.72 (0.57-0.92) ^s
Midwest	58.4% (2,790)	0.68 (0.55-0.85) ^s	0.68 (0.55-0.84) ^s
South	55.8% (3,646)	0.62 (0.49-0.77) ^s	0.62 (0.49-0.77) ^s
West	67.3% (4,079)	referent	referent

n is unweighted, all other estimates are weighted

*Developmental, behavioral or social

*Adjusted by all other factors in table except gender

^sStatistically significant odds ratio at $\alpha=0.05$ significance level

For the 0-24 month and the 4-5 year age groups, children in the SHCN/DBSD group have odds of breastfeeding for at least six months that are significantly lower than children in the same age group: multivariate-adjusted ORs 0.64 (95% CI: 0.42-0.96) and 0.57 (95% CI: 0.41-0.79), respectively. This is a large difference; for these two age groups, the odds that a child with increased health needs who started breastfeeding continues for at least the recommended six months are about 40% lower than the odds for other children in the same age group. For both age groups, just over six in ten children without increased health needs and less than five in ten children with increased health needs who started breastfeeding continue for at least six months. For children who were 2-3 years old at the time of the survey, the odds that a child who started breastfeeding continued for six months or more does not differ by SHCN/DBSD status, with about 64% of children in both groups who started breastfeeding meeting this benchmark.

Many but not all of the variables significantly associated with breastfeeding initiation, or “starting,” are also associated with duration, or “stopping.” Although black children have lower odds of starting to breastfeed than white children, black children who initiate breastfeeding are not any less likely to stop prior to six months than white children. As stated earlier, children in Spanish-speaking Hispanic families are three to four times more likely to initiate breastfeeding than white children. However, of children who are ever breastfed, children in Spanish-speaking Hispanic families have odds of continuing for at least six months that are 1.44 times higher than the odds for white children (95% CI: 1.05-1.97). We found that

oldest children have the highest odds of ever breastfeeding, with 2nd, 3rd and 4th oldest children having similar odds. However, for those who were ever breastfed, 2nd, 3rd and 4th oldest children have the greatest odds of reaching the six month benchmark while oldest and only children are not significantly different from one another.

Although breastfeeding initiation varies significantly by income, for those who start breastfeeding, six-month breastfeeding does not. Meanwhile, among children who started breastfeeding, those who have a mother with a high school diploma or less education are twice as likely to stop before six months than children with mothers who have any education beyond high school. Mother's mental and physical health status do not have an effect on breastfeeding initiation after adjusting for confounders. However, children of mothers with maternal mental and/or physical health rated less than very good or excellent are less likely than children of mothers with mental and physical health that are both very good or excellent to continue for at least the recommended six months. Compared to children in other family structures who started breastfeeding, children of single mothers who started breastfeeding have odds of prematurely stopping that are 18% higher (95% CI: 9-43% higher). Of children who were ever breastfed, children living in households where tobacco is used inside the home have the lowest odds of meeting the six month benchmark, followed by children living in households where someone uses tobacco but not inside the home. Of children who were ever breastfed, children living in households where no one uses tobacco have the highest odd of breastfeeding for at least 6 months. These associations are similar to those found between household tobacco use and breastfeeding initiation. Children living in the West have the highest odds of starting to breastfeed and of those who started, children in the West have the highest odds of continuing for at least six months. However, the associations between breastfeeding status and geographic location are not as large (closer to the null) for duration as they are for initiation.

Table 9: Summary of unadjusted and multivariate adjusted* associations between independent variables and 6 months breastfeeding with interaction term, for those who were ever breastfed only, birth-5 years old, 2007 NSCH

	Breastfed >= 6 months % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Presence of SHCN or high risk of DBS⁺ delays within age groups			
0-24 months No	60.2% (4,157)	referent	referent
0-24 months Yes	46.9% (377)	0.59 (0.39-0.87) ^s	0.64 (0.43-0.96) ^s
2-3 years No	63.3% (3,466)	referent	referent
2-3 years Yes	63.9% (652)	1.03 (0.75-1.41)	1.20 (0.88-1.63)
4-5 years No	62.6% (3,332)	referent	referent
4-5 years Yes	49.3% (819)	0.58 (0.43-0.79) ^s	0.57 (0.41-0.79) ^s

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Table 9, continued from previous page

		Breastfed >= 6 months % yes (n)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Gender				
	Male	60.7% (6,525)	referent	-
	Female	60.1% (6,265)	0.98 (0.85-1.13)	-
Race/ethnicity				
	White, non-Hispanic	61.3% (8,643)	referent	referent
	Black, non-Hispanic	53.5% (667)	0.73 (0.58-0.91) ^S	0.95 (0.74-1.22)
	English speaking Hispanic	57.6% (899)	0.86 (0.64-1.14)	0.98 (0.75-1.27)
	Spanish speaking Hispanic	62.6% (994)	1.06 (0.80-1.39)	1.44 (1.05-1.97) ^S
	Multi and other, non-Hispanic	61.8% (1,400)	1.02 (0.78-1.34)	1.08 (0.84-1.38)
Birth position relative to other children in the household				
	Only child	53.7% (4,880)	referent	referent
	Oldest	57.9% (1,818)	1.19 (0.97-1.46)	1.05 (0.83-1.31)
	2 nd oldest	60.3% (4,015)	1.31 (1.12-1.54) ^S	1.32 (1.12-1.56) ^S
	3 rd or 4 th oldest	67.6% (2,090)	1.80 (1.46-2.23) ^S	1.88 (1.50-2.34) ^S
Household income				
	<99% FPL	58.4% (1,323)	0.76 (0.60-0.95) ^S	1.12 (0.84-1.49)
	100-199% FPL	55.7% (2,020)	0.68 (0.55-0.83) ^S	0.96 (0.76-1.21)
	200-399% FPL	60.1% (4,256)	0.81 (0.68-0.96) ^S	0.91 (0.76-1.08)
	>400% FPL	65.0% (5,204)	referent	referent
Mother's education level				
	High school diploma or less	52.0% (2,199)	0.59 (0.50-0.70) ^S	0.55 (0.46-0.66) ^S
	More than high school	64.8% (10,283)	Referent	referent
Mother's mental and physical health				
	Both very good or excellent	54.9% (3,558)	Referent	referent
	At least one good, fair or poor	64.4% (8,972)	0.67 (0.58-0.79) ^S	0.76 (0.65-0.88) ^S
Family Structure				
	Two parent - biological or adoptive	63.0% (11,368)	Referent	referent
	Single mother	48.6% (1,075)	0.56 (0.45-0.69) ^S	0.72 (0.57-0.91) ^S
	2 parent step family and other	41.7% (312)	0.42 (0.27-0.65) ^S	0.61 (0.28-1.37)
Household tobacco use				
	None	64.3% (10,828)	Referent	referent
	Tobacco use, not inside home	47.7% (1,703)	0.51 (0.42-0.61) ^S	0.61 (0.51-0.74) ^S
	Tobacco use inside the home	38.7% (203)	0.35 (0.24-0.51) ^S	0.50 (0.32-0.76) ^S
Region				
	Northeast	60.9% (2,288)	0.76 (0.60-0.96) ^S	0.72 (0.57-0.91) ^S
	Midwest	58.4% (2,790)	0.68 (0.55-0.85) ^S	0.68 (0.55-0.84) ^S
	South	55.8% (3,646)	0.62 (0.49-0.77) ^S	0.61 (0.49-0.77) ^S
	West	67.3% (4,079)	referent	referent

n is unweighted, all other estimates are weighted

*Developmental, behavioral or social

*Adjusted by all other factors in table except gender

^S Statistically significant odds ratio at $\alpha=0.05$ significance level

Unweighted results

The unweighted odds ratios are slightly different from the weighted odds ratios but in most cases the point estimates are within 10% of one another. The unweighted odds ratios generally have smaller confidence intervals than the weighted ORs, which is expected because the weighting scheme increases standard error. Therefore, while the point estimates are not vastly different, the statistical significance of some of the unweighted odds ratios is different from that for the weighted odds ratio.

Table 10: Unweighted unadjusted and multivariate adjusted* odds ratios for main associations of interest, 2007 NSCH

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Odds of ever breastfed for CSHCN/DBSD versus non-CSHCN/DBSD		
All ages	0.65 (0.60-0.69)	0.85 (0.78-0.92)
0-24 months ⁺	0.62 (0.54-0.72)	0.75 (0.64-0.89)
2-3 years ⁺	0.69 (0.61-0.78)	0.91 (0.79-1.05)
4-5 years ⁺	0.70 (0.63-0.78)	0.81 (0.72-0.92)
Odds of 6 months breastfed for CSHCN/DBSD versus non-CSHCN/DBSD		
All ages	0.73 (0.68-0.78)	0.80 (0.73-0.86)
0-24 months ⁺	0.60 (0.52-0.70)	0.67 (0.57-0.78)
2-3 years ⁺	0.80 (0.70-0.91)	1.03 (0.98-1.08)
4-5 years ⁺	0.70 (0.62-0.79)	0.75 (0.67-0.86)

*Adjusted by same factors as weighted analysis

⁺ Model includes the age-stratified adjusted estimates include the age X SHCN/DBSD interaction term
Reference category for each odds ratio is children in the same age group without special health care needs and at low, no or moderate risk of DBS delays

DISCUSSION

This study provides prevalence estimates for the number of children zero to five years old who have or are at risk of having health service needs that are above routine in type or amount. It provided national estimates for ever breastfeeding and six month breastfeeding among these same children using data from the 2007 National Survey of Children's Health. Three-fourths of children are estimated to have ever been breastfed or fed breast milk, and for 60.4% of the children who were ever breastfed or fed breast milk, the practice continued for at least six months. 18.9% of children age 0-5 years were estimated to have a special health care need or be at high risk of developmental, behavioral or social delays (SHCN/DBSD). Children who fall into this category had an odds of being breastfed that were significantly and meaningfully lower than the odds for other children. Additionally, for children who were ever breastfed, children in the SHCN/DBSD group are significantly more likely to stop breastfeeding before he or she is six months old than other children. Age modified the relationship between health needs and breastfeeding duration but not the relationship between health needs and breastfeeding initiation. However, this was unexpected and puzzling and should be explored to see if it persists in future years of the data.

Comparison with the literature

The prevalence of children with special health care needs for children age 0-17 years is estimated to be 17.6-19.2% using data from the National Survey of Children's Health and 18.8-19.3% using data from MEPS.^{7,50,51} The prevalence of CSHCN is generally accepted to be lower for younger children due to the fact that many conditions and problems emerge and/or are diagnosed at later ages. The prevalence of children with special health care needs or having high risk of developmental, behavioral or social delays in the 0-5 year old age group in this study was 18.9%. This is very consistent with the prevalence estimates for all children, which supports the assumption that most high risk children have a condition or problem that will be identified as a SHCN when the child is older.

The prevalence estimates of breastfeeding and six months breastfeeding for all children found in this study were 75.5% and 45.5%, and are consistent with the accepted national values from the National Health Interview Survey of 74.0% and 43.5%, respectively.⁶ Additionally, the factors found to be associated with breastfeeding in this study: race, income, mother's education, geographic location, mother's health status, tobacco use, parity, and family structure are consistent with previous research.^{1,4,9,36,49,48} The primary finding of this study, that mothers of children with special health needs are less likely to start breastfeeding and more likely to stop breastfeeding prematurely is consistent with mother-reported reasons for not breastfeeding, such as baby becoming sick or admitted to the intensive care unit.⁴

Reasons for the observed association

There are many reasons why children with special health needs may be less likely to breastfeed or continue for the recommended six months. First, the infant may have conditions or problems that decrease his or her ability to breastfeed. Additionally, a mother who spends more time caring for her child's needs, seeking or coordinating health care might have less time to devote to breastfeeding. Mothers' employment status is associated with breastfeeding practices; if a child's health needs are expensive, she may have to go back to work earlier or work more hours to pay for these expenses, thus interfering with her ability to breastfeed.⁴ Additionally, the physical separation that can result in receiving medical treatment can make breastfeeding more challenging. It is easily foreseeable that women who do not have adequate support and who face challenges in caring for their child's health needs would have difficulty finding the time or having the ability to breastfeed or pump.

Confounding, interaction and potential bias

This analysis demonstrated a significant negative association between children with special health care needs or high risk of developmental, behavior or social delays (CSHCN/DBSD) and breastfeeding initiation and duration for those who initiated. This means that not only are mothers of children in this group less likely to initiate breastfeeding but of children who do initiate, children in this group are more likely to stop prior to the recommended six months.

In the model with breastfeeding initiation, we deemed it important to adjust for child's age, race and birth position, household income, mother's education and emotional/physical health status, family structure, household tobacco use and geographic region. The only variable that was true confounder by the ten percent rule of thumb was family structure; the rest changed the OR by less than 10%. Factors that confound a relationship must be associated with both the independent and the dependent variables. Prior research and univariate associations between each potential confounder and SHCN/DBSD status (Table 2) and between each confounder and breastfeeding status (Table 4) show significant associations of varying sizes between each covariate and the independent and dependent variables.

In the multivariate model with breastfeeding duration, we adjusted by the same factors that were in the initiation model, but also found a significant interaction between SHCN/DBSD status and age. Age-stratified ORs for ever breastfeeding were similar across the age groups because no significant interaction was found in that model. However, the OR did vary by age for six month duration among children who were ever breastfed. The odds of breastfeeding for at least six months were significantly lower for the CSHCN/DBSD group than for other children for age 0-24 months and 4-5 years. However, there was no significant association between SHCN/DBSD status and six months breastfeeding for children age 2-3 years at the time of the survey. We assume that the youngest age group has the most accurate report of both breastfeeding measures due less time elapsed between when the child would have been breastfed and time of the survey. Additionally, this is the group that is most likely to have had increased health-related needs concurrently with breastfeeding. Therefore the significant negative association found for the youngest age group supports the hypothesis that mothers of children with increased health needs face more barriers to breastfeeding their child for the recommended six months. Additionally, the large negative association seen for all ages is of great public health importance. The null association seen in the 2-3 year old age group was unexpected and the reasons for it are unknown. Future years of the data should be examined to see if these age differences persist.

It is important to note that the decrease in parent report of ever breastfeeding that occurred with increased child's age had an impact on the denominator of the six month duration analysis, which was performed only on children who were reported as ever breastfed. We speculate that at the older ages,

children who were breastfed longer are more likely to be reported as ever breastfed than children who were breastfed for a shorter duration. Therefore, among the children who were categorized as ever breastfed in each group, a larger proportion did so for at least six months in the older age groups than in the younger age groups. If the decrease in parent report of breastfeeding that occurs with age is differential with regard to SHCN/DBSD status, it could introduce bias into this study. However, there is no indication that differential misclassification occurred.

Strengths and Limitations

There are limitations to this study. Because this was a cross-sectional study, directionality cannot be determined. We do not know exactly when the special health care need manifested. Therefore, CSHCN in this dataset may not have developed special healthcare needs until they were passed breastfeeding age; this is particularly true for children who were older at the time of the survey. Not breastfeeding increases the risk of some chronic conditions. The negative associations found in this study are most likely due to both increased barriers to breastfeeding for children with special health care needs or high risk of delays and increased risk of special health needs or developmental delays following an absence of breastfeeding. In addition, we cannot determine causality and therefore we do not know if decreased prevalence of breastfeeding initiation and six month duration is indeed due to the child's health needs.

We found significant demographic differences between the children included and those excluded from analysis. However, less than 1% of the survey sample was excluded from all analysis and less than 6% who were included in any analysis were excluded from the final model. Even when placing all excluded children in the category that would mostly greatly change the results towards the null (children with special health care needs or high risk of delays who were breastfed), it only had a very minor effect on the odds ratio. Therefore, we do not suspect that these differences among the missing cases decrease the validity of the study results. Additionally, we did not have data on some factors known to affect breastfeeding such as maternal age, maternal employment and type of delivery. However, we would expect that adjusting for these factors would have little or no effect on the multivariate adjusted odds ratios, as did the last few covariates we adding during our additive model building process. Children living in biological and adoptive two parents families are grouped together in the public version of the NSCH for confidentiality. Adoption status is likely associated with breastfeeding and it would have been interesting but not possible to assess this with this dataset.

The response rate of the NSCH is about 51%, which means there is room for non-response bias. However, the weighting and multiple imputation procedures employed by the National Center for Health Statistics take many considerations to account for these effects, making generalization possible. Because

the results from the weighted and unweighted analyses were similar, confidence in the weighted and therefore generalizable findings increases. Additionally, while the response rate is low, the breadth and depth of data contained in the survey adds substantially to our understanding of children's health, well-being, and access to and use of medical services and this survey data is widely accepted as valid for research and policy considerations.

While these are valid limitations to the study, they are outweighed by its strengths. The large sample size and numerous indicators allowed for good statistical power. The breadth of the data allowed us to account for a variety of covariates important to this relationship. Additionally, this study addresses a question of great public health importance and the National Survey of Children's Health is the only large-scale dataset that contains all of the independent and dependent variables needed for this analysis.

Public health implications and future research

This study provides evidence that children with increased health needs are less likely to be breastfed and after starting they are also more likely to stop prematurely. This has important public health implications. Breastfeeding benefits infant health and children who have or are at increased risk for special health care needs who were not breastfed miss out on the protective factors of breastfeeding, even though they may be most in need of them. This indicates a need for improved breastfeeding promotion, education and support systems for parents of children with special health needs and that state Title V programs could target breastfeeding as one way to improve outcomes for CSHCN.

It is important to consider the results of the study in the broader context of the child's life. We found that children with special health care needs or high risk of delays have lower odds of optimal breastfeeding practices. We also found that the following groups of children have lower (even if not statistically significantly lower) performance on at least one measure of breastfeeding: those living in poverty, those with mothers with lower educational attainment, those living in households with tobacco use, those with single mothers and those who are Black. Children with special health care needs or high risk of delays are more likely to fall into each of these categories than children generally. Furthermore, many of these factors go hand-in-hand. For example, it is generally accepted that those with low educational attainment are more likely to live in poverty and are more likely to use tobacco. It is also generally accepted that the black race and single mother families are over represented in the lower income categories. Successful interventions should simultaneously address multiple risk factors for not breastfeeding and decrease health vulnerabilities across multiple domains of the child's life. There is a need to improve cultural attitudes and societal infrastructures that support the entire range of positive health behaviors, including optimal breastfeeding.

Interventions have been designed to increase breastfeeding among mothers who are less likely to start and more likely to stop breastfeeding prematurely. Interventions that do so among women with the lowest rates include supportive and encouraging hospital environments, accommodating workplaces, peer support groups or partnerships and breastfeeding education.^{52,53} Breastfeeding accommodations in other public places such as shopping centers and airports also undoubtedly increase the ease of breastfeeding. These same interventions could be targeted towards mothers of children with special health care needs or high risk of delays. Mothers of these children may also benefit from support and education for pumping, if one of the main barriers is physical separation from the child. Families of infants with chronic health conditions might undergo psychological distress after learning about the child's condition or conditions. They are also likely to face a steep learning curve with regard to caring for a new baby and simultaneously addressing their health needs. Families of children with increased health needs who need breastfeeding support would also benefit from increased support and education with regard to care for the child overall. Breastfeeding interventions done in conjunction with general family support would increase their benefit.

For some groups of women, an intervention that increases breastfeeding initiation may be all that's needed. For example, this research indicates that breastfeeding initiation is less common among black children and children living in low-income families than other children. However, once breastfeeding is initiated for these children they do not have increased odds of stopping prematurely. This indicates that interventions aimed at increasing breastfeeding among black or low-income mothers can have positive outcomes for both initiation and duration even if they only focus on increasing initiation. However, this does not appear to be the case for mothers of children with special health care needs or high risk of delays. For these children, odds of starting breastfeeding and odds of continuing once they have started are both substantially lower than for children generally. This indicates that mothers and families of children with special health care needs or high risk of delays are in need of increased support to start and to continue breastfeeding.

Future research could consist of a cohort study where children are followed from birth to assess how health needs that develop during infancy affect breastfeeding practices. Assessing the relationship in this manner that would better assess temporality and the Children's Study may be one opportunity for this. Further studies could also ascertain the reasons mothers or parents of children with above routine health needs specify for not starting or for stopping to breastfeed. This analysis presents strong evidence that mothers of children with special health care needs or high risk of developmental, behavioral or social delays do face more barriers with regard to initiating and continuing to breastfeed. However, breastfeeding practices are below targets for essentially all demographic groups. Therefore, it would be beneficial to investigate and implement interventions that support breastfeeding for mothers of children with increased

health needs as well as mothers generally. Recently, there has been a large public health emphasis on promoting and supporting breastfeeding. Such efforts should continue as we work to create cultures, infrastructures and environments that adequately encourage and support breastfeeding for all mothers in the United States.

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Appendix A: CSHCN Screener as it appeared in the 2007 NSCH

Presence of a special health care need

QUESTIONS K2Q10-K2Q23 ARE THE CHILDREN WITH SPECIAL HEALTH CARE NEEDS SCREENER. SEE BETHELL ET AL. (2002, *AMBULATORY PEDIATRICS*, VOLUME 2) FOR FURTHER INFORMATION.

K2Q10_INTRO The next questions are about any kind of health problems, concerns, or conditions that may affect [S.C.]’s behavior, learning, growth, or physical development.

K2Q10 Does [S.C.] currently need or use medicine prescribed by a doctor, other than vitamins?

- (1) YES [SKIP TO K2Q11]
- (0) NO [SKIP TO K2Q13]
- (6) DON’T KNOW [SKIP TO K2Q13]
- (7) REFUSED [SKIP TO K2Q13]

HELP SCREEN (K2Q10): This only applies to medications prescribed by a doctor. Over-the-counter medications such as cold or headache medication, or other vitamins, minerals, or supplements purchased without a prescription are not included.

K2Q11 Is [his/her] need for prescription medicine because of ANY medical, behavioral, or other health condition?

- (1) YES [SKIP TO K2Q12]
- (0) NO [SKIP TO K2Q12A]
- (6) DON’T KNOW [SKIP TO K2Q12A]
- (7) REFUSED [SKIP TO K2Q12A]

K2Q12 Is this a condition that has lasted or is expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q13] (0) NO [SKIP TO K2Q13] (6) DON’T KNOW [SKIP TO K2Q13] (7) REFUSED [SKIP TO K2Q13]

K2Q12A. Has [S.C.]’s need for prescription medication lasted or is it expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q13]
- (0) NO [SKIP TO K2Q13]
- (6) DON’T KNOW [SKIP TO K2Q13]

(7) REFUSED [SKIP TO K2Q13]

K2Q13 Does [S.C.] need or use more medical care, mental health, or educational services than is usual for most children of the same age?

- (1) YES [SKIP TO K2Q14]
- (0) NO [SKIP TO K2Q16]
- (6) DON’T KNOW [SKIP TO K2Q16]
- (7) REFUSED [SKIP TO K2Q16]

HELP SCREEN (K2Q13): The child requires more medical care, the use of more mental health services, or the use of more educational services than most children the same age.

K2Q14 Is [his/her] need for medical care, mental health or educational services because of ANY medical, behavioral, or other health condition?

- (1) YES [SKIP TO K2Q15]
- (0) NO [SKIP TO K2Q15A]
- (6) DON’T KNOW [SKIP TO K2Q15A]
- (7) REFUSED [SKIP TO K2Q15A]

K2Q15 Is this a condition that has lasted or is expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q16] (0) NO [SKIP TO K2Q16] (6) DON’T KNOW [SKIP TO K2Q16] (7) REFUSED [SKIP TO K2Q16]

K2Q15A. Has [S.C.]’s need for medical care, mental health, or educational services lasted or is it expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q16]
- (0) NO [SKIP TO K2Q16]
- (7) DON’T KNOW [SKIP TO K2Q16]
- (9) REFUSED [SKIP TO K2Q16]

K2Q16 Is [S.C.] limited or prevented in any way in [his/her] ability to do the things most children of the same age can do?

- (1) YES [SKIP TO K2Q17]
- (0) NO [SKIP TO K2Q19]
- (6) DON'T KNOW [SKIP TO K2Q19]
- (7) REFUSED [SKIP TO K2Q19]

HELP SCREEN (K2Q16): A child is limited or prevented when there are things the child can't do as much or can't do at all that most children the same age can.

K2Q17 Is [his/her] limitation in abilities because of ANY medical, behavioral, or other health condition?

- (1) YES [SKIP TO K2Q18]
- (0) NO [SKIP TO K2Q18A]
- (6) DON'T KNOW [SKIP TO K2Q18A]
- (7) REFUSED [SKIP TO K2Q18A]

K2Q18 Is this a condition that has lasted or is expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q19] (0) NO [SKIP TO K2Q19] (6) DON'T KNOW [SKIP TO K2Q19] (7) REFUSED [SKIP TO K2Q19]

K2Q18A Has (S.C.)'s limitation in abilities lasted or is it expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q19]
- (0) NO [SKIP TO K2Q19]
- (6) DON'T KNOW [SKIP TO K2Q19]
- (7) REFUSED [SKIP TO K2Q19]

K2Q19 Does [S.C.] need or get special therapy, such as physical, occupational, or speech therapy?

- (1) YES [SKIP TO K2Q20]
- (0) NO [SKIP TO K2Q22]
- (6) DON'T KNOW [SKIP TO K2Q22]
- (7) REFUSED [SKIP TO K2Q22]

HELP SCREEN (K2Q19): Special therapy includes physical, occupational, or speech therapy. Do not include psychological therapy.

K2Q20 Is [his/her] need for special therapy because of ANY medical, behavioral, or other health condition?

- (1) YES [SKIP TO K2Q21]
- (0) NO [SKIP TO K2Q21A]
- (6) DON'T KNOW [SKIP TO K2Q21A]
- (7) REFUSED [SKIP TO K2Q21A]

K2Q21 Is this a condition that has lasted or is expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q22] (0) NO [SKIP TO K2Q22] (6) DON'T KNOW [SKIP TO K2Q22] (7) REFUSED [SKIP TO K2Q22]

K2Q21A Has [S.C.]'s need for special therapy lasted or is it expected to last 12 months or longer?

- (1) YES [SKIP TO K2Q22]
- (0) NO [SKIP TO K2Q22]
- (6) DON'T KNOW [SKIP TO K2Q22]
- (7) REFUSED [SKIP TO K2Q22]

K2Q22 Does [S.C.] have any kind of emotional, developmental, or behavioral problem for which [he/she] needs treatment or counseling?

- (1) YES [SKIP TO K2Q23]
- (0) NO [SKIP TO CATI INSTRUCTION BELOW]
- (6) DON'T KNOW [SKIP TO CATI INSTRUCTION BELOW]
- (7) REFUSED [SKIP TO CATI INSTRUCTION BELOW]

HELP SCREEN (K2Q22): These are remedies, therapy, or guidance a child may receive for his/her emotional, developmental, or behavioral problem.

K2Q23 Has [his/her] emotional, developmental or behavioral problem lasted or is it expected to last 12 months or longer?

- (1) YES [SKIP TO CATI INSTRUCTION BELOW]
- (0) NO [SKIP TO CATI INSTRUCTION BELOW]

-
- (6) DON'T KNOW [SKIP TO CATI INSTRUCTION BELOW]
 - (7) REFUSED [SKIP TO CATI INSTRUCTION BELOW]

CATI INSTRUCTION (SECTION 2, SUBDOMAIN 2): CREATE CATI SYSTEM FLAG (CSHCN) INDICATING WHETHER THE CHILD HAS A SPECIAL HEALTH CARE NEED. THIS FLAG SHOULD BE POSITIVE (CSHCN = 1) IF K2Q12 = 1, K2Q15 = 1, K2Q18 = 1, K2Q21 = 1, OR K2Q23 = 1.

[TIMESTAMP_SECTION_23]

Appendix B: Questions adapted from PEDS as they appeared in the 2007 NSCH

Developmental screening

QUESTIONS K6Q01-K6Q09 ARE FROM THE PARENT'S EVALUATION OF DEVELOPMENTAL STATUS (PEDS) CHILD DEVELOPMENT SCREENING TEST. THE PEDS IS PROTECTED BY U.S. AND INTERNATIONAL COPYRIGHT LAW. ALL RIGHTS ARE RESERVED BY FRANCES PAGE GLASCOE. PERMISSION TO USE THESE ITEMS IN THE NSCH HAS BEEN GRANTED BY DR. GLASCOE. PERMISSION MUST BE REQUESTED FROM THE PUBLISHER (FOREPATH.ORG, PO BOX 23186, WASHINGTON, DC, 20026, WWW.FOREPATH.ORG, SUPPORT@FOREPATH.ORG) BEFORE USING THESE ITEMS FOR OTHER PURPOSES.

K6Q01 Do you have any concerns about [S.C.]'s learning, development, or behavior?

- (1) YES
- (0) NO
- (6) DON'T KNOW
- (7) REFUSED

K6Q02_INTRO CATI INSTRUCTION (K6Q02_INTRO): IF AGE_NSCH < 4 MONTHS, SKIP TO K6Q10.

[IF K6Q01 = 0, READ: Although you told me you have no concerns, I need to ask a few specific questions about concerns that some parents may have. Please tell me if you are currently concerned a lot, a little, or not at all about the following.]

[ELSE, READ: The next section asks about specific concerns some parents may have. Please tell me if you are currently concerned a lot, a little, or not at all about the following.]

QUESTION STEM: [Are you concerned a lot, a little, or not at all about...]

- (1) A LOT
- (2) A LITTLE
- (3) NOT AT ALL
- (6) DON'T KNOW
- (7) REFUSED

[CATI: DISPLAY QUESTION STEM FOR EACH OF THE FOLLOWING SCREENS.]

K6Q02 How [S.C.] talks and makes speech sounds?

K6Q03 How [he/she] understands what you say?

K6Q04 How [he/she] uses [his/her] hands and fingers to do things?

K6Q05 How [he/she] uses [his/her] arms and legs?

K6Q06 How [he/she] behaves?

K6Q07 How [he/she] gets along with others?

K6Q08 CATI INSTRUCTION (K6Q08): IF AGE_NSCH < 10 MONTHS, SKIP TO K6Q10.

How [he/she] is learning to do things for (himself/herself)?

K6Q09 CATI INSTRUCTION (K6Q09): IF AGE_NSCH < 18 MONTHS, SKIP TO K6Q10.

How [he/she] is learning pre-school or school skills?

Appendix C: Multivariate Logistic Regression Model Building

Models with 3 variables for ever breastfeeding			
Model containing	risk_CSHCN OR (95% CI)	p-value of new variable	% change from unadjusted OR
risk_CSHCN	0.66 (0.57-0.77)	NA	NA
risk_CSHCN, age_groups	0.70 (0.60-0.82)	<0.001	6.1%
risk_CSHCN, SEX	0.66 (0.57-0.77)	0.626	0.0%
risk_CSHCN, race_lang	0.69 (0.58-0.80)	<0.001	4.5%
risk_CSHCN, agepos_groups	0.66 (0.56-0.77)	0.023	0.0%
risk_CSHCN, povlev4_07	0.70 (0.60-0.82)	<0.001	6.1%
risk_CSHCN, mom_educ	0.70 (0.59-0.82)	<0.001	6.1%
risk_CSHCN, ind6_3_07	0.70 (0.60-0.83)	<0.001	6.1%
risk_CSHCN, famstruc	0.75 (0.64-0.88)	<0.001	13.6%
risk_CSHCN, ind6_4a_07	0.68 (0.58-0.79)	<0.001	3.0%
risk_CSHCN, geo_region	0.68 (0.59-0.79)	<0.001	3.0%

Additive process for ever breastfeeding			
Model containing	CSHCN OR (95%CI)	p-value of new variable	Cox and Snell R-squared
risk_CSHCN, famstruc, age_groups	0.77 (0.66-0.91)	0.034	0.054
risk_CSHCN, famstruc, age_groups, povlev4_07	0.80 (0.68-0.94)	<0.001	0.062
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ	0.79 (0.67-0.94)	<0.001 (povlev=0.115)	0.054
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07	0.80 (0.67-0.95)	0.699	0.054
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07, race_lang	0.81 (0.68-0.96)	<0.001	0.093
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07, race_lang, ind6_4a_07	0.80 (0.68-0.95)	<0.001	0.102
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07, race_lang, ind6_4a_07, geo_region	0.82 (0.69-0.96)	<0.001	0.111
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07, race_lang, ind6_4a_07, geo_region, agepos_groups	0.82 (0.70-0.97)	0.008	0.113
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, ind6_3_07, race_lang, ind6_4a_07, geo_region, agepos_groups, SEX	0.82 (0.70-0.97)	0.714	0.113
risk_CSHCN, famstruc, age_groups, povlev4_07, mom_educ, race_lang, ind6_4a_07, geo_region, agepos_groups	0.81 (0.69-0.95)	NA	0.112