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THE ASSOCIATION OF BREASTFEEDING AND ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER IN PRESCHOOL-AGED CHILDREN

BY
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Degree to be awarded: M.P.H.
Career MPH

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THE ASSOCIATION OF BREASTFEEDING AND ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER IN PRESCHOOL-AGED CHILDREN

BY
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M.P.H., Emory University, 2012
B.A., University of Notre Dame, 2005

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Abstract

THE ASSOCIATION OF BREASTFEEDING AND ATTENTION-DEFICIT/ HYPERACTIVITY DISORDER IN PRESCHOOL-AGED CHILDREN

BY
Alissa Shaul

Background: Attention-deficit/hyperactivity disorder (ADHD) is the most frequently observed neurobehavioral disorder in children and has consequences for the academic achievement, social interactions and the well-being of children. Peak onset occurs at 3-4 years old. Due to the significant implications of ADHD, studies are needed to assess the exposures experienced in childhood that may affect this disorder. Previous studies have found a positive association between breastfeeding and neuropsychological development. Therefore, the objective of this study was to evaluate the relationship between breastfeeding and ADHD in preschool-aged children in the U.S. using data from the National Survey of Children's Health (NSCH).

Methods: We conducted a cross-sectional study using data from the 2007 NSCH for children 2 to 5 years old. In the primary analysis, breastfeeding was the independent variable and defined as whether or not a child ever breastfed. ADHD was the dependent variable and defined as whether or not a child had ADHD or ADD. In secondary analysis, exclusivity of breastfeeding and taking medication for ADHD or ADD were evaluated as independent and dependent variables, respectively. Child sex, race, poverty level, family structure, mental health of parents, education of parents, smoking status of parents and birth weight were examined as potential effect modifiers.

Results: The attempt to assess for effect modification was limited by sparse data, and despite some suggestion of effect modification, the data could not adequately be stratified. The results of the primary analysis showed that children who did not breastfeed had 2.00 (0.58-6.90) the odds of having ADHD as those who breastfed controlling for poverty level, mental health of the mother, and education of the mother. However, the results of this model as well as those in the secondary analyses indicated that the relationship between breastfeeding and ADHD was not significant.

Conclusions: The overall results of this analysis found that breastfeeding was not significantly associated with children aged 2 to 5 years who had ADHD as measured in data from the NSCH in 2007. However, due to a small sample size as well as differing results of other studies, further evaluation is warranted.

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Chapter I: Introduction

Attention-deficit/hyperactivity disorder (ADHD) is the most frequently observed neurobehavioral disorder in children and has considerable consequences for the academic achievement, social interactions and the well-being of children.[1,2] This disorder is diagnosed through an evaluation of a child who presents with behavioral or academic difficulties or symptoms of hyperactivity, impulsivity or inattention, as defined by the American Psychiatric Association's Diagnostic and Statistical Manual-IV, Text Revision (DSM-IV-TR) criteria.[1] Estimates from the National Institute of Health reveal that 3% to 5% of children in the U.S. have diagnostically significant ADHD symptoms, and other studies have estimated as many as 8% of children have ADHD, specifically 2% to 6% of preschool-aged children.[1-6] Further, the prevalence of ADHD has increased overtime by more than 25% from 1997-1999 to 2006-2008 in children aged 3 to 10, necessitating more understanding about this condition.[4] ADHD is also associated with risky behavior, poor relationships, and lower level of education.[7,8]

Due to the significant implications of ADHD, studies are needed to assess the exposures experienced in infancy or childhood that may affect this disorder. Previous studies have found a positive association between breastfeeding and cognitive outcomes and neuropsychological development.[9-16] Therefore, the objective of this study was to evaluate the relationship between breastfeeding and ADHD in preschool-aged children in the U.S. using data from the National Survey of Children's Health (NSCH).

Chapter II: Review of the Literature

Background of ADHD

ADHD is the most common neurobehavioral disorder in children and is characterized by inattention and impulsivity.[1,3,5] The prevalence of ADHD in school-aged children is 5% to 10%, while in preschool aged children it is 2% to 6%.[3,5,6] While ADHD can continue into adulthood, the prevalence of the disorder seems to decrease with age (5-10% in children, 2.5-4% in adolescents, 2.5% in adults).[5] From 2003 to 2007, diagnosed ADHD increased in children aged 4 to 17 by more than 20%.[5,17] This increase may be in part due to the increased awareness and destigmatization of this disorder in children.[4] Patients with ADHD frequently have comorbidities including defiant disorder (32%), anxiety (22%) or conduct disorder (7-70%).[5,6,18] Those with comorbidities are more likely to have a higher level of impairment, experience more peer rejection, and have poor outcomes.[18] Geographically, the west and Midwestern regions of the U.S. are slightly more likely to use stimulant medications for ADHD than the Northeast.[19]

Symptoms associated with ADHD occur as early as 3 years, and the peak onset of ADHD is at 3 to 4 years of age, which is preschool age.[6,20] The most common and well-known symptoms are age-inappropriate inattention, hyperactivity and impulsivity.[3,18] Attention and executive functions are impaired in ADHD. Attention has been described as the "facilitated processing of one piece of information over others", which includes alertness and vigilance.[5] Executive functions are defined as a set of abilities that include memory, response inhibition and error correction that allow children to take the necessary steps to achieve a goal.[5] In other words, there is a lack of control, motivation or forethought due to a cognitive dysfunction.[18] Those with elevated levels of ADHD are at risk of developing problems in social, academic and personal functioning, which oftentimes continue into adulthood.[18] Notably, up to 60% of children

diagnosed with ADHD continue experiencing symptoms from preschool to grade school and even beyond.[6] Specifically, one study found that 75-85% of preschool-aged children with diagnosed ADHD met the criteria for ADHD three years later.[6]

In recent years, the increasing number of preschool-aged children with clinical ADHD symptoms has sparked more research in the validity of ADHD in this age group.[18] Results have indicated that preschool-aged children present with a similar symptom structure, experience the same type of impairment, comorbidities, developmental issues, and deficits than older children and adolescents.[18,20,21] Therefore, preschool-aged children are important to study as ADHD is increasingly being diagnosed and treated in this age group.[20]

Diagnosis

Currently in the U.S., the diagnosis of ADHD is performed using the DSM-IV edition and suggests that any child between the ages of 4 and 18 with academic or behavioral problems and symptoms related to ADHD should be assessed for ADHD.[1] Even though there may be additional challenges associated with diagnosing preschoolers, these guidelines may also be used for that age group.[1] The guidelines use 18 behavioral items to differentiate among three subtypes (Figure 1).[5] ADHD-PI is characterized predominantly by inattentive symptoms, ADHD-PH by hyperactive-impulsive symptoms, and finally, ADHD-C by a combination.[5] ADHD is generally more common, some estimates have reported as much as by three times, in boys than girls, but ADHD-PI is more common in girls.[6,22] Notably, ADHD-PI is very rare in preschool-aged children, who are most commonly diagnosed with ADHD-C (57%).[6] In this age group specifically, there may be concerns about the availability of observations of a child's behavior by someone other than a parent, in which case a physician may recommend a parent-training program and placement in a qualified preschool program if needed.[1]

Management of ADHD is dependent upon age. In all age groups, behavior therapy is recommended. Specifically, for preschool-aged children, evidence-based parent or teacher administered behavior therapy or drug therapy, such as methylphenidate, is recommended.[1] However, if these treatments are unavailable, the risks and benefits of starting medication at a young age compared with a delay in treatment should be weighed.[1] For elementary-aged children (6-11 years), similar behavioral therapy is recommended along with stimulant medications or atomoxetine or clonidine.[1] Finally, for adolescent (12-18 years), either behavioral therapy or FDA-approved medications are recommended.[1]

Social and Economic Burden

ADHD has been associated with significant social burden. Children with ADHD have low self-esteem and limited friendships resulting from relationship and communication problems at home and at school.[7,8] ADHD has also been associated with a lower level of education as a quarter of those with ADHD do not finish high school (versus 1% of controls) and were less likely to complete college, with only 15% receiving a Bachelor's degree (versus 50% of controls).[7,8] Almost half suffer substance abuse.[7] Further, ADHD has been associated with risky behavior such as speeding, driving under the influence and license loss.[6-8]

ADHD has also been associated with significant economic burden. Some studies have estimated the annual health care cost for children with ADHD to be between $775 and $1,330 more per child than for those without ADHD.[23,24] In the UK, a model projected the annual ADHD pharmacotherapy cost for children with ADHD to exceed €310 million in 2012 due primarily to an increase in physician prescriptions of up to 10-fold from previous years.[25] Prescription increases are expected in the coming years due to the rise in diagnosed cases, the acceptance of pharmacotherapy and the higher costs of new medications.[25]

Risk Factors

The exact cause of ADHD is unknown, but studies have determined that the disease is associated with certain risk factors including genetics, the environment, and more specifically, prenatal exposures. ADHD has heritability between 60% and 80%, and environmental risk factors account for up to a third of phenotypic variability in symptoms.[3,5,6,26,27]

Studies have found that the development of ADHD is likely genetically linked. These findings are based on evaluations of families, twins and adopted siblings.[5] Specifically, parents with ADHD tend to influence symptoms of inattentiveness and hyperactive impulsivity in children.[3] Further, if a parent has ADHD, then the risk of the disorder in his or her children is increased two to eight times.[5] Types of family relationships also have an impact on a child developing ADHD. Specifically, relationships with characteristics such as maltreatment, arguments, difficult communication, parental separation, or lack of warmth are also possible risk factors.[3]

Certain prenatal events have been investigated and classified as risk factors associated with the development of ADHD. For example, a mother's bleeding during pregnancy has been related to inattentive symptoms.[3] Further, smoking during pregnancy may be associated with the combined or inattentive symptoms of ADHD.[3] Iodine deficiency and hypothyroxinemia of the mother during pregnancy as well as prenatal exposures, such as metals (e.g., lead, manganese, and phthalates) and chemicals may also be risk factors.[3,6,26,27] Additionally, nutritional factors and lifestyle or psychosocial factors of the mother, including psychosocial adversity, are under investigation.[6,26,27]

Breastfeeding

In recent years, breastfeeding has been studied as an important predicting factor for many childhood outcomes, including cognition. Not only does breastfeeding provide essential

nutrients to infants, it also benefits children in the long term by lowering the incidence of otitis media, gastroenteritis, diabetes, sudden infant death syndrome, the risk of obesity and asthma, and has been associated with improved cognitive development.[28] This is because breastfeeding provides an important source of fatty acids, such as docosahexaenoic acid and arachidonic acid, and bioactive components that are vital for the development of the infant brain, which are lacking in infant formula.[14] Because of the known benefits of breastfeeding, the American Academy of Pediatrics has recommended breastfeeding as the preferred choice of feeding for infants.[28] Specifically, one of the goals of Healthy People 2010 is to achieve a breastfeeding initiation rate of all infants of 75%, a continuation rate of 50% at six months, and a 25% rate at 12 months.[28] Recently, the National Immunization Survey of U.S. children has estimated these rates to be 73%, 39% and 20%, respectively.[28] Breastfeeding initiation and continuation rates have been reportedly higher in the western part of the US as compared to the southeastern part, specifically, in Alabama, Kentucky, Mississippi, and Tennessee.[29-31]

As mentioned, breastfeeding has been associated with positive cognitive development and neuropsychological development in many studies in young children. For example, a population-based cohort study evaluating perinatal data and cognitive outcomes in 1,503 children who were born before 33 weeks gestation found that a lack of breastfeeding was significantly associated with mild and severe cognitive deficiencies after controlling for cerebral lesions and other medical and social factors when the child was 5 years old.[11] Another study found that a short period of breastfeeding was independently associated with poorer cognition in a birth cohort assessment of 418 children in Spain.[10] An Australian cohort study following 2,280 breastfed children until 3 years of age found that those breastfed for at least 4 months had significantly

better functioning and communication skills at 1 and 3 years of age than those not breastfeeding for at least that duration.[15]

Additionally, after a seven-year follow up of almost 500 term infants, one study found that children who were exclusively breastfed for 3 months, 6 months or longer had intelligence quotients (IQs) that were 2.1 (95% confidence interval [CI] 0.24-3.9), 2.6 (0.87-4.27), and 3.8 (2.11-5.45) points, respectively, higher than those not exclusively breastfed.[14] This study not only found that duration of breastfeeding improved IQ scores, but also that the IQ gain observed at the age of 1 continued through preschool age.[14] Slightly different results of the association between breastfeeding and IQ were found in a study of almost 14,000 infants to age 6.[9] This study reported a 7.5 (0.8-14.3) point advantage on verbal IQ scoring for breastfeeding infants, and for full-scale IQ and performance IQ these advantages were not significantly different.[9] Finally, the long-term effect of breastfeeding on neuropsychological development was evaluated in 10 to 12 year olds. This study found that breastfed children performed better on neuropsychological tests specifically in the language domain compared with those who did not breastfeed.[16] Even with the large amount of evidence suggesting an association between a lack of breastfeeding and cognitive impairment, there is no definitive conclusion.

Recently, few studies have assessed the relationship of breastfeeding and mental health outcomes, including the development of ADHD.[32-35] For example, a population-based birth cohort study of almost 400 children measured attention control and response inhibition in Spanish 11 year-olds.[32] This study found significant decreases in commission errors in children with a longer duration of breastfeeding at age 4.[32] Further, another Spanish study assessed the neuropsychological functioning of 4 year olds and found that long-term breastfeeding (> 20 weeks) was significantly related to an increase in executive function scores and a decrease in

attention-deficit hyperactivity symptom scores.[34] Additionally, a retrospective study comparing children with and without ADHD and environmental factors, such as breastfeeding, found that significantly fewer children with ADHD were breastfed for at least 3 months than those without ADHD (60% vs. 32.5%, respectively; $p<0.05$).[35]

As discussed, ADHD is associated with considerable consequences related to the academic, social and psychological advancement in children. In the past few years, there has been a noticeable increase in the prevalence of ADHD in children, and associated risk factors are being evaluated. Breastfeeding has been assessed as a risk factor for cognitive outcomes in many studies, but as a risk factor for the development of ADHD in children in only a few European studies. Thus, the present study serves to determine the potential for a relationship between breastfeeding and ADHD by evaluating data from the National Survey of Children's Health (NSCH).

Chapter III. Methodology

We conducted a cross-sectional analysis to assess the relationship between breastfeeding and ADHD in nationally-representative population based sample of preschool-aged children. This evaluation was performed using data from the NSCH for 2007. The NSCH, a part of the State and Local Area Integrated Telephone Survey (SLAITS), was conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention and sponsored by the Maternal and Child Health Bureau of the Health Resource and Services Administration and the Department of Health and Human Services.[36] The NSCH was a telephone survey that collected information through a random-digit-dialed sample of households with approximately 91,000 children in the U.S. in 2003, 2007 and 2011.[37] One child less than 18 years of age was chosen from each household, and responses were gathered from a parent or guardian who was knowledgeable about the health of the child.[38] The results from the 2007 survey were collected from April 2007 to July 2008.[36]

The aim of the survey was to investigate the physical and emotional well-being of children ages 0 to 17 years, and the data have been used to estimate national and state-level prevalence of child health indicators.[37] Data about the parents and families were also collected. More specifically, the survey contained 11 sections of questions including those requesting information about demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood, middle childhood and adolescence (6-17 years), family functioning, parental health, neighborhood and community characteristics, and additional demographics. From the responses to the questions, certain variables were derived and included in the dataset. For example, age of a child was derived from date of birth, and poverty level was derived from total household members and income value.[38]

The NSCH dataset was suitable for this study because it contained the exposures and outcomes of interest as well as potential confounders in the age group of interest, which is preschool-aged children. The methods of this analysis began with importing the publically available data and cleaning the data using code provided by NSCH. All analyses were conducted using SAS version 9.3 and statistical significance was based an alpha of 0.05. The exposures for this analysis were based on Indicator 1.3: Children less than 6 years old who were never breastfed or fed breast milk or were breastfed or fed breast milk during infancy. This indicator also focused on the exclusivity of breastfeeding. Specifically, the questions associated with this indicator were:

- "K6Q40": "Was [child] ever breastfed or fed breast milk?" The possible answers were "Yes", "No", "Don't know", "Refused";
- "K6Q41": "How old was [he/she] when [he/she] completely stopped breastfeeding or being fed breast milk?" The possible answers were an age, "Still breastfeeding", "Don't know", and "Refused";
- "K6Q42": "How old was [child] when [he/she] was first fed formula?" These answers were the child's age, "At birth", "Child has never been fed formula", "Don't know", "Refused";
- "K6Q43": "This next question is about the first thing that [child] was given other than breast milk or formula. Please include juice, cow's milk, sugar water, baby food, or anything else that [child] might have been given, even water. How old was [child] when [he/she] was first fed anything other than breast milk or formula?" Possible responses included the child's age, "At birth", "Child has never been fed anything other than breast milk or formula", "Don't know", and "Refused".

Based on these questions, the primary exposure in the analysis was whether or not the child was every breastfed or fed breast milk. The responses evaluated were "Yes" or "No". The secondary exposure in this analysis was whether or not the child was exclusively breastfed for 6 months, and the evaluated responses included "Never breastfed or given breast milk", "Exclusively breastfed for the first 6 months", "Breastfed, NOT exclusively for the first 6 months", and "Breastfed, exclusivity not known". To simplify the analysis, this variable was consolidated to "Yes" and "No" responses, classifying "Exclusively breastfed for the first 6 months" as the "Yes" response and all others as "No".

The outcomes for this analysis were based on Indicator 2.7. Indicator 2.7 was "Parent-reported prevalence and use of medication for ADD or ADHD among children age 2-17 years." The questions associated with these indicators were:

- "K2Q31A": "Has a doctor or other health care provider ever told you that [child] had ADD or ADHD?" Possible responses were "Yes", "No", "Don't know", or "Refused";
- "K2Q31B": "Does [child] currently have ADD or ADHD?" Possible responses were "Yes", "No", "Don't know", or "Refused";
- "K2Q31D": "Is [child] currently taking medication for ADD or ADHD?" Possible responses were "Yes", "No", "Don't know", or "Refused".

For the primary outcome in this study, the responses to the questions were consolidated into one variable. It indicates whether or not a child has ADD or ADHD based on a "Yes" response to "K2Q31A", "K2Q31B", or "K2Q31D". The secondary outcome in this study was defined as a "Yes" response to children taking medication for ADD or ADHD only.

Possible confounders or effect modifiers in the data base were considered and included in the evaluation. These variables included:

- Child sex: male or female
    - *Justification for inclusion*: This covariate was included in the analyses of other studies assessing the relationship between breastfeeding and ADHD.[32-34]
- Child's race: white, black, Hispanic, multiracial, or other
    - *Justification for inclusion*: Race was not tested in other studies; however, these studies were non-US based. Thus, race was included since it may be an important factor in a US-based analysis.
- Family poverty level: <100% of federal poverty level (FPL), 100-199% of FPL, 200-399% of FPL and 400% or more of FPL
    - *Justification for inclusion:* Socioeconomic status has been shown to be significantly related to breastfeeding and ADHD in other studies.[32,34]
- Family structure: two parent (biological or adopted), two parent (step family), single mother, other
    - *Justification for inclusion:* While family status was not explicitly modeled in other similar analyses,[32-34] marital status was included in one analysis.[34]
- Mental status of the mother or father: excellent/very good, good, fair/poor
    - *Justification for inclusion*: This covariate was included in the analyses of other studies assessing the relationship between breastfeeding and ADHD.[32,34]
- Education of the mother or father: less than high school; high school graduate; more than high school

    - *Justification for inclusion:* Education has been shown to be significantly related to breastfeeding and ADHD in other studies.[32-34]
- Smoking status of parent or guardian: yes or no
    - *Justification for inclusion:* Smoking has been shown to be significantly related to breastfeeding and ADHD in other studies.[32-34]
- Weight at birth: these data were converted from ounces into grams using the conversion of one ounce to 28.3495 grams, and divided into the widely used categories based on birth weight of <1,500 grams, 1,500-2,500 grams, 2,500-4,000 grams, and >4,000 grams[39]
    - *Justification for inclusion:* Gestational weight has been shown to be significantly related to breastfeeding and ADHD in one study.[34]

We excluded records with missing values or responses coded as "don't know" or "refused to answer". Because this analysis focused on preschool-aged children, we limited our analysis to children who were less than six years old. Additionally, ages two to five years overlapped between the exposure and outcome variables. Thus, the analysis focused on children aged two to five.

The statistical evaluation used logistic regression to yield odds ratios (ORs) to assess the relationship between breastfeeding and ADHD. This regression was performed in SAS using PROC SURVEYLOGISTIC to account for the cross-sectional nature of this study and provide national estimates from the weighted sample. Summary statistics were generated for children with or without ADHD using PROC SURVEYFREQ. The distributions of these groups were compared using the Chi-squared test of independence (homogeneity). Next, interaction was assessed using the backward elimination method and the Breslow-Day test for heterogeneity.

However, due to a paucity of data in the BMI category of children who were breastfed and taking ADHD medication, the model failed to converge using BMI as an interaction term, so this variable was removed from the analysis.

Assessing for confounding using the gold standard OR (with all potential confounders) included removing the least significant variable one by one and comparing the adjusted OR with the gold standard OR using the 10% rule. The gold standard OR is derived from the model including all confounders, but no cross-product terms. Variables were removed from the model as potential confounders unless the 10% rule was violated.

Chapter IV. Results

Primary Analysis

Descriptive Characteristics

Descriptive characteristics for children by the primary outcome, ADHD status, are shown in Table 1. Overall, there were 17,731 (99%) children in the database who did not have ADHD, while only 173 (1%) did have ADHD. When stratifying these groups of children by race and smoking status of the parent/guardian, there was no difference when comparing those with ADHD and those without ADHD. However, when stratifying based on sex, family structure, mental health status of the mother/father, poverty level, education of the mother/father, weight at birth, and breastfeeding status, these groups showed a statistically significant difference. For example, among children with ADHD 76% are male, while 51% of non-ADHD children are male ($P<0.0001$). Further, about half of children with ADHD had a two-parent family, while more than three-quarters of children without ADHD had a two parent family ($P=0.0001$). Only 7% and 5% of mothers and fathers, respectively, of children without ADHD had a mental status of fair/poor, and 19% and 16% of mothers and fathers, respectively, of children with ADHD had this mental status ($P<0.0001$). Additionally, 70% of children with ADHD were living at less than 200% of the FPL, while less than half of children without ADHD were living at this level ($P=0.0022$). Children with ADHD had proportionally fewer mothers/fathers who had more than a high school education (43%/34% versus 64%/63%; $P=0.012$/ $P<0.0038$) than children without ADHD, and they were also born with a very low or low birth weight (<2,500 grams) (19% versus 10%; $P=0.0006$) than those without ADHD. Finally only about half of children with ADHD were ever breastfed, while nearly three-quarters of those without ADHD were ever breastfed ($P<0.0001$).

Descriptive characteristics for children by the primary exposure, whether or not a child ever breastfed, are shown in Table 2. The majority of children surveyed were breastfed (21,095; 77%) compared with those who were not ever breastfed (6,293; 23%). When stratified based on a number of characteristics, sex, mental health of father, and whether or not a child is taking medication for ADHD, there did not seem to be any statistical difference between children who ever breastfed and those who did not. Those characteristics that were significantly different included race, family structure, mental health status of mother, poverty level, education of mother/father, smoking, weight at birth and ADHD status. Interestingly, 23% of children who never breastfed were black, non-Hispanic, while only 9% of children who did breastfeed were this race ($P<0.0001$). More children who never breastfed lived with a single mother and had no father present (26% versus 13%; $P<0.0001$) than those who did breastfeed. Six percent of mothers of children who never breastfed had a mental status of fair/poor, and 4% of mothers of children who ever breastfed had this mental status ($P<0.0041$). Additionally, 54% of children who did not breastfeed were living at less than 200% of the FPL, while 39% of children who did breastfeed were living at this level ($P<0.0001$). Children who did not breastfeed had proportionally fewer mothers/fathers who had more than a high school education (50%/44% versus 68%/66%; $P<0.0001$ / $P<0.0001$), and more of them were born with a very low or low birth weight (<2,500 grams) (11% versus 9%; $P=0.0101$) than those that did breastfeed. More parents of children who never breastfed were smokers (29% versus 12%; $P<0.0001$) than those who did breastfeed. Finally less than 1% of children who breastfed had ADHD, while 2% had ADHD who never breastfed ($P<0.0001$).

Analyses of Potential Effect Modifiers/Confounders

After the descriptive characteristics of these patients were evaluated, simple logistic regression was conducted to separately assess the crude relationships between potential effect modifiers/confounders and the primary outcome (ADHD status) and exposure (ever breastfed). These crude odds ratios (ORs) are shown in Tables 3 and 4. The various characteristics that may significantly impact if a child ever breastfed were family structure, mental health status of mother, poverty level, education of father, smoking status of caretaker, and ADHD status of the child. Race and mental health status of the father were the only two characteristics evaluated that did not have a significant relationship on breastfeeding status. Specifically, children with a step family (OR 0.32; 95% confidence interval [CI] 0.20-0.50) or who had a single mother (0.36; 0.31-0.42) were less likely to breastfeed than those with two biological or adopted parents. Those who were poor were also less likely to breastfeed than those who were wealthy (ORs ranged from 0.36-0.67; $P<0.0001$). Children were more likely to breastfeed if their mother had excellent/very good (1.57; 1.19-2.07) or good (1.41; 1.04-1.92) mental health status than fair/poor status. They were also more likely to breastfeed if their fathers had more than a high school education (1.80; 1.39-2.33), but less likely to breastfeed if they were a high school graduate (0.66; 0.49-0.87) compared to less than high school education. Children without ADHD were additionally more likely to breastfeed (3.03; 1.73-5.30) than those with ADHD.

Three variables had significantly mixed results based on their pre-defined levels; these included race, education status of mother and birth weight. Regarding race, Hispanics were significantly more likely to breastfeed than White, non-Hispanics (1.43; 1.16-1.76), while Black, non-Hispanics were significantly less likely to breastfeed than White, non-Hispanics (0.38; 0.32-0.45). However, there was no significant difference between breastfeeding status of White, non-Hispanics and Multiracial, non-Hispanics ($P=0.41$). Regarding education status of the mother,

women who had more education than high school were more likely to breastfeed their child than those with less than a high school education (1.80; 1.39-2.33), while high school graduates did not have a significantly different breastfeeding status than those with lower education (*P*=0.92). Finally, compared with a very low birth weight (<1,500 grams), babies with a low birth weight (1,500-2,500 grams) were less likely to be breastfed (0.44; 0.26-0.76), as well as babies with an average birth weight (2,500-4,000 grams). However, babies with a high birth weight (>4,000 grams) did not have a significantly different breastfeeding status than babies with a very low birth weight.

The characteristics that may significantly impact if a child had ADHD or not were sex, family structure, and whether or not a child was breastfed, while race and smoking status of the caretaker did not have a significant relationship on breastfeeding status. Specifically, children with a step family (OR 3.79; 1.54-9.36) or who had a single mother (2.49; 1.33-4.64) were more likely to have ADHD than those with two biological or adopted parents. Further, males were more likely to have ADHD than females (3.08; 1.70-5.55). Children who were not breastfed were more likely to have ADHD than those who were breastfed (3.03; 1.73-5.30).

Six variables had significantly mixed results based on their pre-defined levels; these included mental health status of the mother/father, poverty level, education of the mother/father, and birth weight. Those who were very poor were more likely to have ADHD than the wealthiest group (1.52; 1.23-1.86), while those who were in the middle categories (100-199% of FPL or 200-399% of FPL) were not significantly more or less likely to have ADHD than the wealthiest group. Children were significantly less likely to have ADHD if their mother/father had excellent/very good mental health status than fair/poor status, but there was no difference seen between those with good mental health status and the latter group of mothers or fathers. A

similar pattern was seen for education level of the mother/father. Children were less likely to have ADHD if their mother/father had more than a high school education (0.40; 0.20-0.80 / 0.33; 0.14-0.76) than those parents with less than a high school education, but children of parents who were high school graduates were not significantly more or less likely to have ADHD than the latter groups. Finally, compared with a very low birth weight (<1,500 grams), only babies with an average birth weight were less likely to have ADHD (0.14; 0.04-0.49), while, babies with a low (1,500-2,500 grams) or high birth weight (>4,000 grams) did not have a significantly different breastfeeding status than babies with a very low birth weight.

Based on the results of the crude ORs, variables were considered for inclusion in the adjusted logistic regression. The characteristics that were independently significantly related to both the primary exposure (breastfeeding status) and primary outcome (ADHD status) as well as those variables that have shown significance in previous analyses, were considered for inclusion in the final model. The following is a summary of the decisions to include or exclude certain variables from the analysis.

- Sex
    - Males and females did not significantly differ in their breastfeeding status, but males were more likely to have ADHD. Even though this variable was not significant in both the exposure and outcome analyses, sex was included in the adjusted regression analysis because it has been included in related studies.[32-34]
- Race
    - Race was not included in the adjusted regression analyses. It has not been shown to be significant in other related analyses, and it was not significant in both the exposure and outcome analyses.

- Family Structure
    - This variable showed significance in the crude ORs of both breastfeeding and ADHD status; thus, it was included in the regression analysis.
- Mental Health of Mother
    - This variable showed significance in the crude ORs of breastfeeding but it varied by level for ADHD status. Further, this variable was not included in the regression analyses in all related studies.[32-34] However, to be conservative, it was included in the present analysis.
- Mental Health of Father
    - This variable was not included in the adjusted regression analyses. It has not been shown to be significant in other related analyses, and it was not significant in both the exposure and outcome analyses.[32-34]
- Poverty Level
    - The relationship was significantly different between this variable and ever breastfed, but it varied by level between this variable and if a child had ADHD. However, because two of the three levels showed significance, and this variable has been include in other related analyses, it was included presently.
- Education of Mom/Dad
    - The significance of these relationships varied; however, these variables were included in related analyses, so they were included in the present one.[32-34]
- Smoking

    - Smoking was significantly related to breastfeeding status, but it was not related to ADHD status. However, in related studies, this variable was included, so it was in this regression analysis.[32-34]
- Birth Weight
    - The statistical significance of this relationship varied between the exposure and outcome crude ORs. Because of this inconsistency, it was not included in the analysis.

Thus, the logistic regression model tested for interaction containing sex, family structure, poverty level, education of the mother/father, smoking and mental health status of the mother. Notably, the attempt to assess for effect modification was limited by sparse data, and despite some suggestion of effect modification for the variables education of the mother, smoking status and sex, the data could not adequately be stratified. For example, only 10 female children aged less than 6 have ADHD. Thus, the data likely would not provide useful information, so the pooled/adjusted estimates were analyzed.

Next, confounding was assessed using a gold standard model with the exposure of breastfeeding and the outcome of ADHD status of the child controlling for education of the mother, poverty level, education of the father, child's sex, mental health of the mother, family structure and smoking status. After evaluation, the results of the final model showed that children who did not breastfeed had 2.00 (0.58-6.90) the odds of having ADHD as those who breastfed controlling for poverty level, mental health of the mother, and education of the mother. However, the results of our model indicate that this relationship was not significant, which means that breastfeeding a child is not associated with whether or not a child develops ADHD at a young age (less than 6).

Secondary Analysis

Descriptive characteristics for children by the secondary outcome, ADHD status as defined by medicinal utilization only, are shown in Table 5. Overall, there were 17,731 (99.6%) children in the database who did not have ADHD, while only 66 (<1%) did have ADHD as defined by taking medicine. When stratifying these groups of children by poverty level, education of the mother, and smoking status of the parent/guardian, there was no difference when comparing those with ADHD and those without ADHD. However, when stratifying based on sex, race, family structure, mental health status of the mother/father, education of the father, weight at birth, and breastfeeding status, these groups showed a statistically significant difference. For example, more 79% of children with ADHD were male, while 51% without ADHD were male (P=0.001). More children with ADHD were white, non-Hispanic (88%) than those did not have ADHD (55%; P<0.0001). Further, 36% of children with ADHD had a two-parent family, while more than three-quarters of children without ADHD had a two-parent family (P=0.0001). Only 7% and 5% of mothers and fathers, respectively, of children without ADHD had a mental status of fair/poor, and 29% and 19% of mothers and fathers, respectively, of children with ADHD had this mental status (P<0.0001; 0.0079). Additionally, children with ADHD had proportionally fewer fathers who had more than a high school education (18% versus 63%; P=0.0008) than those without ADHD, and they were also born with a very low or low birth weight (<2,500 grams) (31% versus 10%; P=0.0008) as compared with those without ADHD. Finally, only 37% of children with ADHD were ever breastfed, while nearly three-quarters of those without ADHD were ever breastfed (P<0.0001).

Descriptive characteristics for children by the secondary exposure, whether or not a child exclusively breastfed, are shown in Table 6. The majority of children surveyed were not

exclusively breastfed (21,759; 86%) compared with those who were exclusively breastfed (6,293; 14%). When stratified based on a number of characteristics, sex, mental health of father, poverty level, and whether or not a child is taking medication for ADHD, there did not seem to be any statistical difference between children who exclusively breastfed and those who did not. Those characteristics that were significantly different included race, family structure, mental health status of mother, education of mother/father, smoking, weight at birth and ADHD status. Thirteen percent of children who did not exclusively breastfeed were black, non-Hispanic, while 8% of children exclusively breastfed (P=0.042). More children (17%) who did not exclusively breastfeed lived with a single mother and had no father present than those who did exclusively breastfeed (10%; P<0.0001). Three percent of mothers of children who exclusively breastfed had a mental status of fair/poor, and 7% of mothers of children who did not exclusively breastfeed had this mental status (P=0.0028). Children who did not exclusively breastfeed had proportionally fewer mothers/fathers who had more than a high school education (62%/60% versus 73%/73%; P=0.0007/ P<0.0001) when compared with those who did exclusively breastfeed, and more of them were born with a very low or low birth weight (<2,500 grams) (10% versus 8%; P=0.003) than those who did exclusively breastfeed. More parents of children who did not exclusively breastfeed were smokers (21% versus 8%; P<0.0001) than those who did exclusively breastfeed. Finally less than one-third of a percent of children who exclusively breastfed had ADHD, while just over 1% had ADHD who did not exclusively breastfeed (P<0.0006).

Similarly to the primary analysis, the logistic regression model tested for interaction contained sex, family structure, poverty level, education of the mother/father, smoking and mental health status of the mother in each of the following scenarios:

1. Exposure: Ever breastfed; Outcome: Taking medication for ADHD
2. Exposure: Exclusively breastfed for at least 6 months; Outcome: Had ADHD
3. Exposure: Exclusively breastfed for at least 6 months; Outcome: Taking medication for ADHD

Notably, just like in the primary analysis, the attempt to assess for effect modification was limited by sparse data, and despite some suggestion of effect modification for some of the variables, the data could not adequately be stratified. Thus, the data likely would not provide useful information, so the pooled/adjusted estimates were analyzed.

For scenario 1, confounding was assessed using a gold standard model with the exposure of breastfeeding and the outcome of ADHD medication status of the child controlling for education of the mother, poverty level, education of the father, child's sex, mental health of the mother, family structure and smoking status. After evaluation, the results of the final model showed that children who did not breastfeed had 2.40 (0.55-10.47) the odds of taking medication for ADHD as those who breastfed controlling for poverty level, education of the dad, mental health status of the mother, and sex. However, the results of our model indicate that this relationship was not significant, which means that breastfeeding a child is not associated with whether or not a child takes medicine for ADHD at a young age (less than 6).

For scenario 2, confounding was also assessed using a gold standard model with the exposure of exclusively breastfeeding and the outcome of ADHD status of the child controlling for education of the mother, poverty level, education of the father, child's sex, mental health of the mother, family structure and smoking status. After evaluation, the results of the final model showed that children who did not exclusively breastfeed had 2.71 (0.72-10.15) the odds of having ADHD as

those who did exclusively breastfeed controlling for poverty level, mental health status of the mother, education of the mother, and sex. However, the results of our model indicate that this relationship was not significant, which means that exclusively breastfeeding a child is not associated with ADHD status at a young age (less than 6).

Finally, for scenario 3, confounding was assessed using a gold standard model with the exposure of exclusively breastfeeding and the outcome of ADHD medication status of the child controlling for education of the mother, poverty level, education of the father, child's sex, mental health of the mother, family structure and smoking status. After evaluation, the results of the final model showed that children who did not exclusively breastfeed had 1.73 (0.22-13.71) the odds of taking medicine for ADHD as those who did exclusively breastfeed controlling for poverty level, education of the father, mental health status of the mother, education of the mother, family structure and smoking status of the survey respondent. However, the results of our model indicate that this relationship was not significant, which means that exclusively breastfeeding a child is not associated with ADHD status at a young age (less than 6).

Chapter V. Discussion

Summary of Results and Conclusions

Overall, the results of this analysis found that breastfeeding was not significantly associated with ADHD in children aged 2 to 5 years as measured in data from the NSCH in 2007. The various analyses tested in this study included the following exposures: whether or not a child breastfed; whether or not a child breastfed for at least six months, and outcomes: whether or not a child had ADHD; whether or not a child was taking medication for ADHD. All relationships assessed were statistically insignificant. Thus, the conclusions from this study are that breastfeeding is unrelated to a child's development of ADHD; however, due to the limitations discussed below, further evaluation is suggested using more robust data.

Study Limitations

Similar to other statistical analyses, this study has a few limitations. The NSCH was a telephone survey that collected information through a random-digit-dialed sample of households, which may be prone to certain data collection biases. Parents may inaccurately report medical conditions due to their misunderstanding of the question or the stigma associated with mental disease. However, the main limitation of the data is the relatively small sample size of the population of interest (i.e., children ages 2 to 5 years). Only 173 children had ADHD and only 66 were taking medication for ADHD in the entire dataset. When further refining these children to include those who breastfed or not, there were even fewer children that met the criteria in the dataset, which may not provide enough evidence to see a true association between breastfeeding and ADHD.

The problems associated with few children in the data were specifically seen in the analysis of the data. The attempt to assess for effect modification was limited by this sparse data, and

despite some suggestion of effect modification for the variables including education of the mother, smoking status and sex in the primary analysis, the data could not adequately be stratified. For example, only 10 female children aged less than 6 have ADHD in the primary analysis. Thus, the data likely would not provide useful information, so the pooled/adjusted estimates were analyzed.

Notably, this analysis found that only about 1% of children aged 2 to 5 had ADHD, while estimates in the literature have been reported around 2-6% in preschool-aged children.[6] There could be a few different reasons for this discrepancy. Perhaps most importantly, the prevalence for ADHD in these young children has not been well-defined and remains inconsistently reported in studies.[20] For example, one review article found a wide prevalence range of 2% to 59% in 2 to 5 year olds.[20] Because this age group has only been recently considered important to diagnose, studies are continuing to be published evaluating this demographic. Further, as mentioned, an analysis based on parent- or guardian-reported data may be underreporting the prevalence of disease due to the possible stigma associated with mental disease. Another important point is that each year the prevalence of ADHD has continued to increase among children.[4,17] Specifically, from 1997 to 2008, the prevalence of ADHD in 3 to 10 year-olds increased by almost 25%.[4,17] Because the present analysis was done using data from 2007, the prevalence of ADHD in preschoolers may be underrepresented in the current population in 2012.

Public Health Implications and Recommendations

Maternal health characteristics and mental disorders have long been assessed, and results have consistently shown these characteristics are linked to these disorders. Specifically, multiple studies have shown an increased risk for symptoms of psychopathology in children who were born with low or very low birth weights.[2,40,41] Additionally, Rodriguez et al. found in a

population-based prospective cohort study that maternal pre-pregnancy obesity was linked to child inattention symptoms in Sweden.[42] Further, an Australian-based birth cohort study found that there was a robust association between increased risk of alcohol use disorders and early weaning.[43] Even breastfeeding has been associated with low levels of conduct disorder symptoms.[33]

Few published studies were found in the literature assessing breastfeeding and ADHD specifically, but of those that were uncovered, they all had dissimilar results to the present analysis. Julvez et al. used population-based cohort data to assess the association between breastfeeding and attention behavior in 400 young children (aged 4) in Spain. This study found breastfeeding to be associated with a lower risk of developing ADHD symptoms (relative risk of 0.56; 95% confidence interval 0.37-0.85 for 12-20 weeks of breastfeeding).[34] Julvez et al. controlled for birth weight, maternal social class, education level and smoking habits, all which were associated with duration of breastfeeding. The study type, the age of participants as well as the number of children included in the study may contribute to the differences in results from the present study.

Kadziela-Olech et al. studied breastfeeding and ADHD symptoms in 100 children 4 to 11 years of age in Poland in a case-control study. The results indicate that a short duration of breastfeeding may be considered a risk factor for developing ADHD symptoms as the duration of breastfeeding was significantly greater in the in the control group (0.55 years) as compared with those that had ADHD symptoms (0.44 years; $p<0.04$).[35] Additionally, 60% compared with 32.5% of children with ADHD and without ADHD, respectively, were breastfed for less than 3 months ($p<0.05$). Even though the population for this study was only 100 children, it evaluated children slightly older than the present study, which may contribute to the differing results.

While breastfeeding has been linked to many health benefits in children, no published studies conducted in the U.S. have evaluated the relationship between breastfeeding and ADHD.[44] While the present analysis has shown a lack of association between breastfeeding and ADHD, other studies in the literature have found contrary results. Because the other studies include more children of various ages and are not based on telephone surveys only, there is reason to continue evaluating the relationship between breastfeeding and ADHD in the U.S. using more stringent methods.

Tables and Figures

Table 1. Characteristics of children aged <6 who had ADHD

Characteristic	Had ADHD			No ADHD			Total			
	n=173	%	*SE of %*	n=17,731	%	*SE of %*	n=17,904	%	*SE of %*	*p-value*
Sex*										
Male	130	75.99	*5.45*	9,104	50.71	*0.95*	9,234	50.97	*0.94*	<.0001
Female	43	24.01	*5.45*	8,612	49.29	*0.95*	8,655	49.03	*0.94*	
Race										
Hispanic, any race	20	14.91	*4.88*	2,621	22.18	*0.98*	2,641	22.11	*0.97*	0.4379
White, non-Hispanic	106	57.52	*6.74*	11,343	54.67	*0.98*	11,449	54.70	*0.97*	
Black, non-Hispanic	19	16.41	*4.85*	1,586	12.61	*0.58*	1,605	12.65	*0.58*	
Multiracial, non-Hispanic	15	8.00	*3.70*	982	5.32	*0.51*	997	5.35	*0.50*	
Other, non-Hispanic	11	3.16	*1.26*	912	5.22	*0.43*	923	5.20	*0.43*	
Family Structure*										
Two parent, biological or adopted	81	53.51	*6.76*	13,923	76.03	*0.83*	14,004	75.81	*0.83*	0.0001
Two parent, step family	14	9.35	*3.53*	402	3.50	*0.43*	416	3.56	*0.43*	
Single mother, no father present	49	29.10	*5.94*	2,492	16.62	*0.72*	2,541	16.74	*0.71*	
Other family type	28	8.04	*2.30*	823	3.85	*0.34*	851	3.89	*0.34*	
Mental Health Status of Mother*										
Excellent/very good	76	32.10	*6.12*	12,840	71.97	*0.93*	12,916	71.58	*0.92*	<.0001
Good	47	49.10	*7.43*	3,102	21.43	*0.86*	3,149	21.70	*0.85*	
Fair/poor	23	18.80	*5.04*	866	6.60	*0.53*	889	6.72	*0.53*	
Mental Health Status of Father*										
Excellent/very good	62	37.20	*7.84*	11,990	77.87	*1.02*	12,052	77.55	*1.01*	<.0001
Good	26	46.95	*9.53*	2,098	17.62	*0.92*	2,124	17.85	*0.92*	
Fair/poor	14	15.85	*6.70*	462	4.51	*0.59*	476	4.60	*0.59*	

Poverty Level*										
<100% FPL	43	35.54	*6.90*	2,100	19.01	*0.81*	2,143	19.17	*0.80*	0.0022
100-199% FPL	45	33.67	*7.46*	2,942	22.42	*0.87*	2,987	22.54	*0.87*	
200-399% FPL	40	22.33	*5.47*	5,443	29.24	*0.85*	5,483	29.17	*0.84*	
400% or more FPL	29	8.46	*2.53*	5,698	29.33	*0.91*	5,727	29.12	*0.90*	
Education of Mother*										
Less than high school	24	19.94	*5.39*	1,391	11.96	*0.73*	1,415	12.04	*0.73*	0.012
High school graduate	41	37.05	*7.86*	2,845	23.74	*0.88*	2,886	23.87	*0.88*	
More than high school	81	43.00	*6.99*	12,479	64.30	*0.98*	12,560	64.10	*0.98*	
Education of Father*										
Less than high school	18	20.46	*6.51*	1,097	12.19	*0.88*	1,115	12.26	*0.87*	0.0038
High school graduate	33	45.25	*9.58*	3,029	25.22	*0.95*	3,062	25.38	*0.94*	
More than high school	51	34.29	*8.06*	10,283	62.59	*1.09*	10,334	62.36	*1.08*	
Smoking										
No	58	85.21	*5.13*	3,254	78.29	*1.41*	3,312	78.43	*1.39*	0.2544
Yes	18	14.79	*5.13*	780	21.71	*1.41*	798	21.57	*1.39*	
Weight at Birth*										
<1,500 grams	10	7.17	*3.96*	257	1.44	*0.27*	267	1.49	*0.27*	0.0006
1,500-2,500 grams	19	11.97	*4.52*	1,272	8.23	*0.58*	1,291	8.27	*0.58*	
2,500-4,000 grams	113	57.18	*7.54*	13,777	79.37	*0.81*	13,890	79.15	*0.81*	
4,000 grams	18	23.68	*7.80*	1,803	10.96	*0.60*	1,821	11.09	*0.60*	
Breastfed*										
Yes	87	48.28	*7.06*	13,229	73.84	*0.77*	13,316	73.60	*0.77*	<.0001
No	79	51.72	*7.06*	4,354	26.16	*0.77*	4,433	26.40	*0.77*	
Breastfed Exclusively*										
Never breastfed or given breast milk	79	51.97	*7.10*	4,354	26.51	*0.78*	4,433	26.76	*0.78*	<.0001
Exclusively breastfed for first 6 months	13	4.39	*1.57*	2,558	13.59	*0.66*	2,571	13.50	*0.66*	

Breastfed, NOT exclusively for first 6 months	73	43.64	*7.21*	10,420	59.91	*0.92*	10,493	59.75	*0.91*

*P-value for chi-square test is <0.05

Note: The values for N are unweighted; the percentages are weighed and the SE is of the percentage.

Table 2. Characteristics of children aged <6 who were ever breastfed

Characteristic	Ever Breastfed			Never Breastfed			Total			
	n=21,095	**%**	***SE of %***	**n=6,293**	**%**	***SE of %***	**n=27,388**	**%**	***SE of %***	***p-value***
Sex										
Male	10,951	51.20	*0.91*	3,224	51.03	*1.38*	14,175	51.17	*0.76*	0.9109
Female	10,127	48.80	*0.91*	3,068	48.97	*1.38*	13,195	48.83	*0.76*	
Race*										
Hispanic, any race	3,269	24.85	*0.94*	867	16.33	*1.24*	4,136	22.76	*0.77*	<0.0001
White, non-Hispanic	13,960	55.16	*0.92*	3,572	51.64	*1.41*	17,532	54.29	*0.77*	
Black, non-Hispanic	1,321	9.16	*0.47*	1,078	22.63	*1.15*	2,399	12.46	*0.46*	
Multiracial, non-Hispanic	1,187	5.27	*0.45*	362	5.69	*0.78*	1,549	5.37	*0.39*	
Other, non-Hispanic	1,032	5.57	*0.49*	296	3.71	*0.43*	1,328	5.11	*0.39*	
Family Structure*										
Two parent, biological or adopted	17,958	83.68	*0.68*	4,017	61.45	*1.34*	21,975	78.26	*0.62*	<0.0001
Two parent, step family	257	1.81	*0.32*	190	4.21	*0.58*	447	2.40	*0.28*	
Single mother, no father present	2,339	12.72	*0.59*	1,425	25.98	*1.20*	3,764	15.96	*0.54*	
Other family type	445	1.79	*0.24*	605	8.35	*0.71*	1,050	3.39	*0.25*	
Mental Health Status of Mother*										
Excellent/very good	16,160	73.44	*0.90*	4,163	69.61	*1.34*	20,323	72.55	*0.76*	0.0041
Good	3,481	20.94	*0.85*	1,141	22.03	*1.19*	4,622	21.19	*0.71*	
Fair/poor	873	5.62	*0.47*	361	8.36	*0.84*	1,234	6.26	*0.41*	
Mental Health Status of Father										
Excellent/very good	15,335	78.63	*0.97*	3,578	77.70	*1.42*	18,913	78.44	*0.83*	0.1264
Good	2,444	17.41	*0.91*	660	16.55	*1.23*	3,104	17.23	*0.77*	
Fair/poor	501	3.96	*0.51*	160	5.75	*0.88*	661	4.32	*0.44*	
Poverty Level*										
<100% FPL	2,196	17.51	*0.81*	1,213	29.17	*1.39*	3,409	20.36	*0.70*	<0.0001

100-199% FPL	3,269	21.57	*0.83*	1,184	25.14	*1.35*	4,453	22.44	*0.71*	
200-399% FPL	6,404	29.79	*0.81*	1,790	26.84	*1.17*	8,194	29.07	*0.68*	
400% or more FPL	7,416	31.13	*0.86*	1,504	18.86	*1.07*	8,920	28.13	*0.70*	
Education of Mother*										
Less than high school	1,460	11.51	*0.71*	791	17.67	*1.24*	2,251	12.94	*0.62*	<0.0001
High school graduate	2,965	20.82	*0.83*	1,528	32.39	*1.36*	4,493	23.52	*0.71*	
More than high school	15,991	67.67	*0.94*	3,308	49.95	*1.46*	19,299	63.53	*0.80*	
Education of Father*										
Less than high school	1,219	11.88	*0.83*	513	14.40	*1.27*	1,732	12.39	*0.71*	<0.0001
High school graduate	3,292	22.32	*0.87*	1,432	41.20	*1.79*	4,724	26.18	*0.80*	
More than high school	13,618	65.81	*1.02*	2,389	44.40	*1.67*	16,007	61.43	*0.89*	
Smoking*										
No	3,566	87.68	*1.51*	1,590	70.51	*1.51*	5,156	81.41	*1.04*	<0.0001
Yes	500	12.32	*2.95*	556	29.49	*2.95*	1,056	18.59	*1.04*	
Weight at Birth*										
<1,500 grams	272	1.64	*0.31*	97	0.89	*0.15*	369	1.46	*0.24*	0.0101
1,500-2,500 grams	1,298	7.82	*0.60*	627	9.64	*0.70*	1,925	8.25	*0.48*	
2,500-4,000 grams	17,001	79.71	*0.81*	4,752	80.42	*1.04*	21,753	79.88	*0.67*	
4,000 grams	2,187	10.83	*0.59*	516	9.05	*0.81*	2,703	10.40	*0.49*	
Had ADHD (all)*										
Yes	87	0.64	*0.14*	79	1.90	*0.34*	166	0.97	*0.14*	<0.0001
No	13,229	99.36	*0.14*	4,354	98.10	*0.34*	17,583	99.00	*0.14*	
Had ADHD (medication)										
Yes	33	27.91	*8.43*	30	42.40	*9.29*	63	35.50	*6.68*	0.2294
No	46	72.09	*8.43*	40	57.60	*9.29*	86	64.50	*6.68*	

*P-value for chi-square test is <0.05

Note: The values for N are unweighted; the percentages are weighed and the SE is of the percentage.

Table 3. Unadjusted odds ratios of various characteristics with ever breastfed for children aged <6 years old

Characteristic	Odds Ratio	*95% C.I.*[†]	*p-value‡*
Sex			
Male	1.01	*0.89-1.15*	*0.911*
Female	-	-	-
Race			
Hispanic, any race	1.43	*1.16-1.76*	*0.001*
White, non-Hispanic	-	-	-
Black, non-Hispanic	0.38	*0.32-0.45*	*<0.0001*
Multiracial, non-Hispanic	0.87	*0.62-1.22*	*0.408*
Other, non-Hispanic	1.40	*1.04-1.90*	*0.027*
Family Structure			
Two parent, biological or adopted	-	-	-
Two parent, step family	0.32	*0.20-0.50*	*<0.0001*
Single mother, no father present	0.36	*0.31-0.42*	*<0.0001*
Other family type	0.16	*0.11-0.22*	*<0.0001*
Mental Health Status of Mother			
Excellent/very good	1.57	*1.19-2.07*	*0.002*
Good	1.41	*1.04-1.92*	*0.027*
Fair/poor	-	-	-
Mental Health Status of Father			
Excellent/very good	1.47	*0.97-2.22*	*0.067*
Good	1.53	*0.98-2.40*	*0.064*
Fair/poor	-	-	-
Poverty Level			
<100% FPL	0.36	*0.30-0.45*	*<0.0001*

100-199% FPL	0.52	*0.42-0.64*	*<0.0001*
200-399% FPL	0.67	*0.56-0.80*	*<0.0001*
400% or more FPL	-	-	-
Education of Mother			
Less than high school	-	-	-
High school graduate	0.99	*0.77-1.26*	*0.917*
More than high school	2.08	*1.67-2.60*	*<0.0001*
Education of Father			
Less than high school	-	-	-
High school graduate	0.66	*0.49-0.87*	*0.004*
More than high school	1.80	*1.39-2.33*	*<0.0001*
Smoking			
No	2.98	*2.26-3.92*	*<0.0001*
Yes	-	-	-
Weight at Birth			
<1,500 grams	-	-	-
1,500-2,500 grams	0.44	*0.26-0.76*	*0.003*
2,500-4,000 grams	0.54	*0.33-0.89*	*0.016*
4,000 grams	0.65	*0.38-1.12*	*0.121*
Had ADHD (all)			
Yes	-	-	-
No	3.03	*1.73-5.30*	*0.00*
Had ADHD (medication)			
Yes	-	-	-
No	1.90	*0.64-5.66*	*0.2496*

† C.I. Confidence interval
‡ Wald Chi-square Test

Table 4. Unadjusted odds ratios of various characteristics with ADHD for children aged <6 years old

Characteristic	Odds Ratio	95% C.I.†	*p-value‡*
Sex			
Male	3.08	*1.70-5.55*	*0.000*
Female	-	-	-
Race			
Hispanic, any race	0.64	*0.29-1.42*	*0.270*
White, non-Hispanic	-	-	-
Black, non-Hispanic	1.24	*0.59-2.58*	*0.570*
Multiracial, non-Hispanic	1.43	*0.51-4.02*	*0.499*
Other, non-Hispanic	0.58	*0.24-1.36*	*0.208*
Family Structure			
Two parent, biological or adopted	-	-	-
Two parent, step family	3.79	*1.54-9.36*	*0.004*
Single mother, no father present	2.49	*1.33-4.64*	*0.004*
Other family type	2.97	*1.47-5.99*	*0.002*
Mental Health Status of Mother			
Excellent/very good	0.16	*0.08-0.32*	*<0.0001*
Good	0.804	*0.38-1.72*	*0.575*
Fair/poor	-	-	-
Mental Health Status of Father			
Excellent/very good	0.136	*0.05-0.38*	*0.000*
Good	0.758	*0.24-2.38*	*0.636*
Fair/poor	-	-	-
Poverty Level			
<100% FPL	1.517	*1.23-1.86*	*<0.0001*
100-199% FPL	1.24	*1.00-1.53*	*0.476*

200-399% FPL	1.03	0.85-1.25	*0.760*
400% or more FPL	-	-	-
Education of Mother			
Less than high school	-	-	-
High school graduate	0.936	*0.41-2.16*	*0.877*
More than high school	0.401	*0.20-0.80*	*0.009*
Education of Father			
Less than high school	-	-	-
High school graduate	1.069	*0.42-2.73*	*0.889*
More than high school	0.326	*0.14-0.76*	*0.009*
Smoking			
No	1.598	*0.71-3.61*	*0.259*
Yes	-	-	-
Weight at Birth			
<1,500 grams	-	-	-
1,500-2,500 grams	0.291	*0.07-1.22*	*0.915*
2,500-4,000 grams	0.144	*0.04-0.49*	*0.002*
4,000 grams	0.433	*0.10-1.83*	*0.254*
Breastfed			
Yes	-	-	-
No	3.025	*1.73-5.30*	*0.000*
Breastfed Exclusively			
Never breastfed or given breast milk	-	-	-
Exclusively breastfed for first 6 months	0.165	*0.08-0.36*	*<0.0001*
Breastfed, NOT exclusively for first 6 months	0.372	*0.21-0.67*	*0.001*

† C.I. Confidence interval
‡ Wald Chi-square Test

Table 5. Characteristics of children aged <6 who had ADHD (as defined by taking medication)

Characteristic	Had ADHD			No ADHD			Total			
	n=66	%	*SE of %*	n=17,731	%	*SE of %*	n=17,797	%	*SE of %*	*p-value*
Sex*										
Male	45	79.23	*6.99*	9,104	50.71	*0.95*	9,149	50.80	*0.95*	0.001
Female	21	20.77	*6.99*	8,612	49.29	*0.95*	8,633	49.20	*0.95*	
Race*										
Hispanic, any race	4	1.97	*1.13*	2,621	22.18	*0.98*	2,625	22.12	*0.98*	<.0001
White, non-Hispanic	48	80.67	*8.02*	11,343	54.67	*0.98*	11,391	54.75	*0.98*	
Black, non-Hispanic	3	1.95	*1.37*	1,586	12.61	*0.58*	1,589	12.57	*0.58*	
Multiracial, non-Hispanic	7	12.64	*7.83*	982	5.32	*0.51*	989	5.35	*0.51*	
Other, non-Hispanic	3	2.77	*1.73*	912	5.22	*0.43*	915	5.21	*0.43*	
Family Structure*										
Two parent, biological or adopted	27	36.09	*9.41*	13,923	76.03	*0.83*	13,950	75.91	*0.83*	0.0001
Two parent, step family	3	10.45	*7.59*	402	3.50	*0.43*	405	3.52	*0.43*	
Single mother, no father present	21	40.84	*10.70*	2,492	16.62	*0.72*	2,513	16.69	*0.71*	
Other family type	14	12.61	*4.93*	823	3.85	*0.34*	837	3.87	*0.34*	
Mental Health Status of Mother*										
Excellent/very good	26	22.30	*6.93*	12,840	71.97	*0.93*	12,866	71.82	*0.93*	<.0001
Good	15	49.17	*11.55*	3,102	21.43	*0.86*	3,117	21.51	*0.86*	
Fair/poor	11	28.53	*10.53*	866	6.60	*0.53*	877	6.66	*0.53*	
Mental Health Status of Father*										
Excellent/very good	20	39.67	*12.71*	11,990	77.87	*1.02*	12,010	77.81	*1.01*	0.0079
Good	9	41.04	*14.22*	2,098	17.62	*0.92*	2,107	17.66	*0.92*	
Fair/poor	4	19.28	*14.50*	462	4.51	*0.59*	466	4.53	*0.59*	

Poverty Level										
<100% FPL	15	35.97	*12.06*	2,100	19.01	*0.81*	2,115	19.06	*0.81*	0.1026
100-199% FPL	19	31.51	*9.46*	2,942	22.42	*0.87*	2,961	22.45	*0.87*	
200-399% FPL	15	27.13	*9.34*	5,443	29.24	*0.85*	5,458	29.24	*0.85*	
400% or more FPL	8	5.39	*2.49*	5,698	29.33	*0.91*	5,706	29.25	*0.91*	
Education of Mother										
Less than high school	7	17.60	*8.95*	1,391	11.96	*0.73*	1,398	11.98	*0.73*	0.0744
High school graduate	17	42.98	*11.84*	2,845	23.74	*0.88*	2,862	23.79	*0.88*	
More than high school	28	39.42	*10.54*	12,479	64.30	*0.98*	12,507	64.23	*0.98*	
Education of Father*										
Less than high school	7	27.39	*12.42*	1,097	12.19	*0.88*	1,104	12.22	*0.88*	0.0008
High school graduate	10	54.41	*13.79*	3,029	25.22	*0.95*	3,039	25.28	*0.94*	
More than high school	16	18.20	*6.73*	10,283	62.59	*1.09*	10,299	62.51	*1.08*	
Smoking										
No	28	82.74	*8.33*	3,254	78.29	*1.41*	3,282	78.33	*1.40*	0.628
Yes	9	17.26	*8.33*	780	21.71	*1.41*	789	21.67	*1.40*	
Weight at Birth*										
<1,500 grams	1	1.53	*1.54*	257	1.44	*0.27*	258	1.44	*0.27*	0.0008
1,500-2,500 grams	11	29.05	*10.97*	1,272	8.23	*0.58*	1,283	8.30	*0.58*	
2,500-4,000 grams	39	58.92	*10.53*	13,777	79.37	*0.81*	13,816	79.30	*0.81*	
4,000 grams	8	10.50	*4.92*	1,803	10.96	*0.60*	1,811	10.96	*0.60*	
Breastfed*										
Yes	33	37.18	*9.09*	13,229	73.84	*0.77*	13,262	73.73	*0.77*	<.0001
No	30	62.82	*9.09*	4,354	26.16	*0.77*	4,384	26.27	*0.77*	
Breastfed Exclusively*										
Never breastfed or given breast milk	30	63.74	*9.14*	4,354	26.51	*0.78*	4,384	26.63	*0.78*	<.0001
Exclusively breastfed for first 6 months	4	2.59	*1.45*	2,558	13.59	*0.66*	2,562	13.55	*0.66*	

Breastfed, NOT exclusively for first 6 months	28	33.67	*9.03*	10,420	59.91	*0.92*	10,448	59.82	*0.92*

*P-value for chi-square test is <0.05
Note: The values for N are unweighted; the percentages are weighed and the SE is of the percentage.

Table 6. Characteristics of children aged <6 who exclusively breastfed in the first 6 months

Characteristic	Exclusively Breastfed			Not Exclusively Breastfed			Total			
	n=3,438	%	*SE of %*	n=21,759	%	*SE of %*	n=25,197	%	*SE of %*	*p-value*
Sex										
Male	1,672	48.34	*2.30*	11,403	51.73	*0.85*	13,075	51.31	*0.80*	0.1683
Female	1,763	51.66	*2.30*	10,342	48.27	*0.85*	12,105	48.69	*0.80*	
Race*										
Hispanic, any race	490	22.15	*2.31*	3,285	22.34	*0.86*	3,775	22.32	*0.80*	0.0417
White, non-Hispanic	2,361	59.56	*2.37*	13,817	54.11	*0.86*	16,178	54.79	*0.80*	
Black, non-Hispanic	163	8.35	*1.28*	2,046	13.12	*0.52*	2,209	12.52	*0.48*	
Multiracial, non-Hispanic	182	4.78	*0.88*	1,223	5.38	*0.45*	1,405	5.30	*0.41*	
Other, non-Hispanic	181	5.17	*0.84*	1,050	5.05	*0.43*	1,231	5.07	*0.39*	
Family Structure*										
Two parent, biological or adopted	3,057	87.91	*1.27*	17,063	76.40	*0.72*	20,120	77.84	*0.65*	<.0001
Two parent, step family	26	0.70	*0.23*	416	2.86	*0.35*	442	2.59	*0.31*	
Single mother, no father present	262	9.55	*1.20*	3,234	17.04	*0.62*	3,496	16.11	*0.57*	
Other family type	81	1.84	*0.39*	922	3.70	*0.30*	1,003	3.47	*0.26*	
Mental Health Status of Mother*										
Excellent/very good	2,737	78.36	*2.10*	15,816	71.37	*0.84*	18,553	72.25	*0.78*	0.0028
Good	494	18.31	*2.02*	3,849	21.91	*0.79*	4,343	21.46	*0.73*	
Fair/poor	105	3.33	*0.78*	1,051	6.72	*0.47*	1,156	6.29	*0.43*	
Mental Health Status of Father										
Excellent/very good	2,606	79.22	*2.34*	14,687	78.43	*0.91*	17,293	78.53	*0.85*	0.4167
Good	407	17.65	*2.33*	2,489	16.99	*0.82*	2,896	17.08	*0.78*	
Fair/poor	88	3.13	*0.61*	537	4.59	*0.52*	625	4.39	*0.46*	
Poverty Level										
<100% FPL	332	17.70	*2.26*	2,777	20.33	*0.76*	3,109	20.00	*0.73*	0.0617

100-199% FPL	521	19.33	*1.90*	3,600	23.15	*0.81*	4,121	22.66	*0.75*	
200-399% FPL	1,077	29.98	*1.96*	6,494	28.93	*0.76*	7,571	29.07	*0.71*	
400% or more FPL	1,222	32.99	*2.36*	6,973	27.59	*0.77*	8,195	28.27	*0.74*	
Education of Mother*										
Less than high school	217	10.21	*1.66*	1,831	12.80	*0.67*	2,048	0.62	*0.62*	0.0007
High school graduate	418	17.27	*1.86*	3,682	24.78	*0.81*	4,100	0.75	*0.75*	
More than high school	2,682	72.51	*2.24*	15,101	62.43	*0.89*	17,783	0.83	*0.83*	
Education of Father*										
Less than high school	187	12.8596	*2.33*	1,397	12.04	*0.75*	1,584	12.15	*0.72*	<.0001
High school graduate	431	14.5476	*1.45*	3,909	28.14	*0.94*	4,340	26.30	*0.85*	
More than high school	2,454	72.5928	*2.43*	12,243	59.82	*1.00*	14,697	61.55	*0.93*	
Smoking*										
No	424	91.60	*1.88*	4,313	79.50	*1.19*	4,737	80.47	*1.11*	<.0001
Yes	54	8.40	*1.88*	956	20.50	*1.19*	1,010	19.53	*1.11*	
Weight at Birth*										
<1,500 grams	36	0.70	*0.18*	311	1.68	*0.30*	347	1.55	*0.26*	0.003
1,500-2,500 grams	176	7.10	*1.59*	1,598	8.24	*0.50*	1,774	8.10	*0.48*	
2,500-4,000 grams	2,786	76.43	*2.59*	16,943	80.24	*0.70*	19,729	79.76	*0.69*	
4,000 grams	363	15.77	*2.40*	2,125	9.85	*0.47*	2,488	10.59	*0.52*	
Had ADHD (all)*										
Yes	13	0.32	*0.11*	153	1.07	*0.16*	166	0.97	*0.14*	0.0006
No	2,558	99.68	*0.11*	15,025	98.93	*0.16*	17,583	99.03	*0.14*	
Had ADHD (medication)										
Yes	4	19.07	*10.35*	59	36.35	*6.97*	63	35.53	*6.68*	0.2113
No	9	80.93	*10.35*	77	63.65	*6.97*	86	64.47	*6.68*	

*P-value for chi-square test is <0.05

Note: The values for N are unweighted; the percentages are weighed and the SE is of the percentage.

Figure 1. American Psychiatric Association's Diagnostic and Statistical Manual-IV, Text Revision (DSM-IV-TR) Criteria for ADHD[45]

I. Either A or B:

A. Six or more of the following symptoms of inattention have been present for at least 6 months to a point that is inappropriate for developmental level:

Inattention

1.
    1. Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
    2. Often has trouble keeping attention on tasks or play activities.
    3. Often does not seem to listen when spoken to directly.
    4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions).
    5. Often has trouble organizing activities.
    6. Often avoids, dislikes, or doesn't want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
    7. Often loses things needed for tasks and activities (e.g. toys, school assignments, pencils, books, or tools).
    8. Is often easily distracted.
    9. Is often forgetful in daily activities.

Six or more of the following symptoms of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for developmental level:

Hyperactivity

1.
    1. Often fidgets with hands or feet or squirms in seat when sitting still is expected.
    2. Often gets up from seat when remaining in seat is expected.
    3. Often excessively runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
    4. Often has trouble playing or doing leisure activities quietly.
    5. Is often "on the go" or often acts as if "driven by a motor".
    6. Often talks excessively.

Impulsivity

    7. Often blurts out answers before questions have been finished.
    8. Often has trouble waiting one's turn.
    9. Often interrupts or intrudes on others (e.g., butts into conversations or games).

II. Some symptoms that cause impairment were present before age 7 years.

III. Some impairment from the symptoms is present in two or more settings (e.g. at school/work and at home).

IV. There must be clear evidence of clinically significant impairment in social, school, or work functioning.

V. The symptoms do not happen only during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder. The symptoms are not better accounted for by another mental disorder (e.g. Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).

Based on these criteria, three types of ADHD are identified:

IA. ADHD, ***Combined Type***: if both criteria IA and IB are met for the past 6 months;

IB. ADHD, ***Predominantly Inattentive Type***: if criterion IA is met but criterion IB is not met for the past six months;

IC. ADHD, ***Predominantly Hyperactive-Impulsive Type***: if Criterion IB is met but Criterion IA is not met for the past six months.

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Appendix A. SAS Code

```
libname Hdrive 'H:\Maternal and Child Health Epi\';

************CREATE AND FORMAT DATASET;

data test; set Hdrive.nsch_2007_puf;
keep idnumr state hispanic ageyr_child sex k6q40 k6q41r K6Q42R
K6Q43R K4Q23 K2Q31D K9Q23 K9Q24
famstruct flg_06_mnth bmiclass racer poverty_levelr nschwt
EDUC_MOMR EDUC_DADR K9Q41 K2Q04R k2Q31A k2Q31b;
run;

*Sex of child;
proc format;
value sex
1="1=Male"
2="2=Female";
run;

data testsex; set test;
sex_07 = SEX; /*Sex of child*/
if sex_07 > 2 then sex_07 = .; /*Don't know or Refused*/
label sex_07 = "Sex of child";
format sex_07 sex.;
run;

/*Race and ethnicity of child*/
proc format;
value hisprace
1 = "1=Hispanic, any race"
2 = "2=White, non-Hispanic"
3 = "3=Black, non-Hispanic"
4 = "4=Multiracial, non-Hispanic"
5 = "5=Other, non-Hispanic";
run;

data testrace; set testsex;
if HISPANIC = 0 then HISPANIC = 2;
race5_07 = .; /*Race and ethnicity*/
if HISPANIC = 2 and RACER = 1 then race5_07 = 2; /*White, non-
Hips*/
if HISPANIC = 2 and RACER = 2 then race5_07 = 3; /*Black, non-
Hisp*/
if HISPANIC = 1 then race5_07 = 1; /*Hispanic*/
```

```
if HISPANIC = 2 and RACER = 3 then race5_07 = 4; /* Multiracial,
non-Hisp*/
if HISPANIC = 2 and RACER = 4 then race5_07 = 5; /*Other, non-
Hisp*/
if race5_07= .  then race5_07 = .; /*DK/REF/SYSMISS to HISPANIC
or RACER or both*/
label race5_07 = "Race and ethnicity of child";
format race5_07 hisprace.;
run;

/*Family structure*/
proc format;
value famstruct /*famstruct_07*/
1 = "1=Two parent, biological or adopted"
2 = "2=Two parent, step family"
3 = "3=Single mother, no father present"
4 = "4=Other family type";
run;

data testfamstruct; set testrace;
famstruct_07 = FAMSTRUCT; /*Family structure*/
label famstruct_07 = "Type of family structure in household";
format famstruct_07 famstruct.;
run;


/*Indicator 1.4: BMI for age*/
proc format;
value bmi /*ind1_4_07*/
1 = "1=Underweight (less than 5th percentile)"
2 = "2=Healthy weight (5th to 84th percentile)"
3 = "3=Overweight (85th to 94th percentile)"
4 = "4=Obese (95th percentile or above)";
run;

data testbmi; set testfamstruct;
bmi_ind = BMICLASS;  /*BMI for age*/
if AGEYR_CHILD < 10 then bmi_ind = .; if BMICLASS = .M then
bmi_ind = .;
label bmi_ind = "Indicator 1.4: Weight status - BMI-for-age, 4
categories, age 10-17";
format bmi_ind bmi.;
run;

/*Income level of household*/
proc format;
value pov  /*povlev4_07*/
```

```
1 = "1=< 100% FPL"
2 = "2=100-199% FPL"
3 = "3=200-399% FPL"
4 = "4=400% or more FPL";
run;

data testpov; set testbmi;
povlev4_07 = .; /*Household income - no imputation*/
if POVERTY_LEVELR in (1) then povlev4_07 =1;
if POVERTY_LEVELR in (2,3,4,5) then povlev4_07 =2;
if POVERTY_LEVELR in (6,7) then povlev4_07 =3;
if POVERTY_LEVELR in (8) then povlev4_07 =4;
label povlev4_07 = "Household income level expressed as
percentage of Federal Poverty Level (FPL)";
/*NOTE: Results for this variable differ from those shown on the
DRC website, because it is based on POVERTY_LEVELR, which does
not include imputed values for missing income. To match DRC
results, replace missing values with imputed values as described
in "Notes for Data Users" above.*/
format povlev4_07 pov.;
run;

/*Indicator 1.3: Breastfed ever*/
proc format;
value brstfd_yn /*ind1_3_07*/
1 = "1=Yes"
2 = "2=No";
run;

data testbreastfed; set testpov;
BFever = K6Q40; /*Breastfed ever*/
if BFever in (6,7,.N) then BFever = .;
if BFever = 0 then BFever = 2; /* RECODES from 0,1 to 1,2 */
label BFever = "Indicator 1.3: Ever breastfed or fed breast
milk, age 0-5";
format BFever brstfd_yn.;
run;

/*Indicator 1.3a: Exclusive breastfeeding*/
proc format;
value ex_brstfd /*ind1_3a_07*/
1 = "1=Never breastfed or given breast milk"
2 = "2=Exclusively breastfed for first 6 months"
3 = "3=Breastfed, NOT exclusively for first 6 months"
run;

data testbfonly; set testbreastfed;
```

```
mnth_brstfd = K6Q41R;
if K6Q41R ge 0 then mnth_brstfd = K6Q41R/30;
if K6Q41R = 9995 then mnth_brstfd = 995;/*Still breastfeeding*/
if K6Q41R in (9996,9997) then mnth_brstfd = .;
label mnth_brstfd = "Month child stopped breastfeeding";
if mnth_brstfd < 6 then mnth_brstfd2 = 1;/*Stoped brstfd <
6mos*/
if mnth_brstfd >= 6 then mnth_brstfd2 = 2;/*Stoped brstfd >=
6mos*/
if mnth_brstfd in (.,.L,.N) then mnth_brstfd2 = .;
mnth_form= K6Q42R;
if K6Q42R gt 0 then mnth_form= K6Q42R/30;
if K6Q42R = 0 then mnth_form= 0;/*Fed formula at birth*/
if K6Q42R = 9994 then mnth_form= 994;/*Never been fed formula*/
if K6Q42R in (9996,9997) then mnth_form= .;
label mnth_form= "Month child first fed formula";
if mnth_form < 6 then mnth_form2 = 1;/*start form < 6mos*/
if mnth_form >= 6 then mnth_form2 = 2;/*start form >= 6mos*/
if mnth_form in (.,.L,.N) then mnth_form2 = .;
mnth_food= K6Q43R;
if K6Q43R gt 0 then mnth_food= K6Q43R/30;
if K6Q43R = 0 then mnth_food= 0;/*Fed juice/food/cows milk at
birth*/
if K6Q43R = 9994 then mnth_food= 994;/*Never been fed
juice/food/cows milk */
if K6Q43R in (9996,9997) then mnth_food= .;
label mnth_food= "Month child first fed juice/food/cows milk";
if mnth_food < 6 then mnth_food2 = 1;/*start food >= 6mos*/
if mnth_food >= 6 then mnth_food2 = 2;/*start food >= 6mos*/
if mnth_food in (.,.L,.N) then mnth_food2 = .;
BFonly  = .; if K6Q40 = 0 then BFonly  = 1; /*Never breastfed */
if mnth_brstfd2 = 2 and mnth_form2 = 2 and mnth_food2 = 2 then
BFonly  = 2; /*Exlusive breastfed for at least 6 months*/
if mnth_brstfd2 = 1 or mnth_form2 = 1 or mnth_food2 = 1 then
BFonly  = 3; /*Not exlusive breastfed for at least 6 months*/
if K6Q40 = 1 and BFonly not in (1,2,3) then BFonly  = .;
/*Breastfed - Exclusivity Unknown*/
if flg_06_mnth = 1 or AGEYR_CHILD > 5 then BFonly = .;
if K6Q40 in (6,7) then BFonly = .;
label BFonly  = "Indicator 1.3a: Exclusively breastfed or fed
breast milk for first 6 months, age 6 months-5 years";
/*NOTE: For a list of SAS codes for missing data, see "Note for
SAS users – Codes for missing values in public use data files"
in the Introduction, page5.*/
format BFonly ex_brstfd.;
run;
```

```
proc format;
value ex_brstfda
1 = "1=Yes"
2 = "2=No";
run;
data testbfonly1; set testbfonly;
BFonly1 = .;
if BFonly = 2 then BFonly1 = 1;
if BFonly = 1 then BFonly1 = 2;
if BFonly = 3 then BFonly1 = 2;
label BFonly1 = "Exclusive BF Y or N";
format BFonly1 ex_brstfda.;
run;

/*Indicator 6.2: Mother's mental-emotional health status*/
proc format;
value health_mm /*ind6_2_07*/
1 = "1=Excellent/very good "
2 = "2=Good "
3 = "3=Fair/poor";
run;

data testmhealth; set testbfonly1;
momhealth = .; /*Maternal Mental Health Status*/
if K9Q23 in (1,2) then momhealth = 1;
if K9Q23 = (3) then momhealth = 2;
if K9Q23 in (4,5) then momhealth = 3; if K9Q23 in (6,7) then
momhealth = .; /*Don't know or Refused*/
label momhealth = "Indicator 6.2: Mental and emotional health
status of mother, children living with mother";
format momhealth health_mm.;
run;


/*Indicator 6.2a: Father's mental-emotional health status*/
proc format;
value health_mf /*ind6_2a_07*/
1 = "1=Excellent/very good "
2 = "2=Good "
3 = "3=Fair/poor";
run;

data testdhealth; set testmhealth;
dadhealth= .; /*Father's Mental Health Status*/
if K9Q24 in (1,2) then dadhealth = 1;
if K9Q24 = 3 then dadhealth = 2;
```

```
if K9Q24 in (4,5) then dadhealth = 3; if K9Q24 in (6,7) then
dadhealth= .; /*Don't know or Refused*/
label dadhealth= "Indicator 6.2a: Mental and emotional health
status of father, children living with father";
format dadhealth health_mf.;
run;

/*Indicator 2.7: Medication for ADD/ADHD*/
proc format;
value adhd_med /*ind2_7_07*/
1 = "1=Has ADD or ADHD (may or may not be using medication)"
2 = "2=Does not currently have ADD or ADHD";
run;

data testmedadd; set testdhealth;
adhdmed = .; /*Medication for ADD-ADHD*/
if K2Q31D = 1 then adhdmed =1;
if K2Q31A = 0 then adhdmed =2;
if K2Q31B = 0 then adhdmed =2;
label adhdmed = "Has ADHD/ADD (meds)";
format adhdmed adhd_med.;
run;

/*ADD/ADHD (all)*/
proc format;
value adhd_all
1 = "1=Has ADD or ADHD (all)"
2 = "2=Does not currently have ADD or ADHD";
run;

data testmedadd1; set testmedadd;
adhdall = .; /*ADD-ADHD (all)*/
if K2Q31B = 1 then adhdall =1;
if K2Q31A = 1 then adhdall =1;
if K2Q31B = 0 then adhdall =2;
if K2Q31A = 0 then adhdall =2;
label adhdall = "Has ADHD/ADD (all)";
format adhdall adhd_all.;
run;

/*Mother's education*/
proc format;
value educMom
1 = "1=Less than high school"
2 = "2=HS grad"
3 = "3=More than HS";
run;
```

```
data testeducM; set testmedadd1;
educM = .;
if EDUC_MOMR = 1 then educM = 1;
if EDUC_MOMR = 2 then educM = 2;
if EDUC_MOMR = 3 then educM = 3;
label educM = "Mom Education";
format educM educMom.;
run;

/*Dad's education*/
proc format;
value educDad
1 = "1=Less than high school"
2 = "2=HS grad"
3 = "3=More than HS";
run;
data testeducD; set testeducM;
educD = .;
if EDUC_DADR = 1 then educD = 1;
if EDUC_DADR = 2 then educD = 2;
if EDUC_DADR = 3 then educD = 3;
label educD = "Dad Education";
format educD educDad.;
run;

*SMOKE;
proc format;
value smoke_form
1 = "1=No"
2 = "2=Yes";
run;
data testsmoke; set testeducD;
smoke = .;
if K9Q41 = 0 then smoke = 1;
if K9Q41 = 1 then smoke = 2;
label smoke = "Anyone smoke";
format smoke smoke_form.;
run;
/*
proc univariate data=testsmoke;
var K2Q04R;
weight nschwt;
run;
*/


*WEIGHT;
```

```
proc format;
value wt_form
1 = "1=<1500"
2 = "2=1500-2500"
3 = "3=2500-4000"
4 = "4=>4000";
run;
data testwt; set testsmoke;
grams=K2Q04R*28.3495;
birthwt = .;
if grams < 1500 and grams > 1000 then birthwt = 1;
if grams > 1500 and grams < 2500 then birthwt = 2;
if grams > 2500 and grams < 4000  then birthwt = 3;
if grams > 4000 and grams < 6000 then birthwt = 4;
if grams = M then bithwt = .;
label birthwt = "Birthweight (grams)";
format birthwt wt_form.;
run;

data Hdrive.nsch1_AS; set testwt;
keep idnumr state ageyr_child sex_07 race5_07 famstruct_07
bmi_ind povlev4_07
BFever BFonly adhdmed momhealth dadhealth nschwt educM educD
smoke K2Q04R adhdall BFonly1 birthwt;
run;

**************RUN ANALYSES;


*Create DOMAIN;
proc format;
value mykeep
1 = "1=<=5 (in)"
2 = "2=>5 (out)";
run;

data nsch_AS1; set Hdrive.nsch1_AS;
mykeepage = .;
if ageyr_child <6 then mykeepage = 1;
if mykeepage = . then mykeepage = 2;
label mykeepage = "Domain for Age (1=in; 2=out)";
format mykeepage mykeep.;
run;
```

```
/*
*********ADHD_ALL;

ods rtf;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*sex_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*race5_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*famstruct_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*bmi_ind/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*momhealth/ row col ChiSq;
run;
```

```
proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*dadhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*povlev4_07/ row col ChiSq1;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*BFever/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*BFonly/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*educM/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*educD/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
```

```
tables mykeepage*adhdall*smoke/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*birthwt/ row col ChiSq;
run;


ods rtf close;


*********ADHD_MEDS;

ods rtf;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*sex_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*race5_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*famstruct_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
```

```
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*bmi_ind/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*momhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*dadhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*povlev4_07/ row col ChiSq1;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*BFever/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*BFonly/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*educM/ row col ChiSq;
run;
```

```
proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*educD/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*smoke/ row col ChiSq;
run;

ods rtf close;



**********BFever;
ods rtf;


proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*sex_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*race5_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
```

```
weight nschwt;
tables mykeepage*BFever*famstruct_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*bmi_ind/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*momhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*dadhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*povlev4_07/ row col ChiSq1;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*ADHDall/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*ADHDmed/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
```

```
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*educM/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*educD/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFever*smoke/ row col ChiSq;
run;

ods rtf close;



**********BFonly;



ods rtf;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*sex_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
```

```
weight nschwt;
tables mykeepage*BFonly1*race5_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*famstruct_07/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*bmi_ind/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*momhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*dadhealth/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*povlev4_07/ row col ChiSq1;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*ADHDall/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
```

```
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*ADHDmed/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*educM/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*educD/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*BFonly1*smoke/ row col ChiSq;
run;

ods rtf close;

ods rtf ;
proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdall*birthwt/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*adhdmed*birthwt/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
```

```
weight nschwt;
tables mykeepage*bfever*birthwt/ row col ChiSq;
run;

proc surveyfreq data=nsch_AS1;
strata state;
cluster idnumr;
weight nschwt;
tables mykeepage*bfonly1*birthwt/ row col ChiSq;
run;

ods rtf close;
*/



/*



ods rtf;
**************Testing potential confounders and primary
exposure;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
domain mykeepage;
model  BFever (EVENT='1=Yes')= sex_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class race5_07 (PARAM=ref REF='2=White, non-Hispanic');
domain mykeepage;
model  BFever (EVENT='1=Yes')= race5_07;
weight nschwt;
run;


proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
```

```
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
domain mykeepage;
model  BFever (EVENT='1=Yes')= famstruct_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class momhealth (PARAM=ref REF='3=Fair/poor');
domain mykeepage;
model  BFever (EVENT='1=Yes')= momhealth;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class dadhealth (PARAM=ref REF='3=Fair/poor');
domain mykeepage;
model  BFever (EVENT='1=Yes')= dadhealth;
weight nschwt;
run;


proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
domain mykeepage;
model  BFever (EVENT='1=Yes')= povlev4_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class educm (PARAM=ref REF='1=Less than high school');
domain mykeepage;
model  BFever (EVENT='1=Yes')= educm;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
```

```
class educd (PARAM=ref REF='1=Less than high school');
domain mykeepage;
model  BFever (EVENT='1=Yes')= educd;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class smoke (PARAM=ref REF='2=Yes');
domain mykeepage;
model  BFever (EVENT='1=Yes')= smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class birthwt (PARAM=ref REF='1=<1500');
domain mykeepage;
model  BFever (EVENT='1=Yes')= birthwt;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class adhdall (PARAM=ref REF='1=Has ADD or ADHD (all)');
domain mykeepage;
model  BFever (EVENT='1=Yes')= adhdall;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class adhdmed (PARAM=ref REF='1=Has ADD or ADHD (may or may not
be using medication)');
domain mykeepage;
model  BFever (EVENT='1=Yes')= adhdmed;
weight nschwt;
run;



**************Testing potential confounders and primary outcome;
```

```
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')= sex_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class race5_07 (PARAM=ref REF='2=White, non-Hispanic');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')= race5_07;
weight nschwt;
run;


proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')= famstruct_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class momhealth (PARAM=ref REF='3=Fair/poor');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')= momhealth;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class dadhealth (PARAM=ref REF='3=Fair/poor');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')= dadhealth;
weight nschwt;
run;
```

```
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')=povlev4_07;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class educm (PARAM=ref REF='1=Less than high school');
domain mykeepage;
model  adhdall (EVENT='1=Has ADD or ADHD (all)')=educm;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class educd (PARAM=ref REF='1=Less than high school');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= educd;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class smoke (PARAM=ref REF='2=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class birthwt (PARAM=ref REF='1=<1500');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')=  birthwt;
weight nschwt;
run;
```

```
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class BFonly (PARAM=ref REF='1=Never breastfed or given breast
milk');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFonly;
weight nschwt;
run;

ods rtf close;

*/


**********TEST FOR INTERACTION - CHUNK;
ods rtf;
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educm educd smoke
BFever*sex_07 BFever*educm BFever*smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
```

```
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educm educd smoke;
weight nschwt;
run;

ods rtf close;
```

```
**********************************TEST FOR INTERACTION;
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educm educd smoke
BFever*sex_07 BFever*povlev4_07 BFever*famstruct_07
BFever*momhealth BFever*educm BFever*educd BFever*smoke;
weight nschwt;
run;

*Testing interaction stratified;
ods rtf;
proc surveylogistic data=nsch_AS1;
strata state;
```

```
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage sex_07;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever
povlev4_07 famstruct_07 momhealth educm educd smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage educm;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educd smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage smoke;
```

```
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educm educd;
weight nschwt;
run;

ods rtf close;



*TEST FOR CONFOUNDING;


ods rtf;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever sex_07
povlev4_07 famstruct_07 momhealth educm educd smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFever
povlev4_07 momhealth educm;
```

```
weight nschwt;
run;

ods rtf close;


**********************************TEST FOR INTERACTION;
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFonly1 (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFonly1 sex_07
povlev4_07 famstruct_07 momhealth educm educd smoke
BFonly1*povlev4_07 BFonly1*famstruct_07 BFonly1*momhealth
BFonly1*educm BFonly1*educd BFonly1*smoke;
weight nschwt;
run;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFonly1 (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdmed (EVENT='1=Has ADD or ADHD (may or may not be using
medication)')= BFonly1 sex_07 povlev4_07 famstruct_07 momhealth
educm educd smoke BFonly1*sex_07 BFonly1*povlev4_07
BFonly1*famstruct_07 BFonly1*momhealth BFonly1*educd
BFonly1*smoke;
weight nschwt;
run;
```

```
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdmed (EVENT='1=Has ADD or ADHD (may or may not be using
medication)')= BFever sex_07 povlev4_07 famstruct_07 momhealth
educm educd smoke BFever*povlev4_07 BFever*momhealth
BFever*educm BFever*educd;
weight nschwt;
run;

*BFever to ADHD MEDS;

proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFever (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdmed (EVENT='1=Has ADD or ADHD (may or may not be using
medication)')= BFever sex_07 povlev4_07 momhealth educD;
weight nschwt;
run;


*BF only and ADHD all;
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
```

```
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFonly1 (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdall (EVENT='1=Has ADD or ADHD (all)')= BFonly1 sex_07
povlev4_07 momhealth educm;
weight nschwt;
run;

*BF only and ADHD meds;
proc surveylogistic data=nsch_AS1;
strata state;
cluster idnumr;
class sex_07 (PARAM=ref REF='2=Female');
class famstruct_07 (PARAM=ref REF='1=Two parent, biological or
adopted');
class povlev4_07 (PARAM=ref REF='4=400% or more FPL');
class momhealth (PARAM=ref REF='3=Fair/poor');
class educm (PARAM=ref REF='1=Less than high school');
class educd (PARAM=ref REF='1=Less than high school');
class smoke (PARAM=ref REF='2=Yes');
class BFonly1 (PARAM=ref REF='1=Yes');
domain mykeepage;
model adhdmed (EVENT='1=Has ADD or ADHD (may or may not be using
medication)')= BFonly1 povlev4_07 famstruct_07 educm educd
momhealth;
weight nschwt;
run;
```