THE ASSOCIATION BETWEEN AUTISM SPECTRUM DISORDER AND ASTHMA AND USE OF ADDITIONAL SERVICES FOR THEIR MANAGEMENT IN THE NATIONAL SURVEY OF CHILDREN'S HEALTH

by

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ABSTRACT

ABBAS G. HAMEDANI. The Association Between Autism Spectrum Disorder and Asthma and use of additional services for their management in the national survey of children's health (Under the direction of DR. YVETTE M. HUET)

This study was conducted to provide additional data on the association in the diagnosis of Autism Spectrum Disorder (ASD) and Asthma among children aged 3 – 17 and the likelihood of utilizing additional services for the management of these conditions. Asthma is one of the most common chronic inflammatory diseases among children 18 years old and younger (~ 5 million). ASD is a neurodevelopment disorder characterized by language impairments, social and communication. ASD has an onset age of < 3 years old and affect one out of 2,500 children. Both Asthma and ASD patients utilize prescription medications but other services are available to these children for disorder management and their use can decrease the use of medications. Previous research has had mixed outcomes and because the NCHS survey has collected data from children with both conditions **this research will use this data to more definitively answer questions regarding the association of Asthma and Autism Spectrum Disorder and the use of additional services by those children with this diagnosis.** There were 60,951 children who responded to both ASD and asthma questions. The unadjusted weighted analysis showed the evidence of association between children with concurrent diagnoses of ASD and asthma among children aged 3 – 17 years old (OR=2.25 with 95% CI of 1.48 – 3.42). In addition, we found evidence for an association between severity of asthma and severity of ASD in the utilization of additional services in combination with prescription medication (OR=1.54 and OR=2.58 respectively). Finally, we found some evidence for use of additional services in combination with prescription medication in those children diagnosed with ASD and Asthma based on the severity of their ASD (OR=8.97).

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DEDICATION

I would like to dedicate this work to my wife Afsaneh, my son Ali, My daughter Negeen and her little Daisy for their strong support, and to the memory of my brother Hassan.

"Science is but a perversion of itself unless it has as its ultimate goal the betterment of humanity." Nikola Tesla

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAFA	Asthma and Allergy Foundation of America
ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
BBT	Biologically Based Treatments
CAHMI	Child and Adolescent Health Measurement Initiative
CAM	Complementary and Alternative Treatments
CDC	Centers for Disease Control and Prevention
CNS	Central Nervous System
CI	Confidence Interval
DRC	Data Resource Center
GABA	Gamma-Aminobutyric Acid
GCP	Good Clinical Practice
MBP	Myelin Basic Protein
MS-AFP	Maternal Serum (MS) Alpha-Fetoprotein (AFP)
OR	Odds Ratio
NAEPP	National Asthma Education and Prevention Program
NAFP	Neuron Axon Filament Protein
NBBT	Nonbiologically Based CAM Treatments
NCCIH	National Center for Complementary and Integrative Health
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung and Blood Institute
NIH	National Institute of Health
NSCH	National Survey of Children's Health

NS-CSHCN	National Survey of Children with Special Health Care Needs
NSHS	National Center for Health Statistics
TLR	Toll-Like Receptors
TLR2	Toll-Like Receptors 2
USA	United State of America
WHI	World Health Organization

DEFINITIONS

HLA-A2	"Is a human leukocyte antigen serotype within the HLA-A serotype group. The serotype is determined by the antibody recognition of the α2 domain of the HLA-A α-chain. For A*02, the α chain is encoded by the HLA-A*02 gene and the β chain is encoded by the B2M locus."
HLA-DR4	"Is an HLA-DR serotype that recognizes the DRB1*04 gene products. The DR4 serogroup is large and has a number of moderate frequency alleles spread over large regions of the world."
DDT	Discrete Trial Training (DTT): "Is a method of teaching in simplified and structured steps. Instead of teaching an entire skill in one go, the skill is broken down and "built-up" using discrete trials that teach each step one at a time (Smith, 2001)."
MET	met proto-oncogene (MET): "This gene encodes a member of the receptor tyrosine kinase family of proteins and the product of the proto-oncogene MET. The encoded preproprotein is proteolytically processed to generate alpha and beta subunits that are linked via disulfide bonds to form the mature receptor."

α2β1	"Is a major collagen receptor that is widely expressed and known to promote cell migration and control tissue homeostasis."
PLAUR	"This gene encodes the receptor for urokinase plasminogen activator and, given its role in localizing and promoting plasmin formation, likely influences many normal and pathological processes related to cell-surface plasminogen activation and localized degradation of the extracellular matrix. It binds both the proprotein and mature forms of urokinase plasminogen activator and permits the activation of the receptor-bound pro-enzyme by plasmin."
ITGB3	"This gene provides instructions for making the beta3 subunit of a receptor protein called integrin alphaIIb/beta3 (αIIbβ3), which is found on the surface of small cell fragments called platelets. Platelets circulate in blood and are an essential component of blood clots."
SERPINE1	"The SERPINE1 gene provides instructions for making a protein called plasminogen activator inhibitor 1 (PAI-1). PAI-1 is involved in normal blood clotting (hemostasis). After an injury, clots protect the body by sealing off damaged blood vessels and preventing further blood loss."

Coenzyme Q10 (CoQ10)	"Is an antioxidant that your body produces naturally. Your cells use CoQ10 for growth and maintenance."
Perna	"Is the green-lipped mussel, is a shellfish that is a natural source of glycosaminoglycans (GAGS) including chondroitin."
Immunoglobulins	"Is a protein produced by plasma cells and lymphocytes and characteristic of these types of cells. Immunoglobulins play an essential role in the body's immune system. They attach to foreign substances, such as bacteria, and assist in destroying them."
Cytokines	"Cytokines are a category of signaling molecules that mediate and regulate immunity, inflammation and hematopoiesis. Cytokines are produced throughout the body by cells of diverse embryological origin."

CHAPTER 1: INTRODUCTION

1.1. Background

Asthma is one of the most common chronic diseases among children 18 years old and younger (~ 5 million). The prevalence of asthma in children is 2:1 in comparison with adults. It has been reported that children with asthma miss over 12 million school days due to asthma each year [1].

Autism Spectrum Disorder (ASD) is a neurological development disorder with the symptom of language impairments, social and communication deficiency as well as repetitive behaviors. ASD has a strong genetic basis in combination with other factors with the onset age of < 3 years old and will affect one out of 2,500 children [2]. There are several studies that show that there is an interest in having access to additional services by children or their parents in order to decrease the use of prescription medication costs or side effects [3]. Several epidemiologic studies have shown that there is evidence for the association of asthma and allergies or autoimmune disorders in families with autistic children [4]. This evidence suggested that children with ASD are at higher risk of suffering from asthma.

This study is being conducted to provide additional data on the association between ASD and Asthma among children aged 3 – 17 and the use of additional services by these patients.

1.2. Asthma

Asthma is a complex hereditary disorder that affects the airways and cannot be cured but with current available treatments, children with asthma can live a normal life [4,5,6,7]. Children, who have chronic asthma (asthmatics), have inflamed walls in their

airways and this inflammation makes their airways very sensitive to irritations and increases their susceptibility to an allergic reaction. Since this type of inflammation will cause the airways to become narrower, less air can pass through them to the lungs. Asthmatic children have symptoms like wheezing, chest tightness, breathing problems, and coughing which they experience with higher frequently during the night and the early morning [4, 5]. A study by Oh et. al. showed the genetic associations between asthma and ASD [4]. Some of those published reports indicated six out of eight genomes scanned and evaluated for dichotomous asthma phenotype showed evidence for linkage of chromosome 12q and asthma-related phenotypes [4,5,6,7]. This is an area of the chromosome that is related to potential alterations in cytokine and antibody production.

The childhood onset of asthma occurs when children become sensitive to common allergens in the environment due to a genetic predisposition. Allergens are defined as any foreign substance that triggers the immune system to respond. These triggers are different among different children. The airway cells are sensitive to these allergens, which can include animal proteins, fungi, pollen, house-dust mites and some types of dust [6,7].

Eleven Americans die from asthma every day based on the asthma death rate reported between 1980 and 1996 but, this rate has been declining since 2000. Sixth-four percent of asthmatics patients who die from asthma are female (all ages) but the proportion of boys that die each year from asthma is higher than girls. The burden of asthma on the US health system is very high with about 13 million outpatient visits and 2 million trips to the emergency room per year. Based on the Asthma and Allergy Foundation of America (AAFA) estimate, the annual cost of asthma is approximately $19.7 billion with about $10 billion in direct health care costs (hospitalizations) and about $8 billion for indirect costs such as lost earnings due to asthma or death. Asthma

is the fourth leading cause of missed school and low work productivity, which resulted in approximately 12 million missed or less productive workdays each year [1].

The pathophysiology of asthma is not well defined but the autopsy of the lungs of patients who have died from asthma shows significant inflation of their lungs[5,6,7]. This over inflation of the lungs is seen under the microscope as a dramatic distention of the alveoli. The airways of patients who have been diagnosed with asthma are very responsive to variety of external and internal stimulants. The airway inflammation of the asthmatic patient has been characterized by increases in the number of eosinophils, T cells, and mast cells in the airway mucosa and loss of integrity of the airway epithelium [6,7]. Chronic inflammation of the airways results in a loss of airway elasticity, which causes the airways to easily inflate. However, this also decreases their ability to recoil and reduces airflow out of the lungs, which on autopsy is seen as over inflation.

1.3. Complementary or Alternative Asthma Therapies

The pharmaceutical medication for asthma has been well developed but important reported concerns of patients with asthma are the side effects of these medications, especially for females of child bearing age. Some studies have shown that children whose mothers took asthma medication during their pregnancy have a higher risk of developing ASD. These patients, as well as other patients who prefer to minimize the side effects of their asthma medication, look for other alternatives to reduce the amount of their asthma medication. For sustainable and effective asthma management, patients must carry out very complex medication plans such as changes in home environment, monitoring their asthma symptoms, understanding the effect and availabilities of complementary therapies for asthma as well as coordination among different providers. According to the National Heart, Lung, and Blood Institute

(NHLBI) guidelines, clinicians must teach their patients these important skills by integrating and reinforcing patient education into every step of their clinical care [3].

It has been reported that about 37% of adult asthmatics in the US used some type of complementary therapy to manage their asthma. There have been several CAMs recommended for asthma management that ranges from breathing exercises to herbal remedies, but in the absence of controlled, clinical trials the safety and efficacy of these therapies are not clear [8, 9]. Five complementary therapies that have shown some benefit to asthmatic patients are breathing techniques, acupuncture, yoga, mindful meditation, and dietary nutrients [8, 9].

A survey of 4,741 asthmatic patients that was conducted by the United Kingdom National Asthma Campaign showed that 59% of those responding had tried some type of Complementary or Alternative Medicine (CAM). Thirty three percent of the asthmatic children from the above survey reported that they had experience with CAM. Editorials in CHEST, volume 115, issued in January 1999, reported that 40% of the United States general population is using some form of CAM and that the rate for asthmatic patients could be much higher [9].

Kohn et.al. conducted a meta-analysis of CAM for asthma management and they indicated that there is evidence that suggests about 79% of asthmatic patients use CAM. They identified several studies that used natural products such as Curcumin, Lipid Extract of Perna Canaliculus, Solanum Xanthocarpum, Solanum Trilobatum, and Coenzyme Q10 and they concluded that there is very limited evidence that the oral and topical CAMs have any effect on lung function, asthma symptoms, quality of life, frequency of asthma medication, healthcare utilization, and adverse events. The National Center for Complementary and Integrative Health (NCCIH) a division of the NIH, is currently funding studies to determine the effect of mindfulness meditation

practices, Vitamin E, Borage oil or Ginkgo biloba, and Under-the-tongue (sublingual) immunotherapy on asthmatic patients [10].

Ng et. al. conducted a study on 802 Asian asthmatic patients for one year to evaluate the prevalence and pattern of CAM use to make a comparison with Western asthmatic patients. This study showed that about 27% of patients used CAM as a part of their asthma management program. They compared this study with the study that was conducted by Blanc et. al., which was a study of 482 adult asthmatic patients of which 14% of the asthmatic patients were found to use CAM as a part of their asthma management program [11].

Philp et. al. conducted a retrospective cohort longitudinal study of 1,322 asthmatic children during 2004 to 2007. In this study only 187 (14%) of the patients reported that they used some type of CAM as a part of their asthma management program and they concluded that CAM is not being considered as replacement for conventional asthma therapies. They also stated that health care providers should be diligent regarding patient's choice of CAM as complimentary to their conventional asthma therapies [12].

Steurer-Stey et. al. published a summary report from their review of randomized controlled studies to evaluate the efficacy of CAM in asthmatic patients. In this report, they indicated that in the US, there are large proportion of the asthmatic patients that uses CAM and some of the data that they reviewed suggested that there is an increasing demand for CAM as a complimentary therapy for asthma. Patients should know that the complementary therapies are not a substitute for pharmacological treatments, but they should be educated on how complementary therapies could provide added benefit to their asthma management [13].

As indicated above there was an increase in the prevalence of asthma during the 1980s and 1990s. The federal health agencies responded to this increase by introducing the National Asthma Education and Prevention Program (NAEPP), which is controlled by the National Institutes of Health's National Heart, Lung, and Blood Institute. They issued the first guidelines regarding the diagnosis and management of asthma. These guidelines were updated in 1997 and 2007 to reflect new research findings [3]. A group of scientists from the CDC and federal, state, and other agencies were tasked in 1998 with discovering more ways to control asthma [1]. The result of NSCH survey showed that the prevalence of asthma increased by 21% between 2003 and 2011-2012.

The American College of Allergy, Asthma & Immunology indicated that those with a medical specialty in asthma as well as allergists-immunologists are highly knowledgeable regarding successful asthma management types. They have identified that comprehensive asthma management programs must have clear goals for the program and should identify the key elements of the program; programs must be a partnership between the health care providers and patients; professional care should be multidisciplinary, must have a strong education component; and nationally acceptable asthma care standards such as those produced by National Heart, Lung and Blood Institute (NHLBI) must be considered in the design for successful asthma management programs. They also recommended that case managers be identified and available for asthmatic patients, programs for intermittent asthmatic patients should be depended on primary care, programs for moderate to severe asthmatic patients should include the specialist; additional or incremental treatments should be based on the disease severity, and ongoing assessment using the data driving intervention must be planned [3].

Several managed care companies such as Evolent Health have developed programs to guide the care of the asthmatic patients and improve their quality of life as

well as controlling health care costs. These asthma programs concentrate on the prevention of asthma exacerbations as well on supporting the relationship of the health care providers and patients using evidence-based practice guidelines and ongoing evaluation of clinical, humanistic and economic outcomes. The goals of these asthma programs are to deliver an intervention that will minimize risk and is tailored to needs of the patient through a patient selection process and ongoing monitoring [15].

Education is one of the most important interventions that should be provided to asthmatic patients to help them identify and avoid asthma triggers to maintain long-term control of their asthma. These asthma triggers are different for each patient and once they have been identified using patient self-reported signs and symptoms then, the health care providers can help the patients to take necessary steps to reduce or eliminate them [3,10,14,15].

The American Lung Association has recommended that the care for asthmatic patients should be based on The National Heart Lung and Blood Institute and National Asthma Education and Prevention Program (NAEPP) Guidelines that were released in 2007. The NAEPP was developed by 32 Expert Panel that recommended assessment and monitoring of patients with asthma, education about asthma self-management, control of environmental exposures that affect asthma, and medications to treat asthma should be considered for asthma management program [3].

1.4. Autism Spectrum Disorder (ASD)

ASD is a group of neurodevelopmental disorders that includes several symptoms, change in skills, and levels of disability. Patients with ASD will present with characteristics such as ongoing social problems, with difficulty in communicating and interacting with others, repetitive behaviors as well as limited interests or activities, symptoms that typically are recognized in the first two years of life, and symptoms that

hurt the individual's ability to function socially, at school or work, or other areas of life [16,17].

Some of the patients with ASD have mild impairment because of their symptoms, but others are severely disabled. The Centers for Disease Control and Prevention (CDC) has reported that the onset of ASD is at < 3 years of age and affects one per 2,500 individuals [2]. The result of NSCH survey showed that the prevalence of ASD increased by 32% between 2007 and 2011-2012.

Several studies have shown that there is an immunological involvement in children with ASD and these systemic immunologic aberrations have been linked with both autoimmunity within the central nervous system (CNS) and with altered immunity in immune cell subsets that results in changes in specific immune cell(s) dysfunction [18].

Van de Water and Ashwood indicated that there are varieties of anti-brain antibodies that have been found in autistic patients. These antibodies include the autoantibodies to serotonin receptor, myelin basic protein (MBP), neuron axon filament protein (NAFP), cerebellar neurofilaments, nerve growth factor, alpha-2-adrenergic binding sites, anti-brain endothelial cell proteins and antibodies against the caudate nucleus [18].

Based on these and other reports it is clear that there are imbalances between immune and inflammatory processes in patients with ASD, which include aberrations in antibody levels, cytokines, and cellular subsets. Recent reports have also described an increased frequency of HLA-A2 and HLA-DR4 antigens in patients with ASD [19]. A study by Chena et. al. showed that there are statistically significant associations between maternal autoimmune diseases developed during pregnancy or maternal

thyroid disease and the risk of ASD in offspring and maternal autoimmune disease is likely to be an independent risk factor of ASD in offspring [20].

The pathophysiological significance of the antibodies described above in children with ASD is not well defined. The increased in autoantibodies could suggest that there is increase in neuronal damage [21]. Several studies have shown there is an association in the dysfunctionality of various neurotransmitter systems and ASD. The major neurotransmitters that are identified as associated with ASD are serotonin, dopamine, glutamate, and Gamma-aminobutyric acid (GABA) [22].

Choudhury et al. have shown that glutamate has direct involvement in general cognitive functions such as memory and learning ability. They also indicated that the receptors for glutamate have been identified as potential candidates for several neurological and psychiatric diseases. Several neuroanatomical studies have provided evidence that the ASD is a hypoglutamatergic disorder [22]. It has been shown that patients with ASD have high levels of plasma glutamate concentration and low levels of glutamate concentration in their platelets [23]. The deficiency in development of neurons has adverse effects on several brain functions [24].

1.5. Complementary or Alternative ASD Therapies

Medications that are available for Autism Spectrum Disorder (ASD) only help some patients manage their symptoms leading to better functioning. These medications might not affect all children in the same way, and it is important for children to be under the care of a specialist that has experience in treating children with ASD. Children's progress should be monitored very closely by parents and health care providers while these children are taking medications to weigh their risks and benefits [25].

There is some evidence that showed "early intervention" programs are effective in changing the natural long-term outcome for some patients with an early diagnosis of

ASD. These services include, but are not limited to, therapies that target speech, walking, and interacting with others. There are several different types of treatments such as Behavioral and Communication Approaches, Dietary Approaches, Medication, and Complementary and Alternative Medicine (CAM) that are available for children with ASD [25,26].

The American Academy of Pediatrics and the National Research Council defined behavioral and communication approaches as those that provide structure, direction, and organization for the children with ASD, in addition to the family. These approaches are Applied Behavior Analysis (ABA), Discrete Trial Training (DTT), Early Intensive Behavioral Intervention (EIBI), Pivotal Response Training (PRT), and Verbal Behavior Intervention (VBI). They also recommended that Developmental, Individual Differences, Relationship-Based Approach (DIR; also called "Floortime"), Treatment and Education of Autistic and related Communication-handicapped, Children (TEACCH), Occupational Therapy, Sensory Integration Therapy, Speech Therapy, and Picture Exchange Communication System (PECS) to be considered for children with ASD [17].

Complementary and Alternative Treatments (CAM) such as special diets, chelation (a treatment to remove heavy metals, like lead, from the body), biologicals (e.g., secretin), or body-based systems (like deep pressure) have been used to help children with ASD in combination with their medication. These therapies are controversial, and it is recommended that the use of such treatments should be done only in consultation with the child's physician [26,27].

Leslie and Martin reported the estimated cost of the health care expenditures for patients with ASD increased from 2000 to 2004 by about 20%. They reported that the average cost of health care for patients with ASD was $4,965 per patient in 2000 and

with the adjustment for inflation this cost increased to $5,979 per patient in 2004. The cost of health care for patients with ASD was higher than patients with other mental disorders, but the cost of ASD treatment had a smaller burden on health insurers due to relatively lower prevalence and treatment. They concluded that even with the earlier diagnoses and treatment of patients with ASD, the burden of care for ASD on the health care system will continue to increase [28].

Miller et. al. conducted a retrospective study of 15,175 later-born sibling of children who were diagnosed with ADHD, ASD, and no known diagnosis between 1995 and 2013 in US. They compared recurrence of ADHD or ASD among later-born siblings of those diagnosed with ADHD or ASD and siblings of those how have not been diagnosed with ADHD or ASD. They showed that later-born siblings of those with ADHD or ASD were more likely to be diagnosed with ADHD or ASD. This implies that later-born siblings of children with ASD appear to be at a higher risk of ADHD and vice versa. They also showed that the rate of ASD in later-born siblings of children diagnosed with ASD was about 12% and the rate of ASD among later-born siblings of children not diagnosed with ASD was about 0.45% [29].

Siegel and Gabriels reported that 11% of children who have been diagnosed with ASD were admitted to a psychiatric hospital unit by 21 years of age. These children were admitted due to behaviors such as aggression, self-injury, and tantrums. They indicated that there is some preliminary evidence that the specialized hospital psychiatry units designed for the patients with ASD are very effective for these children. In this article, they estimated that the one-year prevalence of children with ASD admitted to psychiatric hospitals is 1.3% to 7% in comparison to only 0.23% of privately insured children in the US that were admitted to psychiatric hospital. In one of the studies that they reviewed, children with ASD incurred over 12 times the cost for

psychiatric hospitalization than children without ASD and 10% of the children with ASD accounted for over 50% of the annual total cost of medical care [30].

Various organizations such as National Institute of Mental Health provide guidelines for treatment options including mental, emotional, and social health, to manage and treat ASD . They have indicated that a teams of healthcare providers should be part of the diagnoses of children with ASD and should also be part of the any type of treatment programs for these children as early as possible [16].

Brondino et. al., in a review article, described CAM as Biologically Based Treatments (BBT) and Nonbiologically Based CAM Treatments (NBBT). They defined the BBT's as Dietary Interventions, Nutraceuticals as well as Hyperbaric Oxygen Therapy and they defined the NBBT as Music Therapies, Auditory Integration Training, Sensory Integration Therapy, Drama Therapy, Dance Therapy, Acupuncture, Massage, Yoga, Pet Therapy, and Chiropractic Care. They concluded that the efficacy of CAM therapies in ASD patients' needs further investigation and they recommended that a large controlled randomized clinical trial will be needed to evaluate the efficacy of CAM therapies [26].

It has been reported that the use of CAM in children and adolescents in the US was about 12% during 2007-2012. This report also indicated that 28% to 51% of the children with ASD used CAM and the use of CAM was higher in families of Non-Hispanic whites, with a higher socio-economic status, and with parents who have higher education status. The majority of the families who reported the use of CAM treatments indicated that there was some improvement in their child's ASD symptoms, but they had some concern regarding the cost of CAM treatments [26,27].

Levy and Hyman determined that that the most effective treatment for patients with ASD is a combination of specialized CAM treatments. They also categorized

CAM treatments into supportive educational programming, communication training, social skills support, behavioral therapies, and other therapies such as occupational therapy. They reported that the children with ASD and other chronic diseases such as cancer and asthma are treated with CAM at a higher rate and that the most commonly reported reasons for the use of the CAM is concern for the side effects of medications. They concluded that health care providers should consider CAM therapies in combination with pharmacological treatment when they are treating patients with ASD [31].

Two studies one by Umbarger and one by Klein evaluated the scientific evidence of the efficacy of CAM treatments for ASD. He identified some of the interventions that showed promise among health care providers. These interventions are vitamin B_6, hippotherapy, and therapeutic riding. Other interventions were not recommended as beneficial therapies for ASD including facilitated communication and auditory integration training, dietary interventions, secretin, heavy-metal chelation, and dolphin-assisted therapy. He recommended the following for improving CAM interventions: Improve the quality of research; Improve the dependent variables to measure the behaviors that are associated with ASD; Services that have been validated regarding their efficacy for management of ASD; Recommend CAM treatments based on efficacy and validated research; Research studies must be randomized and include a control group; and Provide better and up to date availability of information on popular media. These therapies are controversial, and it is recommended that the use of such treatments should be done only in consultation with the child's physician [32, 33].

Whitehouse in a review article evaluated the rationale, safety, and efficacy of CAM treatments that have been used for ASD. He indicated that current evidence has shown that melatonin could be recommended as a treatment option to treat the sleep

disturbances symptom of ASD and rejected the secretin treatment for majority of children with ASD symptoms. He also concluded that there is no compelling evidence to support the efficacy of modified diets, vitamin and fatty acid supplementation, hyperbaric oxygen therapy, and immune therapy. He stated that there is a need for researchers to develop research studies to provide evidence of the safety and efficacy of CAM treatments and develop guidance to help health care providers as well as patient's families regarding these treatments for patients with ASD [34].

Xu et al. used data from the 2016 National Survey of Children's Health and evaluated the prevalence of CAM treatments for patients who had been diagnosed with ASD. They showed that the prevalence of ASD in the US was high, and there exist large variations in the prevalence of CAM across the US. The data suggested that about 30% of the children with ASD in US did not received any type of behavioral or medication treatments and there is a strong need to evaluate the underlining reason for these children's lack of treatment. They concluded from these findings that appropriate actions are require by health care providers, and state and federal governments to overcome these barriers, so that these children could receive much needed treatments for their ASD [35].

Zablotsky et. al. used the probability-base national sample of 2,077 children who were diagnosed with ASD, Intellectual Disability (ID) or both (ASD & ID). Their analysis using the weighted multivariate logistic regressions to examine the current medication and services that were used within each group. Their results showed that children who were diagnosed with both ASD and ID were significantly more likely to receive both medications and available services. The found that children who were diagnosed with multiple psychiatric disorders were more likely to receive medication, but not current available services. Finally, they also found that the parents of children

who were diagnosed with ASD and other co-existing psychiatric disorders were significantly more likely to report the unmet needs of their children in comparison with parents of children that were diagnosed with only ASD [36].

1.6. Relationship between Asthma and ASD

Strong epidemiological evidence has shown that acetaminophen use by mothers during late pregnancy and/or given to infants in the first year of life increases the risk of developing childhood asthma and related allergic disorders, which could be due to direct effects on immunological pathways or secondary effects such as through alterations in blood serotonin of glutathione. Fever has been shown to have a modifying effect on behaviors in patients with ASD, and acetaminophen has been used to treat childhood fever as well as symptoms associated with childhood infections and childhood vaccines [22,24].

As previously described ASD is a neurodevelopmental disorder, which has been categorized by abnormalities in social interaction, impairment in language and communication, restrictive or repetitive interests, and stereotyped behaviors as well as movements. ASD has been described as imbalance of immune and inflammatory processes and altered levels of cytokines, inflammatory markers and immunoglobulin have been found in ASD [2]. Several studies have shown that there is evidence of many immune-mediated conditions having frequent comorbidity with autism [23]. Asthma is an immune-mediated disorder that has been categorized as an inappropriate inflammatory response in the lungs. Some studies have shown a higher prevalence of asthma in children with ASD compared to controls [22]. Thus, there is a likelihood that asthma and ASD could result from related pathophysiological changes in the immune system [22, 23].

Multiple studies of autism have looked at genetic linkages including several that reported that there is an association between met proto-oncogene (MET) or hepatocyte growth factor receptor, and autism. MET regulates mast-cell activation (an immune cell) as a co-receptor with α2β1 integrin. Two genes that are involved in the MET signaling cascade and in the fibrinolytic system are SERPINE1 and PLAUR, which have been genetically associated with autism and asthma and play an important role in the pathogenesis of asthma [2, 4, 22, 23, 36, 37]. Other genetic association studies have shown that the polymorphisms in Integrin beta 3 (ITGB3) on chromosome 17 have been associated with multiple disorders, including autism and asthma [2, 22, 23]. The ADRB2, the beta-2 adrenergic receptor, which is a G protein-coupled receptor, influences many pathological states including asthma, obesity and Type 2 diabetes. It has been reported that the Glu27 allele of ADRB2 has association with autism and that polymorphism of ADRB2 is also associated with asthma disease severity and drug response [22, 23]. Together these indicate further potential linkages between asthma and ASD.

The result of NSCH survey showed that the prevalence of asthma increased by 21% between 2003 and 2011-2012 [37, 38]. Kotey et. al. used the 2007 NSCH data (N=77,951) to examine the co-occurrence of ASD and asthma. Their unadjusted analysis showed that the OR for asthma among children with ASD was 1.35 (95% CI : 1.03 – 1.36). The result of this cross-sectional study also showed that children with ASD are 35% more likely to suffer from asthma [39].

Zheng et. al. conducted a Meta-Analysis of 10 studies with a total of 175,406 participants. Individually, these 10 studies were split regarding an association between ASD and asthma. The result of the Meta-Analysis however, showed no association between ASD and asthma, but they indicated that the association between ASD and

asthma was plausible. They showed that the prevalence of asthma in ASD using the pooled OR from cross-sectional studies was 1.26 and from case-control studies was 0.98. They discussed that asthma has been characterized as chronic inflammation of pathways that are activated due to immune dysfunction, which also has been described as possible mechanisms related to the pathogenesis of ASD. Based on these findings they suggested that asthma and ASD could have common etiologies [21].

Based on currently available and an understanding of the pathophysiology of ASD and asthma and their disordered immune function, we believe there is association between ASD and asthma. The first purpose of this study was to look at the prevalence of children with ASD, asthma, and ASD and Asthma. Some studies have been done on the use of other services (i.e. CAM) in the treatment of either asthma and ASD but there have been no studies done looking at the use of these services in patients with dual diagnoses. Thus, we also evaluated the current use of additional services for children with asthma and children with both ASD and asthma. Based on this background information, we identified the following **SPECIFIC AIMS** for our study:

1.6.1. Specific Aim 1

Is there an association between Autism Spectrum Disorder (ASD) and Asthma?

Null Hypothesis H_0: There is no association between ASD and Asthma.

Alternative Hypothesis H_A: There is an association between ASD and Asthma.

1.6.2. Specific Aim 2

Will additional services in combination with Asthma medication have additional benefit in comparison with those that use medication only for management of their Asthma among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their Asthma.

Alternative Hypothesis H_A: There is an association in additional services for management of Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their Asthma.

1.6.3. Specific Aim 3

Will additional services in combination with ASD medication have additional benefit in comparison with those that use medication only for management of their ASD among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of ASD among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD.

Alternative Hypothesis H_A: There is an association in additional services for management of ASD among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD.

1.6.4. Specific Aim 4

Will the subjects with ASD + Asthma benefit from additional services in combination with their medication in comparison with those that use medication only for management of their ASD and asthma among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma.

Alternative Hypothesis H_A: There is an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma.

1.7. RESEARCH DESIGN AND METHODS

1.8. Methodology

This study was a retrospective study of 60,951 male and female children (ages 3-17) with a current diagnosis of ASD by their doctors and taking medication or a combination of medication and services for this condition which were part of the 71,811 survey of parents/caregivers of children and youth who participated as part of the National Survey of Children's Health (NSCH) survey during (NSCH) survey during 2016 – 2017 in USA.

The 2016 – 2017 National Survey of Children with Special Health Care Needs (NS-CSHCN) is a national mail and online survey that were conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NSHS). It is sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (3 – 17 years), family functioning, parental health status and neighbourhood and community characteristics, and a baseline daily diary to record

headache frequency and severity. No formal sample size and power analyses were conducted for this study.

The 2016-2017 NSCH were completed by parents/caregiver of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households with a weighted response rate of 41%. The 2017 survey was completed by 21,599 households from the sample of 59,135 households with a weighted response rate of 37%. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617).

CHAPTER 2: ASSOCIATION BETWEEN CHILDREN WITH AUTISM SPECTRUM DISORDER AND ASTHMA AMONG CHILDREN AGED 3 – 17

Abstract

Background and Purpose:

This study was a retrospective study of 60,951 male and female children (ages 3 – 17) with special health care needs who were living in United States of America (USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

Methods:

The 2016 – 2017 NS-CSHCN was a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It was sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6 – 17 years), family functioning, parental health status and neighborhood and community characteristics.

Results:

There were 31,218 (51%) males and 29,713 (49%) female children with the age range of 3 to 17 years old. The higher proportion of males and females were between 12 and 17 years old 47% and 48% respectively. Seventy percent of the children surveyed were White, 6% Black, 11% Hispanic, and 13% Non-Hispanic other. During this survey period, the proportion of male children with any Autism Spectrum Disorder (ASD) was higher than female children (4% vs. 1% respectively). The proportion of

male children who require prescription medication was slightly higher than female children (21% vs. 17% respectively) and the same trend was observed for elevated services, functional limitations, special therapies, ongoing emotional developmental behavioral conditions, and special care needs.

The proportion of children who were diagnosed with ASD and asthma was slightly higher than that of children who were not suffering from ASD (13% vs. 9% respectively). The proportion of male and female children who were diagnosed with ASD and asthma was the same (13%). The proportion of male subjects who were not suffering from ASD but were diagnosed with asthma was slightly higher than of females (10% vs. 8% respectively). The adjusted and unadjusted analysis shows that children who were diagnosed with ASD are more likely to suffer from asthma.

Conclusions:

Using unadjusted and adjusted analysis, we found evidence for an association between children with concurrent diagnoses of ASD and asthma among children aged 3 – 17 years old. There is a likelihood that asthma and ASD could result from related pathophysiological changes in the immune system since asthma is an immune-mediated disorder and ASD has been described as imbalance of immune and inflammatory processes. The association between diagnoses could indicate that children with either disorder has altered immune responses leading to a sensitivity to allergens, foods or chemicals in their environments that predisposes them to developing the other disorder. State and county health providers should consider evaluating their policy(ies) regarding the availability of special programs and monitoring the implementation of such programs for this population.

2 INTRODUCTION

Asthma is one of the most common chronic diseases among children 18 years old and younger (~ 5 million). The prevalence of asthma in children is 2:1 in comparison with adults. It has been reported that children with asthma miss over 12 million school days due to asthma each year [1]. Asthma is a complex hereditary disorder that affects the airways and cannot be cured but with the current available treatments, children with asthma can live a normal life [4,5]. Children who have chronic asthma (asthmatics), have inflamed walls in their airways and this inflammation makes their airways very sensitive to irritations and increases their susceptibility to an allergic reaction [3]. Since this type of inflammation causes the airways to become narrower, less air can pass through them to the lungs. Asthmatic children have symptoms that can include wheezing, chest tightness, breathing problems, and coughing which they experience with higher frequently during the night and the early morning [3]. There are many studies that have been done over the past 40 years demonstrating various genetic linkages with the asthma phenotype [3,4].

Autism Spectrum Disorder (ASD) is a neurodevelopment group of disorders with symptoms including language impairments, social and communication deficiency and repetitive behaviors. ASD has an onset age of < 3 years old and affects one out of 2,500 children [2]. The results of NSCH survey showed that the prevalence of ASD increased by 32% between 2007 and 2011-2012. ASD patients may exhibit communication difficulties, repetitive behaviors, and levels of disability that inhibit the individual's ability to function socially, at school or work, or other areas of life [16, 17,36].

Some of the patients with ASD have mild impairment because of their symptoms, but others are severely disabled. Symptoms and the ability of patients with ASD to function can be improved with treatments and services [8].

Several studies have shown that there is an immunological involvement in children with ASD and these systemic immunologic aberrations have been linked with both autoimmunity, in the central nervous system (CNS) leading to neuronal tissue destruction and abnormal immune cells and their function [18].

Several reports have shown that there are imbalances between immune and inflammatory processes in patients with ASD, which includes aberrations in antibody levels, cytokines, and cellular subsets. Recent reports have also described an increased frequency of HLA-A2 and HLA-DR4 antigens in patients with ASD [20]. A study done by Shao et. al. showed that there are statistically significant associations between maternal autoimmune diseases developed during pregnancy or maternal thyroid disease and the risk of ASD in offspring and maternal autoimmune disease is likely to be an independent risk factor of ASD in offspring [20].

Both ASD and asthma patients have dysfunctional immune systems. Several studies have been done previously looking at dual diagnoses, but the collective results have produced mixed outcomes. Some studies indicate an association while others do not [20,22]. Thus, this study has utilized the large dataset available from the NSCH survey to reexamine a possible association and more clearly understand the potential linkage between these two disorders.

2.1. Methods

This study was a retrospective study of 60,951 male and female children (ages 3 – 17) with special health care needs who were living in United States of America

(USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

The 2016 – 2017 NS-CSHCN was a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It was sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. The 2016-2017 NSCH were completed by parents/caregiver of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households with a weighted response rate of 41%. The 2017 survey was completed by 21,599 households from the sample of 59,135 households with a weighted response rate of 37%. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617). There were 10,860 children who did not responded to the ASD or asthma questions and they were not included in our analysis.

2.2. Measures

The Questionnaire that was used for this survey had topics such as demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6–17years), family functioning, parental health status and neighborhood and community characteristics. The current ASD and asthma conditions were collected from parents/caregiver of the child. Parents/caregivers were required to

respond to the question truthfully and accurately regarding the status and diagnoses of their child. The question used in determining diagnosis of ASD asked whether a doctor or healthcare provider had ever diagnosed the (your) child with ASD. The possible responses that were available on the questionnaire were: Do not currently have; Ever told, but not current; Currently have autism.

The possible responses to the questions regarding having ASD and asthma were "Do not currently have", "Ever told, but not current", "Currently have". There were 1664 children who have responded "Currently have autism" and 59,287 children who were not diagnosed with ASD. Among children who were suffering from ASD, 216 of them were diagnosed with asthma . There were 5,224 children who were not diagnosed with ASD but were diagnosed with asthma. The same type of question was asked regarding asthma diagnosis and we selected only those children that were identified as "Currently have asthma" in our analysis. The severity of ASD and asthma for those children with these conditions was collected by using the following possible responses: Current autism rated mild; Current autism rated moderate/severe; Current asthma rated mild; Current asthma rated moderate/severe.

The parents/caregivers were also asked regarding their child's qualification for needing "Specific Types of Special Health Care Needs" and they were required to select one of the following responses: None; With functional limitations; With conditions managed by prescription medication ONLY; Service use ONLY; With conditions managed by prescription medications AND service use needs.

We selected those children who were identified as "With conditions managed by prescription medication only" and called that group "Rx Medication Only". We combined those children who were identified as " Services use only" or "With

conditions managed by prescription medications AND service use need" as one category that was called "Rx Medication & Services used".

2.3. Covariates

The association between ASD and asthma was evaluated using 7 different models with the adjustments for Age, Race, Sex, Emotional and Developmental or Behavioral Conditions, Functional Limitation, and Social Economic Status. The Social Economic Status was derived from the responses to "Children live in working poor households (parent's income less than 100% FPL)" question. The possible responses for this question were "Does not live in 'working poor' HH" which we defined it as "No" and "Lives in 'working poor' household" which we defined it as "Yes".

2.4. Statistical Analyses

All analyses were performed after all subjects completed the survey and the database was available. The primary population of interest for this study was children 3 to 17 years old who were surveyed during the 2016 – 2017 NSCH. The primary comparison of interest was the proportion of children who were diagnosed with ASD and Asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using weighted and unweighted methods and as a sensitivity analysis we used GENMOD procedure for Generalized Estimating Equations [40]. The statistical significance of each variable was measured using Mantel-Haenzel $\chi 2$ statistics. For statistical analyses, all tests were two-sided with significance interpreted at the $\alpha=0.05$ significance level and all analyses were conducted using SAS version 9.4.

Once collected, all data were assessed for missing and nonsensical data. All missing data were confirmed with the original data collection forms and corrected in the database if it was possible. Subjects missing data for the primary outcome were not

included in the primary analysis (unweighted analysis). All continuous variables such as age and number of days were categorized by NSCH data center and the defined categories were included in the database. Demographic characteristics were summarized by sex, categorical variables were presented by counts and percentages.

2.5. REGULATORY AND ETHICAL CONSIDERATIONS

2.5.1. Ethical Conduct of the Study and Ethics Approval

This study was conducted in accordance with "good clinical practice" (GCP) and all applicable regulatory requirements, including, where applicable, the 2008 version of the Declaration of Helsinki. This study uses only de-identified data from a dataset created by NS-CSHCN.

2.5.2. Confidentiality

The personal and medical information collected on subjects in this study were de-identified and kept confidential.

2.6. Results

2.6.1. Subject Accountability

A total of 60,951 children aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children Health and responded to ASD and asthma questions were part of the unweighted and GENMOD analyses, but the weighted analyses were conducted on 71,811 who were surveyed in the NSCH survey.

2.6.2. Demographic and Baseline Characteristics

There were 31,218 (51%) males and 29,713 (49%) female children within the age range of 3 to 17 years old. The higher proportion of males and female were between 12 and 17 years old 47% and 48% respectively. Seventy percent of the children surveyed were White with 6% Black, 11% Hispanic, and 13% Non-Hispanic other.

Seventy-two percent of the children who were surveyed during the 2016 – 2017 survey were living with both parents and 25% of the children were Special Health Care Needs. Table 1 (and Figure 1) shows the summary of the demographics and baseline characteristics.

Table 1: Demographics Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have ASD and Asthma

Baseline	Male (N=31238) n (%)	Female (N=29713) n (%)
Current Age (Years)		
≤ 5	5563 (18)	5103 (17)
6 – 11	10903 (35)	10326 (35)
12 – 17	14772 (47)	14284 (48)
Race		
Non-Hispanic White	21951 (70)	20630 (69)
Non-Hispanic Black	1929 (6)	1773 (6)
Hispanic	3474 (11)	3310 (11)
Non-Hispanic Multi-racial/Other	3884 (13)	4000 (14)
Family Structure		
Two parents currently married	22602 (72)	21402 (72)
Two parents not currently married	1964 (6)	1796 (6)
Single mother	3845 (12)	3875 (13)
Other family type	2284 (7)	2162 (7)
Missing	543 (2)	478 (2)
Children with Special Health Care Needs (CSHCN)		
Yes	8590 (27)	6670 (22)
No	22648 (73)	23043 (78)

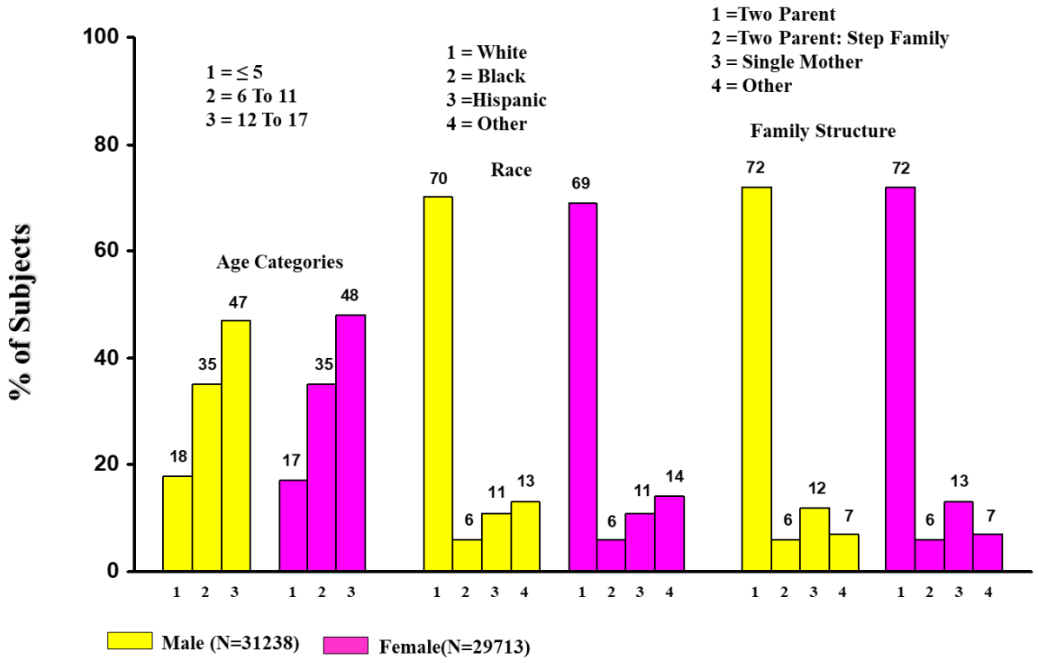

Figure 1: Demographics Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have ASD and Asthma

Table 2 shows the baseline characteristics of 60,951 children and their diagnosis that were surveyed during 2016 – 2017 National Survey of Children Health. During this survey period, the proportion of male children with ASD was higher than female children (4% vs. 1% respectively). Over all severity of the ASD in both groups was the same within the mild and moderate/severe categories. The proportion of male children who require prescription medication was slightly higher than female children (21% vs. 17% respectively) and the same trends were observed for elevated services, functional limitations, special therapies, ongoing emotional developmental behavioral conditions, and special care needs.

Table 2: Baseline Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have ASD and Asthma

Baseline	Male (N=31238) n (%)	Female (N=29713) n (%)
Qualified on RX Medication Use		
Yes	6470 (21)	5162 (17)
No	24768 (79)	24551 (83)
Qualified on elevated service use or need		
Yes	4545 (15)	3119 (10)
No	26693 (85)	26594 (90)
Qualified on Functional Limitations		
Yes	2196 (7)	1300 (4)
No	29042 (93)	28413 (96)
Qualified on Special Therapies		
Yes	2252 (7)	1248 (4)
No	28986 (93)	28465 (96)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	3822 (12)	2691 (9)
No	27416 (88)	27022 (91)
Children Qualified as having Specific Types of Special Health Care Needs		
None	22648 (73)	23043 (78)
With functional limitations	2196 (7)	1300 (4)
With conditions managed by prescription medication ONLY	2676 (9)	2348 (8)
Service use ONLY	1321 (4)	1081 (4)
With conditions managed by prescription medications AND service use needs	2397 (8)	1941 (7)
With and without emotional, developmental and/or behavioral health special needs		
Qualifying on Mental health needs	3822 (12)	2691 (9)
Not qualifying on Mental health needs	4768 (15)	3979 (13)
None	22648 (73)	23043 (78)
Children currently have autism or autism spectrum disorder, **age 3 – 17**		
Do not currently have	29798 (95)	29360 (99)
Ever told, but not current	102 (< 1)	27 (< 1)
Currently have autism	1338 (4)	326 (1)
Severity of current autism, **age 3 – 17**		
Does not currently have autism	29900 (96)	29387 (99)
Current autism rated mild	663 (2)	176 (1)
Current autism rated moderate/severe	659 (2)	147 (< 1)
Missing	16 (< 1)	3 (< 1)

Table 3 (and Figure 2) shows the Physical, Emotional & Mental Health of the children and their diagnosis. During this survey period, the proportions of male and female children for whom it was reported that their health is in excellent/very good condition were the same. The proportion of children with learning disabilities was also the same among male and female children. The proportion of male children who were diagnosed with asthma was higher than the proportion of female children (10% vs. 8% respectively) and the same trend was observed for other chronic health conditions. Overall, the severity of asthma in both groups was the same within the mild and moderate/severe categories.

Table 3: Physical, Emotional & Mental Health of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have ASD and Asthma

Physical, Emotional & Mental Health	Male (N=31238) n (%)	Female (N=29713) n (%)
Physical Health of Children		
Excellent/very good	28462 (91)	27257 (92)
Good	2319 (7)	2037 (7)
Fair/poor	395 (1)	365 (1)
Missing	62 (< 1)	54 (<1)
Children with Learning Disability		
Does not have condition	30662 (98)	29346 (99)
Ever told, but does not currently have condition	12 (< 1)	5 (< 1)
Currently has condition	433 (1)	256 (1)
Missing	131 (< 1)	106 (< 1)
Children with Asthma		
Does not have condition	26343 (84)	26211 (88)
Ever told, but does not currently have condition	1825 (6)	1132 (4)
Currently has condition	3070 (10)	2370 (8)
Severity of current asthma, **age 3 – 17**		
Does not currently have asthma	28168 (90)	27343 (92)
Current asthma rated mild	2211 (7)	1631 (5)
Current asthma rated moderate/severe	848 (3)	728 (3)
Missing	11 (<1)	11 (< 1)
Children with one or more Current Chronic Health Conditions		
Does not have any current chronic health conditions from the list of 18 asked	16066 (52)	17385 (58)
Currently has 1 chronic health conditions from the list of 18 asked	6927 (22)	6402 (22)
Currently has 2 or more chronic health conditions from the list of 18 asked	8245 (26)	5926 (20)
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	27221 (87)	27017 (91)
Yes, on meds for emotions etc.	3696 (12)	2397 (8)
Missing	321 (1)	299 (1)

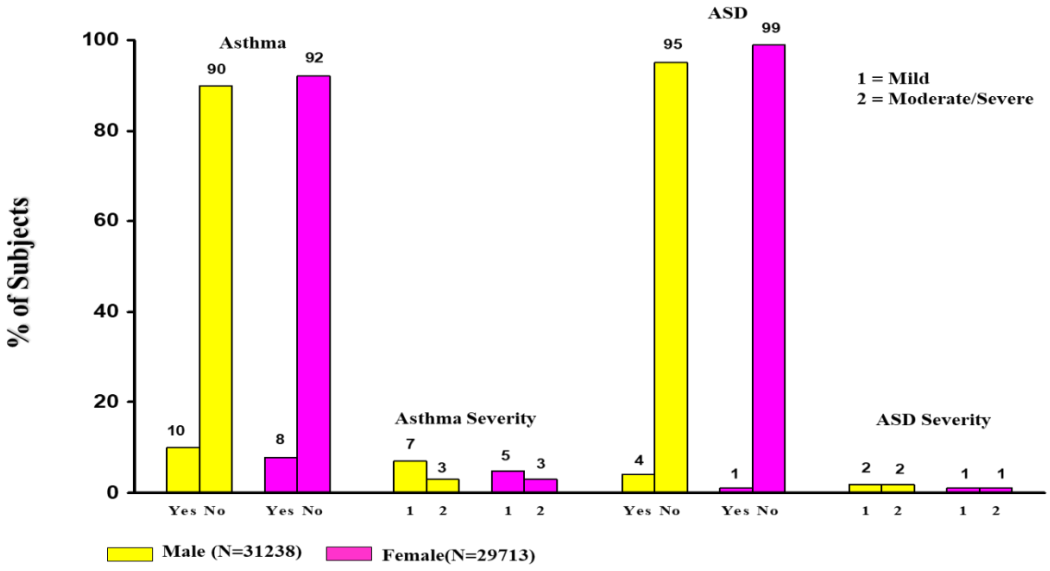

Figure 2: Physical, Emotional & Mental Health of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have ASD and Asthma

2.7. SPECIFIC OUTCOMES RESULT

Primary Analysis

The primary analysis was the proportion of children who were diagnosed with Autism Spectrum Disorder and asthma among children aged 3 – 17 years.

Table 4 (Figure 3) shows the summary of children who were diagnosed with ASD as well as asthma by their doctors. The proportion of children who were diagnosed with ASD and asthma were slightly higher than children who were not suffering from ASD (13% vs. 9% respectively). The unadjusted analyses from all 3 methods (Unweighted, Weighted, and GEE from GENMOD) show that children who were diagnosed with ASD are more likely to suffer from asthma.

Table 4: Proportion of subjects with ASD Asthma: Unadjusted Analysis

	Children with ASD	
	Yes (N = 1664)	No (N = 59287)
Children with Asthma Yes No	 216 (13%) 1448 (87%)	 5224 (9%) 54063 (91%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 1.54 (1.33 – 1.80) < 0.0001	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 2.25 (1.48 – 3.42) < 0.0001	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 1.55 (1.33 – 1.79) < 0.0001	

Model 1 Children with ASD = Asthma;
*Using χ^2 test

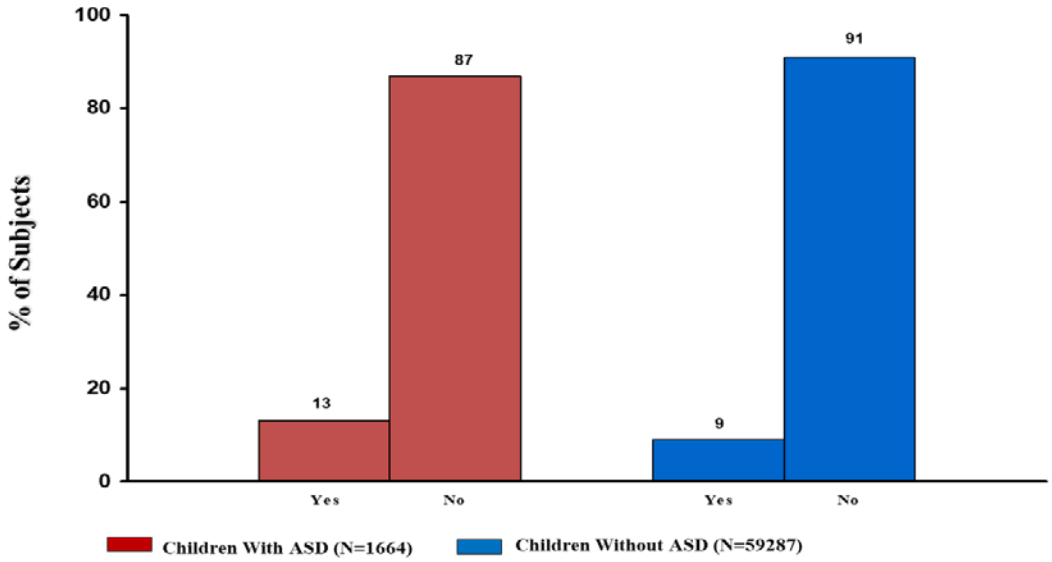

Figure 3: Proportion of subjects with ASD and Asthma: Unadjusted Analysis

Table 5 shows by sex, a summary of children who were diagnosed with ASD, as well as asthma by their doctors. The proportion of male and female children who were diagnosed with ASD and asthma were the same (13%). The proportion of male subjects who were not suffering from ASD, but that were diagnosed with asthma was slightly higher that of females (10% vs. 8% respectively). The unadjusted analyses from all 3 methods (Unweighted, Weighted, and GEE from GENMOD) show that male and female children who were diagnosed with ASD are more likely to suffer from asthma.

Table 5: Proportion of subjects with ASD and Asthma: By Sex

	Children with ASD			
	Male (N=31238)		Female (N=29713)	
	Yes (N = 1338)	No (N = 29900)	Yes (N = 326)	No (N = 29387)
Children with Asthma				
Yes	175 (13%)	2895 (10%)	41 (13%)	2329 (8%)
No	1163 (87%)	27005 (90%)	285 (87%)	27058 (92%)
Model 1: Unweighted Analysis Using logistic				
Odds Ratio (95% CI)	1.40 (1.20 – 1.70)		1.67 (1.20 – 2.33)	
P-Value*	< 0.0001		0.0023	
Model 1: Weighted Analysis Using Surveylogistic				
Odds Ratio (95% CI)	2.12 (1.31 – 3.43)		2.01 (0.98 – 4.13)	
P-Value*	< 0.0001		< 0.0001	
Model 1 :GEE Using GENMOD Analysis				
Odds Ratio (95% CI)	1.40 (1.20 – 1.65)		1.67 (1.20 – 2.32)	
P-Value*	< 0.0001		0.0023	

Model 1 Children with ASD = Asthma;
*Using χ^2 test

Additional adjusted analyses using 3 different methods (Unweighted, Weighted, and GEE from GENMOD) on pre-specified variables had similar results as the unadjusted analysis. Seven different models were used to examine the effects of these covariates on the association between children who were diagnosed with ASD and asthma (Table 6).

Table 6: Proportion of subjects with ASD and Asthma: Adjusted Analysis

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	2.25 (1.48 – 3.42)	1.54 (1.33 – 1.80)	1.55 (1.33 – 1.79)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	2.10 (1.39 – 3.178)	1.45 (1.25 – 1.70)	1.45 (1.25 – 1.68)
P-Value*	0.0005	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.27 (0.193 – 0.38)	0.25 (0.22 – 0.28)	0.25 (0.22 – 0.28)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	2.21 (1.46 – 3.34)	1.54 (1.33 – 1.80)	1.54 (1.33 – 1.78)
P-Value*	0.0002	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.20 (1.46 – 3.34)	1.02 (0.92 – 1.13)	1.02 (0.91 – 1.13)
P-Value*	> 0.05	< 0.0001	> 0.05
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	2.19 (1.46 – 3.30)	1.51 (1.30 – 1.74)	1.51 (1.30 – 1.74)
P-Value*	0.0002	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.25 (1.10 – 1.46)	1.26 (1.18 – 1.35)	1.26 (1.18 – 1.35)
P-Value*	0.0042	< 0.0001	< 0.0001
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	2.02 (1.34 – 3.024)	1.42 (1.22 – 1.64)	1.41 (1.22 – 1.64)
P-Value*	0.0007	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.26 (1.10 – 1.50)	1.28 (1.19 – 1.37)	1.28 (1.20 – 1.37)
P-Value*	0.0034	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.22 (0.94 – 1.60)	1.04 (0.94 – 1.16)	1.04 (0.94 – 1.16)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.27 (0.20 – 0.38)	0.248 (0.22 – 0.28)	0.25 (0.22 – 0.28)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 6 Adjusted for:			
Odds Ratio (95% CI)	0.86 (0.57 – 1.29)	0.75 (0.63 – 0.89)	0.75 (0.63 – 0.90)
P-Value*	> 0.05	0.0012	0.0021
Age			
Odds Ratio (95% CI)	1.20 (0.95 – 1.44)	1.15 (1.06 – 1.25)	1.15 (1.06 – 1.25)
P-Value*	> 0.05	0.0012	0.0012
Race			
Odds Ratio (95% CI)	1.13 (0.86 – 1.50)	0.95 (0.83 – 1.07)	0.94 (0.83 – 1.07)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.34 (0.24 – 0.47)	0.280 (0.24 – 0.32)	0.28 (0.24 – 0.32)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Emotional and developmental or behavioral conditions	16.40 (11.64 – 23.12)	14.39 (12.51 – 16.55)	14.39 (12.33 – 16.78)
Odds Ratio (95% CI)	< 0.0001	< 0.0001	< 0.0001
P-Value*			
Functional Limitation	7.43 (5.49 – 10.05)	8.17 (7.18 – 9.29)	8.17 (7.08 – 9.42)
Odds Ratio (95% CI)	< 0.0001	< 0.0001	< 0.0001
P-Value*			
Social Economic Status	1.19 (0.85 – 1.66)	1.17 (1.03 – 1.32)	1.17 (1.03 – 1.32)
Odds Ratio (95% CI)	> 0.05	0.0137	0.017
P-Value*			
Model 7 Adjusted for:			
Odds Ratio (95% CI)	1.94 (1.30 – 2.90)	1.40 (1.20 – 1.60)	1.37 (1.18 – 1.58)
P-Value*	0.001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.25 (1.10 – 1.45)	1.30 (1.20 – 1.36)	1.26 (1.18 – 1.58)
P-Value*	0.0051	< 0.0001	< 0.0001
Social Economic Status			
Odds Ratio (95% CI)	2.41 (1.85 – 3.15)	2.40 (2.15 – 2.63)	2.37 (2.15 – 2.63)
P-Value*	< 0.0001	< 0.0001	< 0.0001

Model 1 Children with ASD = Asthma; Model 2: Children with ASD = Asthma Sex;
Model 3: Children with ASD = Asthma Race; Model 4: Children with ASD = Asthma Age;
Model 5: Children with ASD = Asthma Age Race Sex;
Model 6: Children with ASD = Asthma Age Race Sex Emotional and developmental or behavioural conditions Functional Limitation Social Economic Status; Model 7(Final): Children with ASD = Asthma Age Social Economic Status
* Using χ^2 test

2.8. DISCUSSION

There are several reports that indicate that abnormalities in the immune system could play a role in ASD. These abnormalities have been found at the molecular, physiological, and epidemiological level. The autopsies of brain tissues of ASD patients have shown some alteration in levels of immunoglobulins, cytokines and, inflammatory markers. These abnormalities have been identified in the serum and cerebral spinal fluid as well. In addition, gastrointestinal inflammation as well as pathological evidence of neuroinflammation in ASD patients has been shown to activate brain microglia [22].

Children with ASD have shown differential monocyte responses to Toll-like receptors (TLR), which suggests the involvement of innate immune pathways [2]. Activation of TLR2 inhibits embryonic neural progenitor cell proliferation resulting in cortical dysgenesis in vitro and in utero in a mouse model [2]. Evidence from epidemiological studies have shown immune involvement and increased frequency of autoimmune disorders in family members of ASD patients [22]. This is the first retrospective study to examine the association between ASD and Asthma using the NSCH 2016-2017 survey data. The results of this study demonstrate that there is an association in concurrent diagnoses of ASD and Asthma among children aged 3 – 17 years old.

During this survey, many aspects of children's health were examined including physical, emotional, behavioral health, as well as normal daily activities. Over 80% of the children who were included in this survey period were school aged children (6 – 17 years old) in Excellent/very good physical health. Greater than 85% of the children were born at normal weight and about 10% of the children were born premature. The proportion of children with learning disabilities was very low (1%) and the proportion of children with one or more current chronic health conditions was 45%.

The proportion of children who were diagnosed with asthma was 9% and about 3% of children were diagnosed with ASD. The adjusted and unadjusted analysis showed that there is strong evidence for an association between children with concurrent diagnoses of ASD and asthma among children aged 3 – 17 years old. Subjects who were diagnosed with ASD reported the severity of their ASD as mild and moderate /severe (50% vs. 50% respectively) and of these, 13% have reported that they were suffering from asthma. Subjects who were diagnosed with asthma reported the severity of their asthma as mild (71%) and moderate /severe (29%).

Our results provide evidence that there is an association in concurrent diagnoses of ASD and asthma among children aged 3 – 17 years old. There is a likelihood that asthma and ASD could result from related underlying pathophysiological changes in the immune system since asthma is an immune-mediated disorder and ASD has been described as imbalance of immune and inflammatory processes. The association between diagnoses could indicate that children with either disorder has altered immune responses that predisposes them to developing the other disorder.

The Center for Autism & Related Disorders provides several services specific Autism such as Applied Behavior Analysis, Diagnosis & Assessment, Center-Based Services, Specialized Outpatient Services, Remote Clinical Services, and Child Services for children with ASD, but some of these programs are not well known to everyone and thus, this organization should be more proactive in promoting and monitoring their services (https://www.centerforautism.com/services).

The Autism Society of North Carolina (ASNC) provides several different toolkits such as Behavior & the Individualized Education Program, Bullying, Accessing Services, Residential Options, and Health information to the families of the children with ASD. ASNC has acknowledged that the services and supports systems for autistic

children and their families are complex and could be difficult to navigate. The toolkits that they have available provide help to the parents/caregivers so they can understand the type of the services and supports that are available and how they can obtain them.

The North Carolina Public Health department has developed an asthma program to help children who are suffering from asthma. The goal of this program is to reduce the burden of asthma for asthmatic children and their family(s) by developing and maintaining a statewide asthma surveillance program, developing and implementing an asthma plan, increasing the public awareness for the support of policies, providing technical assistant to local asthma coalitions, and providing support to the Asthma Alliance of North Carolina (https://www.asthma.ncdhhs.gov/).

Each of these organizations is providing information and services for one disorder and does not consider that children with these diagnoses may have more than one disorder. Based on the results presented here that there is an association between ASD and asthma, state and county health providers should consider those individuals with dual diagnoses when evaluating their policy(ies) regarding the availability of special programs and monitoring the implementation of such programs for this population.

Future directions for providing health services to young children with these types of special health care needs should include exploration of the gender specific needs and the underlying deficiencies. Future research should look at other health care needs in this population such as dental and mental health issues. Our results could be helpful for enhancing future Health Services programs for this population.

2.9. Strengths and Limitations

A strength of this study is that there is a complicated and detailed adjudication process for identifying the children with ASD and asthma. This study focused on

children who were diagnosed with ASD and asthma by their caregivers and could be good candidates for services that address both conditions simultaneously. The survey was completed by the parents of children and the data were processed and coded by The Data Resource Center for Child and Adolescent Health (DRC). The DRC is sponsored by the Maternal and Child Health Bureau and is led by the Child and Adolescent Health Measurement Initiative (CAHMI) based at the Oregon Health and Science University in Portland, Oregon. It is located online at www.childhealthdata.org.

Limitations of this research include the lack of medical history for maternal asthma or familial history of siblings with ASD (with or without asthma), which could increase the risk of developing ASD. There are several research studies that have looked at/are looking for an association between asthma medications taken during the pregnancy and risk of ASD in children after the birth. Other limitations with this data are parents/caregivers recall biases regarding the responses to the diagnoses and treatments that they reported for their children, the possibility that treatment or service periods were not reported, and that the weighted response rate for this survey period was lower than for other periods (41% vs. 72%) which shows a nonresponse bias.

CHAPTER 3: ASSOCIATION BETWEEN SEVERITY OF ASTHMA AND THE USE OF ADDITIONAL SERVICES ALONE OR IN COMBINATION WITH PRESCRIPTION (Rx) MEDICATION FOR MANAGEMENT OF ASTHMA AMONG CHILDREN AGED 3 – 17

Abstract

Background and Purpose:

This study was a retrospective study to determine the association between the severity of their disease and the use of additional services in combination with prescription medication for the 5,440 asthmatic male and female children (ages 3 – 17) with special health care needs who were living in United States of America (USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

Methods:

The 2016 – 2017 NS-CSHCN provides a broad range of information about children's health and well-being collected in a manner that allows comparisons nationally as we as among states. It is a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It is sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6 – 17 years), family functioning, parental health status and neighborhood and community characteristics.

Results:

There were 3,070 (56%) males and 2,370 (44%) female asthmatic children with the age range of 3 to 17 years old. The highest proportions of males and females were between 12 and 17 years old; 49% and 58% respectively. Sixty-three percent of the asthmatic children surveyed were White, 12% Black, 12% Hispanic, and 13% Non-

Hispanic other. During this survey period, the proportion of asthmatic children with special health care needs were 71%. The proportion of asthmatic male and female children who require prescription medication was the same (66%). The proportion of male children who require elevated services was slightly higher than female children (32% vs. 26% respectively) and the same trend was observed for, functional limitations, special therapies, and ongoing emotional developmental behavioral conditions.

The proportion of male children who were diagnosed with mild asthma was slightly higher than that of female children (72% vs. 69% respectively). The proportion of children who were suffering from asthma and utilized additional services was lower than children who had other conditions and utilized additional services (40% vs. 64% respectively). The proportion of mild asthmatic children that utilized additional services in combination with their prescription (Rx) medication was lower than that of children who used Rx medication for the management of their asthma (63% vs. 73% respectively). The proportion of moderate/severe asthmatic children that utilized additional services in combination with their Rx medication was higher than that of children who used Rx medication for the management of their asthma (37% vs. 27% respectively). The unadjusted analysis shows that children who were diagnosed with moderate/severe asthma are more likely to utilize additional services in combination with their Rx medication for the management of their asthma.

Conclusions:

Using unadjusted and adjusted analyses, we found evidence for an association between severity of asthma and utilizing additional services in combination with Rx medication among asthmatic children aged 3 – 17 years old.

3 INTRODUCTION

Asthma is one of the most complex hereditary and uncurable disorders affecting the airways. The current available treatments are very effective in helping children with asthma to have a normal life. Over 5 million children aged 18 years old and younger suffer from chronic asthma. The prevalence of asthma in children is 2:1 in comparison with adults. It has been reported that children with asthma miss over 12 million school days due to asthma each year [1]. Asthmatics (chronic asthma) children, have inflamed walls in their airways and this inflammation makes their airways very sensitive to irritations and increases their susceptibility to an allergic reaction. Less air can pass through to the lungs due to this type of inflammation which causes the airways to become narrower. Asthmatic children have several symptoms such as wheezing, chest tightness, breathing problems, and coughing which they experience with higher frequently during the night and the early morning [5,6].

Eleven Americans die from asthma every day based on the asthma death rate reported between 1980 and 1996 but this rate has been declining since 2000. Sixth-four percent of all asthmatics patients who die from asthma are female but the proportion of boys (<18 years old) that die each year from asthma is higher than girls (<18 years old) [1]. The burden of asthma on the US health system is very high with about 13 million outpatient visits and 2 million trips to the emergency room per year. Based on the Asthma and Allergy Foundation of America (AAFA) estimate, the annual cost of asthma is approximately $19.7 billion with about $10 billion in direct health care costs (hospitalizations) and about $8 billion for indirect costs such as lost earnings due to asthma or death. Asthma is the fourth leading cause of missed school and low work

productivity, which resulted in approximately 12 million missed or less productive workdays each year [1].

There was an increase in the prevalence of asthma during the 1980s and 1990. The federal health agencies responded to this increase by introducing the National Asthma Education and Prevention Program (NAEPP), which is controlled by the National Institutes of Health's National Heart, Lung, and Blood Institute. They issued the first guidelines regarding the diagnosis and management of asthma. These guidelines were updated in 1997 and 2007 to reflect new research findings. A group of scientists from the CDC and federal, state, and other agencies were tasked in 1998 with discovering more ways to control asthma [3]. The result of NSCH survey showed that the prevalence of asthma increased by 21% between 2003 and 2011-2012 [37, 38].

The pathophysiology of asthma is not well defined but the autopsy of the lungs of patients who have died from asthma shows significant inflation of their lungs which appears as dramatic distention of the alveoli when viewed microscopically [4,5,6]. The airways of the patients who have been diagnosed with asthma are very responsive to variety of external and internal stimulants. The airway inflammation of the asthmatic patient is characterized by increases in the number of eosinophils, T cells, and mast cells in the airway mucosa and loss of integrity of the airway epithelium [5,6]. Chronic inflammation of the airways results in a loss of airway elasticity, which causes the airways to easily inflate. However, this also decreases their ability to recoil and reduces airflow out of the lungs, which on autopsy is seen as over inflation.

The pharmaceutical medication for asthma has been well developed but the most important reported concern of patients with asthma are the side effects of these medications, especially for females of child bearing potential. Some studies have shown that children of mothers that took asthma medication during their pregnancy have a

higher risk of developing ASD [8,9,10]. These patients, as well as other patients who prefer to minimize the side effects of their asthma medication, look for other alternatives to reduce the amount of their asthma medication. For sustainable and effective asthma management, patients must carry out very complex medication plans such as changes in home environment, monitoring their asthma symptoms, understanding the effect and availabilities of complementary therapies for asthma as well as coordination among different providers. According to the National Heart, Lung, and Blood Institute (NHLBI) guidelines, clinicians must teach their patients these important skills by integrating and reinforcing patient education into every step of their clinical care [3]. Examining the association between asthma and the use of additional services (i.e. CAM) in conjunction with medications may promote efforts to implement more strategies using additional treatments in this subpopulation. Therefore, the aim of this study was to systematically review the prevalence of the use of additional services as part of their treatment, in those children with asthma in the NSCH survey 2016-2017.

3.1. Methods

This study was a retrospective study to determine the association between the severity of their disease and the use of additional services in combination with prescription medication for the 5,440 asthmatic male and female children (ages 3 – 17) with special health care needs who were living in United States of America (USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

This study used the 2016 – 2017 NS-CSHCN. This was a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health

Statistics. It was sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides information regarding children's health and well-being, collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics that are included in this survey are; demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (3 – 17 years), family functioning, parental health status and neighborhood and community characteristics. No formal sample size and power analyses were conducted for this study.

The 2016-2017 NSCH was completed by parents/caregiver of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households with the weighted response rate of 41%. The 2017 survey was completed by 21,599 households from the sample of 59,135 households with the weighted response rate of 37%. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617).

3.2. Methods

The Questionnaire that was used for this survey had topics such as demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6–17years), family functioning, parental health status and neighborhood and community characteristics. Parents/caregivers provided the information regarding their children's current asthma conditions. They were

(parents/caregivers) asked to respond to the question truthfully and accurately regarding their children's status and diagnoses as well as whether a doctor or healthcare provider had ever diagnosed their child with asthma. The possible responses that were available on the questionnaire regarding asthma diagnosis were: "Do not currently have; Ever told, but not current; Currently have asthma". We selected those children that were identified as "Currently have asthma" in our analysis. The severity of asthma for those children with this condition was collected by using the following possible responses: Current asthma rated mild; Current asthma rated moderate/severe.

The parents/caregivers were also asked about their child's qualification for needing "Specific Types of Special Health Care Needs" and they were required to select one of the following responses: None; With functional limitations; With conditions managed by prescription medication ONLY; Service use ONLY; With conditions managed by prescription medications AND service use needs.

We selected those children that were identified as "With conditions managed by prescription medication only" and those children were in a group called "Rx Medication Only". We combined those children identified as " Services use only" or "With conditions managed by prescription medications AND service use need" as one category called "Rx Medication & Services used".

3.3. Covariates

The association between severity of asthma and management method was evaluated using 7 different models with the adjustments for Age, Race, Sex, Emotional and Developmental or Behavioral Conditions, Functional Limitation, and Social Economic Status. The Social Economic Status was derived from the responses to "Children live in working poor households (parent's income less than 100% FPL)" question. The possible responses for this question were "Does not live in 'working poor'

HH” which we defined it as “No” and “Lives in 'working poor' household” which we defined it as “Yes”.

3.4. Statistical Analyses

All analyses were performed after all subjects completed the survey and the database was available. The primary population of interest for this study was children 3 to 17 years old who were surveyed during the 2016 – 2017 NSCH. The primary comparison of interest was the proportion of children who were diagnosed with asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using weighted and unweighted methods and as a sensitivity analysis we used GENMOD procedure for Generalized Estimating Equations [40]. The statistical significance of each variable was measured using Mantel-Haenzel $\chi 2$ statistics. For statistical analyses, all tests were two-sided with significance interpreted at the $\alpha=0.05$ significance level and all analyses were conducted using SAS version 9.4.

Once collected, all data were assessed for missing and nonsensical data. All missing data were confirmed with the original data collection forms and corrected in the database if it was possible. Subjects missing data for the primary outcome were not included in the primary analysis (unweighted analysis). All continuous variables such as age and number of days were categorized by NSCH data center and the defined categories were included in the database. Demographic characteristics were summarized by sex, categorical variables were presented by counts and percentages.

3.5. REGULATORY AND ETHICAL CONSIDERATIONS

3.5.1. Ethical Conduct of the Study and Ethics Approval

This study was conducted in accordance with "good clinical practice" (GCP) and all applicable regulatory requirements, including, where applicable, the 2008

version of the Declaration of Helsinki. This study used only de-identified data from a dataset created by the NSCH.

3.5.2. Confidentiality

The personal and medical information collected on subjects in this study were de-identified and kept confidential.

3.6. Results

3.6.1. Subject Accountability

There were 5,440 asthmatic children aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health were selected for this study.

3.6.2. Demographic and Baseline Characteristics

The proportion of male asthmatic children were higher than female asthmatic children (56% and 44% respectively) with the age range of 3 to 17 years old. Forty-nine percent of male asthmatic were between the age of 12 and 17 years in comparison with 58% of female asthmatic children. Sixty-three percent of the asthmatic children surveyed were White, 12% Black, 12% Hispanic, and 13% Non-Hispanic other. Sixty-four percent of the asthmatic children who were surveyed during the 2016 – 2017 survey were living with both parents and 71% of these children required Special Health Care Needs. The proportion of asthmatic male and female children who require prescription medication were the same (66%). The proportion of male children who require elevated services was slightly higher than that of female children (32% vs. 26% respectively) and the same trend was observed for, functional limitations, special therapies, and ongoing emotional developmental behavioral conditions. Table 7 (Figure 4) shows the summary of the demographics and baseline characteristics.

Table 7: Demographics Characteristics of Children with Asthma aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Baseline	Male (N=3070) n (%)	Female (N=2370) n (%)
Current Age (Years)		
≤ 5	405 (13)	227 (9)
6 – 11	1168 (38)	775 (33)
12 – 17	1497 (49)	1368 (58)
Race		
Non-Hispanic White	1926 (63)	1521 (64)
Non-Hispanic Black	371 (12)	256 (11)
Hispanic	379 (12)	294 (12)
Non-Hispanic Multi-racial/Other	394 (13)	299 (13)
Family Structure		
Two parents currently married	2009 (65)	1478 (62)
Two parents not currently married	228 (7)	196 (8)
Single mother	549 (18)	466 (20)
Other family type	234 (8)	194 (8)
Missing	50 (2)	36 (2)
Children with Special Health Care Needs (CSHCN)		
Yes	2192 (71)	1671 (71)
No	878 (29)	699 (29)

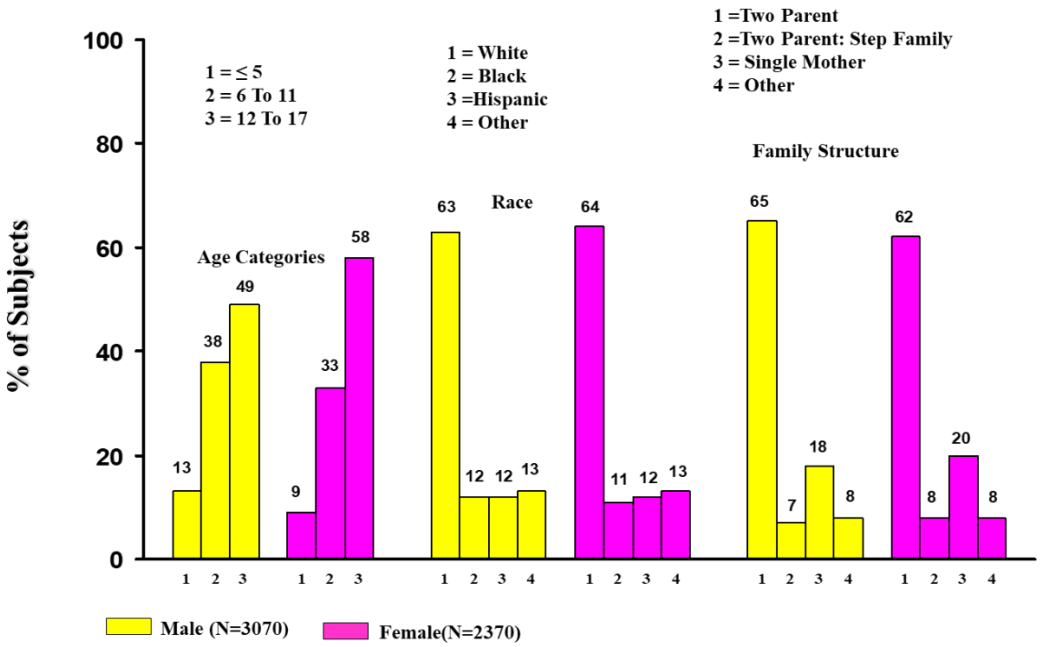

Figure 4: Demographics Characteristics of Children with Asthma aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Table 8 displays the baseline characteristics of male (3070) and female (2370) asthmatic children and the treatments for which they were qualified during the 2016 – 2017 NSCH survey period. The proportion of male children who require elevated services was slightly higher than that of female children (32% vs. 26% respectively) and the same trend was observed for, functional limitations, special therapies, and ongoing emotional developmental behavioral conditions. There were 72% male

asthmatics who reported the severity of their asthma as mild in comparison with 69% of female asthmatics who reported the severity of their asthma as mild. The proportion of asthmatic children who require prescription medication was the same in both groups (66%).

Table 8: Baseline Characteristics of Children with Asthma aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Baseline	Male (N=3070) n (%)	Female (N=2370) n (%)
Qualified on RX Medication Use		
Yes	2041 (66)	1572 (66)
No	1029 (34)	798 (34)
Qualified on elevated service use or need		
Yes	970 (32)	623(26)
No	2100 (68)	1747 (74)
Qualified on Functional Limitations		
Yes	437 (14)	277 (12)
No	2633 (86)	2093 (88)
Qualified on Special Therapies		
Yes	349 (11)	176 (7)
No	2721 (89)	2194 (93)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	600 (20)	404 (17)
No	2470 (80)	1966 (83)
Children Qualified as having Specific Types of Special Health Care Needs		
None	878 (29)	699 (29)
With functional limitations	437 (14)	277 (12)
With conditions managed by prescription medication ONLY	1017 (33)	875 (37)
Service use ONLY	98 (3)	68 (3)
With conditions managed by prescription medications AND service use needs	640 (21)	451 (19)
With and without emotional, developmental and/or behavioral health special needs	600 (20)	404 (17)
Qualifying on Mental health needs	1592 (52)	1267 (53)
Not qualifying on Mental health needs	878 (28)	699 (29)
None		
Severity of current asthma, **age 3 – 17**		
Current asthma rated mild	2211 (72)	1631 (69)
Current asthma rated moderate/severe	848 (28)	728 (31)
Missing	11 (< 1)	11 (< 1)

During this survey period, the proportion of asthmatic male and female children for whom their health was reported as in excellent/very good condition, was the same (76%; Table 9). The proportion of asthmatic children with learning disabilities was the same among males and females (2%). The proportion of male asthmatic children who were diagnosed with ASD was higher than female asthmatic children (6% vs. 2% respectively; Table 9). The proportion of male asthmatic children with 2 or more chronic health conditions was slightly higher than that of female asthmatic children (79% vs. 77% respectively; Table 9).

Table 9: Physical, Emotional & Mental Health of Children with Asthma aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Physical, Emotional & Mental Health	Male (N=3070) n (%)	Female (N=2370) n (%)
Physical Health of Children		
Excellent/very good	2341 (76)	1803 (76)
Good	606 (20)	455 (19)
Fair/poor	117 (4)	110 (5)
Missing	6 (< 1)	2 (< 1)
Children with Learning Disability		
Does not have condition	2993 (97)	2329 (98)
Ever told, but does not currently have condition	2 (< 1)	0
Currently has condition	65 (2)	32 (2)
Missing	10 (< 1)	9 (< 1)
Children currently have autism or autism spectrum disorder, **age 3 – 17**		
Do not currently have	2889 (94)	2324 (98)
Ever told, but not current	6 (< 1)	5 (< 1)
Currently have autism	175 (6)	41 (2)
Severity of current autism, **age 3 – 17**		
Does not currently have autism	2895 (94)	2329 (98)
Current autism rated mild	86 (3)	24 (1)
Current autism rated moderate/severe	86 (3)	17 (1)
Missing	3 (< 1)	0
Children with one or more Current Chronic Health Conditions		
Currently has 1 chronic health conditions from the list of 18 asked	643 (21)	548 (23)
Currently has 2 or more chronic health conditions from the list of 18 asked	2427 (79)	1822 (77)
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	2458 (80)	2021 (85)
Yes, on meds for emotions etc.	578 (19)	329 (14)
Missing	34 (1)	20 (1)

3.7. SPECIFIC OUTCOMES RESULT

Primary Analysis

The primary analyses are the proportion of children who were diagnosed with asthma and utilized additional services in combination with their Rx medication for management of their asthma as well as impact of asthma severity on additional services used among asthmatic children aged 3 – 17 years.

Table 10 (Figure 5) shows the summary of children who were suffering from asthma and utilized additional services (40%) in comparison to the numbers of children who had other conditions and utilized additional services (64%). Unadjusted analyses from all 3 methods (Unweighted, Weighted, and GEE from GENMOD) showed that asthmatic children are less likely to utilize additional services for the management of their asthma.

Table 10: Proportion of subjects with Asthma and Frequency of Services Used: Unadjusted Analysis

	Children with Asthma (N = 3149)	Children with other Conditions (N = 8615)
Utilizing services Yes No	 1257 (40%) 1892 (60%)	 5483 (64%) 3132 (36%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 0.380 (0.350 – 0.413) < 0.0001	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 0.377 (0.315 – 0.452) < 0.0001	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 0.38 (0.35 – 0.413) < 0.0001	

Model 1: Asthma = Services used;
*Using χ^2 test

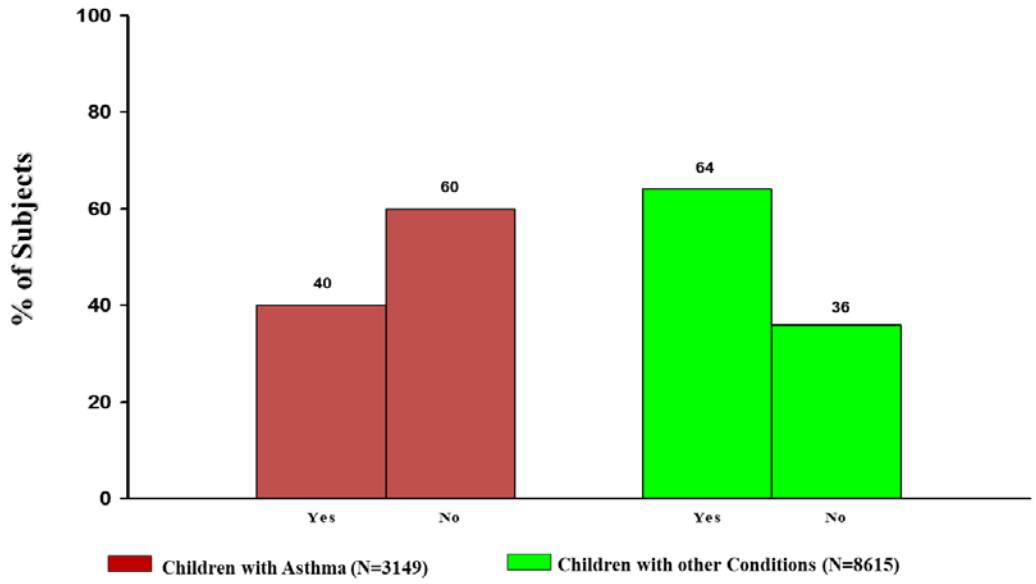

Figure 5: Proportion of subjects with Asthma and Frequency Services Used Unadjusted Analysis

The proportion of mild asthmatic children that utilized additional services in combination with their Rx medication was lower than the proportion of children who used only Rx medication for the management of their asthma (63% vs. 73% respectively; table 11& Figure 6). The proportion of moderate/severe asthmatic children that utilized additional services in combination with their Rx medication was higher than children who used Rx medication for the management of their asthma (37% vs. 27% respectively). Unadjusted analyses from all 3 methods (Unweighted,

Weighted, and GEE from GENMOD) show that children who were diagnosed with moderate/severe asthma were more likely to utilize additional services in combination with their Rx medication for the management of their asthma.

Table 11: Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used by Asthma Severity: Unadjusted Analysis

	Children with Asthma	
	Use Rx Medication & Services (N = 1253)	Use Rx Medication Only (N = 1885)
Asthma Severity Mild Moderate/Severe	 791 (63%) 462 (37%)	 1383 (73%) 502 (27%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 1.61 (1.38 – 1.88) < 0.0001	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 1.54 (1.12 – 2.11) < 0.0001	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 1.61 (1.38 – 1.88) < 0.0001	

Model 1: Use Rx Medication & Services = Asthma Severity;
*Using χ^2 test

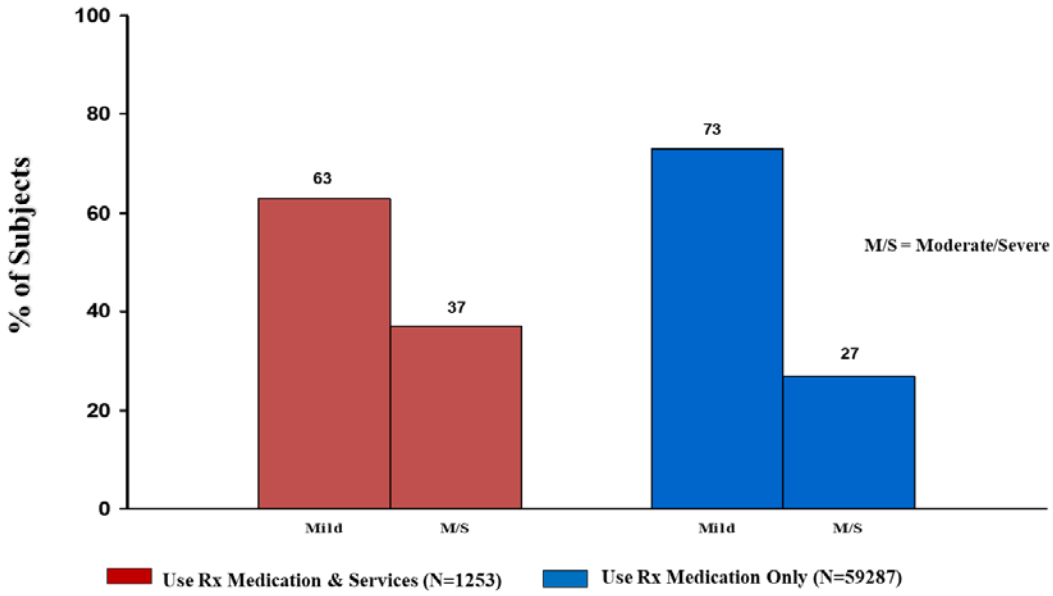

Figure 6: Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used by Asthma Severity: Unadjusted Analysis

Table 12 shows a summary of children, by sex, who were diagnosed with asthma by their doctors. The proportion of the male asthmatic children who were diagnosed with mild asthma and used additional services in combination with their Rx medication was slightly higher than male subjects with mild asthmatics that used Rx

medication only for management of their asthma (37% vs. 24% respectively). The same trend was observed among female children with mild asthma (37% vs. 30% respectively). The proportion of the male asthmatic children who were diagnosed with moderate/severe asthma and that used additional services in combination with their Rx medication was lower than male moderate/severe asthmatics that only used Rx medication for management of their asthma (63% vs. 76% respectively). The same trend was observed among mild female asthmatic children (63% vs. 70% respectively).

Table 12: Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used: Unadjusted Analysis by Sex

	Children with Asthma			
	Male (3070)		Female (2370)	
	Use Rx Medication & Services (N = 735)	Use Rx Medication Only (N = 1014)	Use Rx Medication & Services (N = 518)	Use Rx Medication Only (N = 871)
Asthma Severity				
Mild	272 (37%)	240 (24%)	190 (37%)	262 (30%)
Moderate/Severe	463 (63%)	774 (76%)	328 (63%)	609 (70%)
Model 1: Unweighted Analysis Using logistic				
Odds Ratio (95% CI)	1.90 (1.54 – 2.33)		1.35 (1.10 – 1.70)	
P-Value*	< 0.0001		0.0112	
Model 1: Weighted Analysis Using Surveylogistic				
Odds Ratio (95% CI)	1.67 (1.12 – 2.54)		1.45 (0.88 – 2.40)	
P-Value*	< 0.0001		< 0.0001	
Model 1 :GEE Using GENMOD Analysis				
Odds Ratio (95% CI)	1.90 (1.54 – 2.33)		1.35 (1.10 – 1.70)	
P-Value*	< 0.0001		0.0112	

Model 1: Use Rx Medication & Services = Asthma Severity;
*Using χ^2 test

Our target population was asthmatic children who were provided some additional services in combination with their Rx medication for management of their asthma. These findings were not specifically looked at previously in other reports using the survey data.

3.8. DISCUSSION

Asthma is a complex hereditary disorder that affects the airways and cannot be cured but with the current available treatments children with asthma can live a normal life. Children who have chronic asthma (asthmatics), have inflamed walls in their

airways and this inflammation makes their airways very sensitive to irritations and increases their susceptibility to an allergic reaction. Since this type of inflammation will cause the airways to become narrower, less air can pass through them to the lungs. Asthmatic children have symptoms like wheezing, chest tightness, breathing problems, and coughing which they experience with higher frequently during the night and the early morning [6,7].

Eleven Americans die from asthma every day based on the asthma death rate reported between 1980 and 1996 but this rate has been declining since 2000. Sixth-four percent of asthmatics patients who die from asthma are female but the proportion of boys (<18 years old) that die each year from asthma is higher than girls(<18 years old) [1].

The results of this study demonstrate that there is some interest among asthmatic children (or their parents) in the utilization of additional services in combination with Rx medication. Some potential reasons that they may be interested include wanting to reduce the frequency and cost of Rx medication(s) or to limit their side effects. These findings are consistent with the several studies that reported the need for comprehensive asthma management programs that includes Rx medication and CAM. During this survey, children's health was examined including their physical, emotional, behavioral health, and normal daily activities. Over 85% of the asthmatic children who were included in this survey period were school aged children (6 – 17 years old) with Excellent/very good physical health (76%). Greater than 80% of the children were born at normal weight and about 17% of the children were born premature.

The data demonstrated that the proportion of children with two or more current chronic health conditions was 78% and we believe that there is a need for

comprehensive health care programs that address children with multiple concurrent health conditions.

We were able to determine that in this population, the proportion of children who were diagnosed with mild asthma was 71% and proportion of children with moderate/severe asthma was 29%. The adjusted and unadjusted analysis showed that asthmatic children aged 3 – 17 years old are less likely to utilize additional services for the management of their asthma. The proportion of male asthmatic children who were diagnosed with mild asthma and used additional services in combination with their Rx medication was slightly higher than male subjects with mild asthma that used only Rx medication for management of their asthma (37% vs. 24% respectively). These results are consistent with several studies that reported approximately 30% of the asthmatic patients look for CAM for management of their asthma. Thus, based on the unadjusted and adjusted analysis results, it is clear that there are some asthmatic children that make use of additional services in combination with Rx medication among those aged 3 – 17 years old. This information should be important for state and county health providers. Because we now understand this correlation, these health providers should consider evaluating their policy(ies) regarding the availability of special programs and monitoring the implementation of such programs for this population. As stated above, the NHLBI guidelines discuss the need for clinicians to include and reinforce patient education in every step of their clinical care [3]. This would include making sure that patients understand the role that additional services may play in treatment of asthma.

Future directions for providing the health services to young children with these types of special health care needs should include exploration of the gender specific needs and the underlying deficiencies. More research is also needed in understanding other health care needs of this population, such as dental and mental health among the

young children. Our results could be helpful for enhancing future Health Services programs for this population.

3.9. Strengths and Limitations

A strength of this study is that there is a complicated and detailed adjudication process for identifying the children with asthma. This study focused on children who were diagnosed with asthma by their caregivers and could be good candidates for services that address their asthma management needs. The survey was completed by the parents of children and the data were processed and coded by The Data Resource Center for Child and Adolescent Health (DRC). The DRC is sponsored by the Maternal and Child Health Bureau and is led by the Child and Adolescent Health Measurement Initiative (CAHMI) based at the Oregon Health and Science University in Portland, Oregon. It is located online at www.childhealthdata.org.

Limitations of this research include the lack of history of regarding asthma medications that children were taking, as type of asthma medications are dependent on the severity of asthma or responsiveness of individuals. Other limitations with this data are that treatment or services periods were not reported, there may be parents/caregivers recall bias regarding the responses to the diagnoses and treatments that they reported for their children, and the weighted response rate for this survey period (2016-2017) was lower than other periods, such as 2011-2012 (41% vs. 72%), which shows a nonresponse bias.

CHAPTER 4: ASSOCIATION BETWEEN SEVERITY OF ASD AND THE USE OF ADDITIONAL SERVICES ALONE OR IN COMBINATION WITH PRESCRIPTION (Rx) MEDICATION FOR MANAGEMENT OF ASD AMONG CHILDREN AGED 3 – 17

Abstract

Background and Purpose:

This was a retrospective study of 1,664 male and female children (ages 3 – 17) with Autism Spectrum Disorder (ASD) and special health care needs who were living in United States of America (USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

Methods:

The 2016 – 2017 NS-CSHCN provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. It is a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It is sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6 – 17 years), family functioning, parental health status and neighborhood and community characteristics.

Results:

There were 1,338 (80%) males and 326 (20%) female children with the age range of 3 to 17 years old who were diagnosed with ASD. The higher proportion of males and female was between 12 and 17 years old ;53% and 55% respectively. Sixty-nine percent of the autistic children surveyed were White with 7% Black, 12% Hispanic, and 12% Non-Hispanic other. During this survey period, the proportion of autistic children with special health care needs was 93%. The proportion of male

children with ASD who require prescription medication was slightly lower than female children with ASD (53% vs. 56%). The proportion of male and female children who require elevated services was the same and the same trend was observed for, functional limitations, special therapies, and ongoing emotional developmental behavioral conditions.

The proportion of male children who were diagnosed with mild ASD was slightly lower than that of female children (50% vs. 54% respectively). The proportion of children who were suffering from ASD and utilized additional services was higher than that of children who had other conditions and utilized additional services (94% vs. 56% respectively). The proportion of children with mild ASD that utilized additional services in combination with their prescription (Rx) medication was lower than the of children who used Rx medication for the management of their ASD (74% vs. 84% respectively). The proportion of children with moderate/severe ASD that utilized additional services in combination with their Rx medication were higher than that of children who used Rx medication for the management of their ASD (26% vs. 16% respectively). The unadjusted analysis shows that children who were diagnosed with moderate/severe ASD are more likely to utilize additional services in combination with their Rx medication for the management of their ASD.

Conclusions:

Using unadjusted and adjusted analysis, we found evidence for an association between severity of ASD and utilization of additional services in combination with Rx medication among children aged 3 – 17 years old who are suffering from ASD.

4 INTRODUCTION

Autism Spectrum Disorder (ASD) is a group of neurodevelopmental disorders that includes several symptoms, changes in skills, and levels of disability. Patients with ASD show the following characteristics [7, 11]: Ongoing social problems such as difficulty communicating and interacting with others; Repetitive behaviors as well as limited interests or activities; Symptoms that typically are recognized in the first two years of life; Symptoms that hurt the individual's ability to function socially, at school or work, or other areas of life. Some of the patients with ASD have mild impairment because of their symptoms, but others are severely disabled. Symptoms and the ability of patients with ASD to function can be improved with treatments and services. The Centers for Disease Control and Prevention (CDC) has reported that the onset of ASD is < 3 years of age and affects one per 2,500 individuals [2].

Several reports have shown that there are imbalances between immune and inflammatory processes in patients with ASD, which include aberrations in antibody levels, cytokines, and cellular subsets. Recent reports have also described an increased frequency of HLA-A2 and HLA-DR4 antigens in patients with ASD [11]. A study by Shao et. al. showed that there are statistically significant associations between maternal autoimmune diseases developed during pregnancy or maternal thyroid disease and the risk of ASD in offspring and maternal autoimmune disease is likely to be an independent risk factor of ASD in offspring [20]. Van de Water and Ashwood indicated that there are a variety of anti-brain antibodies that have been found in autistic patients. These antibodies include the autoantibodies to serotonin receptor, myelin basic protein (MBP), neuron axon filament protein (NAFP), cerebellar neurofilaments, nerve growth

factor, alpha-2-adrenergic binding sites, anti-brain endothelial cell proteins and antibodies against the caudate nucleus [18].

The pathophysiological significance of the antibodies described above in children with ASD is not well defined. The increased in autoantibodies could suggest that there is increase in neuronal damage [21]. In addition, several studies have shown there is an association in the dysfunctionality of various neurotransmitter systems and ASD. The major neurotransmitters that are identified as associated with ASD are serotonin, dopamine, glutamate, and Gamma-aminobutyric acid (GABA) [22].

Medications that are available for Autism Spectrum Disorder (ASD) only help some patients manage their symptoms and result in better functioning. These medications might not affect all children in the same way. Close monitoring of the effects of medications and the progress of children with ASD must weigh their risks and benefits [25]. While the pharmaceutical medication for ASD has been well developed the most important concern that patients with ASD have indicated that they have are related to the side effects of these medications. Those patients who prefer to minimize the side effects of their ASD medication look for other alternatives to reduce the amount of their ASD medication [31].

“Early intervention” programs have some promise in effecting changing in the natural long-term outcome for some patients with an early diagnosis of ASD [25,26]. These services include, but are not limited to, therapies that target speech, walking, and interacting with others [25,26]. There are several different types of treatments such as Behavioral and Communication Approaches, Dietary Approaches, Medication, and Complementary and Alternative Medicine (CAM) that are available for children with ASD [25,26].

The American Academy of Pediatrics and the National Research Council defined behavioral and communication approaches as those that provide structure, direction, and organization for the children with ASD, in addition to the family [17].

Complementary and Alternative Treatments (CAM) such as special diets, chelation (a treatment to remove heavy metals, like lead, from the body), biologicals (e.g., secretin), or body-based systems (like deep pressure) have been used to help children with ASD in combination with their medication [26,27]. These therapies are controversial, and it is recommended that the use of such treatments should be done only in consultation with the child's physician [26].

It has been reported that the use of CAM in children and adolescents in the US was about 12% during 2007-2012. This report also indicated that 28% to 51% of the children with ASD used CAM and the use of CAM was higher in families of Non-Hispanic whites, with a higher socio-economic status, and with parents who have higher education status. The majority of the families who reported the use of CAM treatments reported there was some improvement in their child's ASD symptoms, but they had some concern regarding the cost of CAM treatments [15].

Examining the association between ASD and the use of additional services (i.e. CAM) in conjunction with medications may promote efforts to implement more strategies using additional treatments in this population. Therefore, the aim of this study was to systematically review the prevalence of the use of additional services as part of their treatment, in those children with ASD in the NSCH survey 2016-2017.

4.1. Methods

This study was a retrospective study of 1,664 male and female children (ages 3 – 17) with ASD and special health care needs who were living in United States of

America (USA) and were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

The 2016 – 2017 NS-CSHCN was a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It was sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (3 – 17 years), family functioning, parental health status and neighborhood and community characteristics. No formal sample size and power analyses were conducted for this study.

The 2016-2017 NSCH questionnaires were completed by parents/caregivers of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households with the weighted response rate of 41%. The 2017 survey was completed by 21,599 households from the sample of 59,135 households with the weighted response rate of 37%. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617).

4.2. Measures

The questionnaire that was used for this survey had topics such as demographics, health and functional status, health insurance coverage, health care

access and utilization, medical home, early childhood (0–5 years) health issues, health issues specific to middle childhood and adolescence (6–17years), family functioning, parental health status and neighborhood and community characteristics. The current ASD diagnoses were collected from parents/caregiver of the child. Parents/caregivers were required to respond to the question truthfully and accurately regarding the status and diagnoses of their child. The ASD question asked whether a doctor or healthcare provider had ever diagnosed the person's child with ASD. The possible responses that were available on the questionnaire were: Do not currently have; Ever told, but not current; Currently have autism. We selected those children that were identified as "Currently have autism" for our analysis. The severity of ASD for those children with this condition were collected by using the following possible responses: Current autism rated mild; Current autism rated moderate/severe.

The parents/caregivers were also asked about their child's qualification for needing "Specific Types of Special Health Care Needs" and they were required to select one of the following responses: None; With functional limitations; With conditions managed by prescription medication ONLY; Service use ONLY; With conditions managed by prescription medications AND service use needs. We selected those children that were identified as "With conditions managed by prescription medication only" called "Rx Medication Only" and combined those children that were identified as " Services use only" or "With conditions managed by prescription medications AND service use need" as one category called "Rx Medication & Services used".

4.3. Covariates

The association between severity of ASD and management method was evaluated using 7 different models with the adjustments for Age, Race, Sex, Emotional and Developmental or Behavioral Conditions, Functional Limitation, and Social Economic

Status. The Social Economic Status was derived from the responses to “Children live in working poor households (parent’s income less than 100% FPL)” question. The possible responses for this question were “Does not live in 'working poor' HH” which we defined it as “No” and “Lives in 'working poor' household” which we defined it as “Yes”.

4.4. Statistical Analyses

All analyses were performed after all subjects completed the survey and the database was available. The primary population of interest for this study was children 3 to 17 years old who were surveyed during the 2016 – 2017 NSCH. The primary comparison of interest was the proportion of children who were diagnosed with ASD. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using weighted and unweighted methods and as a sensitivity analysis we used GENMOD procedure for Generalized Estimating Equations [40]. The statistical significance of each variable was measured using Mantel-Haenzel $\chi 2$ statistics. For statistical analyses, all tests were two-sided with significance interpreted at the $\alpha=0.05$ significance level and all analyses were conducted using SAS version 9.4.

Once collected, all data were assessed for missing and nonsensical data. All missing data were confirmed with the original data collection forms and corrected in the database if it was possible. Subjects missing data for the primary outcome were not included in the primary analysis (unweighted analysis). All continuous variables such as age and number of days were categorized by NSCH data center and the defined categories were included in the database. Demographic characteristics were summarized by sex, categorical variables were presented by counts and percentages.

4.5. REGULATORY AND ETHICAL CONSIDERATIONS

4.5.1. Ethical Conduct of the Study and Ethics Approval

This study was conducted in accordance with "good clinical practice" (GCP) and all applicable regulatory requirements, including, where applicable, the 2008 version of the Declaration of Helsinki. This study uses only de-identified data from a dataset created by the NS-CSHCN.

4.5.2. Confidentiality

The personal and medical information collected on subjects in this study were de-identified and will be kept confidential.

4.6. Results

4.6.1. Subject Accountability

A total of 1,664 children aged 3 – 17 who were diagnosed with ASD and participated during the 2016 – 2017 National Survey of Children health were selected for this study.

4.6.2. Demographic and Baseline Characteristics

There were 1,338 (80%) males and 326 (20%) female children with the age range of 3 to 17 years old who were diagnosed with ASD. The higher proportion of males and females were between 12 and 17 years old, 53% and 55% respectively. Sixty-nine percent of the autistic children surveyed were White, 7% Black, 12% Hispanic, and 12% Non-Hispanic other. Sixty-six percent of the children who were diagnosed with ASD and participated during the 2016 – 2017 survey were living with both parents and 93% of these children required Special Health Care Needs. The proportion of male children with ASD who require prescription medication was slightly lower than that of female children with ASD (53% vs. 56%). The proportion of male

and female children who require elevated services were the same and the same trend was observed for functional limitations, special therapies, and ongoing emotional developmental behavioral conditions. Table 13 (Figure 7) shows the summary of the demographics and baseline characteristics.

Table 13: Demographics Characteristics of Children with ASD aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Baseline	Male (N=1338) n (%)	Female (N=326) n (%)
Current Age (Years)		
≤ 5	143 (11)	33 (10)
6 – 11	488 (36)	114 (35)
12 – 17	707 (53)	179 (55)
Race		
Non-Hispanic White	925 (69)	227 (70)
Non-Hispanic Black	96 (7)	17 (5)
Hispanic	159 (12)	43 (13)
Non-Hispanic Multi-racial/Other	158 (12)	39 (12)
Family Structure		
Two parents currently married	884 (66)	218 (67)
Two parents not currently married	95 (7)	21 (6)
Single mother	237 (18)	59 (18)
Other family type	106 (8)	24 (8)
Missing	16 (1)	4 (1)
Children with Special Health Care Needs (CSHCN)		
Yes	1239 (93)	307 (94)
No	99 (7)	19 (6)

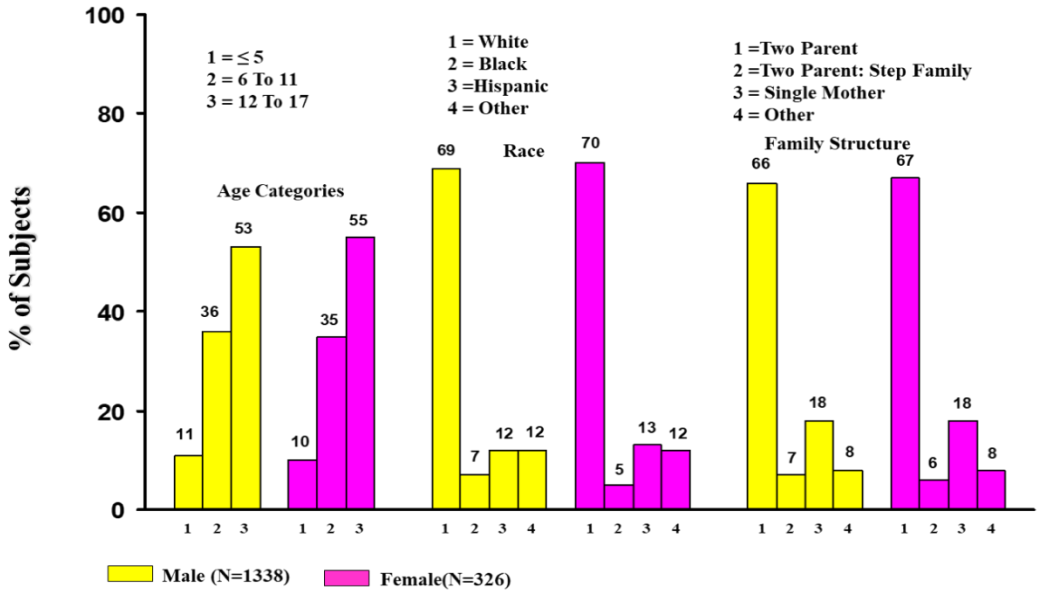

Figure 7: Demographics Characteristics of Children with ASD aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Table 14 shows the baseline characteristics of 1,664 children with ASD and their diagnosis that were surveyed during 2016 – 2017 National Survey of Children Health. The proportion of children who require elevated services was the same among

male and female children (82%) and the same trend was observed for functional limitations, special therapies, and ongoing emotional developmental behavioral conditions. The proportion of male children who were diagnosed with mild ASD was slightly lower than female children (50% vs. 54% respectively). The proportion of male children with ASD who require prescription medication was slightly lower than female children with ASD (53% vs. 56%).

Table 14: Baseline Characteristics of Children with ASD aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Baseline	Male (N=1338) n (%)	Female (N=326) n (%)
Qualified on RX Medication Use		
Yes	709 (53)	182 (56)
No	629 (47)	144 (44)
Qualified on elevated service use or need		
Yes	1091 (82)	266 (82)
No	247 (18)	60 (18)
Qualified on Functional Limitations		
Yes	819 (61)	202 (62)
No	519 (39)	124 (38)
Qualified on Special Therapies		
Yes	899 (67)	221 (68)
No	439 (33)	105 (32)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	1044 (78)	260 (80)
No	294 (22)	66 (20)
Children Qualified as having Specific Types of Special Health Care Needs		
None	99 (7)	19 (6)
With functional limitations	819 (61)	202 (62)
With conditions managed by prescription medication ONLY	22 (2)	9 (3)
Service use ONLY	183 (14)	46 (14)
With conditions managed by prescription medications AND service use needs	215 (16)	50 (15)
With and without emotional, developmental and/or behavioral health special needs	1044 (78)	260 (80)
Qualifying on Mental health needs	195 (15)	47 (14)
Not qualifying on Mental health needs	99 (7)	19 (6)
None		
Severity of current autism, **age 3 – 17**		
Current autism rated mild	663 (50)	176 (54)
Current autism rated moderate/severe	659 (49)	147 (45)
Missing	16 (1)	3 (1)

Table 15 shows the Physical, Emotional & Mental Health of children with ASD and their diagnosis. During this survey period, the proportion of male children with ASD who were reported as having excellent/very good condition health was slightly higher than that of female children (72% vs. 67% respectively). The proportion of children with learning disabilities was slightly higher in male children than female children (82% vs. 79%). There were only 41 female children with ASD who were

diagnosed with asthma but the number of male children with ASD who were diagnosed with asthma was 175. The proportion of male children with ASD and that reported 2 or more chronic health conditions was slightly lower than that of female children with ASD (96% vs. 98% respectively).

Table 15: Physical, Emotional & Mental Health of Children with ASD aged 3 – 17 who participated during the 2016 – 2017 National Survey of Children's Health

Physical, Emotional & Mental Health	Male (N=1338) n (%)	Female (N=326) n (%)
Physical Health of Children		
Excellent/very good	965 (72)	217 (67)
Good	285 (21)	81 (25)
Fair/poor	87 (7)	28 (8)
Missing	1 (< 1)	0
Children with Learning Disability		
Does not have condition	1097 (82)	256 (79)
Ever told, but does not currently have condition	3 (< 1)	0
Currently has condition	230 (17)	68 (21)
Missing	8 (1)	2 (< 1)
Children with Asthma		
Does not have condition	1087 (81)	264 (81)
Ever told, but does not currently have condition	76 (6)	21 (6)
Currently has condition	175 (13)	41 (13)
Severity of current asthma, **age 3 – 17**		
Does not have condition	1163 (87)	285 (87)
Current asthma rated mild	118 (9)	28 (9)
Current asthma rated moderate/severe	55 (4)	13 (4)
Missing	2 (< 1)	0
Children with one or more Current Chronic Health Conditions		
Currently has 1 chronic health conditions from the list of 18 asked	51 (4)	7 (2)
Currently has 2 or more chronic health conditions from the list of 18 asked	1287 (96)	319 (98)
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	697 (52)	170 (52)
Yes, on meds for emotions etc.	632 (47)	154 (47)
Missing	9 (1)	2 (1)

4.7. SPECIFIC OUTCOMES RESULT

Primary Analysis

The primary analyses are the proportion of children who were diagnosed with ASD and utilized additional services alone or in combination with their Rx medication for management of their ASD as well as the impact of ASD severity on the use of additional services among children aged 3 – 17 years.

Table 16 (Figure 8) shows the summary data of children who were diagnosed with ASD and utilized additional services was higher than children who had other conditions and utilized additional services (94% vs. 56% respectively). These analyses

show that children with ASD are more likely to utilize additional services for the management of their ASD.

Table 16: Proportion of subjects with ASD and Frequency Services Used Unadjusted Analysis

	Children with ASD (N = 525)	Children with other Conditions (N = 11239)
Utilizing services Yes No	 494 (94%) 31 (6%)	 6246 (56%) 4993 (44%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 12.74 (8.85 – 18.35) < 0.0001	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 12.38 (6.50 – 23.59) < 0.0001	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 12.74 (8.85 – 18.35) < 0.0001	

Model 1: ASD = Services used;
*Using χ^2 test

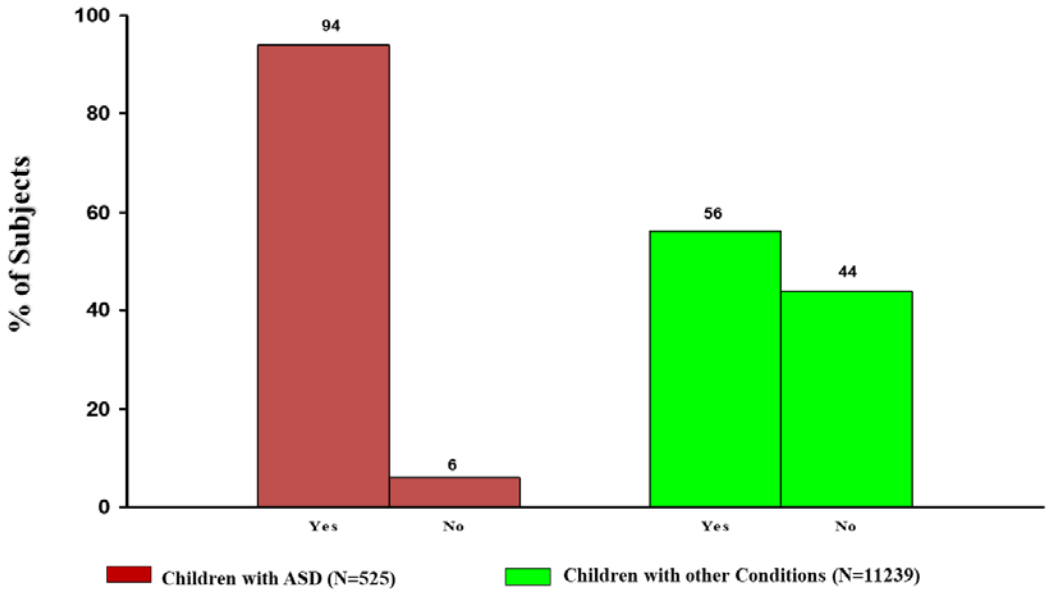

Figure 8: Proportion of subjects with ASD and Frequency Services Used Unadjusted Analysis

Table 17 (Figure 9) shows the summary data of children who were diagnosed with ASD and utilized additional services alone or in combination with their Rx medication. The proportion of children with mild ASD that utilized additional services alone or in combination with their Rx medication was lower than that of children who used Rx medication for the management of their ASD (74% vs. 84% respectively). The proportion of moderate/severe children with ASD that utilized additional services alone

or in combination with their Rx medication was higher than children who used Rx medication for the management of their ASD (26% vs. 16% respectively). The unadjusted analysis shows that children who were diagnosed with moderate/severe ASD are more likely to utilize additional services alone or in combination with their Rx medication for the management of their ASD.

Table 17: Proportion of subjects with ASD and Frequency of Rx Medication and Services Used by ASD Severity: Unadjusted Analysis

	Children with ASD	
	Use Rx Medication & Services (N = 489)	Use Rx Medication Only (N = 31)
ASD Severity Mild Moderate/Severe	 360 (74%) 129 (26%)	 26 (84%) 5 (16%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 1.86 (0.70 – 4.96) > 0.05	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 2.58 (0.66 – 10.02) > 0.05	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 1.86 (0.70 – 4.96) > 0.05	

Model 1: Use Rx Medication & Services = ASD Severity;
*Using χ^2 test

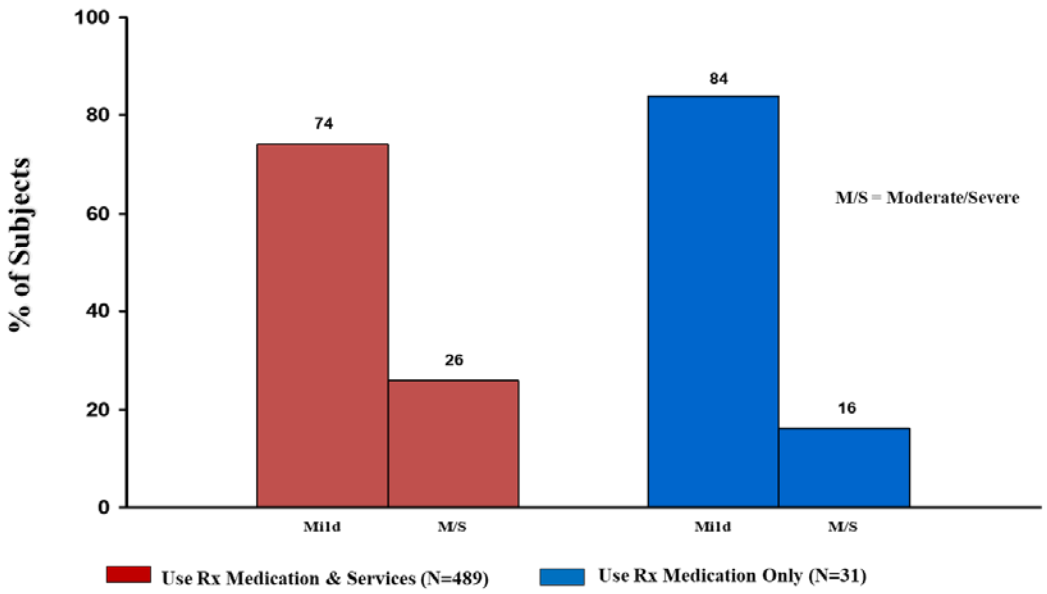

Figure 9: Proportion of subjects with ASD and Frequency Services Used by ASD Severity: Unadjusted Analysis

The proportion of the male children who were diagnosed with mild ASD and used additional services alone or in combination with their Rx medication was slightly

lower than that of male subjects with mild ASD that only used Rx medication for management of their ASD (74% vs. 86% respectively; Table 18). The same trend was observed among female children with mild ASD (74% vs. 78% respectively). The proportion of the male children who were diagnosed with moderate/severe ASD and used additional services alone or in combination with their Rx medication was higher than male children with moderate/severe ASD that only used Rx medication for management of their ASD (26% vs. 14% respectively). The same trend was observed among female children who were diagnosed with moderate/severe ASD (26% vs. 22% respectively).

Table 18: Proportion of subjects with ASD and Frequency of Rx Medication and Services Used: Unadjusted Analysis by Sex

	Children with ASD			
	Male (1338)		Female (326)	
	Use Rx Medication & Services (N = 394)	Use Rx Medication Only (N = 22)	Use Rx Medication & Services (N = 95)	Use Rx Medication Only (N = 9)
ASD Severity Mild Moderate/Severe	 290 (74%) 104 (26%)	 19 (86%) 3 (14%)	 70 (74%) 25 (26%)	 7 (78%) 2 (22%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 2.30 (0.660 – 7.83) > 0.05		 1.25 (0.243 – 6.42) > 0.05	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 3.35 (0.57 – 19.81) > 0.05		 1.64 (0.221 -12.17) > 0.05	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 2.27 (0.660 – 7.83) > 0.05		 1.25 (0.243 – 6.42) > 0.05	

Model 1: Use Rx Medication & Services = ASD Severity;
*Using χ^2 test

The survey methods used were similar for all age sub-groups with the specific interest of age-related activities and needs.

4.8. DISCUSSION

Some of the patients with ASD have mild impairment because of their symptoms, but others are severely disabled. Symptoms, and the ability of patients with ASD to function, can be improved with treatments and services. The result of NSCH

survey showed that the prevalence of ASD increased by 32% between 2007 and 2011-2012.

This is the first retrospective study using the NSCH survey data to examine the association between children with ASD and use of additional services alone or in combination with Rx medication as well as the impact of severity of ASD and additional services used. This survey was conducted to evaluate children's health in the USA as well as the special health care needs for these children.

Our target population were the children with ASD who were provided some additional services alone or in combination with their Rx medication for management of their ASD which were not specifically looked at in previous reports. The results of this study demonstrate that there is use among children with ASD of additional services alone or in combination with Rx medication, possibly to reduce the frequency and cost of Rx medication. During this survey, children's health was examined with respect to their physical, emotional, and behavioral health, and their normal daily activities. There appear to be no other issues related to their health as over 85% of the children who were diagnosed with ASD and participated in this survey period were school aged children (6 – 17 years old) with excellent/very good physical health ($\geq$ 67%). In addition, greater than 75% of the children were born at normal weight.

A Meta-analysis from 54 studies by Loomes et. Al. showed that the male to female ration in children with ASD is 3:1 which is different from previous estimate of 4:1 (male to female) [41]. Our study showed that the prevalence of ASD in male children is 4 times (1338) the prevalence of ASD among female children (326).

The proportion of children who were diagnosed with mild ASD was 50% and the proportion of children with moderate/severe ASD was 50%. In 2018 CDC increased the estimate of ASD's prevalence from 1 in 68 children in 2016 to 1 in 59 children

(15%). The adjusted (OR=2.58 with 95% CI of 0.66 – 10.02) and unadjusted (OR=1.86 with 95% CI of 0.70 – 4.96) analysis showed that children with ASD aged 3 – 17 years old are more likely to utilize additional services for the management of their ASD. These finds are aligned with the OR that has been reported by CDC. The proportion of the male children who were diagnosed with mild ASD and used additional services alone or in combination with their Rx medication was slightly lower than that of male subjects with mild ASD that only used Rx medication for management of their ASD (74% vs. 86% respectively). It is possible that Rx medication can provide greater responses in those with mild autism than for those with moderate or severe autism and that is why there is a great use of additional services in those more severely affected children. This is an area for further research that could provide useful data for practitioners.

In conclusion, using unadjusted and adjusted analysis, we found some evidence for the use of additional services alone or in combination with Rx medication among children with ASD aged 3 – 17 years old. There is clearly use of additional services in this population and greater use is associated with more severe diagnoses. It is important to understand how these services may be used to manage ASD more effectively and if they decrease the use of medications or their side effects.

Accordingly, state and county health providers should consider evaluating their policy(ies) regarding the availability of special programs and monitoring the implementation of such programs for this population. Future directions for providing health services to young children with these types of special health care needs should also include exploration of gender specific needs and the underlying deficiencies. Future research should look at other health care needs in this population, such as dental

and mental health among the young children. Our results could be helpful for enhancing future Health Services programs for this population.

4.9. Strengths and Limitations

A strength of this study is that there is a complicated and detailed adjudication process for identifying the children with ASD. This study focused on children who were diagnosed with ASD by their caregivers and could be good candidates for services that address their ASD management needs. The survey was completed by the parents of children and the data were processed and coded by The Data Resource Center for Child and Adolescent Health (DRC). The DRC is sponsored by the Maternal and Child Health Bureau and is led by the Child and Adolescent Health Measurement Initiative (CAHMI) based at the Oregon Health and Science University in Portland, Oregon. It is located online at www.childhealthdata.org.

Limitations of this research include the lack of medical history and the type of ASD medications that they were taking in order to determine the need for additional services is due to the lack of efficacy of the medication or the tolerance of the medication. Other limitations with this data are the parents/caregivers recall biases regarding the responses to the diagnoses and treatments that they reported for their children, the treatment or services periods were not reported, and the weighted response rate for this survey period (2016-2017) was lower than other periods (41% vs. 72%) which shows the nonresponse bias.

CHAPTER 5: ASSOCIATION BETWEEN SEVERITY OF ASD AND ASTHMA AND THE USE OF ADDITIONAL SERVICES ALONE OR IN COMBINATION WITH PRESCRIPTION Rx MEDICATION FOR MANAGEMENT OF ASD AND ASTHMA AMONG CHILDREN AGED 3 – 17

Abstract

Background and Purpose:

This study was a retrospective study of the use of additional services, alone or in combination with prescription medication in 216 male and female children who were diagnosed with Autism Spectrum Disorder (ASD) and asthma (ages 3 – 17) with special health care needs who were living in United States of America (USA) and which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

Methods:

The 2016 – 2017 NS-CSHCN is a national mail and online survey NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. It was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics and sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6 – 17 years), family functioning, parental health status and neighborhood and community characteristics.

Results:

There were 175 (81%) males and 41 (19%) female children with the age range of 3 to 17 years old who were diagnosed with ASD and asthma. The higher proportions of males and females were between 12 and 17 years old, 94% and 96% respectively. Sixty-three percent of children with ASD and asthma was White, 11% Black, 11%

Hispanic, and 15% Non-Hispanic other. During this survey period, the proportion of children who were suffering from ASD and asthma with special health care needs was 98%. The proportion of male children with ASD and asthma who required prescription medication was higher than female children with ASD and asthma (83% vs. 73%). The proportion of male children who require elevated services was slightly higher than female children. The same trend was observed in functional limitations, special therapies, and ongoing emotional developmental behavioral conditions.

There were 175 (81%) males and 41 (19%) female children with the age range of 3 to 17 years old who were diagnosed with ASD and asthma. The higher proportions of males and females were between 12 and 17 years old, 94% and 96% respectively. Sixty-three percent of children with ASD and asthma was White, 11% Black, 11% Hispanic, and 15% Non-Hispanic other. During this survey period, the proportion of children who were suffering from ASD and asthma with special health care needs was 98%. The proportion of male children with ASD and asthma who require prescription medication was higher than female children with ASD and asthma (83% vs. 73%). The proportion of male children who require elevated services was slightly higher than female children. The same trend was observed in functional limitations, special therapies, and ongoing emotional developmental behavioral conditions.

Conclusions:

Using unadjusted and adjusted analysis, we found evidence for an association between severity of ASD and the utilization of additional services alone or in combination with Rx medication among children, aged 3 – 17 years old, who are suffering from ASD and asthma. However, children with moderate/severe asthma were less likely to utilize additional services.

5 INTRODUCTION

Asthma is one of the most common chronic diseases among children 18 years old and younger (~ 5 million). The prevalence of asthma in children is 2:1 in comparison with adults. It has been reported that children with asthma missed over 12 million school days due to asthma each year [1]. Asthma is a complex hereditary disorder that affects the airways and cannot be cured but with the current available treatments, children with asthma can live a normal life [4]. Children who have chronic asthma (asthmatics), have inflamed walls in their airways and this inflammation makes their airways very sensitive to irritations and increases their susceptibility to an allergic reaction [3]. Since this type of inflammation will cause the airways to become narrower, less air can pass through them to the lungs. Asthmatic children have symptoms like wheezing, chest tightness, breathing problems, and coughing which they experience with higher frequently during the night and the early morning [3].

The pathophysiology of asthma is not well defined but the autopsy of the lungs of patients who have died from asthma shows significant inflation of their lungs which microscopically is associated with a dramatic distention of the alveoli" [5,6,7]. The airways of the patients who have been diagnosed with asthma are very responsive to variety of external and internal stimulants. The airway inflammation of the asthmatic patient has been characterized by increases in the number of eosinophils, T cells, and mast cells in the airway mucosa and loss of integrity of the airway epithelium [5]. Chronic inflammation of the airways results in a loss of airway elasticity, which causes the airways to easily inflate. However, this also decreases their ability to recoil and reduces airflow out of the lungs, which on autopsy is seen as over inflation [5].

Autism Spectrum Disorder (ASD) is a group of neurodevelopmental disorders that includes several symptoms, changes in skills, and levels of disability. Patients with ASD show the following characteristics [17, 18]: ongoing social problems such as difficulty communicating and interacting with others; repetitive behaviors as well as limited interests or activities; symptoms that typically are recognized in the first two years of life; symptoms that hurt the individual's ability to function socially, at school or work, or other areas of life. Some of the patients with ASD have mild impairment because of their symptoms, but others are severely disabled. Symptoms and the ability of patients with ASD to function can be improved with treatments and services. The Centers for Disease Control and Prevention (CDC) has reported that the onset of ASD is < 3 years of age and affects one per 2,500 individuals [2]. Several studies have shown that there is an immunological involvement in children with ASD [10].

These abnormalities have been found at the molecular, pathological, and epidemiological level. Epidemiological evidence has shown the immune involvement and increased frequency of autoimmune disorders in family members of autistic patients [21, 22, 23].

Several studies have shown that there is evidence of many immune-mediated conditions having frequent comorbidity with autism [23]. Some studies have shown a higher prevalence of asthma in children with ASD compared to controls [22]. Asthma is an immune-mediated disorder that has been categorized as an inappropriate inflammatory response in the lungs. ASD has been described as imbalance of immune and inflammatory processes and altered levels of cytokines, inflammatory markers and immunoglobulin have been found in ASD [22]. Thus, there is a likelihood that asthma and ASD could result from related pathophysiological changes in the immune system

[22, 23]. Our previous data demonstrates that there is an association among children with concurrent diagnoses of ASD and asthma among children aged 3 – 17 years old.

Surveys have shown that asthmatic patients are or have used some type of Complementary or Alternative Medicine (CAM) [8]. There have been several recommendations of CAMs for asthma management that ranges from breathing exercises to herbal remedies, but in the absence of controlled, clinical trials the safety and efficacy of these therapies are not clear [9]. Complementary and Alternative Treatments (CAM) such as special diets, chelation (a treatment to remove heavy metals like lead from the body), biologicals (e.g., secretin), or body-based systems (like deep pressure) have been used to help children with ASD in combination with their medication [26,27,33]. These therapies are controversial, and it is recommended that the use of such treatments should be done only in consultation with the child's physician [32].

There are no studies to date that have looked at the use of other services (i.e. CAM) in children with both ASD and asthma. Thus, the aim of this study was to systematically review the use of additional services, alone or in combination with prescription medication in children who were diagnosed with Autism Spectrum Disorder (ASD) and asthma in the 2016-2017 NSCH survey. In addition, we further studied the use of additional services, alone or in combination with prescription medication in this subpopulation as a function of the severity of the two diagnoses.

5.1. Methods

This study was a retrospective study of 216 male and female children who were diagnosed with Autism Spectrum Disorder (ASD) and asthma (ages 3 – 17) with special health care needs who were living in United States of America (USA) and which were

part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

The 2016 – 2017 NS-CSHCN is a national mail and online survey NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. It was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics and sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (3 – 17 years), family functioning, parental health status and neighborhood and community characteristics. No formal sample size and power analyses were conducted for this study.

The 2016-2017 NSCH were completed by parents/caregiver of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households with the weighted response rate of 41%. The 2017 survey was completed by 21,599 households from the sample of 59,135 households with the weighted response rate of 37%. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617).

5.2. Measures

The Questionnaire that was used for this survey had topics such as demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6–17years), family functioning, parental health status and neighborhood and community characteristics. The current ASD and asthma conditions were collected from parents/caregiver of the child. Parents/caregivers were required to respond to the question truthfully and accurately regarding the status and diagnoses of their child. The ASD question regarding whether a doctor or healthcare provider had ever diagnosed your child with ASD. The possible responses that were available on the questionnaire were: Do not currently have; Ever told, but not current; Currently have autism.

We selected those children that were identified as “Currently have autism” in our analysis. The same type of question was asked regarding the asthma and we selected those children that were identified as “Currently have asthma” in our analysis. The severity of ASD and asthma for those children with these conditions were collected by using the following possible responses: Current autism rated mild; Current autism rated moderate/severe; Current asthma rated mild; Current asthma rated moderate/severe.

The parents/caregivers were also asked regarding their child qualification for needing “Specific Types of Special Health Care Needs” and they were required to select one of the following responses: None; With functional limitations; With conditions managed by prescription medication ONLY; Service use ONLY; With conditions managed by prescription medications AND service use needs.

We selected those children that were identified as “With conditions managed by prescription medication only” called “Rx Medication Only” and combined those children that were identified as “ Services use only” or “With conditions managed by prescription medications AND service use need” as one category called “Rx Medication & Services used”.

5.3. Covariates

The association between ASD and asthma was evaluated using 7 different models with the adjustments for Age, Race, Sex, Emotional and Developmental or Behavioral Conditions, Functional Limitation, and Social Economic Status. Since these covariates were not significant we conducted our final analysis on the main model. The Social Economic Status was derived from the responses to “Children live in working poor households (parent’s income less than 100% FPL)” question. The possible responses for this question were “Does not live in 'working poor' HH” which we defined it as “No” and “Lives in 'working poor' household” which we defined it as “Yes”.

5.4. Statistical Analyses

All analyses were performed after all subjects completed the survey and the database was available. The primary population of interest for this study was children 3 to 17 years old who were surveyed during the 2016 – 2017 NSCH. The primary comparison of interest was the proportion of children who were diagnosed with ASD and Asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using weighted and unweighted methods and as a sensitivity analysis we used GENMOD procedure for Generalized Estimating Equations [40]. The statistical significance of each variable was measured using Mantel-Haenzel $\chi 2$ statistics. For

statistical analyses, all tests were two-sided with significance interpreted at the α=0.05 significance level and all analyses were conducted using SAS version 9.4.

Once collected, all data were assessed for missing and nonsensical data. All missing data were confirmed with the original data collection forms and corrected in the database if it was possible. Subjects missing data for the primary outcome were not included in the primary analysis (unweighted analysis). All continuous variables such as age and number of days were categorized by NSCH data center and the defined categories were included in the database. Demographic characteristics were summarized by sex, categorical variables were presented by counts and percentages.

5.5. REGULATORY AND ETHICAL CONSIDERATIONS

5.5.1. Ethical Conduct of the Study and Ethics Approval

This study was conducted in accordance with "good clinical practice" (GCP) and all applicable regulatory requirements, including, where applicable, the 2008 version of the Declaration of Helsinki. This study uses only de-identified data from a dataset created by the NS-CSHCN.

5.5.2. Confidentiality

The personal and medical information collected on subjects in this study were de-identified and kept confidential.

5.6. Results

5.6.1. Subject Accountability

Two hundred sixteen children aged 3 – 17 who were diagnosed with ASD and asthma participated during the 2016 – 2017 National Survey of Children health were selected for this study.

5.6.2. Demographic and Baseline Characteristics

There were 175 (81%) males and 41 (19%) female children with the age range of 3 to 17 years old who were diagnosed with ASD and asthma. There was a higher proportion of males and females between 12 and 17 years old, 58% and 49% respectively. Sixty-three percent of children with ASD and asthma were White, 11% Black, 11% Hispanic, and 15% Non-Hispanic other. Fifty-four percent of the children who were diagnosed with ASD and asthma and participated during the 2016 – 2017 survey were living with both parents and 98% of these children required Special Health Care Needs. Table 19 shows the summary of the demographics and baseline characteristics.

Table 19: Demographics Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have both ASD & Asthma and that utilized additional services alone or in combination with their Rx medication

Baseline	Male (N=175) n (%)	Female (N=41) n (%)
Current Age (Years)		
≤ 5	10 (6)	1 (2)
6 – 11	64 (36)	20 (49)
12 – 17	101 (58)	20 (49)
Race		
Non-Hispanic White	107 (61)	30 (73)
Non-Hispanic Black	22 (13)	2 (5)
Hispanic	19 (11)	5 (12)
Non-Hispanic Multi-racial/Other	27 (15)	4 (10)
Family Structure		
Two parents currently married	93 (53)	24 (58)
Two parents not currently married	17 (10)	4 (10)
Single mother	45 (26)	8 (20)
Other family type	18 (10)	5 (12)
Missing	2 (1)	0
Children with Special Health Care Needs (CSHCN)		
Yes	171 (98)	41 (100)
No	4 (2)	0

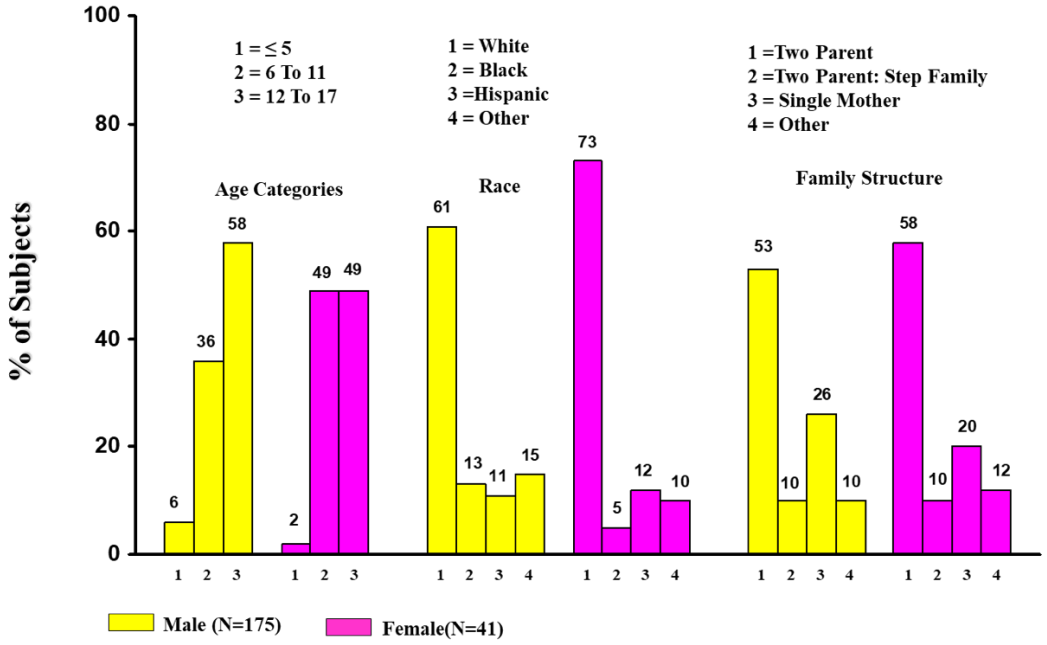

Figure 10: Demographics Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have both ASD & Asthma and that utilized additional services alone or in combination with their Rx medication

The proportion of male children who require elevated services was slightly higher than that of female children and the same trend was observed in functional limitations, special therapies, and ongoing emotional developmental behavioral conditions. The proportion of male children who were diagnosed with mild ASD was lower than the proportion of female children (49% vs. 59% respectively; Table 20). The proportions of male and female children who were diagnosed with mild asthma were the same (68%). The proportion of male children with ASD and asthma who require prescription medication was higher than of female children with ASD and asthma (83% vs. 73%).

Table 20: Baseline Characteristics of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have both ASD & Asthma and that utilized additional services alone or in combination with their Rx medication

Baseline	Male (N=175) n (%)	Female (N=41) n (%)
Qualified on RX Medication Use		
Yes	145 (83)	30 (73)
No	30 (17)	11 (27)
Qualified on elevated service use or need		
Yes	151 (86)	33 (80)
No	24 (14)	8 (20)
Qualified on Functional Limitations		
Yes	105 (60)	24 (59)
No	70 (40)	17 (41)
Qualified on Special Therapies		
Yes	115 (66)	24 (59)
No	60 (34)	17 (41)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	146 (83)	33 (80)
No	29 (17)	8 (20)
Children Qualified as having Specific Types of Special Health Care Needs		
Non	4 (3)	0
With functional limitations	105 (60)	24 (59)
With conditions managed by prescription medication ONLY	6 (3)	1 (2)
Service use ONLY	9 (5)	5 (12)
With conditions managed by prescription medications AND service use needs	51 (29)	11 (27)
With and without emotional, developmental and/or behavioral health special needs	146 (83)	33 (80)
Qualifying on Mental health needs	25 (15)	8 (20)
Not qualifying on Mental health needs	4 (2)	0
Non		
Severity of current autism, **age 3 – 17**		
Current autism rated mild	86 (49)	24 (59)
Current autism rated moderate/severe	86 (49)	17 (41)
Missing	3 (2)	0
Severity of current asthma, **age 3 – 17**		
Current asthma rated mild	118 (68)	28 (68)
Current asthma rated moderate/severe	55 (31)	13 (32)
Missing	2 (1)	0

During this survey period, the proportion of male children with ASD and asthma with a reported excellent/very good condition of health was higher than that of female children (58% vs. 49% respectively; Table 21). The proportion of children with learning disabilities was slightly lower in male children than female children (19% vs. 24%).

Table 21: Physical, Emotional & Mental Health of those Children aged 3 – 17 in 2016 – 2017 National Survey of Children Health that have both ASD & Asthma and that utilized additional services alone or in combination with their Rx medication

Physical, Emotional & Mental Health	Male (N=175) n (%)	Female (N=41) n (%)
Physical Health of Children		
Excellent/very good	101 (58)	20 (49)
Good	56 (32)	14 (34)
Fair/poor	17 (10)	7 (17)
Missing	1 (< 1)	0
Children with Learning Disability		
Ever told, but does not currently have condition	139 (80)	31 (76)
Currently has condition	34 (19)	10 (24)
Missing	2 (1)	0
Children with one or more Current Chronic Health Conditions		
Currently has 2 or more chronic health conditions from the list of 18 asked	175 (100)	41 (100)
Currently taking any meds for problems with emotions, concentration or behavior condition **age 3 – 17**		
No, not on meds for emotions etc.	103 (59)	22 (54)
Yes, on meds for emotions etc.	72 (41)	19 (46)

5.7. SPECIFIC OUTCOMES RESULT

Primary Analysis

The primary analyses are the proportion of children who were diagnosed with ASD and asthma and that utilized additional services alone or in combination with their Rx medication for management of their ASD and asthma as well as the impact of ASD and asthma severity on additional services used among children, aged 3 – 17 years.

Proportion of children who were suffering from ASD and asthma and utilized additional services were higher than children who had other conditions and utilized additional services (92% vs. 57% respectively; Table 22; Figure 11). Unadjusted analyses from all 3 methods (Unweighted, Weighted, and GEE from GENMOD) show that children with ASD and asthma are more likely to utilize additional services for the management of their ASD and asthma.

Table 22: Proportion of subjects with ASD & Asthma and Frequency of Services Used Unadjusted Analysis

	Children with ASD + Asthma (N = 83)	Children with other Conditions (N = 11681)
Utilizing services Yes No	 76 (92%) 7 (8%)	 6664 (57%) 5017 (43%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 8.20 (3.76 – 17.73) < 0.0001	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 4.90 (1.40 – 17.17) 0.0132	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 8.17 (3.77 – 17.74) < 0.0001	

Model: ASD + Asthma = Services Used
* Using χ^2 test

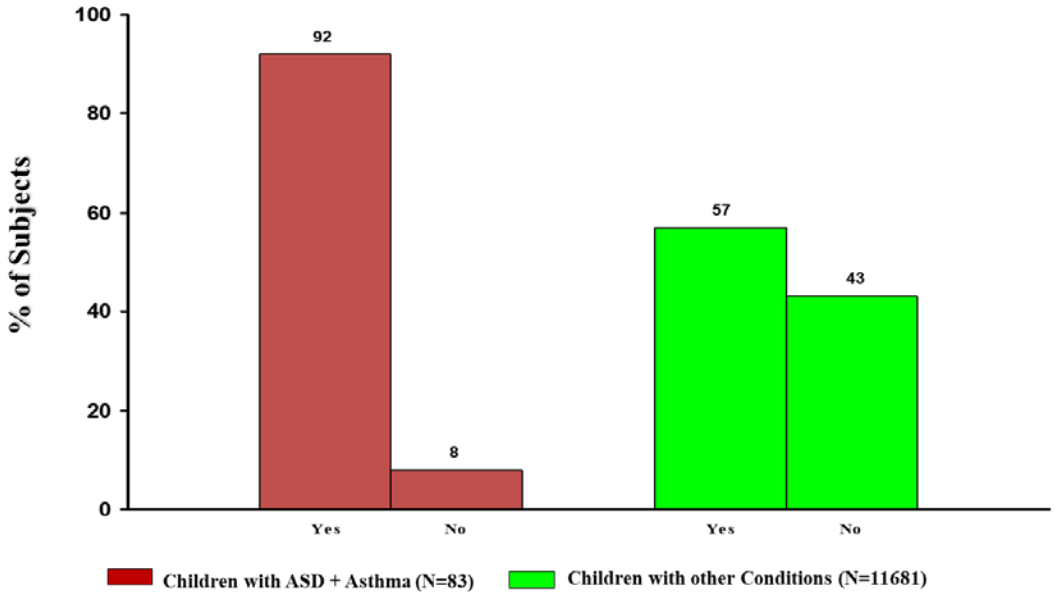

Figure 11: Proportion of subjects with ASD + Asthma and Frequency of Services Used: Unadjusted Analysis

The proportion of children with ASD and asthma with mild ASD that utilized additional services in alone or in combination with their Rx medication was lower than that of children who only used Rx medication for the management of their ASD and asthma (73% vs. 86% respectively; Table 23; Figure 12). The proportion of children who were suffering from ASD and asthma with moderate/severe ASD that utilized additional services alone or in combination with their Rx medication was higher than that of children who only used Rx medication for the management of their ASD and

asthma (27% vs. 14% respectively). The unadjusted analyses from all 3 methods show that children with ASD and asthma who were diagnosed with moderate/severe ASD were more likely to utilize additional services alone or in combination with their Rx medication for the management of their ASD and asthma.

Table 23: Proportion of subjects with ASD & Asthma and Frequency of Rx Medication and Services Used by ASD Severity: Unadjusted Analysis

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
ASD Severity Mild Moderate/Severe	 55 (73%) 20 (27%)	 6 (86%) 1 (14%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 2.20 (0.247 – 19.30) > 0.05	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 8.97 (3.01 – 26.70) 0.0002	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 2.20 (0.247 – 19.30) > 0.05	

Model: Use Rx Medication & Services = ASD Severity
* Using χ^2 test

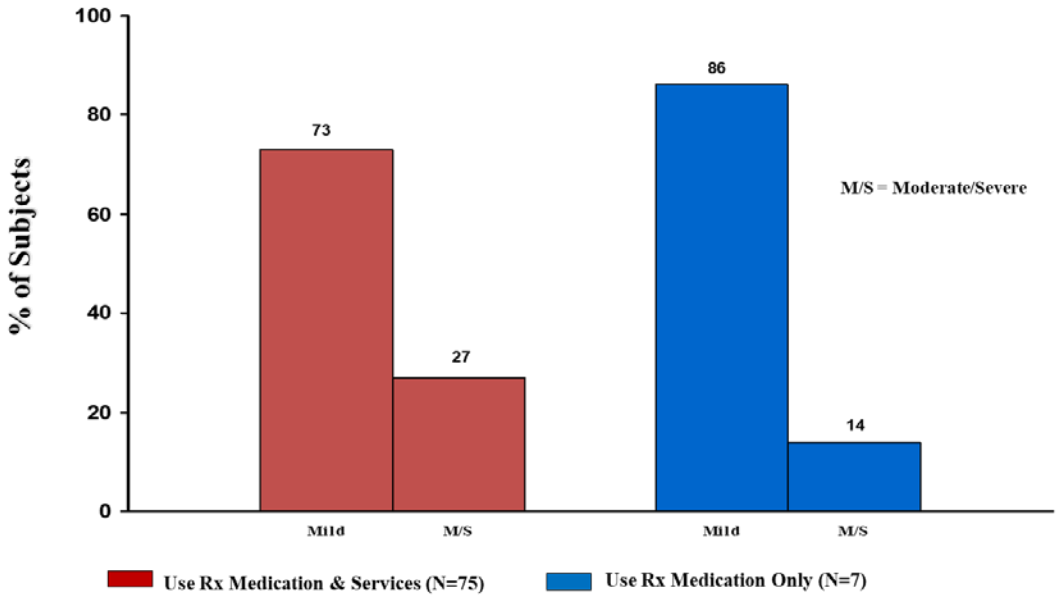

Figure 12: Proportion of subjects with ASD & Asthma and Frequency of Rx Medication and Services Used by ASD Severity: Unadjusted Analysis

Table 24 (Figure 13) shows the summary of children who were suffering from ASD and asthma and utilized additional services alone or in combination with their Rx medication based on their asthma severity. The proportion of children who were

suffering from ASD and asthma with mild asthma that utilized additional services alone or in combination with their Rx medication was higher than that of children who used only Rx medication for the management of their ASD and asthma (72% vs. 57% respectively). The proportion of children who were suffering from ASD and asthma with moderate/severe asthma that utilized additional services alone or in combination with their Rx medication were lower than children who used Rx medication for the management of their ASD and asthma (27% vs. 43% respectively). Unadjusted analyses from all 3 methods show that children with ASD and asthma who were diagnosed with moderate/severe asthma are less likely to utilize additional services alone or in combination with their Rx medication for the management of their ASD and asthma.

Table 24: Proportion of subjects with ASD & Asthma and Frequency of Rx Medication and Services Used by Asthma Severity: Unadjusted Analysis

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
Asthma Severity Mild Moderate/Severe	 54 (72%) 21 (28%)	 4 (57%) 3 (43%)
Model 1: Unweighted Analysis Using logistic Odds Ratio (95% CI) P-Value*	 0.519 (0.107 – 2.52) > 0.05	
Model 1: Weighted Analysis Using Surveylogistic Odds Ratio (95% CI) P-Value*	 0.514 (0.117 – 2.25) > 0.05	
Model 1 :GEE Using GENMOD Analysis Odds Ratio (95% CI) P-Value*	 0.518 (0.107 – 2.52) > 0.05	

Model: Use Rx Medication & Services = Asthma Severity
* Using χ^2 test

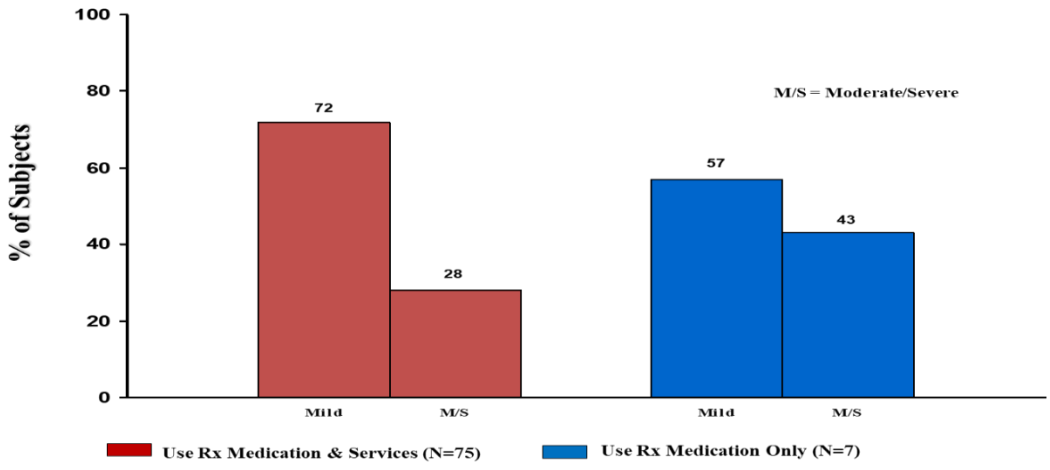

Figure 13: Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used by Asthma Severity: Unadjusted Analysis

The survey methods used were similar for all age sub-groups with the specific interest of age-related activities and needs as well as appropriate weighting strategy for such a large dataset.

5.8. DISCUSSION

Eleven Americans die from asthma every day based on the asthma death rate reported between 1980 and 1996 but this rate has been declining since 2000. Sixth-four percent of asthmatics patients who die from asthma are female but the proportion of boys (aged 2-17 years old) that die each year from asthma is higher than girls (aged 2-17 years old). The burden of asthma on the USA health system is very high with about 13 million outpatient visits and 2 million trips to the emergency room per year. Based on the Asthma and Allergy Foundation of America (AAFA) estimate, the annual cost of asthma is approximately $19.7 billion with about $10 billion in direct health care costs (hospitalizations) and about $8 billion for indirect costs such as lost earnings due to asthma or death. Asthma is the fourth leading cause of missed school and low work productivity, which resulted in approximately 12 million missed or less productive workdays each year [1].

There was an increase in the prevalence of asthma during the 1980s and 1990s. The federal health agencies responded to this increase by introducing the National Asthma Education and Prevention Program (NAEPP), which is controlled by the National Institutes of Health's National Heart, Lung, and Blood Institute. They issued the first guidelines regarding the diagnosis and management of asthma. These guidelines were updated in 1997 and 2007 to reflect new research findings [3]. A group of scientists from the CDC and federal, state, and other agencies were tasked in 1998 with discovering more ways to control asthma [3]. The result of NSCH survey showed that the prevalence of asthma increased by 21% between 2003 and 2011-2012.

The frequency ASD diagnoses has been increasing since 2000. The reason for this increase may be a result of changes in diagnostic criteria, an increased awareness of the disorder by parents and physicians, improved detection, an increase in the incidence or a combination of these factors (Neggers YH (2014) Increasing prevalence, changes in diagnostic criteria, and nutritional risk factors for autism spectrum disorders. ISRN Nutr 2014:514026). The result of the NSCH survey showed that the prevalence of ASD increased by 32% between 2007 and 2011-2012. Over 95% of the children who were diagnosed with ASD and asthma and participated in this survey period were school aged children (6 – 17 years old) with Excellent/very good physical health (≥ 49%). Greater than 70% of the children were born at normal weight and about 27% of the children were born premature.

Epidemiological evidence has shown immune involvement and increased frequency of autoimmune disorders in family members of ASD patients [22]. The result of the NSCH survey showed that the prevalence of ASD increased by 32% between 2007 and 2011-2012.

The pharmaceutical medications for asthma and ASD have been well developed but the most important concern identified by patients with asthma or ASD are the side effects of these medications, especially for females of child bearing age. This is the first retrospective study using the NSCH survey data to examine the association between children with ASD and asthma and use of additional services alone or in combination with Rx medication as well as the impact of severity of ASD/Asthma and additional services used. This survey was conducted to evaluate children's health in the USA as well as the special health care needs for these children.

Our target population, children with ASD and asthma who were provided some additional services alone or in combination with their Rx medication for management

of their ASD and asthma had not been specifically looked at in previous reports. The results of this study demonstrate that there is some interest among children with ASD and asthma in utilizing additional services alone or in combination with Rx medication potentially to reduce the frequency and cost of Rx medication or to decrease the side effects. But according to these results it appears that more services are available to ASD children. Services for asthma management have not been well developed. This survey examined children's health including their physical, emotional, and behavioral health and their normal daily activities.

The proportion of children who were diagnosed with mild ASD was 51% and the proportion of children with moderate/severe ASD was 49%. The proportion of children who were diagnosed with mild asthma was 68% and proportion of children with moderate/severe asthma was 32%. The adjusted and unadjusted analysis based on ASD severity showed that children with ASD and asthma aged 3 – 17 years old are more likely to utilize additional services for the management of their ASD and asthma. The adjusted and unadjusted analysis based on asthma severity showed that children with ASD and asthma, aged 3 – 17 years old, are less likely to utilize additional services for the management of their ASD and asthma.

We found some evidence for use of additional services alone or in combination with Rx medication among children, aged 3 – 17 years old, who were diagnosed with ASD and asthma based on the severity of their ASD. But the analysis based on the severity of asthma showed that children with more severe ASD and asthma favor the use of Rx medication only for management of their ASD and asthma. The data analyzed does not provide information on the specific services being utilized. However, as we indicated above, those using additional services in this population is also associated with moderate to severe ASD diagnoses or mild asthma.

It is important to understand how these services may be used to manage those individuals with dual diagnoses of ASD and asthma most effectively. Accordingly, state and county health providers should consider evaluating their policy(ies) regarding the availability of special programs for children with both of these conditions and monitoring the implementation of such programs for this population. Future directions for providing health services to young children with these types of special health care needs should also include exploration of the gender specific needs and the underlying deficiencies. Future research should look at other health care needs such as mental health among these young children. Our results could be helpful for enhancing future Health Services programs for this population.

5.9. Strengths and Limitations

A strength of this study is that there is a complicated and detailed adjudication process for identifying the children with ASD and asthma. This study focused on children who were diagnosed with ASD and asthma by their caregivers and could be good candidates for services that address their ASD and asthma management needs. The survey was completed by the parents of children and the data were processed and coded by The Data Resource Center for Child and Adolescent Health (DRC). The DRC is sponsored by the Maternal and Child Health Bureau and is led by the Child and Adolescent Health Measurement Initiative (CAHMI) based at the Oregon Health and Science University in Portland, Oregon. It is located online at www.childhealthdata.org.

Limitations of this research include the lack of maternal medical histories since this may increase the risk of developing ASD. There are several researchers that have looked at or are looking for the association of asthma medications taken during pregnancy and the risk of the ASD on children after the birth. The history of the type of the asthma medications that the children were taking during the survey was not

collected as well as the lack of additional services that could be used to address the asthma since the efficacy and safety of the medications are different. Other limitations with this data are the parents/caregivers recall biases regarding the responses to the diagnoses and treatments that they reported for their children, that the treatment or services periods were not reported, and the weighted response rate for this survey period was lower than previous surveys from other time periods (41% vs. 72%) which shows a nonresponse bias. The type of the services and the frequency of them are not known and there was no indication of how the use of the services was being monitored.

CHAPTER 6: OVERALL DISCUSSION AND CONCLUSION

DISCUSSION

It is known that the pathophysiological changes that occur in asthma are due to abnormalities in immune responses. In addition, several reports have indicated that abnormalities in the immune system could play a role in ASD [21]. The dual diagnoses could indicate that children with either disorder has altered immune responses that predisposes them to developing the other disorder. Thus, this retrospective study was done to look at associations between asthmatic children and ASD (Chapter 2), as well as the association between the use of additional services in combination with Rx medication for management of ASD and asthma (Chapter 5). The impact of the severity of asthma as well as the severity of ASD on additional services used were examined. The results of these studies showed the evidence of association between children with concurrent diagnoses of ASD and Asthma among children aged 3 – 17 years old. These results could be helpful for enhancing future Health Services programs for this population. State and county health providers should consider evaluating their policy(ies) regarding the availability of special programs and monitoring the implementation of such programs for this population.

The results of these studies also demonstrated that there is some interest among children with ASD or asthma in utilization of additional services in combination with Rx medication to reduce the frequency and cost of Rx medication. Subjects who were diagnosed with ASD reported the severity of their ASD as mild and moderate /severe (50% vs. 50% respectively) and of these, 13% have reported that they were suffering from asthma as well. Subjects who were diagnosed with asthma reported the severity of their asthma as mild and moderate /severe. The proportion of children who were diagnosed with mild asthma was 71% and proportion of children with moderate/severe asthma was 29%. The adjusted and unadjusted analyses showed that asthmatic children,

aged 3 – 17 years old, are less likely to utilize additional services for the management of their asthma. The proportion of the male asthmatic children who were diagnosed with mild asthma and used additional services in combination with their Rx medication was slightly higher than male subjects with mild asthma that used only Rx medication for management of their asthma (37% vs. 24% respectively). The proportion of the male children who were diagnosed with mild ASD and used additional services in combination with their Rx medication was slightly lower than male subjects with mild ASD that used Rx medication only for management of their ASD (74% vs. 86% respectively).

The proportion of children who were diagnosed with mild ASD was 51% and the proportion of children with moderate/severe ASD was 49%. The proportion of children who were diagnosed with mild asthma was 68% and the proportion of children with moderate/severe asthma was 32%. The adjusted and unadjusted analysis based on ASD severity showed that children with ASD and asthma, aged 3 – 17 years old, are more likely to utilize additional services for the management of their ASD and asthma. The adjusted and unadjusted analysis based on asthma severity showed that children with ASD and asthma, aged 3 – 17 years old, are less likely to utilize additional services for the management of their ASD and asthma. These results suggested that children with ASD and asthma have multiple conditions and difficulties in addition to their ASD and asthma. The results from this data suggested that children with severe ASD or asthma require further attention, which could be additional Rx medications or additional services. This data also showed that many children with mild ASD or asthma managed their condition with additional services and Rx medications. The educational toolkits that have been provided by State and Federal health organizations should

specifically address children with these two conditions as well as targeted by the severity of their conditions.

Complementary and alternative treatments (CAM) such as special diets, chelation (a treatment to remove heavy metals like lead from the body), biologicals (e.g., secretin), or body-based systems (like deep pressure) have been used to help children with ASD or asthma in combination with their medication [12,13,26,30,33,35]. These therapies are controversial, and it is recommended that the use of such treatments should be in consultation with the child's physician [12,26,30,33].

In 2010 the Centers for Medicare and Medicaid Services (CMS) issued a report from the environmental scan of the scientific evidence regarding the efficacy, effectiveness, safety, and availability of services for children, transitioning youth, and adults with ASD. They reported that there is a need for additional research to evaluate the effectiveness and successful implementation of additional services for individuals with ASD [42]. As stated above these additional services should take into the consideration the multiple conditions that children with ASD have and address them appropriately.

The Breathing Association has recommended asthma management services that should be available to both children and adults and should be provided by a qualified respiratory therapist. These services could be based on an in-home program and should be scheduled and tailored to the children and their caregiver's individual needs [1]. Additional services for children with asthma are very limited and there is a need to increase these services and also consider additional services for children with multiple conditions.

In 1965 department of Health and Human Services Office of Inspector General introduced a program called "Head Start Program" which offers comprehensive health

services to children of low-income families. Fifty percent of the grantees that Head Start Program received has been used for development of asthma plans for all children aged 5 years and younger. Eighty-five percent of these grantees helps to provide education and/or training to the parents with asthmatic children as well as asthma education to the children themselves [43]. Based on our findings we think the Head Start Program should be expanded to provide these services to children up to 17 years old as well as children with multiple conditions in addition to their asthma.

The Center for Autism & Related Disorders (CARD) provides several services such as Applied Behavior Analysis (ABA), Diagnosis & Assessment, Center-Based Services, Specialized Outpatient Services, Remote Clinical Services, and Child Services for children with ASD, but some of these programs are not well known to everyone and these organization should be more proactive in promoting and monitoring their services (https://www.centerforautism.com/services). These services should be updated with additional services to address children with ADS and other conditions [44,45,46,47,48,49,50,51,52,53,54,55,56].

The Autism Society of North Carolina (ASNC) provides several different toolkits such as Behavior & the Individualized Education Program, Bullying, Accessing Services, Residential Options, and Health information to the families of the children with ASD. ASNC has acknowledged that the services and supports systems for autistic children and their families are complex and could be difficult to navigate. The toolkits that they have available will help parents/caregivers to understand the type of the services and supports that are available and how they can obtain them. The toolkits from these organizations should be updated to include toolkits for that would be pertinent to children with multiple conditions [57,58,59,60,6162,63,64,65,66,67,68].

The future directions for providing health services to young children with these types of special health care needs should include exploration of gender specific needs and underlying deficiencies. Future research areas should include looking at other health care needs, such as mental health, among young children and investigations of the history of asthma and asthma medication among mothers of asthmatic children and their association with ASD.

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Appendix A: TABLES

LIST OF TABLES

Table 1
Demographics & Baseline Characteristics

Baseline	Male (N=31238) n (%)	Female (N=29713) n (%)
Current Age (Years)		
≤ 5	5563 (18)	5103 (17)
6 – 11	10903 (35)	10326 (35)
12 – 17	14772 (47)	14284 (48)
Race		
Non-Hispanic White	21951 (70)	20630 (69)
Non-Hispanic Black	1929 (6)	1773 (6)
Hispanic	3474 (11)	3310 (11)
Non-Hispanic Multi-racial/Other	3884 (13)	4000 (14)
Primary Household Language		
Hispanic child Spanish PHL	905 (3)	910 (3)
Hispanic child English PHL	2484 (8)	2331 (8)
Non-Hispanic child	27624 (88)	26262 (88)
Missing	225 (1)	210 (1)
Family Structure		
Two parents currently married	22602 (72)	21402 (72)
Two parents not currently married	1964 (6)	1796 (6)
Single mother	3845 (12)	3875 (13)
Other family type	2284 (7)	2162 (7)
Missing	543 (2)	478 (2)
Children with Special Health Care Needs (CSHCN)		
Yes	8590 (27)	6670 (22)
No	22648 (73)	23043 (78)
Qualified on RX Medication Use		
Yes	6470 (21)	5162 (17)
No	24768 (79)	24551 (83)
Qualified on elevated service use or need		
Yes	4545 (15)	3119 (10)
No	26693 (85)	26594 (90)
Qualified on Functional Limitations		
Yes	2196 (7)	1300 (4)
No	29042 (93)	28413 (96)
Qualified on Special Therapies		
Yes	2252 (7)	1248 (4)
No	28986 (93)	28465 (96)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	3822 (12)	2691 (9)
No	27416 (88)	27022 (91)
Children Qualified as having Specific Types of Special Health Care Needs		
None	22648 (73)	23043 (78)
With functional limitations	2196 (7)	1300 (4)
With conditions managed by prescription medication ONLY	2676 (9)	2348 (8)
Service use ONLY	1321 (4)	1081 (4)
With conditions managed by prescription medications AND service use needs	2397 (8)	1941 (7)
With and without emotional, developmental and/or behavioral health special needs		
Qualifying on Mental health needs	3822 (12)	2691 (9)
Not qualifying on Mental health needs	4768 (15)	3979 (13)
None	22648 (73)	23043 (78)

Table 2
Physical, Emotional & Mental Health

Physical, Emotional & Mental Health	**Male (N=31238) n (%)**	**Female (N=29713) n (%)**
Physical Health of Children		
Excellent/very good	28462 (91)	27257 (92)
Good	2319 (7)	2037 (7)
Fair/poor	395 (1)	365 (1)
Missing	62 (< 1)	54 (<1)
Were Children Ever Breastfed or fed Breast Milk		
Yes	4454 (14)	4150 (14)
No	1040 (3)	904 (3)
Missing	25744 (83)	24659 (83)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	1245 (4)	904 (3)
Healthy weight -- 5th to 84th percentile	11119 (36)	11997 (40)
Overweight -- 85th to 94th percentile	2546 (8)	2367 (8)
Obese -- 95th percentile or above	2677 (9)	1753 (6)
Missing	13651 (44)	12692 (43)
Number of days Children Exercise per Week	25675 (82)	24610 (83)
0 days	1817/25675 (7)	2282/24610 (9)
1-3 days	8860/25675 (35)	9898/24610 (40)
4-6 days	8309/25675 (32)	7780/24610 (32)
Everyday	6250/25675 (24)	4163/24610 (17)
Missing	439/25675 (2)	487/24610 (2)
Number of Missed School days during past 12 Month due to Illness or Injury	25675 (82)	24610 (83)
0 days	6871/25675 (27)	6093/24610 (25)
1-3 days	12115/25675 (47)	11587/24610 (47)
4-6 days	3786/25675 (15)	3867/24610 (16)
7-10 days	1474/25675 (6)	1559/24610 (6)
11 or more days	963/25675 (4)	987/24610 (4)
Missing	466/25675 (2)	517/24610 (2)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	27260 (87)	26218 (88)
Yes, child was born premature	3532 (11)	3068 (10)
Missing	446 (2)	427 (2)
Children Birth Weight		
Child was born with low birth weight (<1500g)	363 (1)	391 (1)
Child was born with low birth weight (1501 – 2500 g)	1815 (6)	2077 (7)
Child had normal birth weight	27154 (87)	25370 (86)
Missing	1906 (6)	1875 (6)
Children with Learning Disability		
Does not have condition	30662 (98)	29346 (99)
Ever told, but does not currently have condition	12 (< 1)	5 (< 1)
Currently has condition	433 (1)	256 (1)
Missing	131 (< 1)	106 (< 1)
Children currently have autism or autism spectrum disorder, **age 3 – 17**		
Do not currently have	29798 (95)	29360 (99)
Ever told, but not current	102 (< 1)	27 (< 1)
Currently have autism	1338 (4)	326 (1)
Severity of current autism, **age 3 – 17**		
Does not currently have autism	29900 (96)	29387 (99)
Current autism rated mild	663 (2)	176 (1)
Current autism rated moderate/severe	659 (2)	147 (< 1)
Missing	16 (< 1)	3 (< 1)
Children with Asthma		
Does not have condition	26343 (84)	26211 (88)
Ever told, but does not currently have condition	1825 (6)	1132 (4)
Currently has condition	3070 (10)	2370 (8)
Severity of current asthma, **age 3 – 17**		
Does not currently have asthma	28168 (90)	27343 (92)
Current asthma rated mild	2211 (7)	1631 (5)
Current asthma rated moderate/severe	848 (3)	728 (3)
Missing	11 (<1)	11 (< 1)
Children with one or more Current Chronic Health Conditions		
Does not have any current chronic health conditions from the list of 18 asked	16066 (52)	17385 (58)
Currently has 1 chronic health conditions from the list of 18 asked	6927 (22)	6402 (22)
Currently has 2 or more chronic health conditions from the list of 18 asked	8245 (26)	5926 (20)

Table 2
Physical, Emotional & Mental Health

Physical, Emotional & Mental Health	**Male (N=31238) n (%)**	**Female (N=29713) n (%)**
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	27221 (87)	27017 (91)
Yes, on meds for emotions etc.	3696 (12)	2397 (8)
Missing	321 (1)	299 (1)
Child finishes the tasks and follows through with what he/she says & do**, age 6-17 years**	25675 (82)	24610 (83)
Definitely True	15106/25675 (59)	17138/24610 (70)
Somewhat or not true	10205/25675 (40)	7054/24610 (29)
Missing	364/25675 (1)	418/24610 (2)
Child stays calm and in control when facing a challenge**, age 6-17 years**	25675 (82)	24610 (83)
Definitely True	12224/25675 (48)	12840/24610 (52)
Somewhat or not true	11245/25675 (44)	10067/24610 (41)
Not True	1845/25675 (7)	1293/24610 (5)
Missing	361/25675 (1)	410/24610 (2)
Child shows interest and curiosity in learning new things**, age 6-17 years**	25675 (82)	24610 (83)
Definitely True	20813/25675 (81)	21157/24610 (86)
Somewhat or not true	4759/25675 (19)	3357/24610 (14)
Missing	103/25675 (< 1)	96/24610 (< 1)

Table 3
Community and School Activities

Community and School Activities	**Male (N=31238) n (%)**	**Female (N=29713) n (%)**
Children currently receive a special education or early intervention plan, **age 1-17**	3978 (13)	1941 (7)
Yes	27078 (87)	27621 (93)
No	182 (< 1)	151 (< 1)
Missing		
Have Children repeated any grades since starting kindergarten, **ages 6 – 17**	25675 (82)	24610 (83)
Yes	1525/25675 (6)	972/24610 (4)
No	23652/25675 (92)	23084/24610 (94)
Missing	498/25675 (2)	554/24610 (2)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, **ages 6 – 17**	25675 (82)	24610 (83)
Definitely True to both items	14879/25675 (58)	18284/24610 (74)
Somewhat true for at least one item	8562/25675 (33)	5171/24610 (21)
Not true to any item	1947/25675 (8)	824/24610 (3)
Missing	287/25675 (1)	331/24610 (1)
Children who care about doing well in school, **ages 6 – 17**	25675 (82)	24610 (83)
Definitely True	17782/24610	20540/24610
Somewhat true	6504/24610	3259/24610
Not true	985/24610	370/24610
Missing	404/24610	441/24610
Have Children complete all required homework**, ages 6 – 17**	25675 (82)	24610 (83)
Definitely True	16886/25675 (66)	19403/24610 (79)
Somewhat true	6736/25675 (26)	4051/24610 (16)
Not true	1630/25675 (6)	696/24610 (3)
Missing	423/25675 (2)	460/24610 (2)
Children have Participates in 1 or more organized activities outside of school, **ages 6 – 17**	25675 (82)	24610 (83)
Children participates in one or more extracurricular activities	21274/25675 (83)	21119/24610 (86)
Children do not participate in extracurricular activities	3992/25675 (16)	3051/24610 (12)
Missing	409/25675 (1)	440/24610 (2)
Children participate in community service or volunteer work at school, church, or in the community, **age 6-17**	25675 (82)	24610 (83)
Yes	11886/25675 (46)	13138/24610 (53)
No	13055/25675 (51)	10755/24610 (44)
Missing	734/25675 (3)	717/24610 (3)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work**, ages 12-17**	14772 (47)	14284 (48)
Worked for pay	6984/14772 (47)	6535/14284 (46)
Did not work for pay	7431/14772 (50)	7383/14284 (52)
Missing	357/14772 (2)	366/14284 (3)
Children have at least one adult mentor they can rely on for advice or guidance, **age 6-17**	25675 (82)	24610 (83)
Yes	22832/25675 (89)	22198/24610 (90)
No	1900/25675 (7)	1473/24610 (6)
Missing	943/25675 (4)	939/24610 (4)

Table 4
Family Health & Activities

Family Health & Activities	Male (N=31238) n (%)	Female (N=29713) n (%)
Mother of the Children Physical & Mental Health Status	28855 (92)	27494 (92)
Physical & mental health BOTH excellent/very good	18543/28855 (64)	17676/27494 (64)
One or both of physical & mental health are NOT excellent/very good	9485/28855 (33)	9053/27494 (33)
Missing	827/28855 (3)	765/27494 (3)
Father of the Children & Mental Health Status	25870 (83)	24333 (82)
Physical & mental health BOTH excellent/very good	17167/25870 (66)	16068/24333 (66)
One or both of physical & mental health are NOT excellent/very good	7904/25870 (31)	7508/24333 (31)
Missing	799/25870 (3)	757/24333 (3)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco		
Yes	4640 (15)	4228 (14)
No	26179 (84)	25038 (84)
Missing	419 (1)	447 (2)
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)		
No one smokes in the household	26179 (84)	25038 (84)
Someone smokes, not inside the house	3935 (13)	3612 (12)
Someone smokes inside the house	657 (2)	579 (2)
Missing	467 (2)	484 (2)
Children live in working poor households (parent's income less than 100% FPL)		
Does not live in 'working poor' HH	28451 (91)	27064 (91)
Lives in 'working poor' household	2177 (7)	2090 (7)
Missing	610 (2)	559 (2)
Hours child get sleep on average weeknights, age **4 months-17 years**		
Child sleeps recommended age-appropriate hours	21556 (69)	20174 (68)
Child sleeps less than recommended age-appropriate hours	9176 (29)	9010 (30)
Missing	506 (2)	529 (2)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	6099 (20)	5701 (19)
Never/Rarely hard to get by on family income	24587 (79)	23487 (79)
Missing	552 (2)	525 (2)
Parent felt child is much harder to care for than most children during the past month		
Never	19893 (64)	20372 (69)
Rarely	5734 (18)	5317 (18)
Sometimes	3708 (12)	2755 (9)
Usually or always	1549 (5)	916 (3)
Missing	354 (1)	353 (1)
Parent felt angry with child during the past month		
Never	9017 (29)	9293 (31)
Rarely	15123 (48)	14775 (50)
Sometimes	6379 (20)	5086 (17)
Usually or always	306 (1)	181 (1)
Missing	413 (1)	378 (1)
Children whose parents who felt aggravation from parenting during the past month		
Parent usually or always feels aggravation from parenting	1914 (6)	1205 (4)
Parent seldom feels aggravation from parenting	29046 (93)	28250 (95)
Missing	278 (1)	258 (1)

Table 5
Proportion of subjects with ASD and Frequency of Asthma

	Children with ASD	
	Yes (N = 1664)	No (N = 59287)
Children with Asthma		
Yes	216 (13%)	5224 (9%)
No	1448 (87%)	54063 (91%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	1.54 (1.33 – 1.80)	
P-Value*	< 0.0001	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	2.25 (1.48 – 3.42)	
P-Value*	< 0.0001	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	1.55 (1.33 – 1.79)	
P-Value*	< 0.0001	

Model 1: Children with ASD = Asthma;
* Using $\chi 2$ test

Table 5.1
Proportion of subjects with ASD and Frequency of Asthma

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	2.25 (1.48 – 3.42)	1.54 (1.33 – 1.80)	1.55 (1.33 – 1.79)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	2.10 (1.39 – 3.178)	1.45 (1.25 – 1.70)	1.45 (1.25 – 1.68)
P-Value*	0.0005	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.27 (0.193 – 0.38)	0.25 (0.22 – 0.28)	0.25 (0.22 – 0.28)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	2.21 (1.46 – 3.34)	1.54 (1.33 – 1.80)	1.54 (1.33 – 1.78)
P-Value*	0.0002	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.20 (1.46 – 3.34)	1.02 (0.92 – 1.13)	1.02 (0.91 – 1.13)
P-Value*	> 0.05	< 0.0001	> 0.05
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	2.19 (1.46 – 3.30)	1.51 (1.30 – 1.74)	1.51 (1.30 – 1.74)
P-Value*	0.0002	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.25 (1.10 – 1.46)	1.26 (1.18 – 1.35)	1.26 (1.18 – 1.35)
P-Value*	0.0042	< 0.0001	< 0.0001
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	2.02 (1.34 – 3.024)	1.42 (1.22 – 1.64)	1.41 (1.22 – 1.64)
P-Value*	0.0007	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.26 (1.10 – 1.50)	1.28 (1.19 – 1.37)	1.28 (1.20 – 1.37)
P-Value*	0.0034	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.22 (0.94 – 1.60)	1.04 (0.94 – 1.16)	1.04 (0.94 – 1.16)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.27 (0.20 – 0.38)	0.248 (0.22 – 0.28)	0.25 (0.22 – 0.28)
P-Value*	< 0.0001	< 0.0001	< 0.0001

Model 1 Children with ASD = Asthma; Model 2: Children with ASD = Asthma Sex;
Model 3: Children with ASD = Asthma Race;
Model 4: Children with ASD = Asthma Age;
Model 5: Children with ASD = Asthma Age Race Sex
Model 6: Children with ASD = Asthma Age Race Sex Emotional and developmental or behavioural conditions Functional Limitation Social Economic Status
Model 7(Final): Children with ASD = Asthma Age Social Economic Status
* Using $\chi 2$ test

Table 5.1
Proportion of subjects with ASD and Frequency of Asthma

	Weighted	Unweighted	GEE from GENMOD
Model 6 Adjusted for:			
Odds Ratio (95% CI)	0.86 (0.57 – 1.29)	0.75 (0.63 – 0.89)	0.75 (0.63 – 0.90)
P-Value*	> 0.05	0.0012	0.0021
Age			
Odds Ratio (95% CI)	1.20 (0.95 – 1.44)	1.15 (1.06 – 1.25)	1.15 (1.06 – 1.25)
P-Value*	> 0.05	0.0012	0.0012
Race			
Odds Ratio (95% CI)	1.13 (0.86 – 1.50)	0.95 (0.83 – 1.07)	0.94 (0.83 – 1.07)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.34 (0.24 – 0.47)	0.280 (0.24 – 0.32)	0.28 (0.24 – 0.32)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Emotional and developmental or behavioral conditions	16.40 (11.64 – 23.12)	14.39 (12.51 – 16.55)	14.39 (12.33 – 16.78)
Odds Ratio (95% CI)	< 0.0001	< 0.0001	< 0.0001
P-Value*			
Functional Limitation	7.43 (5.49 – 10.05)	8.17 (7.18 – 9.29)	8.17 (7.08 – 9.42)
Odds Ratio (95% CI)	< 0.0001	< 0.0001	< 0.0001
P-Value*			
Social Economic Status	1.19 (0.85 – 1.66)	1.17 (1.03 – 1.32)	1.17 (1.03 – 1.32)
Odds Ratio (95% CI)	> 0.05	0.0137	0.017
P-Value*			
Model 7 Adjusted for:			
Odds Ratio (95% CI)	1.94 (1.30 – 2.90)	1.40 (1.20 – 1.60)	1.37 (1.18 – 1.58)
P-Value*	0.001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.25 (1.10 – 1.45)	1.30 (1.20 – 1.36)	1.26 (1.18 – 1.58)
P-Value*	0.0051	< 0.0001	< 0.0001
Social Economic Status			
Odds Ratio (95% CI)	2.41 (1.85 – 3.15)	2.40 (2.15 – 2.63)	2.37 (2.15 – 2.63)
P-Value*	< 0.0001	< 0.0001	< 0.0001

Model 1 Children with ASD = Asthma;
Model 2: Children with ASD = Asthma Sex;
Model 3: Children with ASD = Asthma Race;
Model 4: Children with ASD = Asthma Age;
Model 5: Children with ASD = Asthma Age Race Sex
Model 6: Children with ASD = Asthma Age Race Sex Emotional and developmental or behavioural conditions Functional Limitation Social Economic Status
Model 7(Final): Children with ASD = Asthma Age Social Economic Status
* Using $\chi 2$ test

Table 5.2
Proportion of subjects with ASD and Frequency of Asthma: By Sex

	Children with ASD			
	Male		Female	
	Yes (N = 1338)	No (N = 29900)	Yes (N = 326)	No (N = 29387)
Children with Asthma				
Yes	175 (13%)	2895 (10%)	41 (13%)	2329 (8%)
No	1163 (87%)	27005 (90%)	285 (87%)	27058 (92%)
Model 1: Unweighted Analysis Using logistic				
Odds Ratio (95% CI)	1.40 (1.20 – 1.70)		1.67 (1.20 – 2.33)	
P-Value*	< 0.0001		0.0023	
Model 1: Weighted Analysis Using Surveylogistic				
Odds Ratio (95% CI)	2.12 (1.31 – 3.43)		2.01 (0.98 – 4.13)	
P-Value*	< 0.0001		< 0.0001	
Model 1 :GEE Using GENMOD Analysis				
Odds Ratio (95% CI)	1.40 (1.20 – 1.65)		1.67 (1.20 – 2.32)	
P-Value*	< 0.0001		0.0023	

Model 1 Children with ASD = Asthma;
* Using $\chi 2$ test

Table 6
Demographics & Baseline Characteristics
Subject with Asthma

Baseline	Male (N=3070) n (%)	Female (N=2370) n (%)
Current Age (Years)		
≤ 5	405 (13)	227 (9)
6 – 11	1168 (38)	775 (33)
12 – 17	1497 (49)	1368 (58)
Race		
Non-Hispanic White	1926 (63)	1521 (64)
Non-Hispanic Black	371 (12)	256 (11)
Hispanic	379 (12)	294 (12)
Non-Hispanic Multi-racial/Other	394 (13)	299 (13)
Primary Household Language		
Hispanic child Spanish PHL	73 (2)	61 (3)
Hispanic child English PHL	297 (10)	224 (9)
Non-Hispanic child	2680 (87)	2062 (87)
Missing	20 (1)	23 (1)
Family Structure		
Two parents currently married	2009 (65)	1478 (62)
Two parents not currently married	228 (7)	196 (8)
Single mother	549 (18)	466 (20)
Other family type	234 (8)	194 (8)
Missing	50 (2)	36 (2)
Children with Special Health Care Needs (CSHCN)		
Yes	2192 (71)	1671 (71)
No	878 (29)	699 (29)
Qualified on RX Medication Use		
Yes	2041 (66)	1572 (66)
No	1029 (34)	798 (34)
Qualified on elevated service use or need		
Yes	970 (32)	623(26)
No	2100 (68)	1747 (74)
Qualified on Functional Limitations		
Yes	437 (14)	277 (12)
No	2633 (86)	2093 (88)
Qualified on Special Therapies		
Yes	349 (11)	176 (7)
No	2721 (89)	2194 (93)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	600 (20)	404 (17)
No	2470 (80)	1966 (83)
Children Qualified as having Specific Types of Special Health Care Needs		
None	878 (29)	699 (29)
With functional limitations	437 (14)	277 (12)
With conditions managed by prescription medication ONLY	1017 (33)	875 (37)
Service use ONLY	98 (3)	68 (3)
With conditions managed by prescription medications AND service use needs	640 (21)	451 (19)
With and without emotional, developmental and/or behavioral health special needs		
Qualifying on Mental health needs	600 (20)	404 (17)
Not qualifying on Mental health needs	1592 (52)	1267 (53)
None	878 (28)	699 (29)

Table 7
Physical, Emotional & Mental Health
Subject with Asthma

Physical, Emotional & Mental Health	Male (N=3070) n (%)	Female (N=2370) n (%)
Physical Health of Children		
Excellent/very good	2341 (76)	1803 (76)
Good	606 (20)	455 (19)
Fair/poor	117 (4)	110 (5)
Missing	6 (< 1)	2 (< 1)
Were Children Ever Breastfed or fed Breast Milk		
Yes	308 (10)	178 (8)
No	93 (3)	47 (2)
Missing	2669 (87)	2145 (91)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	121 (4)	62 (3)
Healthy weight -- 5th to 84th percentile	1009 (33)	1018 (43)
Overweight -- 85th to 94th percentile	298 (10)	265 (11)
Obese -- 95th percentile or above	411 (13)	255 (11)
Missing	1231 (40)	770 (32)
Number of days Children Exercise per Week	2665 (87)	2143 (90)
0 days	228/2665 (9)	231/2143 (11)
1-3 days	952/2665 (35)	886/2143 (41)
4-6 days	817/2665 (31)	630/2143 (29)
Everyday	616/2665 (23)	360/2143 (17)
Missing	52/2665 (2)	36/2143 (2)
Number of Missed School days during past 12 Month due to Illness or Injury	2665 (87)	2143 (90)
0 days	512/2665 (19)	367/2143 (17)
1-3 days	1097/2665 (41)	822/2143 (39)
4-6 days	499/2665 (19)	461/2143 (21)
7-10 days	298/2665 (11)	239/2143 (11)
11 or more days	215/2665 (8)	213/2143 (10)
Missing	44/2665 (2)	41/2143 (2)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	2465 (80)	1962 (83)
Yes, child was born premature	548 (18)	374 (16)
Missing	57 (2)	34 (1)
Children Birth Weight		
Child was born with low birth weight (<1500g)	70 (2)	69 (3)
Child was born with low birth weight (1501 – 2500 g)	249 (8)	202 (9)
Child had normal birth weight	2547 (83)	1965 (83)
Missing	204 (7)	134 (6)
Children with Learning Disability		
Does not have condition	2993 (97)	2329 (98)
Ever told, but does not currently have condition	2 (< 1)	0
Currently has condition	65 (2)	32 (2)
Missing	10 (< 1)	9 (< 1)
Children currently have autism or autism spectrum disorder, **age 3 – 17**		
Do not currently have	2889 (94)	2324 (98)
Ever told, but not current	6 (< 1)	5 (< 1)
Currently have autism	175 (6)	41 (2)
Severity of current autism, **age 3 – 17**		
Does not currently have autism	2895 (94)	2329 (98)
Current autism rated mild	86 (3)	24 (1)
Current autism rated moderate/severe	86 (3)	17 (1)
Missing	3 (< 1)	0
Severity of current asthma, **age 3 – 17**		
Current asthma rated mild	2211 (72)	1631 (69)
Current asthma rated moderate/severe	848 (28)	728 (31)
Missing	11 (< 1)	11 (< 1)
Children with one or more Current Chronic Health Conditions		
Currently has 1 chronic health conditions from the list of 18 asked	643 (21)	548 (23)
Currently has 2 or more chronic health conditions from the list of 18 asked	2427 (79)	1822 (77)

Table 7
Physical, Emotional & Mental Health
Subject with Asthma

Physical, Emotional & Mental Health	**Male (N=3070) n (%)**	**Female (N=2370) n (%)**
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	2458 (80)	2021 (85)
Yes, on meds for emotions etc.	578 (19)	329 (14)
Missing	34 (1)	20 (1)
Child finishes the tasks and follows through with what he/she says & do**, age 6-17 years**	2665 (87)	2143 (90)
Definitely True	1434/2665 (54)	1402/2143 (65)
Somewhat or not true	1188/2665 (44)	709/2143 (33)
Missing	43/2665 (2)	32/2143 (2)
Child stays calm and in control when facing a challenge**, age 6-17 years**	2665 (87)	2143 (90)
Definitely True	1093/2665 (41)	980/2143 (46)
Somewhat or not true	1269/2665 (48)	966/2143 (45)
Not True	264/2665 (10)	167/2143 (8)
Missing	39/2665 (1)	30/2143 (1)
Child shows interest and curiosity in learning new things**, age 6-17 years**	2665 (87)	2143 (90)
Definitely True	2136/2665 (80)	1756/2665 (82)
Somewhat or not true	524/2665 (20)	379/2665 (18)
Missing	5/2665 (< 1)	8/2665 (< 1)

Table 8
Community and School Activities
Subject with Asthma

Community and School Activities	Male (N=3070) n (%)	Female (N=2370) n (%)
Children currently receive a special education or early intervention plan, **age 1-17**		
Yes	548 (18)	252 (11)
No	2500 (81)	2109 (89)
Missing	22 (1)	9 (< 1)
Have Children repeated any grades since starting kindergarten, **ages 6 – 17**	2665 (87)	2143 (90)
Yes	203/2665 (8)	110/2143 (5)
No	2411/2665 (90)	1991/2143 (93)
Missing	51/2665 (2)	42/2143 (2)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, **ages 6 – 17**	2665 (87)	2143 (90)
Definitely True to both items	1462/2665 (55)	1507/2143 (71)
Somewhat true for at least one item	926/2665 (35)	495/2143 (23)
Not true to any item	246/2665 (9)	116/2143 (5)
Missing	31/2665 (1)	25/2143 (1)
Children who care about doing well in school, **ages 6 – 17**	2665 (87)	2143 (90)
Definitely True	1796/2665 (67)	1745/2143 (81)
Somewhat true	714/2665 (27)	321/2143 (15)
Not true	112/2665 (4)	45/2143 (2)
Missing	43/2665 (2)	32/2143 (2)
Children who do all required homework**, ages 6 – 17**	2665 (87)	2143 (90)
Definitely True	1662/2665 (62)	1578/2143 (73)
Somewhat true	747/2665 (28)	424/2143 (20)
Not true	213/2665 (8)	101/2143 (5)
Missing	43/2665 (2)	40/2143 (2)
Children have Participates in 1 or more organized activities outside of school, **ages 6 – 17**	2665 (87)	2143 (90)
Children participates in one or more extracurricular activities	2148/2665 (81)	1769/2143 (83)
Children do not participate in extracurricular activities	477/2665 (18)	344/2143 (16)
Missing	40/2665 (1)	30/2143 (1)
Children participate in community service or volunteer work at school, church, or in the community, **age 6-17**	2665 (87)	2143 (90)
Yes	1183/2665 (44)	1137/2143 (53)
No	1412/2665 (53)	959/2143 (45)
Missing	70/2665 (3)	47/2143 (2)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work**, ages 12-17**	1497 (49)	1368 (58)
Worked for pay	629/1497 (42)	638/1368 (46)
Did not work for pay	831/1497 (56)	707/1368 (52)
Missing	37/1497 (2)	23/1368 (2)
Children have at least one adult mentor they can rely on for advice or guidance, **age 6-17**	2665 (87)	2143 (90)
Yes	2378/2665 (89)	1930/2143 (90)
No	188/2665 (7)	140/2143 (7)
Missing	99/2665 (4)	73/2143 (3)

Table 9
Family Health & Activities
Subject with Asthma

Family Health & Activities	Male (N=3070) n (%)	Female (N=2370) n (%)
Mother of the Children Physical & Mental Health Status	2829 (92)	2182 (92)
Physical & mental health BOTH excellent/very good	1555/2829 (55)	1151/2182 (53)
One or both of physical & mental health are NOT excellent/very good	1196/2829 (42)	979/2182 (45)
Missing	78/2829 (3)	52/2182 (2)
Father of the Children & Mental Health Status	2325 (76)	1736 (73)
Physical & mental health BOTH excellent/very good	1434/2325 (62)	1041/1736 (60)
One or both of physical & mental health are NOT excellent/very good	817/2325 (35)	643/2325 (37)
Missing	74/2325 (3)	52/2325 (3)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco		
Yes	547 (18)	448 (19)
No	2483 (81)	1896 (80)
Missing	40 (1)	26 (1)
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)		
No one smokes in the household	2483 (81)	1896 (80)
Someone smokes, not inside the house	459 (15)	365 (15)
Someone smokes inside the house	77 (2)	80 (4)
Missing	51 (2)	29 (1)
Children live in working poor households (parent's income less than 100% FPL)		
Does not live in 'working poor' HH	2736 (90)	2113 (89)
Lives in 'working poor' household	238 (8)	221 (9)
Missing	51 (2)	36 (2)
Hours child get sleep on average weeknights, age **4 months-17 years**		
Child sleeps recommended age-appropriate hours	1972 (64)	1483 (63)
Child sleeps less than recommended age-appropriate hours	1043 (34)	854 (36)
Missing	55 (2)	33 (1)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	872 (28)	676 (29)
Never/Rarely hard to get by on family income	2146 (70)	1666 (70)
Missing	52 (2)	28 (1)
Parent felt child is much harder to care for than most children during the past month		
Never	1794 (58)	1507 (64)
Rarely	587 (19)	435 (18)
Sometimes	461 (15)	288 (12)
Usually or always	198 (7)	117 (5)
Missing	30 (1)	23 (1)
Parent felt angry with child during the past month		
Never	868 (28)	712 (30)
Rarely	1427 (47)	1148 (48)
Sometimes	702 (23)	464 (20)
Usually or always	40 (1)	24 (1)
Missing	33 (1)	22 (1)
Children whose parents who felt aggravation from parenting during the past month		
Parent usually or always feels aggravation from parenting	245 (8)	152 (6)
Parent seldom feels aggravation from parenting	2806 (91)	2204 (93)
Missing	19 (1)	14 (1)

Table 10
Proportion of subjects with Asthma and Frequency Services Used
Unadjusted Analysis

	Children with Asthma (N = 3149)	Children with other Conditions (N = 8615)
Utilizing services		
Yes	1257 (40%)	5483 (64%)
No	1892 (60%)	3132 (36%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	0.380 (0.350 – 0.413)	
P-Value*	< 0.0001	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	0.377 (0.315 – 0.452)	
P-Value*	< 0.0001	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	0.38 (0.35 – 0.413)	
P-Value*	< 0.0001	

Model 1: Asthma = Services used
* Using $\chi 2$ test

Table 10.1
Proportion of subjects with Asthma and Frequency Services Used

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	0.377 (0.315 – 0.452)	0.380 (0.350 – 0.413)	0.380 (0.350 – 0.413)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	0.377 (0.315 – 0.452)	0.380 (0.350 – 0.412)	0.380 (0.350 – 0.412)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.904 (0.753 – 1.085)	0.906 (0.833 – 0.985)	0.906 (0.833 – 0.985)
P-Value*	> 0.05	0.0213	0.0211
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	0.359 (0.299 – 0.431)	0.372 (0.342 – 0.405)	0.372 (0.342 – 0.405)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.87 (1.56 – 2.24)	1.62 (1.48 – 1.78)	1.62 (1.48 – 1.78)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	0.374 (0.313 – 0.447)	0.378 (0.348 – 0.411)	0.378 (0.348 – 0.411)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.866 (0.764 – 0.982)	0.864 (0.813 – 0.919)	0.864 (0.813 – 0.919)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	0.355 (0.296 – 0.427)	0.370 (0.340 – 0.403)	0.370 (0.340 – 0.403)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.885 (0.779 – 1.005)	0.887 (0.833 – 0.944)	0.887 (0.833 – 0.944)
P-Value*	> 0.05	0.0002	0.0002
Race			
Odds Ratio (95% CI)	1.86 (1.55 – 2.23)	1.61 (1.47 – 1.76)	1.61 (1.47 – 1.76)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.907 (0.754 – 1.091)	0.920 (0.845 – 1.001)	0.920 (0.845 – 1.001)
P-Value*	> 0.05	> 0.05	> 0.05

Model 1: Asthma = Services used;
Model 2: Asthma = Services used Sex;
Model 3: Asthma = Services used Race;
Model 4 Asthma = Services used Age;
Model 5: Asthma = Services used Age Race Sex
Model 6: Asthma = Services used Age Race Sex Social Economic Status;
Model 7 (Final): Asthma = Services used Social Economic Status
* Using $\chi 2$ test

Table 10.1
Proportion of subjects with Asthma and Frequency Services Used

	Weighted	Unweighted	GEE from GENMOD
Model 6 Adjusted for:			
Odds Ratio (95% CI)	0.598 (0.478 – 0.747)	0.538 (0.483 – 0.599)	0.538 (0.483 – 0.599)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.950 (0.836 – 1.079)	0.920 (0.864 – 0.980)	0.920 (0.864 – 0.980)
P-Value*	> 0.05	0.0092	0.0092
Race			
Odds Ratio (95% CI)	1.85 (1.54 – 2.22)	1.60 (1.46 – 1.75)	1.60 (1.46 – 1.75)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.877 (0.732 – 1.052)	0.916 (0.841 – 0.997)	0.916 (0.841 – 0.997)
P-Value*	> 0.05	0.0436	0.0436
Social Economic Status			
Odds Ratio (95% CI)	1.25 (1.025 – 1.535)	1.26 (1.15 – 1.39)	1.26 (1.15 – 1.39)
P-Value*	0.0281	< 0.0001	< 0.0001
Model 7 Adjusted for:			
Odds Ratio (95% CI)	0.368 (0.308 – 0.440)	0.371 (0.341 – 0.401)	0.371 (0.341 – 0.401)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Social Economic Status			
Odds Ratio (95% CI)	1.263 (1.035 – 1.543)	1.25 (1.14 – 1.38)	1.25 (1.14 – 1.38)
P-Value*	0.0219	< 0.0001	< 0.0001

Model 1: Asthma = Services used;
Model 2: Asthma = Services used Sex;
Model 3: Asthma = Services used Race;
Model 4 Asthma = Services used Age;
Model 5: Asthma = Services used Age Race Sex
Model 6: Asthma = Services used Age Race Sex Social Economic Status;
Model 7 (Final): Asthma = Services used Social Economic Status
* Using $\chi 2$ test

Table 10.2
Proportion of subjects with Asthma and Frequency Services Used: by Sex

	Children with Asthma			
	Male (3070)		Female (2370)	
	Use Rx Medication & Services (N = 735)	Use Rx Medication Only (N = 1014)	Use Rx Medication & Services (N = 518)	Use Rx Medication Only (N = 871)
Asthma Severity				
Mild	272 (37%)	240 (24%)	190 (37%)	262 (30%)
Moderate/Severe	463 (63%)	774 (76%)	328 (63%)	609 (70%)
Model 1: Unweighted Analysis Using logistic				
Odds Ratio (95% CI)	1.90 (1.54 – 2.33)		1.35 (1.10 – 1.70)	
P-Value*	< 0.0001		0.0112	
Model 1: Weighted Analysis Using Surveylogistic				
Odds Ratio (95% CI)	1.67 (1.12 – 2.54)		1.45 (0.88 – 2.40)	
P-Value*	< 0.0001		< 0.0001	
Model 1 :GEE Using GENMOD Analysis				
Odds Ratio (95% CI)	1.90 (1.54 – 2.33)		1.35 (1.10 – 1.70)	
P-Value*	< 0.0001		0.0112	

Model 1: Use Rx Medication & Services = Asthma Severity;
*Using $\chi 2$ test

Table 11
Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used By Asthma Severity

	Children with Asthma	
	Use Rx Medication & Services (N = 1253)	Use Rx Medication Only (N = 1885)
Asthma Severity		
Mild	791 (63%)	1383 (73%)
Moderate/Severe	462 (37%)	502 (27%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	1.61 (1.38 – 1.88)	
P-Value*	< 0.0001	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	1.54 (1.12 – 2.11)	
P-Value*	< 0.0001	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	1.61 (1.38 – 1.88)	
P-Value*	< 0.0001	

Model 1: Use Rx Medication & Services = Asthma Severity;
*Using $\chi 2$ test

Table 11.1
Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used By Asthma Severity

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	1.54 (1.12 – 2.11)	1.61 (1.38 – 1.88)	1.61 (1.38 – 1.88)
P-Value*	0.0073	< 0.0001	< 0.0001
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	1.57 (1.15 – 2.16)	1.63 (1.40 – 1.90)	1.62 (1.39 – 1.89)
P-Value*	0.0049	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.808 (0.593 – 1.102)	0.805 (0.696 – 0.931)	0.805 (0.696 – 0.932)
P-Value*	> 0.05	0.0035	0.0036
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	1.52 (1.11 – 2.10)	1.59 (1.37 – 1.86)	1.59 (1.366 – 1.86)
P-Value*	0.0096	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	1.17 (0.87 – 1.57)	1.20 (1.001 – 1.352)	1.16 (1.001 – 1.352)
P-Value*	> 0.05	0.049	0.049
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	1.52 (1.11 – 2.09)	1.61 (1.38 – 1.87)	1.61 (1.38 – 1.87)
P-Value*	0.0048	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.809 (0.656 – 0.999)	0.970 (0.874 – 1.076)	0.970 (0.874 – 1.076)
P-Value*	0.049	> 0.05	> 0.05
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	1.54 (1.12 – 2.11)	1.61 (1.38 – 1.1.88)	1.61 (1.38 – 1.1.88)
P-Value*	0.0076	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.820 (0.663 – 1.013)	0.991 (0.892 – 1.101)	0.991 (0.892 – 1.100)
P-Value*	> 0.05	> 0.05	> 0.05
Race			
Odds Ratio (95% CI)	1.17 (0.875 – 1.57)	1.16 (0.995 – 1.35)	1.16 (0.995 – 1.35)
P-Value*	> 0.05	0.058	0.058
Sex			
Odds Ratio (95% CI)	0.823 (0.605 – 1.12)	0.808 (0.698 – 0.936)	0.808 (0.698 – 0.936)
P-Value*	> 0.05	0.0043	0.0044

Model 1: Use Rx Medication & Services = Asthma Severity;
Model 2: Use Rx Medication & Services = Asthma Severity Sex;
Model 3: Use Rx Medication & Services = Asthma Severity Race;
Model 4 Use Rx Medication & Services = Asthma Severity Age;
Model 5: Use Rx Medication & Services = Asthma Severity Age Race Sex
Model 6: Use Rx Medication & Services = Asthma Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = Asthma Severity Sex Social Economic Status
* Using $\chi 2$ test

Table 11.1
Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used By Asthma Severity

	Weighted	Unweighted	GEE from GENMOD
Model 6 Adjusted for:			
Odds Ratio (95% CI)	1.61 (1.09 – 2.40)	1.93 (1.59 – 2.34)	1.53 (1.31 – 1.80)
P-Value*	0.0181	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.645 (0.502 – 0.829)	0.727 (0.640 – 0.826)	0.980 (0.879 – 1.09)
P-Value*	0.0006	< 0.0001	> 0.05
Race			
Odds Ratio (95% CI)	1.80 (1.25 – 2.50)	1.24 (1.02 – 1.50)	1.13 (0.969 – 1.31)
P-Value*	0.0014	0.0277	> 0.05
Sex			
Odds Ratio (95% CI)	0.818 (0.555– 1.204)	0.750 (0.622 – 0.905)	0.811 (0.70 – 0.94)
P-Value*	> 0.05	0.0026	0.0054
Social Economic Status			
Odds Ratio (95% CI)	1.75 (1.20 – 2.63)	1.34 (1.09 – 1.65)	1.72 (1.46 – 2.02)
P-Value*	0.0076	0.0059	< 0.0001
Model 7 Adjusted for:			
Odds Ratio (95% CI)	1.41 (1.037 – 1.93)	1.54 (1.32 – 1.80)	1.53 (1.31 – 1.80)
P-Value*	0.0288	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.785 (0.582 – 1.060)	0.807 (0.697 – 0.934)	0.811 (0.70 – 0.94)
P-Value*	> 0.05	0.0040	0.0054
Social Economic Status			
Odds Ratio (95% CI)	2.03 (1.50 – 2.78)	1.73 (1.47 – 2.03)	1.72 (1.46 – 2.02)
P-Value*	< 0.0001	< 0.0001	< 0.0001

Model 1: Use Rx Medication & Services = Asthma Severity;
Model 2: Use Rx Medication & Services = Asthma Severity Sex;
Model 3: Use Rx Medication & Services = Asthma Severity Race;
Model 4 Use Rx Medication & Services = Asthma Severity Age;
Model 5: Use Rx Medication & Services = Asthma Severity Age Race Sex
Model 6: Use Rx Medication & Services = Asthma Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = Asthma Severity Sex Social Economic Status
* Using $\chi 2$ test

Table 12
Demographics & Baseline Characteristics
Subject with ASD

Baseline	Male (N=1338) n (%)	Female (N=326) n (%)
Current Age (Years)		
≤ 5	143 (11)	33 (10)
6 – 11	488 (36)	114 (35)
12 – 17	707 (53)	179 (55)
Race		
Non-Hispanic White	925 (69)	227 (70)
Non-Hispanic Black	96 (7)	17 (5)
Hispanic	159 (12)	43 (13)
Non-Hispanic Multi-racial/Other	158 (12)	39 (12)
Primary Household Language		
Hispanic child Spanish PHL	45 (3)	9 (3)
Hispanic child English PHL	112 (9)	34 (10)
Non-Hispanic child	1178 (88)	282 (87)
Missing	3 (< 1)	1 (< 1)
Family Structure		
Two parents currently married	884 (66)	218 (67)
Two parents not currently married	95 (7)	21 (6)
Single mother	237 (18)	59 (18)
Other family type	106 (8)	24 (8)
Missing	16 (1)	4 (1)
Children with Special Health Care Needs (CSHCN)		
Yes	1239 (93)	307 (94)
No	99 (7)	19 (6)
Qualified on RX Medication Use		
Yes	709 (53)	182 (56)
No	629 (47)	144 (44)
Qualified on elevated service use or need		
Yes	1091 (82)	266 (82)
No	247 (18)	60 (18)
Qualified on Functional Limitations		
Yes	819 (61)	202 (62)
No	519 (39)	124 (38)
Qualified on Special Therapies		
Yes	899 (67)	221 (68)
No	439 (33)	105 (32)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	1044 (78)	260 (80)
No	294 (22)	66 (20)
Children Qualified as having Specific Types of Special Health Care Needs		
None	99 (7)	19 (6)
With functional limitations	819 (61)	202 (62)
With conditions managed by prescription medication ONLY	22 (2)	9 (3)
Service use ONLY	183 (14)	46 (14)
With conditions managed by prescription medications AND service use needs	215 (16)	50 (15)
With and without emotional, developmental and/or behavioral health special needs		
Qualifying on Mental health needs	1044 (78)	260 (80)
Not qualifying on Mental health needs	195 (15)	47 (14)
None	99 (7)	19 (6)

Table 13
Physical, Emotional & Mental Health
Subjects with ASD

Physical, Emotional & Mental Health	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Physical Health of Children		
Excellent/very good	965 (72)	217 (67)
Good	285 (21)	81 (25)
Fair/poor	87 (7)	28 (8)
Missing	1 (< 1)	0
Were Children Ever Breastfed or fed Breast Milk		
Yes	108 (8)	26 (8)
No	35 (3)	7 (2)
Missing	1195 (89)	293 (90)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	70 (5)	12 (4)
Healthy weight -- 5th to 84th percentile	443 (33)	111 (34)
Overweight -- 85th to 94th percentile	135 (10)	43 (13)
Obese -- 95th percentile or above	204 (15)	42 (13)
Missing	486 (37)	118 (36)
Number of days Children Exercise per Week	1195 (89)	293 (90)
0 days	233/1195 (19)	73/293 (25)
1-3 days	511/1195 (43)	130/293 (44)
4-6 days	257/1195 (22)	49/293 (17)
Everyday	178/1195 (15)	35/293 (12)
Missing	16/1195 (1)	6/293 (2)
Number of Missed School days during past 12 Month due to Illness or Injury	1195 (89)	293 (90)
0 days	254/1195 (21)	61/293 (21)
1-3 days	442/1195 (37)	97/293 (33)
4-6 days	224/1195 (19)	51/293 (17)
7-10 days	119/1195 (10)	40/293 (14)
11 or more days	135/1195 (11)	34/293 (12)
Missing	21/1195 (2)	10/293 (3)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	1086 (81)	255 (78)
Yes, child was born premature	232 (17)	61 (19)
Missing	20 (2)	10 (3)
Children Birth Weight		
Child was born with low birth weight (<1500g)	36 (3)	11 (3)
Child was born with low birth weight (1501 – 2500 g)	110 (8)	48 (15)
Child had normal birth weight	1114 (83)	244 (75)
Missing	78 (6)	23 (7)
Children with Learning Disability		
Does not have condition	1097 (82)	256 (79)
Ever told, but does not currently have condition	3 (< 1)	0
Currently has condition	230 (17)	68 (21)
Missing	8 (1)	2 (< 1)
Severity of current autism, **age 3 – 17**		
Current autism rated mild	663 (50)	176 (54)
Current autism rated moderate/severe	659 (49)	147 (45)
Missing	16 (1)	3 (1)
Children with Asthma		
Does not have condition	1087 (81)	264 (81)
Ever told, but does not currently have condition	76 (6)	21 (6)
Currently has condition	175 (13)	41 (13)
Severity of current asthma, **age 3 – 17**		
Does not have condition	1163 (87)	285 (87)
Current asthma rated mild	118 (9)	28 (9)
Current asthma rated moderate/severe	55 (4)	13 (4)
Missing	2 (< 1)	0
Children with one or more Current Chronic Health Conditions		
Currently has 1 chronic health conditions from the list of 18 asked	51 (4)	7 (2)
Currently has 2 or more chronic health conditions from the list of 18 asked	1287 (96)	319 (98)

Table 13
Physical, Emotional & Mental Health
Subjects with ASD

Physical, Emotional & Mental Health	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Currently taking any meds for problems with emotions, concentration or behavior condition **age 2 – 17**		
No, not on meds for emotions etc.	697 (52)	170 (52)
Yes, on meds for emotions etc.	632 (47)	154 (47)
Missing	9 (1)	2 (1)
Child finishes the tasks and follows through with what he/she says & do**, age 6-17 years**	1195 (89)	293 (90)
Definitely True	261/1195 (22)	75/293 (26)
Somewhat or not true	918/1195 (77)	212/293 (72)
Missing	16/1195 (1)	6/293 (2)
Child stays calm and in control when facing a challenge**, age 6-17 years**	1195 (89)	293 (90)
Definitely True	87/1195 (7)	18/293 (6)
Somewhat or not true	622/1195 (52)	154/293 (52)
Not True	471/1195 (39)	116/293 (40)
Missing	15/1195 (1)	5/293 (2)
Child shows interest and curiosity in learning new things**, age 6-17 years**	1195 (89)	293 (90)
Definitely True	575/1195 (48)	147/293 (50)
Somewhat or not true	614/1195 (51)	145/293 (50)
Missing	6/1195 (1)	1/293 (< 1)

Table 14
Community and School Activities
Subjects with ASD

Community and School Activities	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Children currently receive a special education or early intervention plan, **age 1-17**		
Yes	1006 (75)	219 (67)
No	321 (24)	103 (32)
Missing	11 (1)	4 (1)
Have Children repeated any grades since starting kindergarten, **ages 6 – 17**	1195 (89)	293 (90)
Yes	179/1195 (15)	51/293 (17)
No	999/1195 (84)	236/293 (81)
Missing	17/1195 (1)	6/293 (2)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, **ages 6 – 17**	1195 (89)	293 (90)
Definitely True to both items	292/1195 (24)	87/293 (30)
Somewhat true for at least one item	523/1195 (44)	122/293 (41)
Not true to any item	368/1195 (31)	79/293 (27)
Missing	12/1195 (1)	5/293 (2)
Children who care about doing well in school, **ages 6 – 17**	1195 (89)	293 (90)
Definitely True	441/1195 (37)	123/293 (42)
Somewhat true	522/1195 (44)	117/293 (40)
Not true	215/1195 (18)	45/293 (15)
Missing	17/1195 (1)	8/293 (3)
Have Children complete all required homework**, ages 6 – 17**	1195 (89)	293 (90)
Definitely True	409/1195 (34)	107/293 (36)
Somewhat true	475/1195 (40)	113/293 (39)
Not true	293/1195 (25)	67/293 (23)
Missing	18/1195 (1)	6/293 (2)
Children have Participates in 1 or more organized activities outside of school, **ages 6 – 17**	1195 (89)	293 (90)
Children participates in one or more extracurricular activities	702/1195 (59)	188/293 (64)
Children do not participate in extracurricular activities	479/1195 (40)	98/293 (34)
Missing	14/1195 (1)	7/293 (2)
Children participate in community service or volunteer work at school, church, or in the community, **age 6-17**	1195 (89)	293 (90)
Yes	327/1195 (27)	101/293 (34)
No	841/1195 (71)	181/293 (62)
Missing	27/1195 (2)	11/293 (4)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work**, ages 12-17**	707 (53)	179 (55)
Worked for pay	148/707 (21)	43/179 (24)
Did not work for pay	549/707 (78)	133/179 (74)
Missing	10/707 (1)	3/179 (2)
Children have at least one adult mentor they can rely on for advice or guidance, **age 6-17**	1195 (89)	293 (90)
Yes	1017/1195 (85)	248/293 (85)
No	139/1195 (12)	29/293 (10)
Missing	39/1195 (3)	16/293 (5)

Table 15
Family Health & Activities
Subjects with ASD

Family Health & Activities	Male (N=1338) n (%)	Female (N=326) n (%)
Mother of the Children Physical & Mental Health Status	1231 (92)	306 (94)
Physical & mental health BOTH excellent/very good	577/1231 (47)	138/306 (45)
One or both of physical & mental health are NOT excellent/very good	620/1231 (50)	160/306 (52)
Missing	34/1231 (3)	8/306 (3)
Father of the Children & Mental Health Status	1015 (76)	250 (77)
Physical & mental health BOTH excellent/very good	562/1015 (55)	128/250 (51)
One or both of physical & mental health are NOT excellent/very good	431/1015 (43)	115/250 (46)
Missing	22/1015 (2)	7/250 (3)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco		
Yes	241 (18)	69 (21)
No	1087 (81)	251 (77)
Missing	10 (1)	6 (2)
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)		
No one smokes in the household	1087 (81)	251 (77)
Someone smokes, not inside the house	199 (15)	56 (17)
Someone smokes inside the house	39 (3)	12 (4)
Missing	13 (1)	7 (2)
Children live in working poor households (parent's income less than 100% FPL)		
Does not live in 'working poor' HH	1226 (92)	290 (89)
Lives in 'working poor' household	93 (7)	31 (10)
Missing	19 (1)	5 (1)
Hours child get sleep on average weeknights, age **4 months-17 years**		
Child sleeps recommended age-appropriate hours	837 (63)	211 (65)
Child sleeps less than recommended age-appropriate hours	484 (36)	105 (32)
Missing	17 (1)	10 (3)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	485 (36)	135 (41)
Never/Rarely hard to get by on family income	837 (63)	185 (57)
Missing	16 (1)	6 (2)
Parent felt child is much harder to care for than most children during the past month		
Never	210 (16)	40 (12)
Rarely	192 (14)	50 (15)
Sometimes	444 (33)	100 (31)
Usually or always	484 (36)	132 (41)
Missing	8 (1)	4 (1)
Parent felt angry with child during the past month		
Never	331 (25)	78 (24)
Rarely	557 (42)	127 (39)
Sometimes	408 (30)	108 (33)
Usually or always	31 (2)	9 (3)
Missing	11 (1)	4 (1)
Children whose parents who felt aggravation from parenting during the past month		
Parent usually or always feels aggravation from parenting	503 (38)	134 (41)
Parent seldom feels aggravation from parenting	828 (62)	188 (58)
Missing	7 (< 1)	4 (1)

Table 16
Proportion of subjects with ASD and Frequency Services Used
Unadjusted Analysis

	Children with ASD (N = 525)	Children with other Conditions (N = 11239)
Utilizing services		
Yes	494 (94%)	6246 (56%)
No	31 (6%)	4993 (44%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	12.74 (8.85 – 18.35)	
P-Value*	< 0.0001	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	12.38 (6.50 – 23.59)	
P-Value*	< 0.0001	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	12.74 (8.85 – 18.35)	
P-Value*	< 0.0001	

Model 1: ASD = Services used;
*Using χ^2 test

Table 16.1
Proportion of subjects with ASD and Frequency Services Used

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	12.38 (6.50 – 23.60)	12.74 (8.85 – 18.35)	12.74 (8.85 – 18.35)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	12.32 (6.47 – 23.50)	12.73 (8.83 – 18.34)	12.73 (8.83 – 18.34)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Sex			
Odds Ratio (95% CI)	0.321 (0.201 – 0.514)	0.284 (0.228 – 0.354)	0.284 (0.228 – 0.354)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	12.40 (6.53 – 23.56)	12.76 (8.86 – 18.37)	12.76 (8.86 – 18.37)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Race			
Odds Ratio (95% CI)	0.968 (0.655 – 1.432)	0.940 (0.772 – 1.146)	0.940 (0.772 – 1.146)
P-Value*	> 0.05	> 0.05	> 0.05
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	12.40 (6.50 – 23.51)	12.75 (8.85 – 18.38)	12.76 (8.86 – 18.37)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.962 (0.716 – 1.30)	1.081 (0.943 – 1.239)	1.081 (0.947 – 1.233)
P-Value*	> 0.05	> 0.05	> 0.05
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	12.40 (6.50 – 23.43)	12.82 (8.89 – 18.47)	12.82 (8.89 – 18.47)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	1.023 (0.756 – 1.38)	1.179 (1.025 – 1.357)	1.179 (1.028 – 1.353)
P-Value*	> 0.05	0.0211	0.0187
Race			
Odds Ratio (95% CI)	0.972 (0.661 – 1.43)	0.930 (0.761 – 1.135)	0.930 (0.761 – 1.135)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.320 (0.201 – 0.512)	0.277 (0.223 – 0.346)	0.277 (0.222 – 0.346)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Model 6 Adjusted for:			
Odds Ratio (95% CI)	8.24 (3.93 – 17.30)	6.70 (4.50 – 10.05)	6.70 (4.50 – 10.05)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Age			
Odds Ratio (95% CI)	0.962 (0.706 – 1.31)	1.095 (0.948 – 1.264)	1.095 (0.948 – 1.264)
P-Value*	> 0.05	> 0.05	> 0.05
Race			
Odds Ratio (95% CI)	0.957 (0.656 – 1.40)	0.917 (0.750 – 1.122)	0.917 (0.750 – 1.122)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.325 (0.204 – 0.519)	0.274 (0.220 – 0.342)	0.274 (0.220 – 0.342)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Social Economic Status			
Odds Ratio (95% CI)	1.12 (0.728 – 1.71)	0.966 (0.793 – 1.178)	0.966 (0.793 – 1.178)
P-Value*	> 0.05	> 0.05	> 0.05
Model 7 Adjusted for:			
Odds Ratio (95% CI)	12.26 (6.50 – 23.21)	12.72 (8.83 – 18.32)	12.72 (8.83 – 18.32)
P-Value*	< 0.0001	< 0.0001	< 0.0001
Social Economic Status			
Odds Ratio (95% CI)	1.11 (0.732 – 1.694)	1.02 (0.840 – 1.239)	1.02 (0.840 – 1.238)
P-Value*	> 0.05	> 0.05	> 0.05

Model 1: ASD = Services Used; Model 2: ASD = Services Used Sex; Model 3: ASD = Services Used Race;
Model 4 ASD = Services Used Age; Model 5 ASD = Services Used Age Race Sex;
Model 6: ASD = Services Used Age Race Sex Social Economic Status; Model 7 (Final): ASD = Services Used Social Economic Status
* Using $\chi 2$ test

Table 17
Proportion of subjects with ASD and Frequency of Rx Medication and Services Used by ASD Severity: Unadjusted Analysis

	Children with ASD	
	Use Rx Medication & Services (N = 489)	Use Rx Medication Only (N = 31)
ASD Severity		
Mild	360 (74%)	26 (84%)
Moderate/Severe	129 (26%)	5 (16%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	1.86 (0.70 – 4.96)	
P-Value*	> 0.05	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	2.58 (0.66 – 10.02)	
P-Value*	> 0.05	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	1.86 (0.70 – 4.96)	
P-Value*	> 0.05	

Model 1: Use Rx Medication & Services = ASD Severity;
*Using χ^2 test

Table 17.1
Proportion of subjects with ASD and Frequency of Rx Medication and Services Used By ASD Severity

	Weighted	Unweighted	GEE from GENMOD
Model 1			
Odds Ratio (95% CI)	2.58 (0.663 – 10.023)	1.86 (0.70 – 4.96)	1.86 (0.70 – 4.96)
P-Value*	> 0.05	> 0.05	> 0.05
Model 2 Adjusted for Sex			
Odds Ratio (95% CI)	2.62 (0.638 – 10.065)	1.87 (0.70 – 4.98)	1.87 (0.70 – 4.96)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.706 (0.218 – 2.28)	0.588 (0.262 – 1.319)	0.588 (0.261 – 1.32)
P-Value*	> 0.05	> 0.05	> 0.05
Model 3 Adjusted for Race			
Odds Ratio (95% CI)	2.40 (0.299 – 0.431)	1.80 (0.674 – 4.79)	1.80 (0.665 – 4.86)
P-Value*	< 0.0001	> 0.05	> 0.05
Race			
Odds Ratio (95% CI)	1.97 (0.518 – 7.51)	1.59 (0.636 – 3.97)	1.59 (0.630 – 4.02)
P-Value*	> 0.05	> 0.05	> 0.05
Model 4 Adjusted for Age			
Odds Ratio (95% CI)	2.71 (0.696 – 10.57)	1.87 (0.70 – 4.98)	1.87 (0.70 – 4.98)
P-Value*	> 0.05	> 0.05	> 0.05
Age			
Odds Ratio (95% CI)	0.449 (0.184 – 1.10)	0.719 (0.384 – 1.348)	0.719 (0.384 – 1.348)
P-Value*	> 0.05	> 0.05	> 0.05
Model 5 Adjusted for Age, Race, and Sex			
Odds Ratio (95% CI)	2.71 (0.67 – 10.92)	1.82 (0.682 – 4.86)	1.82 (0.677 – 4.90)
P-Value*	> 0.05	> 0.05	> 0.05
Age			
Odds Ratio (95% CI)	0.483 (0212 – 1.10)	0.742 (0.393 – 1.401)	0.742 (0.405 – 1.36)
P-Value*	> 0.05	> 0.05	> 0.05
Race			
Odds Ratio (95% CI)	1.53 (0.413 – 5.64)	1.59 (0.630 – 3.99)	1.59 (0.635 – 3.96)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.648 (0.202 – 2.08)	0.568 (0.252 – 1.281)	0.568 (0.251 – 1.29)
P-Value*	> 0.05	> 0.05	> 0.05
Model 6 Adjusted for:			
Odds Ratio (95% CI)	2.43 (0.630 – 9.42)	1.46 (0.468 – 4.531)	1.80 (0.67 – 4.83)
P-Value*	> 0.05	> 0.05	> 0.05
Age			
Odds Ratio (95% CI)	0.571 (0.238 – 1.373)	0.588 (0.273 – 1.265)	0.746 (0.41 – 1.36)
P-Value*	> 0.05	> 0.05	> 0.05
Race			
Odds Ratio (95% CI)	1.34 (0.374 – 4.82)	2.335 (0.853 – 6.387)	1.53 (0.613 – 3.83)
P-Value*	> 0.05	> 0.05	> 0.05
Sex			
Odds Ratio (95% CI)	0.595 (0.185 – 1.92)	0.433 (0.161 – 1.163)	0.522 (0.224 – 1.22)
P-Value*	> 0.05	> 0.05	> 0.05
Social Economic Status			
Odds Ratio (95% CI)	4.32 (1.11 – 16.73)	1.603 (0.579 – 4.439)	1.88 (0.714 – 4.98)
P-Value*	0.0343	> 0.05	> 0.05
Model 7 Adjusted for:			
Odds Ratio (95% CI)	0.368 (0.308 – 0.440)	1.81 (0.68 – 4.82)	1.81 (0.68 – 4.85)
P-Value*	< 0.0001	> 0.05	> 0.05
Social Economic Status			
Odds Ratio (95% CI)	1.263 (1.035 – 1.543)	1.80 (0.721 – 4.477)	1.80 (0.716 – 4.50)
P-Value*	0.0219	> 0.05	> 0.05

Model 1: Use Rx Medication & Services = ASD Severity; Model 2: Use Rx Medication & Services = ASD Severity Sex;
Model 3: Use Rx Medication & Services = ASD Severity Race; Model 4 Use Rx Medication & Services = ASD Severity Age;
Model 5: Use Rx Medication & Services = ASD Severity Age Race Sex
Model 6: Use Rx Medication & Services = ASD Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = ASD Severity Social Economic Status
* Using $\chi 2$ test

Table 17.2
Proportion of subjects with ASD and Frequency of Rx Medication and Services Used: Unadjusted Analysis by Sex and ASD Severity

	Children with ASD			
	Male (1338)		Female (326)	
	Use Rx Medication & Services (N = 394)	Use Rx Medication Only (N = 22)	Use Rx Medication & Services (N = 95)	Use Rx Medication Only (N = 9)
ASD Severity				
Mild	290 (74%)	19 (86%)	70 (74%)	7 (78%)
Moderate/Severe	104 (26%)	3 (14%)	25 (26%)	2 (22%)
Model 1: Unweighted Analysis Using logistic				
Odds Ratio (95% CI)	2.30 (0.660 – 7.83)		1.25 (0.243 – 6.42)	
P-Value*	> 0.05		> 0.05	
Model 1: Weighted Analysis Using Surveylogistic				
Odds Ratio (95% CI)	3.35 (0.57 – 19.81)		1.64 (0.221 -12.17)	
P-Value*	> 0.05		> 0.05	
Model 1 :GEE Using GENMOD Analysis				
Odds Ratio (95% CI)	2.27 (0.660 – 7.83)		1.25 (0.243 – 6.42)	
P-Value*	> 0.05		> 0.05	

Model 1: Use Rx Medication & Services = ASD Severity
* Using $\chi 2$ test

Table 18
Demographics & Baseline Characteristics
Subject with ASD + Asthma

Baseline	Male (N=175) n (%)	Female (N=41) n (%)
Current Age (Years)		
≤ 5	10 (6)	1 (2)
6 – 11	64 (36)	20 (49)
12 – 17	101 (58)	20 (49)
Race		
Non-Hispanic White	107 (61)	30 (73)
Non-Hispanic Black	22 (13)	2 (5)
Hispanic	19 (11)	5 (12)
Non-Hispanic Multi-racial/Other	27 (15)	4 (10)
Primary Household Language		
Hispanic child Spanish PHL	0	1 (2)
Hispanic child English PHL	18 (10)	4 (10)
Non-Hispanic child	156 (89)	35 (86)
Missing	1 (1)	1 (2)
Family Structure		
Two parents currently married	93 (53)	24 (58)
Two parents not currently married	17 (10)	4 (10)
Single mother	45 (26)	8 (20)
Other family type	18 (10)	5 (12)
Missing	2 (1)	0
Children with Special Health Care Needs (CSHCN)		
Yes	171 (98)	41 (100)
No	4 (2)	0
Qualified on RX Medication Use		
Yes	145 (83)	30 (73)
No	30 (17)	11 (27)
Qualified on elevated service use or need		
Yes	151 (86)	33 (80)
No	24 (14)	8 (20)
Qualified on Functional Limitations		
Yes	105 (60)	24 (59)
No	70 (40)	17 (41)
Qualified on Special Therapies		
Yes	115 (66)	24 (59)
No	60 (34)	17 (41)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	146 (83)	33 (80)
No	29 (17)	8 (20)
Children Qualified as having Specific Types of Special Health Care Needs		
None	4 (3)	0
With functional limitations	105 (60)	24 (59)
With conditions managed by prescription medication ONLY	6 (3)	1 (2)
Service use ONLY	9 (5)	5 (12)
With conditions managed by prescription medications AND service use needs	51 (29)	11 (27)
With and without emotional, developmental and/or behavioral health special needs		
Qualifying on Mental health needs	146 (83)	33 (80)
Not qualifying on Mental health needs	25 (15)	8 (20)
None	4 (2)	0

Table 19
Physical, Emotional & Mental Health
Subject with ASD + Asthma

Physical, Emotional & Mental Health	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Physical Health of Children		
Excellent/very good	101 (58)	20 (49)
Good	56 (32)	14 (34)
Fair/poor	17 (10)	7 (17)
Missing	1 (< 1)	0
Were Children Ever Breastfed or fed Breast Milk		
Yes	5 (3)	0
No	5 (3)	1 (2)
Missing	165 (94)	40 (98)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	6 (3)	3 (7)
Healthy weight -- 5th to 84th percentile	52 (30)	11 (27)
Overweight -- 85th to 94th percentile	23 (13)	1 (2)
Obese -- 95th percentile or above	37 (21)	9 (22)
Missing	57 (33)	17 (42)
Number of days Children Exercise per Week		
0 days	31 (18)	9 (22)
1-3 days	74 (42)	17 (41)
4-6 days	30 (17)	9 (22)
Everyday	27 (15)	4 (10)
Missing	13 (8)	2 (5)
Number of Missed School days during past 12 Month due to Illness or Injury		
0 days	24 (14)	5 (12)
1-3 days	50 (29)	8 (20)
4-6 days	34 (19)	9 (22)
7-10 days	25 (14)	6 (14)
11 or more days	29 (17)	9 (22)
Missing	13 (7)	4 (10)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	122 (70)	26 (63)
Yes, child was born premature	46 (26)	13 (32)
Missing	7 (4)	2 (5)
Children Birth Weight		
Child was born with low birth weight (<1500g)	8 (5)	4 (10)
Child was born with low birth weight (1501 – 2500 g)	19 (11)	7 (17)
Child had normal birth weight	133 (76)	26 (63)
Missing	15 (8)	4 (10)
Children with Learning Disability		
Ever told, but does not currently have condition	139 (80)	31 (76)
Currently has condition	34 (19)	10 (24)
Missing	2 (1)	0
Severity of current autism, **age 3 – 17**		
Current autism rated mild	86 (49)	24 (59)
Current autism rated moderate/severe	86 (49)	17 (41)
Missing	3 (2)	0
Severity of current asthma, **age 3 – 17**		
Current asthma rated mild	118 (68)	28 (68)
Current asthma rated moderate/severe	55 (31)	13 (32)
Missing	2 (1)	0
Children with one or more Current Chronic Health Conditions		
Currently has 2 or more chronic health conditions from the list of 18 asked	175 (100)	41 (100)
Currently taking any meds for problems with emotions, concentration or behavior condition **age 3 – 17**		
No, not on meds for emotions etc.	103 (59)	22 (54)
Yes, on meds for emotions etc.	72 (41)	19 (46)
Child finishes the tasks and follows through with what he/she says & do**, age 6-17 years**	165 (94)	40 (98)
Definitely True	31/165 (19)	10/40 (25)
Somewhat or not true	132/165 (80)	29/40 (73)
Missing	2/165 (1)	1/40 (2)

Table 19
Physical, Emotional & Mental Health
Subject with ASD + Asthma

Physical, Emotional & Mental Health	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Child stays calm and in control when facing a challenge**, age 6-17 years**	165 (94)	40 (98)
Definitely True	11/165 (7)	2/40 (5)
Somewhat or not true	80/165 (48)	24/40 (60)
Not True	72/165 (44)	13/40 (33)
Missing	2/165 (1)	1/40 (2)
Child shows interest and curiosity in learning new things**, age 6-17 years**	165 (94)	40 (98)
Definitely True	77/165 (47)	23/40 (57)
Somewhat or not true	88/165 (53)	17/40 (43)
Missing	0	0

Table 20
Community and School Activities
Subject with ASD + Asthma

Community and School Activities	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Children currently receive a special education or early intervention plan, **age 1-17**		
Yes	127 (73)	24 (59)
No	45 (26)	17 (41)
Missing	3 (1)	0
Have Children repeated any grades since starting kindergarten, **ages 6 – 17**	165 (94)	40 (98)
Yes	31/165 19)	9/40 (23)
No	130/165 (79)	30/40 (75)
Missing	4/165 (2)	1/40 (2)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, **ages 6 – 17**	165 (94)	40 (98)
Definitely True to both items	42/165 (25)	12/40 (30)
Somewhat true for at least one item	75/165 (46)	18/40 (45)
Not true to any item	47/165 (28)	9/40 (23)
Missing	1/165 (1)	1/40 (2)
Children who care about doing well in school, **ages 6 – 17**	165 (94)	40 (98)
Definitely True	65/165 (39)	18/40 (45)
Somewhat true	71/165(43)	14/40 (35)
Not true	28/165 (17)	7/40 (18)
Missing	1/165 (1)	1/40 (2)
Have Children complete all required homework**, ages 6 – 17**	165 (94)	40 (98)
Definitely True	52/165 (31)	14/40 (35)
Somewhat true	71/165 (43)	17/40 (42)
Not true	41/165 (25)	7/40 (18)
Missing	1 /165 (1)	2/40 (5)
Children have Participates in 1 or more organized activities outside of school, **ages 6 – 17**	165 (94)	40 (98)
Children participates in one or more extracurricular activities	93/165 (57)	22 /40 (55)
Children do not participate in extracurricular activities	70/165 (42)	17/40 (43)
Missing	2/165 (1)	1/40 (2)
Children participate in community service or volunteer work at school, church, or in the community, **age 6-17**	165 (94)	40 (98)
Yes	50/165 (30)	16/40 (40)
No	111/165 (67)	23/40 (58)
Missing	4/165 (3)	1/40 (2)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work**, ages 12-17**	101 (58)	20 (49)
Worked for pay	12/101 (12)	7/20 (35)
Did not work for pay	89/101 (88)	12/20 (60)
Missing	0	1/20 (5)
Children have at least one adult mentor they can rely on for advice or guidance, **age 6-17**	165 (94)	40 (98)
Yes	140/165 (85)	37/40 (93)
No	19/165 (11)	1/40 (2)
Missing	6/165 (4)	2/40 (5)

Table 21
Family Health & Activities
Subject with ASD + Asthma

Family Health & Activities	Male (N=175) n (%)	Female (N=41) n (%)
Mother of the Children Physical & Mental Health Status	158 (90	38 (93)
Physical & mental health BOTH excellent/very good	62/158 (39)	9/38 (24)
One or both of physical & mental health are NOT excellent/very good	88/158 (56)	29/38 (76)
Missing	8/158 (5)	0
Father of the Children & Mental Health Status	114 (65)	29 (71)
Physical & mental health BOTH excellent/very good	62/114 (54)	10/29 (34)
One or both of physical & mental health are NOT excellent/very good	48/114 (42)	19/29 (66)
Missing	4/114 (4)	0
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco		
Yes	42 (24)	13 (32)
No	131 (75)	28 (68)
Missing	2 (1)	0
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)		
No one smokes in the household	131 (75)	28 (68)
Someone smokes, not inside the house	32 (18)	11 (27)
Someone smokes inside the house	9 (5)	2 (5)
Missing	3 (2)	0
Children live in working poor households (parent's income less than 100% FPL)		
Does not live in 'working poor' HH	156 (89)	37 (90)
Lives in 'working poor' household	18 (10)	4 (10)
Missing	1 (1)	0
Hours child get sleep on average weeknights, age **4 months-17 years**		
Child sleeps recommended age-appropriate hours	108 (62)	25 (61)
Child sleeps less than recommended age-appropriate hours	65 (37)	15 (37)
Missing	2 (1)	1 (2)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	86 (49)	24 (59)
Never/Rarely hard to get by on family income	88 (50)	17 (41)
Missing	1 (1)	0
Parent felt child is much harder to care for than most children during the past month		
Never	32 (18)	7 (17)
Rarely	21 (12)	3 (7)
Sometimes	68 (39)	20 (49)
Usually or always	53 (30)	11 (27)
Missing	1 (1)	0
Parent felt angry with child during the past month		
Never	40 (23)	11 (27)
Rarely	68 (39)	14 (34)
Sometimes	59 (34)	16 (39)
Usually or always	8 (4)	0
Children whose parents who felt aggravation from parenting during the past month		
Parent usually or always feels aggravation from parenting	57 (33)	11 (27)
Parent seldom feels aggravation from parenting	118 (67)	30 (73)

Table 22
Proportion of subjects with ASD + Asthma and Frequency of Services Used
Unadjusted Analysis

	Children with ASD + Asthma (N = 83)	Children with other Conditions (N = 11681)
Utilizing services		
Yes	76 (92%)	6664 (57%)
No	7 (8%)	5017 (43%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	8.20 (3.76 – 17.73)	
P-Value*	< 0.0001	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	4.90 (1.40 – 17.17)	
P-Value*	0.0132	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	8.17 (3.77 – 17.74)	
P-Value*	< 0.0001	

Model: ASD + Asthma = Services Used
* Using $\chi 2$ test

Table 23
Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used by ASD Severity: Unadjusted Analysis

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
ASD Severity		
Mild	55 (73%)	6 (86%)
Moderate/Severe	20 (27%)	1 (14%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	2.20 (0.247 – 19.30)	
P-Value*	> 0.05	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	8.97 (3.01 – 26.70)	
P-Value*	0.0002	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	2.20 (0.247 – 19.30)	
P-Value*	> 0.05	

Model: Use Rx Medication & Services = ASD Severity
* Using $\chi 2$ test

Table 24
Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used by Asthma Severity: Unadjusted Analysis

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
Asthma Severity		
Mild	54 (72%)	4 (57%)
Moderate/Severe	21 (28%)	3 (43%)
Model 1: Unweighted Analysis Using logistic		
Odds Ratio (95% CI)	0.519 (0.107 – 2.52)	
P-Value*	> 0.05	
Model 1: Weighted Analysis Using Surveylogistic		
Odds Ratio (95% CI)	0.514 (0.117 – 2.25)	
P-Value*	> 0.05	
Model 1 :GEE Using GENMOD Analysis		
Odds Ratio (95% CI)	0.518 (0.107 – 2.52)	
P-Value*	> 0.05	

Model: Use Rx Medication & Services = Asthma Severity
* Using $\chi 2$ test

Appendix B: Statistical Analysis Plan

ASSOCIATION BETWEEN ASTHMA AND AUTISM SPECTRUM DISORDER

Statistical Analysis Plan

by

Abbas G. Hamedani

INTRODUCTION

This Statistical analysis plan (SAP) documents the planned analyses to be carried out for retrospective study of male and female children (ages 3-17) using the 2016 – 2017 NS-CSHCN is a national telephone interview conducted by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics.

STUDY OBJECTIVE(S) AND ENDPOINT(S)

Primary Objectives

1. To determine if there is an association in children aged 3 – 17 years old with Autism Spectrum Disorder (ASD) and a concurrent diagnosis of Asthma.

2. To determine subjects with more severe Asthma will benefit from additional services in combination with Asthma medication in comparison with those that use medication only for management of their Asthma among children aged 3 – 17 years old.

3. To determine subjects with more severe ASD will benefit from additional services in combination with ASD medication in comparison with those that use medication only for management of their ASD among children aged 3 – 17 years old.

4. To determine subjects with ASD and asthma will benefit from additional services in combination with their medication in comparison with those that use medication only for management of their ASD and asthma among children aged 3 – 17 years old.

Study Endpoint(s)

1. Proportion of children who were diagnosed with ASD and Asthma.
2. Proportion of children aged 3 – 17 years old needs additional services in combination with prescription medication for management of their asthma.
3. Proportion of children aged 3 – 17 years old needs additional services in combination with prescription medication for management of their ASD.
4. Proportion of children aged 3 – 17 years old needs additional services in combination with prescription medication for management of their ASD + asthma.

AIMS

Specific Aim 1:Is there an association between Autism Spectrum Disorder (ASD) and Asthma?

Null Hypothesis H_0: There is no association between ASD and Asthma.

Alternative Hypothesis H_A: There is an association between ASD and Asthma.

Specific Aim 2: Will additional services in combination with Asthma medication have additional benefit in comparison with those that use medication only for management of their Asthma among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their Asthma.

Alternative Hypothesis H_A: There is an association in additional services for management of Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their Asthma.

Specific Aim 3: Will additional services in combination with ASD medication have additional benefit in comparison with those that use medication only for management of their ASD among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of ASD among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD.

Alternative Hypothesis H_A: There is an association in additional services for management of ASD among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD.

Specific Aim 4: Will the subjects with ASD + Asthma benefit from additional services in combination with their medication in comparison with those that use medication only for management of their ASD and asthma among children aged 3 – 17 years old?

Null Hypothesis H_0: There is not an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma.

Alternative Hypothesis H_A: There is an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma.

Research Questions and Hypothesis

Primary Research Questions

1. Is there an association between children with ASD and Asthma?

2. Will additional services in combination with Asthma medication have additional benefit in comparison with those that use medication only for management of their Asthma among children aged 3 – 17 years old?

3. Will additional services in combination with ASD medication have additional benefit in comparison with those that use medication only for management of their ASD among children aged 3 – 17 years old?

4. There is an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma?

Primary Hypotheses

1. There is an association between children with ASD and Asthma among children aged 3 – 17 years old.

2. There is an association in additional services for management of Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their Asthma.

3. There is an association in additional services for management of ASD among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD.

4. There is an association in additional services for management of ASD + Asthma among children aged 3 – 17 years old in combination with prescription medication based on the severity of their ASD and Asthma.

STUDY DESIGN

Methodology

This study was a retrospective study of 60,951 male and female children (ages 3 – 17) with special health care needs who were living in United States of America (USA) which were part of the 71,811 children who participated in the NSCH survey during 2016 – 2017 in USA.

The 2016 – 2017 NS-CSHCN was a national mail and online survey that was conducted from June 2016 through February of 2017 by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. It was sponsored by the U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. The NSCH provides a broad range of information about children's health and well-being collected in a manner that allows comparisons among states as well as nationally. Questionnaire topics include demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (3 – 17 years), family functioning, parental health

status and neighborhood and community characteristics. No formal sample size and power analyses were conducted for this study.

The 2016-2017 NSCH were completed by parents/caregiver of the children within each household. The 2016 survey was completed by 50,212 households from the sample of 139,923 households. The 2017 survey was completed by 21,599 households from the sample of 59,135 households. The combined data was weighted to adjust for the demographic composition of non-institutionalized children and youth aged 0–17 years in each state. For the weighted analyses we used the 2016-2017 weights that were calculated by NSCH (variable name: FWC_1617).

Measures

The Questionnaire that was used for this survey had topics such as demographics, health and functional status, health insurance coverage, health care access and utilization, medical home, early childhood (0–5 years) issues, issues specific to middle childhood and adolescence (6–17years), family functioning, parental health status and neighborhood and community characteristics. The current ASD and asthma conditions were collected from parents/caregiver of the child. Parents/caregivers were required to respond to the question truthfully and accurately regarding the status and diagnoses of their child. The ASD question regarding whether a doctor or healthcare provider had ever diagnosed your child with ASD. The possible responses that were available on the questioner were:

- Do not currently have
- Ever told, but not current
- Currently have autism

We selected those children that were identified as “Currently have autism” in our analysis. The same type of question was asked regarding the asthma and we selected those children that were identified as “Currently have asthma” in our analysis. The severity of ASD and asthma for those children with these conditions were collected by using the following possible responses:

- Current autism rated mild
- Current autism rated moderate/severe
- Current asthma rated mild
- Current asthma rated moderate/severe

The parents/caregivers were also asked regarding their child qualification for needing “Specific Types of Special Health Care Needs” and they were required to select one of the following responses:

- None
- With functional limitations
- With conditions managed by prescription medication ONLY
- Service use ONLY
- With conditions managed by prescription medications AND service use needs

We selected those children that were identified as “With conditions managed by prescription medication only” called “Rx Medication Only” and combined those children that were identified as “ Services use only” or “With conditions managed by prescription medications AND service use need” as one category called “Rx Medication & Services used”.

Covariates

The association between ASD and asthma was evaluated using 7 different models with the adjustments for Age, Race, Sex, Emotional and Developmental or Behavioral Conditions, Functional Limitation, and Social Economic Status. The Social Economic Status was derived from the responses to “Children live in working poor households (parent’s income less than 100% FPL)” question. The possible responses for this question were “Does not live in 'working poor' HH” which we defined it as “No” and “Lives in 'working poor' household” which we defined it as “Yes”.

Statistical Analyses

All analyses were performed after all subjects completed the survey and the database was available. The primary population of interest for this study was children 3 to 17 years old who were surveyed during the 2016 – 2017 NSCH. The primary comparison of interest was the proportion of children who were diagnosed with ASD and Asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using weighted and unweighted methods and as a sensitivity analysis we used GENMOD procedure for Generalized Estimating Equations [40]. The statistical significance of each variable was measured using Mantel-Haenzel $\chi 2$ statistics. For statistical analyses, all tests were two-sided with significance interpreted at the $\alpha=0.05$ significance level and all analyses were conducted using SAS version 9.4.

Once collected, all data were assessed for missing and nonsensical data. All missing data were confirmed with the original data collection forms and corrected in the database if it was possible. Subjects missing data for the primary outcome were not included in the primary analysis (unweighted analysis). All continuous variables such

as age and number of days were categorized by NSCH data center and the defined categories were included in the database. Demographic characteristics were summarized by sex, categorical variables were presented by counts and percentages.

Primary Comparisons of Interest

Specific Aim 1:

The primary comparison of interest is the proportion of children who were diagnosed with ASD and Asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) will be calculated. The statistical significance of each variable will be measured using Mantel-Haenzel χ^2 statistics.

Specific Aim 2:

The primary comparison of interest is the proportion of children who were diagnosed with Asthma and using additional services for management of their Asthma based on the severity of their Asthma and show that subjects with more severe Asthma will benefit more from the additional services. The severity of Asthma was categorized as Mild and Moderate/Severe.

Specific Aim 3:

The primary comparison of interest is the proportion of children who were diagnosed with ASD and using additional services for management of their ASD based on the severity of their ASD and show that subjects with more severe ASD will benefit more from the additional services. The severity of ASD was categorized as Mild and Moderate/Severe.

Specific Aim 4:

The primary comparison of interest is the proportion of children who were diagnosed with ASD + Asthma and using additional services for management of their ASD + Asthma based on the severity of their ASD and Asthma.

STUDY POPULATION

Demographic and Baseline Characteristics

Demographic characteristics will be summarized by sex. Continuous variables such as age will be presented using the five-number summary (i.e., mean, standard deviation, median, minimum, and maximum), categorical variables will be presented by counts and percentages.

PRIMARY ANALYSES

Specific Aim 1:

The primary comparison of interest is the proportion of children who were diagnosed with ASD and Asthma. Odds ratios (ORs) and 95% confidence intervals (CIs) will be calculated. The statistical significance of each variable will be measured using Mantel-Haenzel χ^2 statistics.

Model 1 (Main Model)

a. Children with ASD = ASTHMA where variables:

    i. 1 = Children who have ASD, 2 = Children who do not have ASD)

    ii. ASTHMA (1=YES, 0=NO)

The following covariates will be examined and those with the significant affect will be included in the final model:

- Sex
- Age
- Race
- Emotional
- Functional limitations
- Socioeconomic

Specific Aim 2:

The primary comparison of interest is the proportion of children who were diagnosed with Asthma and using additional services for management of their asthma.

Specific Aim 3:

The primary comparison of interest is the proportion of children who were diagnosed with ASD and using additional services for management of their ASD.

Specific Aim 4:

The primary comparison of interest is the proportion of children who were diagnosed with ASD + Asthma and using additional services for management of their ASD + Asthma.

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Appendix C: List of Analysis Variables

Demographic Variables	
VARIABLES	**DESCRIPTIONS**
AGE3_1617	CHILDREN'S AGE IN 3 CATEGORIES (1 = ≤ 5, 2 = 6-11, AND 3 = 12-17)
RACE4_1617	RACE/ETHNICITY CATEGORIES (1 = "HISPANIC", 2 = WHITE, NON-HISPANI, 3 = BLACK, NON-HISPANIC, AND 4 = MULTI-RACIAL/OTHER, NON-HISPANIC)
HISPLANG_1617	PRIMARY HOUSEHOLD LANGUAGE PARSED TO HISPANIC AND NON-HISP (1 = HISPANIC CHILD SPANISH PHL, 2 = HISPANIC CHILD ENGLISH PHL, AND 3 = NON-HISPANIC CHILD)
FAMSTRUCT_1617	FAMILY STRUCTURE (1 = "TWO PARENT--BIOLOGICAL OR ADOPTED, 2 = TWO PARENT--STEP FAMILY, 3 = SINGLE MOTHER--NO FATHER PRESENT, AND 4 = OTHER FAMILY TYPE)
CSHCN_1617	RESULTS FOR CSHCN SCREENER (1 = YES"AND 0 = NO)
RXMEDS_1617	QUALIFIED ON RX'D MED USE (1 = YES AND 0 = NO)
SERVE_1617	QUALIFIED ON ELEVATED SERVICE USE OR NEEDS (1 = YES AND 0 = NO)
FUNC_1617	QUALIFIED ON FUNCTIONAL LIMITS (1 = YES AND 0 = NO)
THERAPY_1617	QUALIFIED ON USE OF SPECIAL THERAPIES (1 = YES AND 0 = NO)
MHEALTH_1617	QUALIFIED ON ONGOING EMOTIONAL, DEVELOPMENTAL OR BEHAVIORAL CONDITIONS (1 = YES AND 0 = NO)
CSHCNTYPE_1617	SCREENER QUALIFYING CATEGORIES (0 = NON, 1 = WITH FUNCTIONAL LIMITATIONS, 2 = WITH CONDITIONS MANAGED BY PRESCRIPTION MEDICATION ONLY, 3 = SERVICE USE ONLY", AND 4 = WITH CONDITIONS MANAGED BY PRESCRIPTION MEDICATIONS AND SERVICE USE NEEDS)
MHNEEDS_1617	CSHCN WITH AND WITHOUT EMOTIONAL, DEVELOPMENTAL AND/OR BEHAVIORAL HEALTH SPECIAL NEEDS (1 = QUALIFYING ON MENTAL HEALTH NEEDS, 2 = NOT QUALIFYING ON MENTAL HEALTH NEEDS)", AND 3 = NON)

Physical & Mental Health Variables	
VARIABLES	**DESCRIPTIONS**
CHHLTHST_1617	PHYSICAL HEALTH OF CHILDREN (1=EXCELLENT/VERY GOOD, 2= GOOD, AND 3=FAIR/POOR)
BRSTEVER_1617	WERE CHILDREN EVER BREASTFED OR FED BREAST MILK (1=YES, 0=NO)
BMI4_1617	WEIGHT STATUS OF CHILDREN BASED ON BMI (1=UNDERWEIGHT -- LESS THAN 5TH PERCENTILE, 2=HEALTHY WEIGHT -- 5TH TO 84TH PERCENTILE, 3=OVERWEIGHT -- 85TH TO 94TH PERCENTILE, AND 4=OBESE -- 95TH PERCENTILE OR ABOVE)
PHYSACT_1617	NUMBER OF DAYS CHILDREN EXERCISE PER WEEK (1=0 DAYS, 2=1-3 DAYS 3= 4-6 DAYS, AND 4=EVERYDAY)
SCHLMISS_1617	NUMBER OF MISSED SCHOOL DAYS DURING PAST 12 MONTH DUE TO ILLNESS OR INJURY (1=0 DAYS, 2=1-3 DAYS, 3=4-6 DAYS, 4=7-10, AND 5=11 OR MORE DAYS)
BORNPRE_1617	WERE CHILDREN BORN PREMATURE (MORE THAN 3 WEEKS) (0=NO, CHILD WAS NOT BORN PREMATURE AND 1=YES, CHILD WAS BORN PREMATURE)
VERYLBWGHT_1617	CHILDREN BIRTH WEIGHT (1=CHILD WAS BORN WITH LOW BIRTH WEIGHT (<1500G, 2=CHILD WAS BORN WITH LOW BIRTH WEIGHT (1501 – 2500 G), AND 3=CHILD HAD NORMAL BIRTH WEIGHT)
INTDISAB_1617	CHILDREN WITH LEARNING DISABILITY (1=DOES NOT HAVE CONDITION, 2=EVER TOLD, BUT DOES NOT CURRENTLY HAVE CONDITION, AND 3=CURRENTLY HAS CONDITION)
AUTISM_1617	CHILDREN WITH ASD (AGE 3 – 17) (1=DOES NOT HAVE CONDITION, 2=EVER TOLD, BUT DOES NOT CURRENTLY HAVE CONDITION, AND 3=CURRENTLY HAS CONDITION)
AUTISM_1617	SEVERITY OF CURRENT ASD (AGE 3 – 17) (1=DOES NOT HAVE CONDITION, 2=CURRENT ASD RATED MILD, 3= CURRENT ASD RATED MODERATE/ SEVERE)
ASTHMA_1617	CHILDREN WITH ASTHMA (1=DOES NOT HAVE CONDITION, 2=EVER TOLD, BUT DOES NOT CURRENTLY HAVE CONDITION, AND 3=CURRENTLY HAS CONDITION)
ASTHMSEV_1617	SEVERITY OF CURRENT Asthma (AGE 3 – 17) (1=DOES NOT HAVE CONDITION, 2=CURRENT Asthma RATED MILD, 3= CURRENT Asthma RATED MODERATE/SEVERE)
COND2MORE27_1617	CHILDREN WITH ONE OR MORE CURRENT CHRONIC HEALTH CONDITIONS (1=DOES NOT HAVE ANY CURRENT CHRONIC HEALTH CONDITIONS FROM THE LIST OF 18 ASKED, 2=CURRENTLY HAS 1 CHRONIC HEALTH CONDITIONS FROM THE LIST OF 18 ASKED, AND 3=CURRENTLY HAS 2 OR MORE CHRONIC HEALTH CONDITIONS FROM THE LIST OF 18 ASKED)
MEDEMOTION_1617	CURRENTLY TAKING ANY MEDS FOR PROBLEM WITH EMOTION, CONCENTRATION OR BEHAVIOR CONDITION - AGE 2-17 (1 = YES AND 0 = NO)
FINISHES_1617	MEASURE OF FLOURISHING FOR CHILDREN AND ADOLESCENTS, AGE 6-17 YEARS (1= DEFINITELY TRUE AND 2= SOMEWHAT OR NOT TRUE)
RESIL6TO17_1617	CHILD STAYS CALM AND IN CONTROL WHEN FACING A CHALLENGE, AGE 6-17 YEARS (1= DEFINITELY TRUE, 2= SOMEWHAT OR NOT TRUE, AND 3=NOT TRUE
CURIOUS6TO17_1617	CHILD SHOWS INTEREST AND CURIOSITY IN LEARNING NEW THINGS, AGE 6-17 YEARS (1 = DEFINITELY TRUE, 2= SOMEWHAT OR NOT TRUE)
COMMUNITY AND SCHOOL ACTIVITIES VARIABLES	
VARIABLES	**DESCRIPTIONS**

SPEDUCPLN_1617	CHILDREN CURRENTLY RECEIVE A SPECIAL EDUCATION OR EARLY INTERVENTION PLAN, AGES 1 – 17 (1=YES, 0=NO)
REPTGRADE_1617	CHILDREN REPEATED ANY GRADES SINCE STARTING KINDERGARTEN, AGE 6-17 (1=YES, 0=NO)
SCHLENGAGE_1617	HAVE CHILDREN ENGAGED IN SCHOOL ACTIVITIES, CARES ABOUT DOING WELL, AND DO HOMEWORK IN THE PAST MONTH, AGES 6 – 17 (1= DEFINITELY TRUE TO BOTH ITEMS, 2=SOMEWHAT TRUE FOR AT LEAST ONE ITEM, AND 3=NOT TRUE TO ANY ITEM)
CARES_1617	HOW OFTEN CHILDREN SHOWED THAT THEY CARES ABOUT DOING WELL IN SCHOOL, AGES 6 – 17 (1= DEFINITELY TRUE, 2=SOMEWHAT TRUE, AND 3=NOT TRUE)
HOMEWORK_1617	HAVE CHILDREN COMPLETE ALL REQUIRED HOMEWORK, AGES 6 – 17 (1= DEFINITELY TRUE, 2=SOMEWHAT TRUE, AND 3=NOT TRUE)
AFTSCHACT_1617	CHILDREN HAVE PARTICIPATES IN 1 OR MORE ORGANIZED ACTIVITIES OUTSIDE OF SCHOOL, AGES 6 – 17 (1=CHILDREN PARTICIPATES IN ONE OR MORE EXTRACURRICULAR ACTIVITIES AND 2=CHILDREN DO NOT PARTICIPATE IN EXTRACURRICULAR ACTIVITIES)
VOLUNTEER_1617	HOW OFTEN CHILDREN PARTICIPATED IN VOLUNTEER WORK OR COMMUNITY SERVICE DURING PAST 12 MONTHS, AGES 12 – 17 (1=YES, 2=NO)
WORKPAY_1617	CHILDREN WHO WORKED OUTSIDE HOME FOR PAY DURING PAST WEEK, AGES 12 – 17 (1=WORKED FOR PAY, 2=DID NOT WORK FOR PAY)
READTO_1617	NUMBER OF DAYS CHILDREN WERE READ ALOUD TO DURING THE PAST WEEK, AGE 0-5 YEARS (0=0 DAYS, 1=1-3 DAYS, 2=4-6 DAYS, 3=EVERY DAY)
MENTOR_1617	CHILDREN WITH AT LEAST ONE ADULT MENTOR AT SCHOOL, NEIGHBORHOOD OR COMMUNITY, AGES 6 – 17 (1=YES, 2=NO)

FAMILY HEALTH & ACTIVITIESVARIABLES	
VARIABLES	**DESCRIPTIONS**
MOTHERHST_1617	MOTHER OF THE CHILDREN PHYSICAL & MENTAL HEALTH STATUS (1=PHYSICAL & MENTAL HEALTH BOTH EXCELLENT/VERY GOOD, 2=ONE OR BOTH OF PHYSICAL & MENTAL HEALTH ARE NOT EXCELLENT/VERY GOOD)
FATHERHST_1617	FATHER OF THE CHILDREN PHYSICAL HEALTH STATUS 1=PHYSICAL & MENTAL HEALTH BOTH EXCELLENT/VERY GOOD, 2=ONE OR BOTH OF PHYSICAL & MENTAL HEALTH ARE NOT EXCELLENT/VERY GOOD)
SMOKING_1617	CHILDREN LIVE IN HOUSEHOLD IN WHICH SOMEONE USES CIGARETTES, CIGARS, OR PIPE TOBACCO (1=YES, 0=NO)
SMKINSIDE_1617	CHILDREN EXPOSURE TO SECONDHAND TOBACCO SMOKER LIVES IN HOUSEHOLD (0=NO ONE USES TOBACCO, 1=SOMEONE USES TOBACCO - NOT INSIDE THE HOUSE, 3=SOMEONE USES TOBACCO - SMOKES INSIDE THE HOUSE)
WRKNGPOOR_1617	CHILDREN LIVE IN WORKING POOR HOUSEHOLDS (PARENT'S INCOME LESS THAN 100% FPL) (0= DOES NOT LIVE IN 'WORKING POOR' HH, 1=LIVES IN 'WORKING POOR' HOUSEHOLD)
HRSSLEEP_1617	HOURS CHILD GET SLEEP ON AVERAGE WEEKNIGHTS, AGE 4 MONTHS-17 YEARS (1=CHILD SLEEPS RECOMMENDED AGE-APPROPRIATE HOURS, 2=CHILD SLEEPS LESS THAN RECOMMENDED AGE-APPROPRIATE HOURS)
ACEINCOME2_11	HOW OFTEN HAS IT BEEN HARD TO GET BY ON YOUR FAMILY'S INCOME? (1=SOMEWHAT OFTEN/VERY OFTEN HARD TO GET BY ON FAMILY INCOME, 2=NEVER/RARELY HARD TO GET BY ON FAMILY INCOME)
DIFFCARE_1617	CHILD WAS MUCH HARDER TO CARE FOR THAN OTHER CHILDREN (0=NEVER, 1=RARELY, 2=SOMETIMES, 3=USUALLY OR ALWAYS)
ANGRY_1617	PARENTS FELT ANGRY WITH CHILD (0=NEVER, 1=RARELY, 2=SOMETIMES, 3=USUALLY OR ALWAYS)
PARAGGRAV_1617	CHILDREN WHOSE PARENTS WHO FELT AGGRAVATION FROM PARENTING DURING THE PAST MONTH (1=PARENT USUALLY OR ALWAYS FEELS AGGRAVATION FROM PARENTING, 2=PARENT SELDOM FEELS AGGRAVATION FROM PARENTING)
SOCECON	SOCIAL ECONOMIC STATUS (0=HIGH INCOME, 1=LOW INCOME)

Appendix D: Mock Tables

Table 1
Demographics & Baseline Characteristics

Baseline SEX_1617	Male (N=31238) n (%)	Female (N=29713) n (%)
Current Age (Years) AGE3_1617		
≤ 5	XXX (XX)	XXX (XX)
6 – 11	XXX (XX)	XXX (XX)
12 – 17	XXX (XX)	XXX (XX)
Race		
RACE4_1617	XXX (XX)	XXX (XX)
Non-Hispanic White	XXX (XX)	XXX (XX)
Non-Hispanic Black	XXX (XX)	XXX (XX)
Hispanic	XXX (XX)	XXX (XX)
Non-Hispanic Other	XXX (XX)	XXX (XX)
Missing		
Primary Household Language		
HISPLANG_1617	XXX (XX)	XXX (XX)
Hispanic child Spanish PHL	XXX (XX)	XXX (XX)
Hispanic child English PHL	XXX (XX)	XXX (XX)
Non-Hispanic child	XXX (XX)	XXX (XX)
Missing		
Family Structure		
FAMSTRUCT_1617	XXX (XX)	XXX (XX)
Two parent--biological or adopted	XXX (XX)	XXX (XX)
Two parent--step family	XXX (XX)	XXX (XX)
Single mother--no father present	XXX (XX)	XXX (XX)
Other family type	XXX (XX)	XXX (XX)
Missing		
Children with Special Health Care Needs (CSHCN)		
CSHCN_1617	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No		
Qualified on RX Medication Use		
RXMEDS_1617	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No		
Qualified on elevated service use or need		
SERVE_1617	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No		
Qualified on Functional Limitations FUNC_1617		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Special Therapies		
THERAPY_1617	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No		
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	XXX (XX)	XXX (XX)
MHEALTH_1617	XXX (XX)	XXX (XX)
No		
Children Qualified as having Specific Types of Special Health Care Needs		
Non	XXX (XX)	XXX (XX)
CSHCNTYPE_1617	XXX (XX)	XXX (XX)
With functional limitations	XXX (XX)	XXX (XX)
With conditions managed by prescription medication ONLY	XXX (XX)	XXX (XX)
Service use ONLY	XXX (XX)	XXX (XX)
With conditions managed by prescription medications AND service use needs		
With and without emotional, developmental and/or behavioral health special needs	XXX (XX)	XXX (XX)
Qualifying on Mental health needs	XXX (XX)	XXX (XX)
MHNEEDS_1617	XXX (XX)	XXX (XX)
Not qualifying on Mental health needs		
Non		

Table 2
Physical, Emotional & Mental Health

Physical, Emotional & Mental Health	Male (N=31238) n (%)	Female (N=29713) n (%)
Physical Health of Children CHHLTHST_1617		
Excellent/very good	XXX (XX)	XXX (XX)
Good	XXX (XX)	XXX (XX)
Fair/poor	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children Ever Breastfed or fed Breast Milk BRSTEVER_1617		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Weight Status of Children based on BMI BMI4_1617		
Underweight -- less than 5th percentile	XXX (XX)	XXX (XX)
Healthy weight -- 5th to 84th percentile	XXX (XX)	XXX (XX)
Overweight -- 85th to 94th percentile	XXX (XX)	XXX (XX)
Obese -- 95th percentile or above	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days Children Exercise per Week PHYSACT_1617		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Everyday	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of Missed School days during past 12 Month due to Illness or Injury		
0 days SCHLMISS_1617	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
7-10 days	XXX (XX)	XXX (XX)
11 or more days	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children born Premature (more than 3 weeks)		
BORNPRE_1617	XXX (XX)	XXX (XX)
No, child was not born premature	XXX (XX)	XXX (XX)
Yes, child was born premature	XXX (XX)	XXX (XX)
Missing		
Children Birth Weight		
VERYLBWGHT_1617	XXX (XX)	XXX (XX)
Child was born with low birth weight (<1500g)	XXX (XX)	XXX (XX)
Child was born with low birth weight (1501 – 2500 g)	XXX (XX)	XXX (XX)
Child had normal birth weight	XXX (XX)	XXX (XX)
Missing		
Children with Learning Disability		
INTDISAB_1617	XXX (XX)	XXX (XX)
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Missing		
Children currently have autism or autism spectrum disorder, age 3 – 17		
Do not currently have AUTISM_1617	XXX (XX)	XXX (XX)
Ever told, but not current	XXX (XX)	XXX (XX)
Currently have autism	XXX (XX)	XXX (XX)
Severity of current autism, age 3 – 17 AUTISMSEV_1617		
Does not currently have autism	XXX (XX)	XXX (XX)
Current autism rated mild	XXX (XX)	XXX (XX)
Current autism rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Asthma ASTHMA_1617		
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Severity of current asthma, age 3 – 17 ASTHMSEV_1617		
Does not currently have asthma	XXX (XX)	XXX (XX)
Current asthma rated mild	XXX (XX)	XXX (XX)
Current asthma rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with one or more Current Chronic Health Conditions		
COND2MORE27_1617	XXX (XX)	XXX (XX)
Does not have any current chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 1 chronic health conditions from the list of 18 asked		
Currently has 2 or more chronic health conditions from the list of 18 asked		

Table 2
Physical, Emotional & Mental Health

Physical, Emotional & Mental Health	**Male (N=31238) n (%)**	**Female (N=29713) n (%)**
Currently taking any meds for problems with emotions, concentration or behavior condition age 2 – 17		
MEDEMOTION_1617	XXX (XX)	XXX (XX)
No, not on meds for emotions etc.	XXX (XX)	XXX (XX)
Yes, on meds for emotions etc.	XXX (XX)	XXX (XX)
Missing		
Child finishes the tasks and follows through with what he/she says & do, age 6-17 years	XXX (XX)	XXX (XX)
Definitely True FINISHES_1617	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing		
Child stays calm and in control when facing a challenge, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
RESIL6TO17_1617	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Not True	XXX (XX)	XXX (XX)
Missing		
Child shows interest and curiosity in learning new things, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
CURIOUS6TO17_1617	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing		

Table 3
Community and School Activities

Activities	Male (N=31238) n (%)	Female (N=29713) n (%)
Children currently receive a special education or early intervention plan, age 1-17	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
SPEDUCPLN_1617	XXX (XX)	XXX (XX)
No		
Missing		
Have Children repeated any grades since starting kindergarten, ages 6 – 17		
Yes	XXX (XX)	XXX (XX)
REPTGRADE_1617	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing		
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, ages 6 – 17		
SCHLENGAGE_1617	XXX (XX)	XXX (XX)
Definitely True to both items	XXX (XX)	XXX (XX)
Somewhat true for at least one item	XXX (XX)	XXX (XX)
Not true to any item	XXX (XX)	XXX (XX)
Missing		
Children who care about doing well in school, ages 6 – 17		
CARES_1617	XXX (XX)	XXX (XX)
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing		
Have Children complete all required homework, ages 6 – 17		
HOMEWORK_1617	XXX (XX)	XXX (XX)
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing		
Children have Participates in 1 or more organized activities outside of school, ages 6 – 17	XXX (XX)	XXX (XX)
Children participates in one or more extracurricular activities	XXX (XX)	XXX (XX)
AFTSCHACT_1617	XXX (XX)	XXX (XX)
Children do not participate in extracurricular activities		
Missing		
Children participate in community service or volunteer work at school, church, or in the community, age 6-17		
VOLUNTEER_1617	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing		
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work, ages 12-17		
WORKPAY_1617	XXX (XX)	XXX (XX)
Worked for pay	XXX (XX)	XXX (XX)
Did not work for pay	XXX (XX)	XXX (XX)
Missing		
Number of days children were read aloud to during the past week, age 0-5		
0 days	XXX (XX)	XXX (XX)
READTO_1617	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Every day	XXX (XX)	XXX (XX)
Missing		
Children have at least one adult mentor they can rely on for advice or guidance, age 6-17	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
MENTOR_1617	XXX (XX)	XXX (XX)
No		
Missing		

Table 4
Family Health & Activities

Family Health & Activities	Male (N=31238) n (%)	Female (N=29713) n (%)
Mother of the Children Physical & Mental Health Status		
MOTHERHST_1617	XXX (XX)	XXX (XX)
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing		
Father of the Children & Mental Health Status		
FATHERHST_1617	XXX (XX)	XXX (XX)
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing		
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
SMOKING_1617	XXX (XX)	XXX (XX)
Nor		
Missing		
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)	XXX (XX)	XXX (XX)
No one smokes in the household	XXX (XX)	XXX (XX)
SMKINSIDE_1617	XXX (XX)	XXX (XX)
Someone smokes, not inside the house	XXX (XX)	XXX (XX)
Someone smokes inside the house		
Missing		
Children live in working poor households (parent's income less than 100% FPL)	XXX (XX)	XXX (XX)
Does not live in 'working poor' HH	XXX (XX)	XXX (XX)
WRKNGPOOR_1617	XXX (XX)	XXX (XX)
Lives in 'working poor' household		
Missing		
Hours child get sleep on average weeknights, age 4 months-17 years		
HRSSLEEP_1617	XXX (XX)	XXX (XX)
Child sleeps recommended age-appropriate hours	XXX (XX)	XXX (XX)
Child sleeps less than recommended age-appropriate hours	XXX (XX)	XXX (XX)
Missing		
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
ACEINCOME2_1617	XXX (XX)	XXX (XX)
Somewhat often/Very often hard to get by on family income	XXX (XX)	XXX (XX)
Never/Rarely hard to get by on family income	XXX (XX)	XXX (XX)
Missing		
Parent felt child is much harder to care for than most children during the past month	XXX (XX)	XXX (XX)
Never DIFFCARE_1617	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing		
Parent felt angry with child during the past month ANGRY_1617		
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children whose parents who felt aggravation from parenting during the past month PARAGGRAV_1617	XXX (XX)	XXX (XX)
Parent usually or always feels aggravation from parenting	XXX (XX)	XXX (XX)
Parent seldom feels aggravation from parenting	XXX (XX)	XXX (XX)
Missing		

Table 5
Proportion of subjects with ASD and Frequency of Asthma

	Children with ASD	
	Yes (N = 1664)	No (N = 59287)
Children with Asthma		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Model 1		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 2 Adjusted for Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 3 Adjusted for Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 4 Adjusted for Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 5 Adjusted for Age, Race, and Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Children with ASD = Asthma;
Model 2: Children with ASD = Asthma Sex;
Model 3: Children with ASD = Asthma Race;
Model 4: Children with ASD = Asthma Age;
Model 5 (Final): Children with ASD = Asthma Age Race Sex
Model 6: Children with ASD = Asthma Age Race Sex Emotional and developmental or behavioral conditions Functional Limitation Social Economic Status
Model 7: Children with ASD = Asthma Race Sex Emotional and developmental or behavioral conditions Functional Limitation
* Using χ^2 test

Table 5
Proportion of subjects with ASD and Frequency of Asthma

	Children with ASD	
	Yes (N = 1664)	Yes (N = 1664)
Children with Asthma		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Model 6 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Emotional and developmental or behavioral conditions	X.XX (X.XX – X.XX)	
Odds Ratio (95% CI)	X.XXX	
P-Value*		
Functional Limitation	X.XX (X.XX – X.XX)	
Odds Ratio (95% CI)	X.XXX	
P-Value*		
Social Economic Status	X.XX (X.XX – X.XX)	
Odds Ratio (95% CI)	X.XXX	
P-Value*		
Model 7 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Children with ASD = Asthma;
Model 2: Children with ASD = Asthma Sex;
Model 3: Children with ASD = Asthma Race;
Model 4: Children with ASD = Asthma Age;
Model 5 (Final): Children with ASD = Asthma Age Race Sex
Model 6: Children with ASD = Asthma Age Race Sex Emotional and developmental or behavioral conditions Functional Limitation Social Economic Status
Model 7: Children with ASD = Asthma Race Sex Emotional and developmental or behavioral conditions Functional Limitation
* Using χ^2 test

Table 6
Demographics & Baseline Characteristics
Subject with Asthma

Baseline	**Male (N=3070) n (%)**	**Female (N=2370) n (%)**
Current Age (Years)		
≤ 5	XXX (XX)	XXX (XX)
6 – 11	XXX (XX)	XXX (XX)
12 – 17	XXX (XX)	XXX (XX)
Race		
Non-Hispanic White	XXX (XX)	XXX (XX)
Non-Hispanic Black	XXX (XX)	XXX (XX)
Hispanic	XXX (XX)	XXX (XX)
Non-Hispanic Other	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Primary Household Language		
Hispanic child Spanish PHL	XXX (XX)	XXX (XX)
Hispanic child English PHL	XXX (XX)	XXX (XX)
Non-Hispanic child	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Family Structure		
Two parent--biological or adopted	XXX (XX)	XXX (XX)
Two parent--step family	XXX (XX)	XXX (XX)
Single mother--no father present	XXX (XX)	XXX (XX)
Other family type	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Special Health Care Needs (CSHCN)		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on RX Medication Use		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on elevated service use or need		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Functional Limitations		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Special Therapies		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Children Qualified as having Specific Types of Special Health Care Needs		
Non	XXX (XX)	XXX (XX)
With functional limitations	XXX (XX)	XXX (XX)
With conditions managed by prescription medication ONLY	XXX (XX)	XXX (XX)
Service use ONLY	XXX (XX)	XXX (XX)
With conditions managed by prescription medications AND service use needs	XXX (XX)	XXX (XX)
With and without emotional, developmental and/or behavioral health special needs	XXX (XX)	XXX (XX)
Qualifying on Mental health needs	XXX (XX)	XXX (XX)
Not qualifying on Mental health needs	XXX (XX)	XXX (XX)
Non		

Table 7
Physical, Emotional & Mental Health
Subject with Asthma

Physical, Emotional & Mental Health	**Male (N=3070) n (%)**	**Female (N=2370) n (%)**
Physical Health of Children		
Excellent/very good	XXX (XX)	XXX (XX)
Good	XXX (XX)	XXX (XX)
Fair/poor	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children Ever Breastfed or fed Breast Milk		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	XXX (XX)	XXX (XX)
Healthy weight -- 5th to 84th percentile	XXX (XX)	XXX (XX)
Overweight -- 85th to 94th percentile	XXX (XX)	XXX (XX)
Obese -- 95th percentile or above	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days Children Exercise per Week		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Everyday	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of Missed School days during past 12 Month due to Illness or Injury		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
7-10 days	XXX (XX)	XXX (XX)
11 or more days	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	XXX (XX)	XXX (XX)
Yes, child was born premature	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children Birth Weight		
Child was born with low birth weight (<1500g)	XXX (XX)	XXX (XX)
Child was born with low birth weight (1501 – 2500 g)	XXX (XX)	XXX (XX)
Child had normal birth weight	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Learning Disability		
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children currently have autism or autism spectrum disorder, age 3 – 17		
Do not currently have	XXX (XX)	XXX (XX)
Ever told, but not current	XXX (XX)	XXX (XX)
Currently have autism	XXX (XX)	XXX (XX)
Severity of current autism, age 3 – 17		
Does not currently have autism	XXX (XX)	XXX (XX)
Current autism rated mild	XXX (XX)	XXX (XX)
Current autism rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Severity of current asthma, age 3 – 17		
Does not currently have asthma	XXX (XX)	XXX (XX)
Current asthma rated mild	XXX (XX)	XXX (XX)
Current asthma rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 7
Physical, Emotional & Mental Health
Subject with Asthma

Physical, Emotional & Mental Health	**Male (N=3070) n (%)**	**Female (N=2370) n (%)**
Children with one or more Current Chronic Health Conditions		
Does not have any current chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 1 chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 2 or more chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently taking any meds for problems with emotions, concentration or behavior condition age 2 – 17		
No, not on meds for emotions etc.	XXX (XX)	XXX (XX)
Yes, on meds for emotions etc.	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child finishes the tasks and follows through with what he/she says & do, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child stays calm and in control when facing a challenge, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Not True	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child shows interest and curiosity in learning new things, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 8
Community and School Activities
Subject with Asthma

Activities	Male (N=3070) n (%)	Female (N=2370) n (%)
Children currently receive a special education or early intervention plan, age 1-17	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing		
Have Children repeated any grades since starting kindergarten, ages 6 – 17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, ages 6 – 17		
Definitely True to both items	XXX (XX)	XXX (XX)
Somewhat true for at least one item	XXX (XX)	XXX (XX)
Not true to any item	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children who care about doing well in school, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children complete all required homework, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have Participates in 1 or more organized activities outside of school, ages 6 – 17	XXX (XX)	XXX (XX)
Children participates in one or more extracurricular activities	XXX (XX)	XXX (XX)
Children do not participate in extracurricular activities	XXX (XX)	XXX (XX)
Missing		
Children participate in community service or volunteer work at school, church, or in the community, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work, ages 12-17		
Worked for pay	XXX (XX)	XXX (XX)
Did not work for pay	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days children were read aloud to during the past week, age 0-5		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Every day	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have at least one adult mentor they can rely on for advice or guidance, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 9
Family Health & Activities
Subject with Asthma

Family Health & Activities	**Male (N=3070) n (%)**	**Female (N=2370) n (%)**
Mother of the Children Physical & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Father of the Children & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
Nor	XXX (XX)	XXX (XX)
Missing		
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)	XXX (XX)	XXX (XX)
No one smokes in the household	XXX (XX)	XXX (XX)
Someone smokes, not inside the house	XXX (XX)	XXX (XX)
Someone smokes inside the house	XXX (XX)	XXX (XX)
Missing		
Children live in working poor households (parent's income less than 100% FPL)	XXX (XX)	XXX (XX)
Does not live in 'working poor' HH	XXX (XX)	XXX (XX)
Lives in 'working poor' household	XXX (XX)	XXX (XX)
Missing		
Hours child get sleep on average weeknights, age 4 months-17 years		
Child sleeps recommended age-appropriate hours	XXX (XX)	XXX (XX)
Child sleeps less than recommended age-appropriate hours	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	XXX (XX)	XXX (XX)
Never/Rarely hard to get by on family income	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Parent felt child is much harder to care for than most children during the past month	XXX (XX)	XXX (XX)
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing		
Parent felt angry with child during the past month		
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children whose parents who felt aggravation from parenting during the past month	XXX (XX)	XXX (XX)
Parent usually or always feels aggravation from parenting	XXX (XX)	XXX (XX)
Parent seldom feels aggravation from parenting	XXX (XX)	XXX (XX)
Missing		

Table 10
Proportion of subjects with Asthma and Frequency Services Used

	Children with Asthma (N = 3149)	Children with other Conditions (N = 8615)
Utilizing services		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Model 1		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 2 Adjusted for Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 3 Adjusted for Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 4 Adjusted for Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 5 Adjusted for Age, Race, and Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 6 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 7 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Asthma = Services used; Model 2: Asthma = Services used Sex; Model 3: Asthma = Services used Race;
Model 4 Asthma = Services used Age; Model 5: Asthma = Services used Age Race Sex
Model 6: Asthma = Services used Age Race Sex Social Economic Status; Model 7 (Final): Asthma = Services used Social Economic Status
* Using χ^2 test

Table 11
Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used

	Children with Asthma	
	Use Rx Medication & Services (N = 1253)	Use Rx Medication Only (N = 1885)
Asthma Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model 1		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 2 Adjusted for Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 3 Adjusted for Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 4 Adjusted for Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 5 Adjusted for Age, Race, and Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Use Rx Medication & Services = Asthma Severity;
Model 2: Use Rx Medication & Services = Asthma Severity Sex;
Model 3: Use Rx Medication & Services = Asthma Severity Race;
Model 4 Use Rx Medication & Services = Asthma Severity Age;
Model 5: Use Rx Medication & Services = Asthma Severity Age Race Sex
Model 6: Use Rx Medication & Services = Asthma Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = Asthma Severity Race Sex

* Using χ^2 test

Table 11
Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used

	Children with Asthma	
	Use Rx Medication & Services (N = 1253)	Use Rx Medication Only (N = 1885)
Asthma Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model 6 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 7 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Use Rx Medication & Services = Asthma Severity;
Model 2: Use Rx Medication & Services = Asthma Severity Sex;
Model 3: Use Rx Medication & Services = Asthma Severity Race;
Model 4 Use Rx Medication & Services = Asthma Severity Age;
Model 5: Use Rx Medication & Services = Asthma Severity Age Race Sex
Model 6: Use Rx Medication & Services = Asthma Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = Asthma Severity Sex Social Economic Status
* Using χ^2 test

Table 12
Demographics & Baseline Characteristics
Subject with ASD

Baseline	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Current Age (Years)		
≤ 5	XXX (XX)	XXX (XX)
6 – 11	XXX (XX)	XXX (XX)
12 – 17	XXX (XX)	XXX (XX)
Race		
Non-Hispanic White	XXX (XX)	XXX (XX)
Non-Hispanic Black	XXX (XX)	XXX (XX)
Hispanic	XXX (XX)	XXX (XX)
Non-Hispanic Other	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Primary Household Language		
Hispanic child Spanish PHL	XXX (XX)	XXX (XX)
Hispanic child English PHL	XXX (XX)	XXX (XX)
Non-Hispanic child	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Family Structure		
Two parent--biological or adopted	XXX (XX)	XXX (XX)
Two parent--step family	XXX (XX)	XXX (XX)
Single mother--no father present	XXX (XX)	XXX (XX)
Other family type	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Special Health Care Needs (CSHCN)		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on RX Medication Use		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on elevated service use or need		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Functional Limitations		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Special Therapies		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Children Qualified as having Specific Types of Special Health Care Needs		
Non	XXX (XX)	XXX (XX)
With functional limitations	XXX (XX)	XXX (XX)
With conditions managed by prescription medication ONLY	XXX (XX)	XXX (XX)
Service use ONLY	XXX (XX)	XXX (XX)
With conditions managed by prescription medications AND service use needs	XXX (XX)	XXX (XX)
With and without emotional, developmental and/or behavioral health special needs	XXX (XX)	XXX (XX)
Qualifying on Mental health needs	XXX (XX)	XXX (XX)
Not qualifying on Mental health needs	XXX (XX)	XXX (XX)
Non		

Table 13
Physical, Emotional & Mental Health
Subject with ASD

Physical, Emotional & Mental Health	Male (N=1338) n (%)	Female (N=326) n (%)
Physical Health of Children		
Excellent/very good	XXX (XX)	XXX (XX)
Good	XXX (XX)	XXX (XX)
Fair/poor	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children Ever Breastfed or fed Breast Milk		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	XXX (XX)	XXX (XX)
Healthy weight -- 5th to 84th percentile	XXX (XX)	XXX (XX)
Overweight -- 85th to 94th percentile	XXX (XX)	XXX (XX)
Obese -- 95th percentile or above	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days Children Exercise per Week		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Everyday	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of Missed School days during past 12 Month due to Illness or Injury		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
7-10 days	XXX (XX)	XXX (XX)
11 or more days	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	XXX (XX)	XXX (XX)
Yes, child was born premature	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children Birth Weight		
Child was born with low birth weight (<1500g)	XXX (XX)	XXX (XX)
Child was born with low birth weight (1501 – 2500 g)	XXX (XX)	XXX (XX)
Child had normal birth weight	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Learning Disability		
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Severity of current autism, age 3 – 17		
Does not currently have autism	XXX (XX)	XXX (XX)
Current autism rated mild	XXX (XX)	XXX (XX)
Current autism rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Asthma		
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Severity of current asthma, age 3 – 17		
Does not currently have asthma	XXX (XX)	XXX (XX)
Current asthma rated mild	XXX (XX)	XXX (XX)
Current asthma rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 13
Physical, Emotional & Mental Health
Subject with ASD

Physical, Emotional & Mental Health	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Children with one or more Current Chronic Health Conditions		
Does not have any current chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 1 chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 2 or more chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently taking any meds for problems with emotions, concentration or behavior condition age 2 – 17		
No, not on meds for emotions etc.	XXX (XX)	XXX (XX)
Yes, on meds for emotions etc.	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child finishes the tasks and follows through with what he/she says & do, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child stays calm and in control when facing a challenge, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Not True	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child shows interest and curiosity in learning new things, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 14
Community and School Activities
Subject with ASD

Activities	Male (N=1338) n (%)	Female (N=326) n (%)
Children currently receive a special education or early intervention plan, age 1-17	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing		
Have Children repeated any grades since starting kindergarten, ages 6 – 17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, ages 6 – 17		
Definitely True to both items	XXX (XX)	XXX (XX)
Somewhat true for at least one item	XXX (XX)	XXX (XX)
Not true to any item	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children who care about doing well in school, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children complete all required homework, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have Participates in 1 or more organized activities outside of school, ages 6 – 17	XXX (XX)	XXX (XX)
Children participates in one or more extracurricular activities	XXX (XX)	XXX (XX)
Children do not participate in extracurricular activities	XXX (XX)	XXX (XX)
Missing		
Children participate in community service or volunteer work at school, church, or in the community, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work, ages 12-17		
Worked for pay	XXX (XX)	XXX (XX)
Did not work for pay	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days children were read aloud to during the past week, age 0-5		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Every day	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have at least one adult mentor they can rely on for advice or guidance, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 15
Family Health & Activities
Subject with ASD

Family Health & Activities	**Male (N=1338) n (%)**	**Female (N=326) n (%)**
Mother of the Children Physical & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Father of the Children & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
Nor	XXX (XX)	XXX (XX)
Missing		
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)	XXX (XX)	XXX (XX)
No one smokes in the household	XXX (XX)	XXX (XX)
Someone smokes, not inside the house	XXX (XX)	XXX (XX)
Someone smokes inside the house	XXX (XX)	XXX (XX)
Missing		
Children live in working poor households (parent's income less than 100% FPL)	XXX (XX)	XXX (XX)
Does not live in 'working poor' HH	XXX (XX)	XXX (XX)
Lives in 'working poor' household	XXX (XX)	XXX (XX)
Missing		
Hours child get sleep on average weeknights, age 4 months-17 years		
Child sleeps recommended age-appropriate hours	XXX (XX)	XXX (XX)
Child sleeps less than recommended age-appropriate hours	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	XXX (XX)	XXX (XX)
Never/Rarely hard to get by on family income	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Parent felt child is much harder to care for than most children during the past month	XXX (XX)	XXX (XX)
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing		
Parent felt angry with child during the past month		
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children whose parents who felt aggravation from parenting during the past month	XXX (XX)	XXX (XX)
Parent usually or always feels aggravation from parenting	XXX (XX)	XXX (XX)
Parent seldom feels aggravation from parenting	XXX (XX)	XXX (XX)
Missing		

Table 16
Proportion of subjects with ASD and Frequency of Services Used

	Children with ASD (N = 525)	Children with other Conditions (N = 11239)
Utilizing services		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Model 1		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 2 Adjusted for Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 3 Adjusted for Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 4 Adjusted for Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 5 Adjusted for Age, Race, and Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 6 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 7 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: ASD = Services Used; Model 2: ASD = Services Used Sex; Model 3: ASD = Services Used Race;
Model 4 ASD = Services Used Age; Model 5 ASD = Services Used Age Race Sex;
Model 6: ASD = Services Used Age Race Sex Social Economic Status; Model 7 (Final): ASD = Services Used Social Economic Status

* Using χ^2 test

Table 17
Proportion of subjects with ASD and Frequency of Rx Medication and Services Used

	Children with ASD	
	Use Rx Medication & Services (N = 489)	Use Rx Medication Only (N = 31)
ASD Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model 1		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 2 Adjusted for Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 3 Adjusted for Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 4 Adjusted for Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 5 Adjusted for Age, Race, and Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Use Rx Medication & Services = ASD Severity;
Model 2: Use Rx Medication & Services = ASD Severity Sex;
Model 3: Use Rx Medication & Services = ASD Severity Race;
Model 4 Use Rx Medication & Services = ASD Severity Age;
Model 5: Use Rx Medication & Services = ASD Severity Age Race Sex
Model 6: Use Rx Medication & Services = ASD Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = ASD Severity Social Economic Status

* Using χ^2 test

Table 17
Proportion of subjects with ASD and Frequency of Rx Medication and Services Used

	Children with ASD	
	Use Rx Medication & Services (N = 489)	Use Rx Medication Only (N = 31)
ASD Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model 6 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Age		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Race		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Sex		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Model 7 Adjusted for:		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	
Social Economic Status		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model 1: Use Rx Medication & Services = ASD Severity;
Model 2: Use Rx Medication & Services = ASD Severity Sex;
Model 3: Use Rx Medication & Services = ASD Severity Race;
Model 4 Use Rx Medication & Services = ASD Severity Age;
Model 5: Use Rx Medication & Services = ASD Severity Age Race Sex
Model 6: Use Rx Medication & Services = ASD Severity Age Race Sex Social Economic Status
Model 7 (Final): Use Rx Medication & Services = ASD Severity Social Economic Status
* Using χ^2 test

Table 18
Demographics & Baseline Characteristics
Subject with ASD + Asthma

Baseline	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Current Age (Years)		
≤ 5	XXX (XX)	XXX (XX)
6 – 11	XXX (XX)	XXX (XX)
12 – 17	XXX (XX)	XXX (XX)
Race		
Non-Hispanic White	XXX (XX)	XXX (XX)
Non-Hispanic Black	XXX (XX)	XXX (XX)
Hispanic	XXX (XX)	XXX (XX)
Non-Hispanic Other	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Primary Household Language		
Hispanic child Spanish PHL	XXX (XX)	XXX (XX)
Hispanic child English PHL	XXX (XX)	XXX (XX)
Non-Hispanic child	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Family Structure		
Two parent--biological or adopted	XXX (XX)	XXX (XX)
Two parent--step family	XXX (XX)	XXX (XX)
Single mother--no father present	XXX (XX)	XXX (XX)
Other family type	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Special Health Care Needs (CSHCN)		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on RX Medication Use		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on elevated service use or need		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Functional Limitations		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on Special Therapies		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Qualified on ongoing emotional, developmental or behavioral conditions		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Children Qualified as having Specific Types of Special Health Care Needs		
Non	XXX (XX)	XXX (XX)
With functional limitations	XXX (XX)	XXX (XX)
With conditions managed by prescription medication ONLY	XXX (XX)	XXX (XX)
Service use ONLY	XXX (XX)	XXX (XX)
With conditions managed by prescription medications AND service use needs	XXX (XX)	XXX (XX)
With and without emotional, developmental and/or behavioral health special needs	XXX (XX)	XXX (XX)
Qualifying on Mental health needs	XXX (XX)	XXX (XX)
Not qualifying on Mental health needs	XXX (XX)	XXX (XX)
Non		

Table 19
Physical, Emotional & Mental Health
Subject with ASD + Asthma

Physical, Emotional & Mental Health	Male (N=175) n (%)	Female (N=41) n (%)
Physical Health of Children		
Excellent/very good	XXX (XX)	XXX (XX)
Good	XXX (XX)	XXX (XX)
Fair/poor	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children Ever Breastfed or fed Breast Milk		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Weight Status of Children based on BMI		
Underweight -- less than 5th percentile	XXX (XX)	XXX (XX)
Healthy weight -- 5th to 84th percentile	XXX (XX)	XXX (XX)
Overweight -- 85th to 94th percentile	XXX (XX)	XXX (XX)
Obese -- 95th percentile or above	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days Children Exercise per Week		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Everyday	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of Missed School days during past 12 Month due to Illness or Injury		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
7-10 days	XXX (XX)	XXX (XX)
11 or more days	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Were Children born Premature (more than 3 weeks)		
No, child was not born premature	XXX (XX)	XXX (XX)
Yes, child was born premature	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children Birth Weight		
Child was born with low birth weight (<1500g)	XXX (XX)	XXX (XX)
Child was born with low birth weight (1501 – 2500 g)	XXX (XX)	XXX (XX)
Child had normal birth weight	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children with Learning Disability		
Does not have condition	XXX (XX)	XXX (XX)
Ever told, but does not currently have condition	XXX (XX)	XXX (XX)
Currently has condition	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Severity of current autism, age 3 – 17		
Does not currently have autism	XXX (XX)	XXX (XX)
Current autism rated mild	XXX (XX)	XXX (XX)
Current autism rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Severity of current asthma, age 3 – 17		
Does not currently have asthma	XXX (XX)	XXX (XX)
Current asthma rated mild	XXX (XX)	XXX (XX)
Current asthma rated moderate/severe	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 19
Physical, Emotional & Mental Health
Subject with ASD + Asthma

Physical, Emotional & Mental Health	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Children with one or more Current Chronic Health Conditions		
Does not have any current chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 1 chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently has 2 or more chronic health conditions from the list of 18 asked	XXX (XX)	XXX (XX)
Currently taking any meds for problems with emotions, concentration or behavior condition age 2 – 17		
No, not on meds for emotions etc.	XXX (XX)	XXX (XX)
Yes, on meds for emotions etc.	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child finishes the tasks and follows through with what he/she says & do, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child stays calm and in control when facing a challenge, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Not True	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Child shows interest and curiosity in learning new things, age 6-17 years		
Definitely True	XXX (XX)	XXX (XX)
Somewhat or not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 20
Community and School Activities
Subject with ASD + Asthma

Activities	Male (N=175) n (%)	Female (N=41) n (%)
Children currently receive a special education or early intervention plan, age 1-17	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing		
Have Children repeated any grades since starting kindergarten, ages 6 – 17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children Engaged in school activities, cares about doing well, and do homework in the past month, ages 6 – 17		
Definitely True to both items	XXX (XX)	XXX (XX)
Somewhat true for at least one item	XXX (XX)	XXX (XX)
Not true to any item	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children who care about doing well in school, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Have Children complete all required homework, ages 6 – 17		
Definitely True	XXX (XX)	XXX (XX)
Somewhat true	XXX (XX)	XXX (XX)
Not true	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have Participates in 1 or more organized activities outside of school, ages 6 – 17	XXX (XX)	XXX (XX)
Children participates in one or more extracurricular activities	XXX (XX)	XXX (XX)
Children do not participate in extracurricular activities	XXX (XX)	XXX (XX)
Missing		
Children participate in community service or volunteer work at school, church, or in the community, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children participate in any paid work including regular jobs as well as babysitting, cutting grass, or other occasional work, ages 12-17		
Worked for pay	XXX (XX)	XXX (XX)
Did not work for pay	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Number of days children were read aloud to during the past week, age 0-5		
0 days	XXX (XX)	XXX (XX)
1-3 days	XXX (XX)	XXX (XX)
4-6 days	XXX (XX)	XXX (XX)
Every day	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children have at least one adult mentor they can rely on for advice or guidance, age 6-17		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)

Table 21
Family Health & Activities
Subject with ASD + Asthma

Family Health & Activities	**Male (N=175) n (%)**	**Female (N=41) n (%)**
Mother of the Children Physical & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Father of the Children & Mental Health Status		
Physical & mental health BOTH excellent/very good	XXX (XX)	XXX (XX)
One or both of physical & mental health are NOT excellent/very good	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children live in household in which someone uses cigarettes, cigars, or pipe tobacco	XXX (XX)	XXX (XX)
Yes	XXX (XX)	XXX (XX)
Nor	XXX (XX)	XXX (XX)
Missing		
Someone smokes inside the home (Children exposure to secondhand tobacco smoker)	XXX (XX)	XXX (XX)
No one smokes in the household	XXX (XX)	XXX (XX)
Someone smokes, not inside the house	XXX (XX)	XXX (XX)
Someone smokes inside the house	XXX (XX)	XXX (XX)
Missing		
Children live in working poor households (parent's income less than 100% FPL)	XXX (XX)	XXX (XX)
Does not live in 'working poor' HH	XXX (XX)	XXX (XX)
Lives in 'working poor' household	XXX (XX)	XXX (XX)
Missing		
Hours child get sleep on average weeknights, age 4 months-17 years		
Child sleeps recommended age-appropriate hours	XXX (XX)	XXX (XX)
Child sleeps less than recommended age-appropriate hours	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
How often has it been hard to get by on your family's income - hard to cover basics like food or housing?		
Somewhat often/Very often hard to get by on family income	XXX (XX)	XXX (XX)
Never/Rarely hard to get by on family income	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Parent felt child is much harder to care for than most children during the past month	XXX (XX)	XXX (XX)
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing		
Parent felt angry with child during the past month		
Never	XXX (XX)	XXX (XX)
Rarely	XXX (XX)	XXX (XX)
Sometimes	XXX (XX)	XXX (XX)
Usually or always	XXX (XX)	XXX (XX)
Missing	XXX (XX)	XXX (XX)
Children whose parents who felt aggravation from parenting during the past month	XXX (XX)	XXX (XX)
Parent usually or always feels aggravation from parenting	XXX (XX)	XXX (XX)
Parent seldom feels aggravation from parenting	XXX (XX)	XXX (XX)
Missing		

Table 22
Proportion of subjects with ASD + Asthma and Frequency of Services Used

	Children with ASD + Asthma (N = 83)	Children with other Conditions (N = 11681)
Utilizing services		
Yes	XXX (XX)	XXX (XX)
No	XXX (XX)	XXX (XX)
Model		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model: ASD + Asthma = Services Used
* Using χ^2 test

Table 23
Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
ASD Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model: Use Rx Medication & Services = ASD Severity
* Using χ^2 test

Table 24
Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used

	Children with ASD + Asthma	
	Use Rx Medication & Services (N = 75)	Use Rx Medication Only (N = 7)
Asthma Severity		
Mild	XXX (XX)	XXX (XX)
Moderate/Severe	XXX (XX)	XXX (XX)
Model		
Odds Ratio (95% CI)	X.XX (X.XX – X.XX)	
P-Value*	X.XXX	

Model: Use Rx Medication & Services = Asthma Severity
* Using χ^2 test

Appendix E: SAS CODES for UNWEIGHTED ANALYSIS

For Demographics Characteristics Analysis

```
/*Demographics*/
 proc freq data=ASTH_ASD;
  tables sex_1617;
  format sex_1617 sex.;
  title3 'Analysis population (Age 3-17)';
  footnote1 'SAS Program: ASD_Asthma_All_Freq_21Feb2019';
  run;
%macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) / out=%scan(&vars,&i)freq;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format
      age3_1617 agec.
      race4_1617 race.
            hisplang_1617 hisplang.
            famstruct_1617 fmstruc.
            CSHCN_1617 cshcn.
            rxmeds_1617 eq.
      serve_1617 eq.
      func_1617 eq.
      therapy_1617 eq.
      mhealth_1617 eq.
            CSHCNtype_1617 deffive.
            mhneeds_1617 mhneeds.
      ;
%mend;
options mprint;
proc freq data=ASTH_ASD noprint;
 %vfreq(age3_1617
      race4_1617
            hisplang_1617
            famstruct_1617
            CSHCN_1617
            rxmeds_1617
            serve_1617
      func_1617
      therapy_1617
      mhneeds_1617
      CSHCNtype_1617
            mhealth_1617);
 title4 'Demographics Information';
run;
```

For Physical, Emotional & Mental Health Analysis

```
/* Physical, Emotional & Mental Health */

%macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) / out=%scan(&vars,&i)freq;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format sex_1617 sex.
      ChHlthSt_1617 chhlthst.
      BrstEver_1617 NY.
            BMI4_1617 BMI.
      PhysAct_1617 exercise.
            SchlMiss_1617 missch.
      BornPre_1617 NY.
            VeryLBWght_1617 lowbw.
            IntDisab_1617 cond.
      autism_1617 cond.
            AutismSev_1617 sevirty.
            asthma_1617 cond.
      AsthmSev_1617 sevirty.
            Cond2more27_1617 currcond.
            MedEmotion_1617 NY.
            finishes_1617 tasks.
      resil6to17_1617 calm.
            curious6to17_1617 tasks.
      ;
%mend;
options mprint;

proc freq data=ASTH_ASD noprint;
 %vfreq(ChHlthSt_1617
      BrstEver_1617
            BMI4_1617
      PhysAct_1617
            SchlMiss_1617
      BornPre_1617
            VeryLBWght_1617
            IntDisab_1617
      autism_1617
            AutismSev_1617
            asthma_1617
      AsthmSev_1617
            Cond2more27_1617
            MedEmotion_1617
            finishes_1617
```

```
    resil6to17_1617
        curious6to17_1617);
 title4 'Physical, Emotional & Mental Health';
run;
```

For Community and School Activities Analysis

```
/* Community and School Activities */
 %macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) / out=%scan(&vars,&i)freq noprint;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format sex_1617 sex.
    SpEducPln_1617 NY.
    ReptGrade_1617 NY.
        SchlEngage_1617 engage.
        cares_1617 engage.
        homework_1617 engage.
        AftSchAct_1617 aftsch.
        volunteer_1617 NY.
        workpay_1617 workpay.
        readto_1617 read.
        mentor_1617 NY.
    ;
%mend;
options mprint;

proc freq data=ASTH_ASD noprint;
 %vfreq(
        SpEducPln_1617
    ReptGrade_1617
        SchlEngage_1617
        cares_1617
        homework_1617
        AftSchAct_1617
        volunteer_1617
        workpay_1617
        readto_1617
        mentor_1617);
 title3 'Community and School Activities';
run;
```

For Family Health & Activities Analysis

```
/* Family and Health and Activities */
```

```
%macro vfreq(vars);
 %let i = 1;
 %do %while( %scan(&vars,&i)^= );
   tables %scan(&vars,&i) / out=%scan(&vars,&i)freq noprint;
by sex_1617;
   %let i = %eval(&i+1);
 %end;
format sex_1617 sex.
            MotherHSt_1617 mother.
            FatherHSt_1617 mother.
            smoking_1617 NY.
            SmkInside_1617 secsmoke.
     WrkngPoor_1617 workpoor.
            HrsSleep_1617 sleep.
            ACEincome2_1617 income.
            DiffCare_1617 aggyn.
            angry_1617 aggyn.
     ParAggrav_1617 aggr.
     ;
%mend;
options mprint;
proc freq data=ASTH_ASD noprint;
 %vfreq(MotherHSt_1617
            FatherHSt_1617
            smoking_1617
            SmkInside_1617
     WrkngPoor_1617
            HrsSleep_1617
            ACEincome2_1617
            DiffCare_1617
            angry_1617
     ParAggrav_1617
            );
 title3 'Family and Health and Activities';
run;
```

Proportion of subjects with ASD and Frequency of Asthma

```
proc sort data=nsch.asthma_ASD
          out=ASTH_ASD;
  by sex_1617;
  run;

  proc freq data=ASTH_ASD;
   tables cc*asthma/list;
   format cc case. asthma eq. sex_1617 sex.;
   title2 'Children who have ASD';
   title3 'Analysis population (Age 3-17)';
   footnote1 'SAS Program: ASD_Asthma_Models_21Feb2019';
```

```
run;
 /* Model One */
proc logistic data=ASTH_ASD;
 model cc = asthma/covb;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title3 'Model is Children who have ASD = Asthma';
 run;
 /* Model Two */
proc logistic data=ASTH_ASD;
 model cc = asthma sex_1617 /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(two) is Children who have ASD = Asthma Sex';
 run;
 /* Model Three */
proc logistic data=ASTH_ASD;
 model cc = asthma race /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Three) is Children who have ASD = Asthma race';
 run;
 /* Model Four */
 proc logistic data=ASTH_ASD;
 model cc = asthma age3_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Four) is Children who have ASD = asthma age';
 run;

 /* Model Five */
 proc logistic data=ASTH_ASD;
  model cc = asthma age3_1617 race sex_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Five) is Children who have ASD = Asthma age race sex';
 run;
```

```
/* Model Six */
 proc logistic data=ASTH_ASD;
  model cc = asthma age3_1617 race sex_1617 mhealth_1617 func_1617
socecon/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = Asthma age race sex emotional and
developmental or behavioral conditions functional limits Social Economic Status';
 run;
/* Model Seven (Final) */
 proc logistic data=ASTH_ASD;
  model cc = asthma age3_1617 socecon/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Seven: Final) is Children who have ASD = Asthma, Age, and Social
Economic Status';
 run;
```

Proportion of subjects with Asthma and Frequency Services Used

```
proc sort data=nsch.asthma_ASD
        out=ASTH_ASTHMA1;
  by sex_1617;
  run;

 /* Selecting subjects who used medication or services for management of their ASD
*/

 data asthma;
  set asth_asthma1;
  if CSHCNtype_1617 in (2,3,4);
  run;

data asthma1;
   set asthma;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
 if asthma in (1) and service in (1) then cc=1;
 if asthma in (1) and service in (0) then cc=1;
 if asthma in (0) and service in (1) then cc=2;
 if asthma in (0) and service in (0) then cc=2;
run;
```

```
proc freq data=asthma1 noprint;
   tables cc*service/list out=asthma2;
   format cc case. Asthma eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with Asthma';
   title3 'Cases are children who have Asthma ';
   footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
   run;
proc print data=asthma2;
title2 'Analysis population (Age 3-17): Subjects with Asthma';
title3 'Cases are children who have Asthma';
footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
proc freq data=asthma1;
 tables cc*service/list;
 format cc case. Asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
title3 'Cases are children who have Asthma';
footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
  /* Model One */
proc logistic data=asthma1;
 model cc = service/covb;
 format cc case. Asthma eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 title4 'By Asthma Scerity';
 Title5 'Model is Children who have Asthma = Service';
 run;
/* Model Two */
proc logistic data=asthma1;
 model cc = service sex_1617 /covb ;
 format cc case. Asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(two) is Children who have Asthma  = service Sex';
 run;

 /* Model Three */
proc logistic data=asthma1;
 model cc = service race /covb ;
 format cc case. Asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(Three) is Children who have Asthma = service Race';
 run;
```

```
 /* Model Four */
proc logistic data=asthma1;
model cc = service age3_1617/covb;
format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;
title2 'Analysis population (Age 3-17): Subjects with Asthma';
title3 'Cases are children who have Asthma';
Title5 'Model(Four) is Children who have Asthma = service age';
run;
/* Model Five */
proc logistic data=asthma1;
 model cc = service age3_1617 race sex_1617/covb;
format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;
title2 'Analysis population (Age 3-17): Subjects with Asthma';
title3 'Cases are children who have Asthma';
Title5 'Model(Five) is Children who have Asthma = Service age race sex';
run;
/* Model Six */
proc logistic data=asthma1;
 model cc = service age3_1617 race sex_1617 mhealth_1617 socecon/covb;
format cc case. Asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
title2 'Analysis population (Age 3-17): Subjects with Asthma';
title3 'Cases are children who have Asthma';
Title5 'Model(Six) is Children who Children who have Asthma = Service age race
sex emotional and developmental or behavioral conditions Social Economic Status';
run;
/* Model Seven (Final) */
proc logistic data=asthma1;
 model cc = service socecon/covb;
 format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Children who have Asthma';
 Title5 'Model(Seven: Final) is Children who have Asthma = Service Social
Economic Status';
run;
```

Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used: UNWEIGHTED

```
data asth_ser;
 set asth_asd;
 if CSHCNtype_1617 in (2,3,4);
 run;

 data asth_ser1;
  set asth_ser;
  if CSHCNtype_1617 in (2) then service = 0;
  if CSHCNtype_1617 in (3,4) then service = 1;
  if AsthmSev_1617 in (2) then severity=0;
```

```
   if AsthmSev_1617 in (3) then severity=1;
 if asthma in (1) and service in (1) then cc=1;
 if asthma in (1) and service in (0) then cc=2;
run;

proc sort data=asth_ser1;
   by severity;
   run;

proc freq data=asth_ser1 noprint;
   tables cc*service/list out=sever;
   format cc case. asthma eq. sex_1617 sex.;
   title2 'Subjects with Asthma';
   title3 'Cases are children who have Asthma';
   footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
   by severity;
run;
proc print data=sever;
title2 'Subjects with Asthma';
title3 'Cases are children who have Asthma';
title4 'By Asthma Scerity';
footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
proc freq data=asth_ser1;
   tables cc*severity/list;
   format cc case. asthma eq. sex_1617 sex.;
   title2 'Cases are children who use Asthma medication and services';
   Title3 'By Asthma Scerity';
   footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
  /* Model One */
proc logistic data=asth_ser1;
 model cc = severity/covb;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model is Children who use Asthma medication and services = severity';
 run;
/* Model Two */
proc logistic data=asth_ser1;
 model cc = severity sex_1617 /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(two) is Children who use Asthma medication and services = severity
Sex';
 run;
```

```
/* Model Three */
proc logistic data=asth_ser1;
 model cc = severity race /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title3 'Model(Three) is Children who use Asthma medication and services = severity
Race';
 run;
  /* Model Four */
 proc logistic data=asth_ser1;
 model cc = severity age3_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Four) is Children who use Asthma medication and services = severity
age';
 run;
 /* Model Five */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Five) is Children who use Asthma medication and services = severity
age race sex';
 run;
/* Model Six */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Six) is Children who use Asthma medication and services = severity
age race sex emotional and developmental or behavioral conditions Social Economic
Status';
 run;
/* Model Seven (Final) */
 proc logistic data=asth_ser1;
  model cc = severity sex_1617 socecon/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Seven: Final) is Children who use Asthma medication and services =
severity sex Social Economic Status ';
 run;
```

Proportion of subjects with ASD and Frequency of Services Used

```
proc sort data=nsch.asthma_ASD
        out=ASTH_ASD1;
 by sex_1617;
 run;
 /* Selecting subjects who used medication or services for management of their
ASD*/
 data asd;
  set asth_asd1;
  if CSHCNtype_1617 in (2,3,4);
  run;
data asd1;
   set asd;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
 if asd in (1) and service in (1) then cc=1;
 if asd in (1) and service in (0) then cc=1;
 if asd in (0) and service in (1) then cc=2;
 if asd in (0) and service in (0) then cc=2;
run;
proc freq data=asd1 noprint;
   tables cc*service/list out=asd2;
   format cc case. ASD eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with ASD';
   title3 'Cases are children who have ASD ';
   footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
   run;
proc print data=asd2;
title2 'Analysis population (Age 3-17): Subjects with ASD';
title3 'Cases are children who have ASD';
footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
run;
proc freq data=asd1;
 tables cc*service/list;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
title3 'Cases are children who have ASD';
footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
run;
  /* Model One */
proc logistic data=asd1;
 model cc = service/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model is Children who have ASD = Service';
 run;
```

```
/* Model Two */
proc logistic data=asd1;
 model cc = service sex_1617 /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(two) is Children who have ASD  = service Sex';
 run;
 /* Model Three */
proc logistic data=asd1;
 model cc = service race /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Three) is Children who have ASD = service Race';
 run;
  /* Model Four */
 proc logistic data=asd1;
 model cc = service age3_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Four) is Children who have ASD = service age';
 run;
 /* Model Five */
 proc logistic data=asd1;
  model cc = service age3_1617 race sex_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Five) is Children who have ASD = Service age race sex';
 run;
/* Model Six */
 proc logistic data=asd1;
  model cc = service age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. ASD eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Six) is Children who Children who have ASD = Service age race sex
emotional and developmental or behavioral conditions Social Economic Status';
 run;/* Model Seven (Final) */
 proc logistic data=asd1;
  model cc = service socecon/covb;
  format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;;
  title2 'Analysis population (Age 3-17): Subjects with ASD';
  title3 'Children who have ASD';
  Title5 'Model(Seven: Final) is Children who have ASD = Service Social Economic
Status'; run;
```

Proportion of subjects with ASD and Frequency of Rx Medication and Services Used

```
proc sort data=nsch.asthma_ASD
        out=ASTH_ASD;
 by sex_1617;
where asd in (1) and AutismSev_1617 in (2,3);
 run;

 /* Selecting subjects who used medication or services for management of their ASD
*/
 data asth_ser;
  set asth_asd;
  if CSHCNtype_1617 in (2,3,4);
  run;
  data asth_ser1;
   set asth_ser;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if AutismSev_1617 in (2) then severity=0;
   if AutismSev_1617 in (3) then severity=1;
 if ASD in (1) and service in (1) then cc=1;
 if ASD in (1) and service in (0) then cc=2;
run;
proc sort data=asth_ser1;
   by severity;
   run;
proc freq data=asth_ser1 noprint;
   tables cc*service/list out=sever;
   format cc case. ASD eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with ASD';
   title3 'Cases are children who use ASD medication and services';
   footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
   by severity;
run;
proc print data=sever;
title2 'Analysis population (Age 3-17): Subjects with ASD';
title3 'Cases are children who use ASD medication and services';
title4 'By ASD Scerity';
footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
run;
proc freq data=asth_ser1;
 tables cc*severity/list;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who use ASD medication and services';
 title4 'By ASD Scerity';
 footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
run;
```

```
 /* Model One */
proc logistic data=asth_ser1;
 model cc = severity/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model is Children who use ASD medication and services = Service';
 run;
/* Model Two */
proc logistic data=asth_ser1;
 model cc = severity sex_1617 /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(two) is Children who use ASD medication and services = service Sex';
 run;
 /* Model Three */
proc logistic data=asth_ser1;
 model cc = severity race /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Three) is Children who use ASD medication and services = service
Race';
 run;
  /* Model Four */
 proc logistic data=asth_ser1;
 model cc = severity age3_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Four) is Children who use ASD medication and services = service age';
 run;
 /* Model Five */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Five) is Children who use ASD medication and services = Service age
race sex';
 run;
```

```
/* Model Six */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. ASD eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Children who use ASD medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Six) is Children who use ASD medication and services = Service age
race sex emotional and developmental or behavioral conditions Social Economic
Status';
 run;
/* Model Seven (Final) */
 proc logistic data=asth_ser1;
  model cc = severity socecon/covb;
  format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;;
  title2 'Analysis population (Age 3-17): Subjects with ASD';
  title3 'Children who use ASD medication and services';
  title4 'By ASD Scerity';
  Title5 'Model(Seven: Final) is Children who use ASD medication and services =
Service Social Economic Status';
 run;
```

Proportion of subjects with ASD + Asthma and Frequency of Services Used

```
proc sort data=nsch.asthma_ASD
        out=ASTH_ASD1;
  by sex_1617;;
  run;

 data asd_asth;
  set asth_asd1;
  if CSHCNtype_1617 in (2,3,4);
  run;
/* Selecting subjects who used medication or services for managment of their ASD +
Asthma*/
  data asma;
   set asd_asth;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if asd in (1) and asthma in (1) then asd_ma=1;
   if asd in (0) and asthma in (1) then asd_ma=0;
   if asd in (0) and asthma in (0) then asd_ma=0;
   if asd in (1) and asthma in (0) then asd_ma=0;
 if asd_ma in (1) and service in (1) then cc=1;
 if asd_ma in (1) and service in (0) then cc=1;
 if asd_ma in (0) and service in (1) then cc=2;
 if asd_ma in (0) and service in (0) then cc=2;
run;
```

```
 proc freq data=asma noprint;
  tables cc*service/list out=sever;
  format cc case. ASD eq. sex_1617 sex.;
  title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
  title3 'Cases are children who have ASD & Asthma ';
  footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;
proc print data=sever;
title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
title3 'Cases are children who have ASD & Asthma ';
footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;
proc freq data=asma;
 tables cc*service/list;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;
  /* Model One */
proc logistic data=asma;
 model cc = service/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model is Case = Service';
 run;/* Model Two */
proc logistic data=asma;
 model cc = service sex_1617 /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model(two) is Case = service Sex';
 run; /* Model Three */
proc logistic data=asma;
 model cc = service race /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model(Three) is Case = service Race';
 run;  /* Model Four */
 proc logistic data=asma;
 model cc = service age3_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model(Four) is CC = service age';
 run;
```

```
 /* Model Five */
 proc logistic data=asma;
  model cc = service age3_1617 race sex_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model(Five) is CC = Service age race sex';
 run;
/* Model Six */
 proc logistic data=asma;
  model cc = service age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. ASD eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model(Six) is CC = Service age race sex emotional and developmental or
behavioral conditions Social Economic Status';
 run;
/* Model Seven (Final) */
 proc logistic data=asma;
 model cc = service socecon/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who have ASD & Asthma ';
 Title5 'Model (Seven: Final) is Case = Service socecon';
 run;
```

Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used

```
proc sort data=nsch.asthma_ASD
         out=ASTH_ASD;
  by sex_1617;
   where asthma in (1) and asd in (1);
  run;

/* Asthma severity */

proc sort data=ASTH_ASD
        out=asth_asd;
  by sex_1617;
where asthma in (1) and AsthmSev_1617 in (2,3);
  run;

/*ASD Severity */
proc sort data=ASTH_ASD
         out=ASTH_ASD1;
  by sex_1617;
where asd in (1) and AutismSev_1617 in (2,3);
  run;
```

```
 /* Selecting subjects who used medication or services for management of their ASD
*/
 data asd_ser;
  set asth_asd1;
  if CSHCNtype_1617 in (2,3,4);
  run;

  data asd_ser1;
   set asd_ser;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if AutismSev_1617 in (2) then severity=0;
   if AutismSev_1617 in (3) then severity=1;
 if ASD in (1) and service in (1) then cc=1;
 if ASD in (1) and service in (0) then cc=2;
run;

proc sort data=asd_ser1;
   by severity;
   run;

proc freq data=asd_ser1 noprint;
   tables cc*service/list out=sever;
   format cc case. ASD eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
   title3 'Cases are children who use ASD & Asthma medication and services';
   footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
   by severity;
run;

proc print data=sever;
title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
title3 'Cases are children who use ASD & Asthma medication and services';
title4 'By ASD Scerity';
footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;

proc freq data=asd_ser1;
 tables cc*severity/list;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;
```

```
/* Model One */
proc logistic data=asd_ser1;
 model cc = severity/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model is Case = Service';
 run;
/* Model Two */
proc logistic data=asd_ser1;
 model cc = severity sex_1617 /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(two) is Case = service Sex';
 run;
 /* Model Three */
proc logistic data=asd_ser1;
 model cc = severity race /covb ;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Three) is Case = service Race';
 run;
  /* Model Four */
 proc logistic data=asd_ser1;
 model cc = severity age3_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Four) is CC = service age';
 run;
 /* Model Five */
 proc logistic data=asd_ser1;
  model cc = severity age3_1617 race sex_1617/covb;
 format cc case. ASD eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Five) is CC = Service age race sex';
 run;
```

```
/* Model Six */
 proc logistic data=asd_ser1;
  model cc = severity age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. ASD eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model(Six) is CC = Service age race sex emotional and developmental or
behavioral conditions Social Economic Status';
 run;
/* Model Seven (Final) */
 proc logistic data=asd_ser1;
 model cc = severity/covb;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 title4 'By ASD Scerity';
 Title5 'Model (Seven: Final) is Case = Service';
 run;
```

Proportion of subjects with ASD + Asthma and Frequency of Rx Medication and Services Used

```
data asth_ser;
  set asth_asd;
  if CSHCNtype_1617 in (2,3,4);
  run;
  data asth_ser1;
   set asth_ser;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if AsthmSev_1617 in (2) then severity=0;
   if AsthmSev_1617 in (3) then severity=1;
 if asthma in (1) and service in (1) then cc=1;
 if asthma in (1) and service in (0) then cc=2;
run;
proc sort data=asth_ser1;
   by severity;
   run;
proc freq data=asth_ser1 noprint;
   tables cc*service/list out=sever;
   format cc case. asthma eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
   title3 'Cases are children who use ASD & Asthma medication and services';
   footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
   by severity;
run;
```

```
proc print data=sever;
title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
title3 'Cases are children who use ASD & Asthma medication and services';
title4 'By Asthma Scerity';
footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;

proc freq data=asth_ser1;
  tables cc*severity/list;
  format cc case. asthma eq. sex_1617 sex.;
  title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
  title3 'Cases are children who use ASD & Asthma medication and services';
  Title4 'By Asthma Scerity';
  footnote1 'SAS Program: ASD_Asthma_Severity_Models_21Feb2019';
run;
 /* Model One */
proc logistic data=asth_ser1;
 model cc = severity/covb;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model is Case = Service';
 run;
 /* Model Two */
proc logistic data=asth_ser1;
 model cc = severity sex_1617 /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(two) is Case = service Sex';
 run; /* Model Three */
proc logistic data=asth_ser1;
 model cc = severity race /covb ;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(Three) is Case = service Race';
 run;  /* Model Four */
 proc logistic data=asth_ser1;
 model cc = severity age3_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(Four) is CC = service age';
 run;
```

```
 /* Model Five */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617/covb;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(Five) is CC = Service age race sex';
 run;
/* Model Six */
 proc logistic data=asth_ser1;
  model cc = severity age3_1617 race sex_1617 mhealth_1617 socecon/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(Six) is CC = Service age race sex emotional and developmental or
behavioral conditions Social Economic Status';
 run;
/* Model Seven (Final) */
 proc logistic data=asth_ser1;
  model cc = severity/covb;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD & Asthma';
 title3 'Cases are children who use ASD & Asthma medication and services';
 Title4 'By Asthma Scerity';
 Title5 'Model(Seven: Final) is CC = Service race sex emotional and developmental or
behavioral conditions ';
 run;
```

Appendix F: SAS CODES for WEIGHTED ANALYSIS

```
/*Demographics*/
proc surveyfreq data=ASTH_ASD;
     tables  sex_1617;
     strata  FIPSST;
     cluster HHID;
     weight  FWC_1617;
format sex_1617 sex.;
title3 'Analysis population (Age 3-17)';
footnote1 'SAS Program: ASD_Asthma_All_Freq_8April2019';
   run;
 %macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) ;
      strata  FIPSST;
      cluster HHID;
      weight  FWC_1617;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format
     age3_1617 agec.
     race4_1617 race.
          hisplang_1617 hisplang.
          famstruct_1617 fmstruc.
          CSHCN_1617 cshcn.
          rxmeds_1617 eq.
     serve_1617 eq.
     func_1617 eq.
     therapy_1617 eq.
     mhealth_1617 eq.
          CSHCNtype_1617 deffive.
          mhneeds_1617 mhneeds.
     ;
%mend;
options mprint;
proc surveyfreq data=ASTH_ASD nosummary;
 %vfreq(age3_1617
     race4_1617
          hisplang_1617
          famstruct_1617
          CSHCN_1617
          rxmeds_1617
          serve_1617
     func_1617
     therapy_1617
     mhneeds_1617
```

```
      CSHCNtype_1617
            mhealth_1617);
 title4 'Demographics Information';
run;
/* Physical, Emotional & Mental Health */

%macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) ;
      strata  FIPSST;
      cluster HHID;
      weight  FWC_1617;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format sex_1617 sex.
      ChHlthSt_1617 chhlthst.
      BrstEver_1617 NY.
            BMI4_1617 BMI.
      PhysAct_1617 exercise.
            SchlMiss_1617 missch.
      BornPre_1617 NY.
            VeryLBWght_1617 lowbw.
            IntDisab_1617 cond.
      autism_1617 cond.
            AutismSev_1617 sevirty.
            asthma_1617 cond.
      AsthmSev_1617 sevirty.
            Cond2more27_1617 currcond.
            MedEmotion_1617 NY.
            finishes_1617 tasks.
      resil6to17_1617 calm.
            curious6to17_1617 tasks.
      ;
%mend;
options mprint;

proc surveyfreq data=ASTH_ASD nosummary;
 %vfreq(ChHlthSt_1617
      BrstEver_1617
            BMI4_1617
      PhysAct_1617
            SchlMiss_1617
      BornPre_1617
            VeryLBWght_1617
            IntDisab_1617
      autism_1617
            AutismSev_1617
```

```
            asthma_1617
      AsthmSev_1617
            Cond2more27_1617
            MedEmotion_1617
            finishes_1617
      resil6to17_1617
            curious6to17_1617);
 title4 'Physical, Emotional & Mental Health';
run;
/* Community and School Activities */
%macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) ;
      strata  FIPSST;
      cluster HHID;
      weight  FWC_1617;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format sex_1617 sex.
      SpEducPln_1617 NY.
      ReptGrade_1617 NY.
            SchlEngage_1617 engage.
            cares_1617 engage.
            homework_1617 engage.
            AftSchAct_1617 aftsch.
            volunteer_1617 NY.
            workpay_1617 workpay.
            readto_1617 read.
            mentor_1617 NY.
      ;
%mend;
options mprint;

proc surveyfreq data=ASTH_ASD nosummary;
 %vfreq(
            SpEducPln_1617
      ReptGrade_1617
            SchlEngage_1617
            cares_1617
            homework_1617
            AftSchAct_1617
            volunteer_1617
            workpay_1617
            readto_1617
            mentor_1617);
 title3 'Community and School Activities';
run;
```

```
/* Family and Health and Activities */
%macro vfreq(vars);
  %let i = 1;
  %do %while( %scan(&vars,&i)^= );
    tables %scan(&vars,&i) ;
      strata  FIPSST;
      cluster HHID;
      weight  FWC_1617;
by sex_1617;
    %let i = %eval(&i+1);
  %end;
format sex_1617 sex.
            MotherHSt_1617 mother.
            FatherHSt_1617 mother.
            smoking_1617 NY.
            SmkInside_1617 secsmoke.
      WrkngPoor_1617 workpoor.
            HrsSleep_1617 sleep.
            ACEincome2_1617 income.
            DiffCare_1617 aggyn.
            angry_1617 aggyn.
      ParAggrav_1617 aggr.
      ;
%mend;
options mprint;
proc surveyfreq data=ASTH_ASD nosummary;
 %vfreq(MotherHSt_1617
            FatherHSt_1617
            smoking_1617
            SmkInside_1617
      WrkngPoor_1617
            HrsSleep_1617
            ACEincome2_1617
            DiffCare_1617
            angry_1617
      ParAggrav_1617
            );
 title3 'Family and Health and Activities';
run;
```

Proportion of subjects with Asthma and Frequency Services Used

```
proc sort data=nsch.asthma_ASD
          out=ASTH_ASD;
  by sex_1617;
  run;
```

```
proc surveyfreq data=ASTH_ASD;
  tables cc*asthma;
  strata  FIPSST;
  cluster HHID;
  weight  FWC_1617;
  format cc case. asthma eq. sex_1617 sex.;
  title2 'Children who have ASD';
  title3 'Analysis population (Age 3-17)';
  footnote1 'SAS Program: ASD_Asthma_Models_8April2019';
run;
 /* Model One */
proc surveylogistic data=ASTH_ASD;
 model cc = asthma /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title3 'Model is Children who have ASD = Asthma';
 run;
/* Model Two */
proc surveylogistic data=ASTH_ASD;
 model cc = asthma sex_1617  /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(two) is Children who have ASD = Asthma Sex';
 run;
 /* Model Three */
proc surveylogistic data=ASTH_ASD;
 model cc = asthma race /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Three) is Children who have ASD = Asthma race';
 run;
```

```
 /* Model Four */
 proc surveylogistic data=ASTH_ASD;
 model cc = asthma age3_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Four) is Children who have ASD = asthma age';
 run;
/* Model Five */
 proc surveylogistic data=ASTH_ASD;
 model cc = asthma age3_1617 race sex_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Five) is Children who have ASD = Asthma age race sex';
 run;
/* Model Six */
 proc surveylogistic data=ASTH_ASD;
  model cc = asthma age3_1617 race sex_1617 mhealth_1617 func_1617
socecon/CHISQ(FIRSTORDER);
  strata  FIPSST;
  weight  FWC_1617;
  cluster HHID;
  domain cc;
 format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = Asthma age race sex emotional and
developmental or behavioral conditions functional limits Social Economic Status';
 /* Model Seven (Final) */
 proc surveylogistic data=ASTH_ASD;
  model cc = asthma age3_1617 socecon/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
format cc case. asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
```

```
 Title4 'Model(Seven: Final) is Children who have ASD = Asthma, Age, and Social
Economic Status';
  run;
```

Proportion of subjects with Asthma and Frequency of Rx Medication and Services Used: WEIGHTED

```
proc sort data=nsch.asthma_ASD
          out=ASTH_ASTHMA1;
  by sex_1617;
  run;
 /* Selecting subjects who used medication or services for management of their ASD
*/
 data asthma;
  set asth_asthma1;
  if CSHCNtype_1617 in (2,3,4);
  run;
data asthma1;
   set asthma;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
 if asthma in (1) and service in (1) then cc=1;
 if asthma in (1) and service in (0) then cc=1;
 if asthma in (0) and service in (1) then cc=2;
 if asthma in (0) and service in (0) then cc=2;
run;
proc surveyfreq data=asthma1;
   tables cc*service;
   strata  FIPSST;
   cluster HHID;
   weight  FWC_1617;
   format cc case. Asthma eq. sex_1617 sex.;
   title2 'Analysis population (Age 3-17): Subjects with Asthma';
   title3 'Cases are children who have Asthma ';
   footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
  /* Model One */
proc surveylogistic data=asthma1;
 model cc = service /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 title4 'By Asthma Scerity';
 Title5 'Model is Children who have Asthma = Service';
 run;
```

```
 /* Model Two */
proc surveylogistic data=asthma1;
 model cc = service sex_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(two) is Children who have Asthma  = service Sex';
 run;
 /* Model Three */
proc surveylogistic data=asthma1;
 model cc = service race/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(Three) is Children who have Asthma = service Race';
 run;
  /* Model Four */
 proc surveylogistic data=asthma1;
 model cc = service age3_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(Four) is Children who have Asthma = service age';
 run;
 /* Model Five */
 proc surveylogistic data=asthma1;
 model cc = service age3_1617 race sex_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(Five) is Children who have Asthma = Service age race sex';
 run;
```

```
/* Model Six */
 proc surveylogistic data=asthma1;
 model cc = service age3_1617 race sex_1617 mhealth_1617
socecon/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
 format cc case. Asthma eq. age3_1617 agec. race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
 title2 'Analysis population (Age 3-17): Subjects with Asthma';
 title3 'Cases are children who have Asthma';
 Title5 'Model(Six) is Children who Children who have Asthma = Service age race
sex emotional and developmental or behavioral conditions Social Economic Status';
 run;
/* Model Seven (Final) */
 proc surveylogistic data=asthma1;
 model cc = service socecon/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;
 domain cc;
  format cc case. Asthma eq. age3_1617 agec. race. sex_1617 sex.;;
  title2 'Analysis population (Age 3-17): Subjects with Asthma';
  title3 'Children who have Asthma';
  Title5 'Model(Seven: Final) is Children who have Asthma = Service Social
Economic Status';
 run;

proc sort data=nsch.asthma_ASD
          out=ASTH_ASD;
  by sex_1617;
where asthma in (1) and AsthmSev_1617 in (2,3);
  run;

 /* Selecting subjects who used medication or services for managment of their asthma
*/

 data asth_ser;
  set asth_asd;
  if CSHCNtype_1617 in (2,3,4);
  run;

  data asth_ser1;
   set asth_ser;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if AsthmSev_1617 in (2) then severity=0;
   if AsthmSev_1617 in (3) then severity=1;
```

```
 if asthma in (1) and service in (1) then cc=1;
 if asthma in (1) and service in (0) then cc=2;
run;

proc sort data=asth_ser1;
  by severity;
  run;

proc surveyfreq data=asth_ser1;
  tables cc*service;
  strata  FIPSST;
  cluster HHID;
  weight  FWC_1617;
  by severity;
  format cc case. Asthma eq. sex_1617 sex.;
  title2 'Analysis population (Age 3-17): Subjects with Asthma';
  title3 'Cases are children who have Asthma ';
  footnote1 'SAS Program: Asthma_Severity_Models_21Feb2019';
run;
 /* Model One */
proc surveylogistic data=asth_ser1;
 model cc = severity/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;  domain cc;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model is Children who use Asthma medication and services = severity';
 run;
/* Model Two */
proc surveylogistic data=asth_ser1;
 model cc = severity sex_1617 /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(two) is Children who use Asthma medication and services = severity
Sex';
 run;
 /* Model Three */
proc surveylogistic data=asth_ser1;
 model cc = severity race /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. asthma eq. sex_1617 sex.;
```

```
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title3 'Model(Three) is Children who use Asthma medication and services = severity
Race';
 run;
  /* Model Four */
 proc surveylogistic data=asth_ser1;
 model cc = severity age3_1617 /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. asthma eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Four) is Children who use Asthma medication and services = severity
age';
 run;
 /* Model Five */
 proc surveylogistic data=asth_ser1;
 model cc = severity age3_1617 race sex_1617 /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. asthma eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Five) is Children who use Asthma medication and services = severity
age race sex';
 run;
/* Model Six */
 proc surveylogistic data=asth_ser1;
 model cc = severity age3_1617 race sex_1617 mhealth_1617 socecon
/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Six) is Children who use Asthma medication and services = severity
age race sex emotional and developmental or behavioral conditions Social Economic
Status';
 run;
/* Model Seven (Final) */
 proc surveylogistic data=asth_ser1;
 model cc = severity sex_1617 socecon /CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
```

```
 cluster HHID; domain cc;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;;
 title2 'Children who use Asthma medication and services';
 Title3 'By Asthma Scerity';
 Title4 'Model(Seven: Final) is Children who use Asthma medication and services =
severity sex Social Economic Status ';
 run;
```

Proportion of subjects with ASD and Frequency of Services Used

```
data asd;
  set asth_asd1;
  if CSHCNtype_1617 in (2,3,4);
  run;

data asd1;
   set asd;
   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
 if asd in (1) and service in (1) then cc=1;
 if asd in (1) and service in (0) then cc=1;
 if asd in (0) and service in (1) then cc=2;
 if asd in (0) and service in (0) then cc=2;
run;
proc surveyfreq data=asd1;
   tables cc*service;
   strata  FIPSST;
   cluster HHID;
   weight  FWC_1617;
   title2 'Analysis population (Age 3-17): Subjects with ASD';
   title3 'Cases are children who have ASD ';
   footnote1 'SAS Program: ASD_Severity_Models_21Feb2019';
run;
  /* Model One */
proc surveylogistic data=asd1;
 model cc = service /CHISQ(FIRSTORDER);
strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;  domain cc;
 format cc case. ASD eq. sex_1617 sex. ;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model is is Children who have ASD = Service';
 run;
/* Model Two */
proc surveylogistic data=asd1;
 model cc = service sex_1617/CHISQ(FIRSTORDER);
strata  FIPSST;
```

```
 weight  FWC_1617;
 cluster HHID;  domain cc;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(two) is Children who have ASD  = service Sex';
 run;
 /* Model Three */
proc surveylogistic data=asd1;
 model cc = service race/CHISQ(FIRSTORDER);
strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. ASD eq. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Three) is Children who have ASD = service Race';
 run;
/* Model Four */
 proc surveylogistic data=asd1;
 model cc = service age3_1617/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;  domain cc;
 format cc case. ASD eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Four) is Children who have ASD = service age';
 run;
 /* Model Five */
 proc surveylogistic data=asd1;
 model cc = service age3_1617 race sex_1617/CHISQ(FIRSTORDER);
strata  FIPSST;
 weight  FWC_1617;
 cluster HHID;  domain cc;
 format cc case. ASD eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Five) is Children who have ASD = Service age race sex';
 run;
/* Model Six */
 proc surveylogistic data=asd1;
 model cc = service age3_1617 race sex_1617 mhealth_1617
socecon/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
 format cc case. ASD eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617 eq.
sex_1617 sex.;;
```

```
 title2 'Analysis population (Age 3-17): Subjects with ASD';
 title3 'Cases are children who have ASD';
 Title5 'Model(Six) is Children who Children who have ASD = Service age race sex
emotional and developmental or behavioral conditions Social Economic Status';
 run;
/* Model Seven (Final) */
 proc surveylogistic data=asd1;
 model cc = service socecon/CHISQ(FIRSTORDER);
 strata  FIPSST;
 weight  FWC_1617;
 cluster HHID; domain cc;
  format cc case. ASD eq. age3_1617 agec. race race. sex_1617 sex.;;
  title2 'Analysis population (Age 3-17): Subjects with ASD';
  title3 'Children who have ASD';
  Title5 'Model(Seven: Final) is Children who have ASD = Service Social Economic
Status';
 run;
```

Appendix G: SAS CODES for GEE USNING GENMOD

```
proc sort data=nsch.pyemh1
        out=ASTH_ASD;
 by sex_1617;
 run;

/* Model One */
proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma / dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title3 'Model is is Children who have ASD = Asthma';
 run;
/* Model Two */
proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. sex_1617 sex. ;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(two) is Children who have ASD = Asthma Sex';
 run;
 /* Model Three */
proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma race/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. race" race 1 / exp;
 format cc case. asthma eq. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Three) is Children who have ASD = Asthma race';
 run;
  /* Model Four */
 proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma age3_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. age3_1617" age3_1617 1 / exp;
```

```
 format cc case. asthma eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Four) is Children who have ASD = asthma age';
 run;
 /* Model Five */
 proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma age3_1617 race sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. age3_1617" age3_1617 1 / exp;
    estimate "log O.R. race" race 1 / exp;
    estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. sex_1617 sex.;
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Five) is Children who have ASD = Asthma age race sex';
 run;
/* Model Six */
 proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma age3_1617 race sex_1617 mhealth_1617 func_1617 socecon/
dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. age3_1617" age3_1617 1 / exp;
    estimate "log O.R. race" race 1 / exp;
    estimate "log O.R. sex_1617" sex_1617 1 / exp;
    estimate "log O.R. mhealth_1617" mhealth_1617 1 / exp;
    estimate "log O.R. func_1617" func_1617 1 / exp;
    estimate "log O.R. socecon" socecon 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = Asthma age race sex emotional and
developmental or behavioral conditions functional limits Social Economic Status';
 run;
/* Model Seven (Final) */
 proc genmod data=ASTH_ASD;
    class hhid;
    model cc = asthma age3_1617 socecon/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. asthma" asthma 1 / exp;
    estimate "log O.R. age3_1617" age3_1617 1 / exp;
    estimate "log O.R. socecon" socecon 1 / exp;
format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
```

```
 title2 'Children who have ASD';
 title3 'Analysis population (Age 3-17)';
 Title4 'Model(Seven: Final) is Children who have ASD = Asthma, Age, and Social
Economic Status';
  run;
* Model One */
proc genmod data=asd1;
    class hhid;
    model cc = service/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
 run;
 /* Model Two */
proc genmod data=asd1;
    class hhid;
    model cc = service sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
          estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
 run;
 /* Model Three */
proc genmod data=asd1;
    class hhid;
    model cc = service race/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
          estimate "log O.R. race" race 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
 run;
  /* Model Four */
 proc genmod data=asd1;
    class hhid;
    model cc = service age3_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
```

```
        estimate "log O.R. age3_1617" age3_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
 run;
 /* Model Five */
 proc genmod data=asd1;
    class hhid;
    model cc = service age3_1617 race sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
        estimate "log O.R. age3_1617" age3_1617 1 / exp;
        estimate "log O.R. race" race 1 / exp;
        estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
 run;
/* Model Six */
proc genmod data=asd1;
    class hhid;
    model cc = service age3_1617 race sex_1617 mhealth_1617 socecon/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
    estimate "log O.R. age3_1617" age3_1617 1 / exp;
    estimate "log O.R. race" race 1 / exp;
    estimate "log O.R. sex_1617" sex_1617 1 / exp;
    estimate "log O.R. mhealth_1617" mhealth_1617 1 / exp;

    estimate "log O.R. socecon" socecon 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = Asthma age race sex emotional and
developmental or behavioral conditions functional limits Social Economic Status';
 run;
/* Model Seven (Final) */
proc genmod data=asd1;
    class hhid;
    model cc = service  socecon/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. service" service 1 / exp;
```

```
    estimate "log O.R. socecon" socecon 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = Asthma age race sex emotional and
developmental or behavioral conditions functional limits Social Economic Status';
 run;

 proc sort data=nsch.asthma_ASD
         out=ASTH_ASD;
  by sex_1617;
where asd in (1) and AutismSev_1617 in (2,3);
  run;

 /* Selecting subjects who used medication or services for managment of their ASD */

 data asth_ser;
  set asth_asd;
  if CSHCNtype_1617 in (2,3,4);
  run;

  data asth_ser1;
   set asth_ser;

   if CSHCNtype_1617 in (2) then service = 0;
   if CSHCNtype_1617 in (3,4) then service = 1;
   if AutismSev_1617 in (2) then severity=0;
   if AutismSev_1617 in (3) then severity=1;
 if ASD in (1) and service in (1) then cc=1;
 if ASD in (1) and service in (0) then cc=2;
run;

proc sort data=asth_ser1;
   by sex_1617;
   run;
  /* Model One */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
```

```
 /* Model Two */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
          estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
 /* Model Three */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity race/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
          estimate "log O.R. race" race 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
  /* Model Four */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity age3_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
          estimate "log O.R. age3_1617" age3_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
 /* Model Five */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity age3_1617 race sex_1617/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
          estimate "log O.R. age3_1617" age3_1617 1 / exp;
```

```
            estimate "log O.R. race" race 1 / exp;
            estimate "log O.R. sex_1617" sex_1617 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
/* Model Six */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity age3_1617 race sex_1617 socecon/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
            estimate "log O.R. age3_1617" age3_1617 1 / exp;
            estimate "log O.R. race" race 1 / exp;
            estimate "log O.R. sex_1617" sex_1617 1 / exp;
    estimate "log O.R. socecon" socecon 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
/* Model Seven (Final) */
proc genmod data=asth_ser1;
    class hhid;
    model cc = severity socecon/ dist=bin;
    repeated subject=hhid / type=exch;
    estimate "log O.R. severity" severity 1 / exp;
    estimate "log O.R. socecon" socecon 1 / exp;
 format cc case. asthma eq. age3_1617 agec. race race. mhealth_1617 eq. func_1617
eq. sex_1617 sex.;
title2 'Children who have ASD';
title3 'Analysis population (Age 3-17)';
Title4 'Model(Six) is Children who have ASD = service';
*by sex_1617;
 run;
```