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Early Atopic Dermatitis and Risk of Later Autism Spectrum Disorders

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Walden University

College of Health Sciences and Public Policy

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Annissa Heslope-Mathieu

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Walden University

2026

Abstract

Early Atopic Dermatitis and Risk of Later Autism Spectrum Disorders

by

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MPH/MS, Benedictine University, 2019

BS, South University, 2015

Doctoral Study Submitted in Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

Walden University

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Abstract

Early-onset atopic dermatitis (AD) affects approximately 10-20% of children in the United States, and emerging evidence suggests potential links between early immune dysregulation and neurodevelopmental outcomes. Limited research has examined whether early AD serves as a specific risk factor for later ASD diagnosis. Guided by life course theory, the purpose of this study was to examine whether AD diagnosed within the first two years of life predicts later diagnosis of ASD among U.S. children younger than five years. A secondary analysis of the Fragile Families and Child Wellbeing Study was conducted using a retrospective cohort design. The sample included 2,949 children. Multiple logistic regression models were estimated to evaluate the association between early AD and ASD while controlling for sociodemographic characteristics (race/ethnicity, maternal education, household income) and allergic comorbidities, including asthma, food allergy, and attention-deficit/hyperactivity disorder (ADHD). Results indicated that early AD was not a statistically significant predictor of ASD diagnosis ($B = -0.730, p = .338; OR = 0.482, 95\% CI [0.11, 2.15]$). However, ADHD demonstrated a statistically significant association with ASD diagnosis ($OR = 8.765, p < .001, 95\% CI [3.24, 23.71]$). Findings were limited by class imbalance in the dataset. Results support positive social change by providing evidence-based guidance to pediatricians for risk stratification in developmental screening protocols, informing policymakers about the complexity of neurodevelopmental risk factors, and reassuring caregivers that AD alone does not substantially increase ASD risk.

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Table of Contents

Section 1: Foundation of the Study and Literature Review	1
Introduction.....	1
Background.....	6
AD	7
Chronic Intractable AD.....	10
Assessment and Management of Pediatric Patients With AD	11
Impact of Lifestyle Factors on the Evolution of AD.....	11
Influence of Age on the Living Standards of a Child With AD	12
Risk of Mental Disorders in Children and Adolescents With AD	13
The Mind-Body Disconnect in Research.....	17
Relationship Between AD and Neurodevelopmental Outcomes	18
LCT and Its Relevance to AD and ASD	19
Comorbid Conditions and Confounding Factors	21
Problem Statement.....	21
Existing Research Gaps	23
Implications for Future Research.....	24
Purpose of the Study.....	25
Research Questions and Hypotheses	26
Theoretical and /or Conceptual Framework	28
Nature of the Study.....	29
Literature Search Strategy.....	30

Theoretical Framework.....	31
Limitations	33
Significance.....	34
Summary and Conclusions	37
Section 2: Research Design and Data Collection	38
Introduction.....	38
Research Questions.....	40
Data Source.....	43
Sample Selection and Final Analytical Sample	45
Demographic Characteristics	46
Prevalence of Primary Study Variables.....	47
Comorbidity Patterns and Risks.....	47
Geographic and Temporal Distribution.....	48
Representativeness and Generalizability of Samples	48
Data Analysis Plan	49
Threats to Internal Validity	51
Limitations of External Validity.....	53
Ethics and Challenges	55
Summary	57
Section 3: Presentation of the Results and Findings.....	58
Introduction.....	58
Data Quality and Missing Data Analysis	58

Descriptive Statistics and the Sample Characteristics	59
Limitations	59
Results of the Statistical Analysis	60
Research Question 1: Relationship Between Early AD and Risk of ASD.....	60
Model Performance Problems.....	61
Primary Findings.....	61
Research Question 2: Moderator Effects of Comorbid Conditions	62
Model Degradation	64
Bivariate Logistic Regression Results	65
Attention Deficit Disorder (ADD/ADHD) and Autism Spectrum Disorder (ASD).....	66
Asthma and Autism Spectrum Disorder (ASD).....	66
Food or Digestive Allergies and Autism Spectrum Disorder (ASD).....	67
Eczema or Skin Allergies and Autism Spectrum Disorder (ASD)	68
Gender and Autism Spectrum Disorder (ASD)	69
Summary of Findings Across Models.....	69
Study Limitations.....	70
The Limitations of Secondary Data	70
Implications and Conclusions	71
Section 4: Application to Professional Practice and Implications for Social Change	74
References.....	76

Appendix A: Updated Community Health Intervention Plan	85
Appendix B: Policy Brief Memo	93

Section 1: Foundation of the Study and Literature Review

Introduction

Section 1 establishes the foundation through the examination of current literature, identification of the research problem, articulation of research questions, and explanation of the theoretical framework. Section 2 outlines the research methodology, including data sources, variable operationalization, and analytical procedures.” Section 3 will present the statistical findings, while Section 4 will discuss implications for public health practice and policy. Despite growing evidence suggesting immune-mediated conditions may influence neurodevelopmental outcomes, limited research has specifically examined whether early-onset atopic dermatitis (AD) increases the likelihood of an Autism Spectrum Disorders (ASD) diagnosis in childhood. This study addresses this gap by examining the temporal relationship between early AD and later ASD in a large, diverse sample of U.S. children.

Current research has stated there is an immeasurable link between skin afflictions, mental health, and the standard developmental milestones for infants and toddlers. In this research, I sought to investigate the emerging link between skin and early development detection as it relates to AD. Specifically, the study will focus on the impact of AD on the potential development of ASD. The beginning factors of life are what determine how the rest of a life can be envisioned. Ensuring major milestones are reached from infancy into toddlerhood and beyond allows the fundamentals of the life course theory to be shown. My goal is to examine the life course theory about ASD and determine how AD may influence or predict this diagnosis. Researching connections between AD, and ASD, and

observed the timeliness of milestones could provide valuable insights into how AD may have the potential to impact the development or detect early signs of ASD. The exploration of this topic could potentially bring forth useful information on the interplay between skin conditions and psychological development during the life course stages of infancy and toddlerhood.

This chapter will examine foundational research germane to the association between AD and ASD. It delves into the met and unmet milestones of infants into childhood who experience mild to severe AD and the subsequent connection about other ASD. The study will go on to identify current gaps in existing research, articulate the research questions, establish the theoretical framework, outline the nature of the study, define key terminology, and clarify assumptions regarding the research design and methodologies that may impact potential outcomes. Subsequently, the study will conclude by summarizing the scope and limitations of the study, establishing its significance, and showing its effects on social change.

ASD refers to a group of disorders, including autism, characterized by delays in the development of socialization and communication skills. According to the Centers for Disease Control and Prevention (2020), one in 54 children is known to have an autism spectrum disorder (ASD). One in six children aged 3 to 17 can be diagnosed with a developmental disability (Centers for Disease Control and Prevention, 2020). Parents may note symptoms in early infancy, although most diagnoses occur around the age of 3. Autism can sometimes be diagnosed as early as 2 years of age (Centers for Disease for Control and Prevention, 2023).

Autism is defined as a developmental disorder characterized by difficulties with social interactions, and communication, and also includes but is not exclusive to restricted, repetitive behavior. ASD are characterized by difficulties with movement or behavior, struggles with changes to routines or surroundings, misunderstandings in modes of play and object use, or communication deficits. Parents often observe these symptoms within the first 2 to 3 years of life. Developmental delays can be cognitive, physical, emotional, or social. Children diagnosed with ASD often require more focused education, elevated healthcare, and increased financial needs to address comorbid conditions such as AD and/or cognitive disorders to maintain their quality of life. The long-term socioeconomic impacts could be detrimental leading into adulthood.

Current research has been inconclusive regarding the correlation, causality, or strength of the relationship between various factors influencing the diagnoses of AD and other comorbidities in children with ASD. Factors associated with food allergies and AD are multifaceted, involving environmental, hereditary, and nutritional exposures. Similarly, the link between ASD and AD in children is complex and may involve immunological dysregulation, genetic susceptibility, and environmental factors. Additionally, sensory sensitivities in children with ASD may exacerbate skin issues, increasing the risk of developing AD.

While evidence has suggested a potential relationship between AD and ASD, more research is needed to fully understand the mechanisms involved and determine the best course of action for diagnosis and treatment. Clinicians should consider the possibility of comorbidities when treating children with either condition, warranting

further investigation to improve our understanding of the complex interplay between these conditions.

The wide range of attributing factors has made it difficult to interpret causality, leading to a lack of focus on this area until recent years. However, in the last five years, more studies have been completed, revealing links between AD and ASD. Several studies relate to asthma, allergies, immunizations, and access to healthcare, of such studies there is still a lot of information that needs further investigation. This analysis explores the achieved and unachieved developmental milestones of infants transitioning into childhood, who suffer from mild to severe AD as well as the potential associated risks of ASD.

The association between AD and ASD is intricate and multifaceted. Although some connections have been identified, research gaps remain. Both AD and ASD have common immunological pathways linked to dysregulated immune responses. Individuals with AD often display an exaggerated immune response resulting in inflammation and skin irritation. Similarly, studies suggest immune system abnormalities in individuals with ASD. Although exact mechanisms remain unclear, evidence indicates that both conditions have a genetic component, with certain genes related to immune function and inflammation implicated in both conditions. However, the specific genetic links between atopic disorders and ASD are not well understood and require further investigation.

Exposure to certain environmental triggers may worsen symptoms of both conditions, but the precise relationship between these triggers and the development of AD and ASD is not fully comprehended. Recent research suggests a bidirectional relationship

between the nervous system and the immune system, known as neuroimmune crosstalk. Dysfunction in this crosstalk may contribute to the development of both AD and ASD, but more research is necessary to elucidate the specific mechanisms involved. Some symptoms of AD, such as irritability and sleep disturbances, overlap with those commonly observed in individuals with ASD. This symptom overlap can make it challenging to distinguish between the two conditions, potentially leading to misdiagnosis or underdiagnosis.

Despite these observed connections, several gaps in current research persist. Specifically, there is a lack of large-scale, longitudinal studies examining the relationship between AD and ASD. Most existing research is based on small sample sizes or cross-sectional data, making it difficult to draw definitive conclusions.

Section 1 establishes this study's foundational elements through its structured four-part framework. An evaluation of current scientific literature on AD and ASD starts in the Background by exploring these conditions' statistical occurrence along with their associated risk components and immune system patterns. Through this analysis, researchers can establish the basis for exploring their connection. The Problem Statement focuses on revealing important research gaps that exist in the investigation of early AD as a risk factor for ASD. This investigation relies on the Research Questions and Hypotheses segment to state its particular research directions and topics. In this part, the Theoretical Framework demonstrates that life course theory (LCT) serves as the foundational concept for this study. The LCT demonstrates how medical stress in early childhood creates developmental consequences that determine life direction for people throughout their

lives. The investigation structure continues after Section 1 according to the following order. Section 2 presents the research methodology which uses Princeton Fragile Families and Child Wellbeing Study (FFCWS) data between 1998 to 2020 for a quantitative correlational analysis performed through SPSS v29 multiple logistic regression statistical procedures. The section contains descriptions regarding variable operationalization together with inclusion criteria and data handling processes. The statistical results and their interpretation are presented in Section 3 along with descriptive information and regression outputs along with significance test results. The analysis establishes empirical evidence about whether patients who receive early type of AD diagnosis experience an increased risk of developing ASD while examining how additional health conditions affect this relationship. Section 4 evaluates how the study findings influence both practical public health activities alongside early diagnosis interventions and policy creation. The study outcomes can advance assessment techniques by providing data specifically about infantile autism patients undergoing developmental screening. This research provides knowledge that enables healthcare professionals and both public health practitioners and policymakers to improve services supporting children at risk of ASD by enhancing early diagnosis methods alongside specific treatment approaches and improved health service access.

Background

The background information provided highlights the prevalence of AD and its impact on children in the U.S. Approximately 9 million U.S. children under age 18 are affected by AD, and one-third experience moderate to severe symptoms (National

Eczema Association, 2021). AD is characterized by chronic skin inflammation resulting in redness, itching, and rash. Although its exact cause is unknown, AD is associated with immune dysregulation (National Eczema Association, 2021).

AD is particularly prevalent in early childhood, with symptoms varying in severity from person to person. Common symptoms include dry, sensitive skin, inflamed skin, itching, rash or bumps on the skin, thickened, cracked, or scaly skin, and raw, sensitive, or swollen skin from scratching (National Atopic Dermatitis Association, 2021). In clinical and research practice, the terms atopic dermatitis and AD are used interchangeably.

Some reports suggest elevated rates of AD among children with ASD; however, prevalence estimates vary and findings are inconsistent (Furfaro, 2018; National Eczema Association, 2021). However, studies have suggested that children with autism may develop other ailments, and there is limited research on how AD specifically affects these children.

Therefore, there is a critical gap in the literature regarding the relationship between AD and ASD, which this study aims to address. By providing more insight into how these two conditions interact and their impact on affected individuals, this study will be essential in developing effective interventions and treatments for children with autism and AD (Tonacci et al., 2021).

AD

The increasing prevalence of AD and rising diagnoses of developmental disorders highlight the need to examine whether early AD is associated with ASD while accounting

for potential confounders such as food allergies (Ražnatović Đurović et al., 2019). An understanding of this relationship will aid in the management of AD among this group (Ražnatović Đurović et al., 2019). This knowledge may also influence measures regarding the care and quality of life of children with autism and other ASD (Ražnatović Đurović, 2019).

Jackson-Cowan et al. (2020) noted that limited research has examined the relationship between AD and cognitive dysfunction. Many developmental delays are tracked using the DSM-5 which includes Autism. Jackson-Cowan et al. investigated hyperactivity, memory impairment, and developmental delays in relation to skin disease. Strom and Silverberg (2016) reported an association between AD and childhood speech disorders and examined related developmental challenges.

Johansson (2017) conducted a study to characterize AD and its manifestations in children from infancy to 16 years old. The research further investigated how AD is presented in children aged school-age to 16 who were either breastfed or received specific treatments for AD. The study included a general population sample of 4,089 individuals, with families providing background information relevant to the prognosis of AD. Factors such as family history, severe AD experienced by either parent during childhood, sensitivity to medications, and presence of other dermatological conditions were among the indicators examined (Johansson, 2017).

Tonacci et al. (2021) examined neuroimmune interactions and suggested a possible association between AD and ASD. They hypothesized that a common etiopathological pathway existed between the two conditions, leading to interactions due

to a complex interplay of co-morbidities, genes, and environmental players. Other authors have observed increased risks of ASD and ASD associated with AD in infancy and suggested that a disordered immunologic response was involved with effects on neurodevelopment. Theoharides (2021) reported that mast-cell activation may disrupt the blood–brain barrier and influence neuroinflammatory pathways.

Sayaseng and Vernon (2018) reviewed AD pathophysiology and described variations in clinical presentation. For example, normally as a topical (atypical) incident of seasonal allergy AD will resolve itself in several weeks, and when it does not there is typically genetic causation with longer times of presentation. They reviewed treatment following mother and child, and how it presents in children. The article reviewed how AD presents different demographics and how the usual cases are AD can be managed with primary care. It also reviewed how AD left untreated can complicate other diseases and conditions such as asthma and other types of dermatitis. The purpose of this article is to summarize the role of skin barrier dysfunction and inflammatory pathways and responses in AD pathogenesis.

Several dermatologic conditions share overlapping features with AD, complicating diagnosis and management. Various genetic, environmental, and immunologic factors aid in the development and diagnosis of AD. These can include a strong family history of atopy, use of harsh chemicals in everyday products (i.e. soaps, detergents), seasonal changes/heat, air pollutants, or food allergies. AD can affect the individual and their family's quality of life. There are quality-of-life issues that are frequently associated with AD that individuals and their caregivers should also be

evaluated for such as signs or symptoms of mental health disturbances. Several psychosocial and mental health disorders are associated with AD, including attention deficit hyperactivity disorder, autism, anxiety, and depression. Without an appropriate diagnosis, treatments, and adherence to preventative care, the individual and their family's quality of life is significantly diminished. Most patients diagnosed with mild to moderate AD can be treated by a primary care physician. Treatments should also include the appropriate consideration for types of treatments available and when referrals are necessary (Sayaseng & Vernon, 2018). The study also includes preventing delays in treatments to better manage symptoms of AD. To aid in the treatment and prevention of AD, both providers and individuals should be educated and informed on available therapies, treatments, and measures of prevention. Adherence to available treatments and prevention with consideration to the individual and their caregiver/family factors is critical to managing AD and improving quality of life (Sayaseng & Vernon, 2018).

Chronic Intractable AD

Koblenzer and Koblenzer (1988) provided data representing the dysfunctional relationships developed due to intractable AD. AD in infancy and childhood responds readily and predictably to treatment; only a small percentage remains intractable. Eight illustrative cases are reported in which aggressive dermatologic measures were combined with an approach that helped parents recognize conflict and provided an education that permitted more appropriate behavioral limit setting. This qualitative study followed the child through treatment, personality changes, and relationship patterns with parents during treatment. Though this is an older study the implications that AD treatments have

stayed consistent though a more information is now available is valid to this study (Koblenzer & Koblenzer, 1988).

Assessment and Management of Pediatric Patients With AD

Lara-Corrales et al. (2019) highlighted the characteristics of AD and AD. The article expresses an understanding there are no general biomarkers or assessment tools that can be used to identify or predetermine if a child develops AD. Patient-reported outcomes and subjective assessments of the quality of life in both the patient and family are important considerations when treating pediatric AD. Emergency room visits have increased for AD and are associated with younger patient's age, lower household income, and lack of insurance. Recognizing the high burden of pediatric AD worldwide, it is important to optimize treatment based on the current understanding of the disease. During the assessment and treatment of the disease, health clinical providers should consider both patient and family QoL impairments. Pediatric patients with AD and their families should be counseled about its chronic, recurrent, pruritic, and inflammatory nature, the involvement of both genetic and environmental factors, and the need for continuous care (Lara-Corrales et al., 2019).

Impact of Lifestyle Factors on the Evolution of AD

Solomon et al. (2019) studied that childhood AD causes a significant impact on the quality of life for some families, yet non-concordance with treatment is common. Poor concordance with treatments seems unsurprising within the demographic which is being studied. Alternative treatment for AD is sometimes suggested but this needs to be better explored. This is important to my study to show the importance of how detrimental

the diagnosis of AD can be. There are many treatment options most involving some type of topical emollient but there are now alternative methods to treat (Solomon et al., 2019).

One study suggests a high level of association between AD and Autism in particular (Billeci et al., 2015). Several variables will be evaluated regarding the association between the dependent and independent variables.

Influence of Age on the Living Standards of a Child With AD

Ražnatović Đurović et al. (2019) studied the effect of AD which affects the quality of life (QoL) in children. The aim was to assess if QoL changed with age specificity. Age was in negative correlation with the CDLQI score, leisure domain of the Children's Dermatology Life Quality Index (CDLQI) and CDLQI sleep, and in positive correlation with the Infants' Dermatitis Quality of Life Index (IDQOL) child mood. The Three Item Severity score was in positive correlation with both the IDQOL and CDLQI scores. This study highlighted the quality-of-life changes for infants in the United States who suffer from dermatitis. The QoL measured by CDLQI was more impaired in younger children, whilst IDQOL child mood was more impaired in older infants. The most impaired QoL was seen in children in the age group 5-9 years. Regardless of disease severity, treatment and counseling of children suffering from AD should be tailored specifically to their age. This data and study support age as a factor in the disease of AD. Quality of life in this study is also linked to developmental disorders and sleep disturbances (Ražnatović Đurović et al., 2019)

Billeci et al. (2016) conducted research suggesting a potential association between AD and ASD. They found the studies showed ASD are a heterogeneous group of

neurodevelopmental conditions characterized by impairments in social communication and restricted, stereotyped interests and behaviors. The concurrently increased prevalence of AD and ASD in the last decades has led many scientists to investigate the relationship between the two diseases. Children who have already been diagnosed with AD have a higher risk of developing more atopic diseases and this is typically considered the beginning of the atopic march (Billeci et al., 2016). This is in direct correlation to this study's significance, giving a context as to why this should be explored.

Risk of Mental Disorders in Children and Adolescents With AD

Quantitative studies, characterized by their formal and objective approaches, employ systematic processes to yield measurable numerical outcomes. Unlike opinion-based research, these studies rely on empirical data to test and support theories through statistical analysis. They explore relationships, correlations, and causations, thereby adhering to rigorous scientific standards concerning logistics, instrumentation, and control.

To illustrate the methods of quantitative research, consider an article that investigates the aggregation of autistic traits in undiagnosed family members of children with autism. This study aimed to establish a link between family members regarding the risk and transmission patterns of autism traits. The findings suggest that familial transmission patterns influence the risk of autism symptom burden in undiagnosed siblings of children affected by ASD. Identifying these traits and their molecular genetic causes has significant implications for genetic counseling and understanding inherited liabilities that confer ASD risk across generations (Frazier et al., 2015). The study

highlighted that autism symptom elevations were more pronounced in non-ASD children from families with multiple incidences of ASD and those with a history of language delay and autistic speech qualities, indicating subgroups at higher transmission risk (Frazier et al., 2015). Results showed that children from families with female ASD members had a higher symptom burden and greater recurrence, suggesting that familial aggregation patterns are further influenced by sex-specific thresholds. This supports the notion that females require a higher burden of deleterious factors to cross the threshold for an ASD diagnosis (Frazier et al., 2015). Despite its limitations, this study utilized previous research and statistical data to substantiate its findings.

Additionally, the work of Constantino (2011) provided further insight into quantitative research on autism. Constantino conducted a study on the nature of autistic social impairment, treating it as a quantitative trait rather than a categorically defined condition. This reconceptualization has significant implications for diagnostic classification, measuring changes over time, uncovering genetic and neurobiological mechanisms, and public health initiatives to identify and support affected children (Constantino, 2011). The study aimed to align with recent advancements in genetics and epidemiology, proposing a dimensional approach to understanding autistic social impairment. Although the study did not fully validate its theory with extensive statistical data, it sought to enhance the understanding of diagnosing ASD in children. The research employed a T-score with a social responsiveness scale to evaluate the data for the article.

Xie et al. (2019) suggested a complex relationship between AD and mental disorders. Their study reviewed 35 other studies, finding that children and adolescents

with AD are at an increased risk for various mental disorders compared to those without AD. The studies examined included those on attention deficit disorder, depression, attention deficit hyperactive disorder, eating disorders, sleep disorders, conduct disorders, and ASD.

Xie et al. (2019) also highlighted concern about publication bias, noting that studies showing a positive correlation between AD and mental disorders are more likely to be published, potentially skewing the results. Despite many articles indicating a relationship between ASD and AD, this meta-analysis suggests that the association between AD and mental and developmental disorders might be more intricate than previously thought. However, the meta-analysis faced limitations due to variations in the analytical methods used in the included studies.

Kuniyoshi et al. (2018) aimed to explore the under-researched association between mental health problems and the severity of AD in school children. They assessed the severity in terms of physiological, morphological, functional severity, and overall burden of illness, finding a significant association between the severity of AD and mental health issues across four subcategories: emotional symptoms, conduct problems, hyperactivity/inattention, and peer problems. This study underscores the influence of AD on various mental health disorders and highlights the importance of including younger children in such studies to gain comprehensive insights into the developmental impact of AD.

Specifically, Neumeyer et al. (2019) found that clinically significant comorbidities were common among children with ASD such as AD, which supports the

idea that there are overlapping medical conditions that could follow some shared etiological pathways. Santer et al. (2012) contributed further to the theme by taking a qualitative perspective in portraying the severity of AD and its impacts not only on physical health but also on emotional and developmental wellbeing particularly in children under 5 years of age. These studies, however, do not go far in determining whether early-onset AD which is diagnosed during the first three months of life particularly causes ASD later in life. This gap shows a major flaw in existent literature.

Current study helps overcome this shortcoming by making a quantitative analysis to answer the question whether early-life AD predicts the future acquisition of ASD with a large sample of U.S. children below the age of five years. By so doing, it also closes the loop in the early immune dysregulation-long-term neurodevelopmental areas of interest, namely the developmental timing of AD onset, and comorbid development of allergic conditions. Being a pursued process, this is a direct reaction to the necessity of adding research on the relationship between early-life AD and a clear neurodevelopmental diagnosis and extend theoretical and practical knowledge in the area.

Xu et al. (2020) further assessed how AD, and its flare-ups impact the quality of life for both children and their caregivers. Their study involved 559 children under the age of 16 and examined how the severity of AD affected emotions, stress, sleep, mental health, and social interactions. Children with AD were found to have a higher likelihood of sleep disturbances, social interaction issues, and experiencing social stigma. This study is relevant for highlighting the quality-of-life aspects of children with AD and underscores the social implications of finding effective treatments and cures for the

disease. It emphasizes the significant impact of AD on daily living and social functioning, reinforcing the need for comprehensive care strategies to improve outcomes for affected children and their families.

In conclusion, quantitative studies, with their systematic and empirical methodologies, play a crucial role in advancing our understanding of complex issues such as AD and ASD and their familial transmission patterns. These studies provide valuable insights that can inform genetic counseling, diagnostic practices, and public health strategies.

Understanding the relationship between early-life AD and the development of ASD is essential to addressing broader public health challenges. AD, a chronic inflammatory skin condition, has been linked to systemic immune dysregulation, which may influence neurological development (Silverberg, 2020). Despite the growing body of research examining AD's physiological impact, there remains a significant disconnect in the broader medical and psychological fields regarding the mind-body connection. Many clinicians and researchers tend to examine dermatological and neurodevelopmental disorders separately, neglecting the possibility of shared immunological and neuroinflammatory pathways that may contribute to both conditions (Theoharides, 2021).

The Mind-Body Disconnect in Research

Historically, medical research has compartmentalized conditions affecting different organ systems, leading to an artificial separation between dermatological and neurological conditions. While AD has been widely recognized as an inflammatory disorder of the skin, its systemic effects on immune function and neurodevelopment have

not been fully integrated into mainstream developmental health research (Schmitt et al., 2019). This lack of integration stems, in part, from the traditional medical model that often views conditions in isolation rather than as part of a complex physiological network. Consequently, the potential relationship between early-life AD and neurodevelopmental disorders has been largely overlooked.

Research in psychodermatology—a field that investigates the interaction between skin diseases and psychological well-being—has demonstrated that conditions like AD can have profound neurological and behavioral effects Arck, P. C., Theoharides, T. C., & Paus, R. (2006). Chronic inflammation associated with AD has been linked to alterations in brain function, particularly in regions responsible for emotion regulation, sensory processing, and cognitive development (Billeci et al., 2015). Despite this, many healthcare providers fail to consider how AD-related inflammation and immune activation may contribute to neurodevelopmental outcomes in young children.

Relationship Between AD and Neurodevelopmental Outcomes

Recent research has begun to bridge the gap between dermatological and neurological conditions, providing evidence that immune dysregulation in AD may play a role in neurodevelopmental disorders. Chronic inflammatory responses in AD have been associated with increased levels of pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- α), which are known to affect brain function (Theoharides, 2021). Early immune system activation during critical periods of brain development can lead to changes in neural connectivity, increasing the risk of cognitive, social, and behavioral challenges later in life (Silverberg, 2020).

Studies such as Ahinkorah et al. (2024) have found that children with AD exhibit higher rates of social difficulties and cognitive delays compared to their peers without AD. Similarly, a large-scale cohort study by Abuabara and Langan (2022) indicated that children with moderate to severe AD had an increased likelihood of being diagnosed with ADHD and ASD. These findings suggest that early-life immune dysregulation may play a previously underrecognized role in neurodevelopmental trajectories.

LCT and Its Relevance to AD and ASD

LCT provides a useful framework for understanding the long-term developmental impacts of early-life health conditions. LCT posits that early-life exposures, including chronic inflammatory conditions such as AD, can have cascading effects on physical, cognitive, and social development (Koblenzer & Koblenzer, 1988). According to this framework, critical periods in early development shape long-term health trajectories, meaning that immune disruptions in infancy and early childhood may contribute to neurodevelopmental vulnerabilities that persist throughout life (Hutchinson, 2011).

Applying LCT to the study of AD and ASD highlights how systemic inflammation, combined with environmental, genetic, and social factors, influences developmental pathways. For example, early immune activation associated with AD may not only increase susceptibility to ASD but may also interact with other early-life stressors such as socioeconomic disparities, caregiver stress, and environmental exposures (Augustin, et al., 2015). Understanding this interplay is crucial for designing early intervention strategies that mitigate the impact of AD on neurodevelopmental outcomes.

This study applied Life Course Theory (LCT) to examine how early-life exposures influence long-term developmental outcomes. LCT emphasizes that early biological and environmental stressors accumulate and interact across the lifespan, shaping health trajectories. Within this framework, atopic dermatitis (AD) during infancy is conceptualized as a potential biological stressor that triggers systemic immune dysregulation. Early immune dysregulation in infants with AD may lead to chronic activation of immune responses, which can contribute to persistent inflammation, including neuroinflammation that crosses the blood–brain barrier. Neuroinflammation occurring during sensitive developmental windows may disrupt normal processes such as synaptic pruning, myelination, and neural connectivity. These disruptions in brain development increase vulnerability to ASD. By making this trajectory explicit early immune dysregulation leading to neuroinflammation, which alters brain development and subsequently elevates ASD risk this framework highlights the biological plausibility of the relationship under investigation. At the same time, LCT underscores that such biological processes do not occur in isolation but interact with broader environmental and social contexts such as socioeconomic status, caregiver stress, and healthcare access. This conceptualization not only clarifies the hypothesized mechanisms linking AD to ASD but also strengthens the rationale for early screening and intervention. Situating immune dysregulation within the LCT model emphasizes that early detection and timely care may alter long-term neurodevelopmental trajectories, thereby reducing risk for later disorders.

Comorbid Conditions and Confounding Factors

The presence of comorbid allergic and neurodevelopmental conditions further complicates the relationship between AD and ASD. Comorbid conditions such as asthma, food allergies, and ADHD are prevalent among children with AD, often making it difficult to isolate the effect of AD on neurodevelopmental outcomes (Xie et al., 2019). For example, a longitudinal study conducted by (Dyer et al., 2021) found that children with both AD and asthma exhibited a higher risk of developing cognitive and social challenges compared to children without these conditions.

Additionally, sociodemographic factors such as parental education, household income, and access to healthcare also play a significant role in influencing neurodevelopmental outcomes. Children from lower socioeconomic backgrounds often experience delayed diagnosis and limited access to specialized care, which can exacerbate the progression of ASD (Ahn et al., 2019). Therefore, it is crucial for research to control for these confounding variables to accurately assess the independent effect of AD on ASD risk.

Problem Statement

The specific research problem addressed in this study is whether AD occurring during infancy and toddlerhood before the age of 2 serves as an early predictor of increased risk for developing ASD, including ASD, later in childhood. Guided by LCT, which emphasizes the influence of early-life exposures on long-term health and developmental outcomes, this study examines the potential role of early inflammatory conditions in shaping neurodevelopmental trajectories. The timing of AD onset is

particularly critical, as it occurs during a sensitive period of rapid brain development, immune system programming, and social-emotional growth. This temporal alignment raises concern that immune dysregulation during this window may contribute to atypical neurodevelopment. Recent research has proposed biologically plausible mechanisms linking AD and ASD, including shared inflammatory pathways involving pro-inflammatory cytokines, dysregulated microRNAs, and mast cell activation (Tonacci et al., 2021). Additionally, the presence of neural autoantibodies and blood–brain barrier disruption in mothers of children with ASD further supports the hypothesis that immune dysfunction may play a role in fetal and early postnatal neurodevelopment (Theoharides, 2016).

Despite increasing interest in this area, significant gaps in literature remain. It is not yet clear whether AD alone is an independent risk factor for ASD or whether the presence of allergic comorbidities such as asthma, food sensitivities, and allergic rhinitis amplifies this risk. Although several epidemiological studies have demonstrated associations between early atopic conditions and neurodevelopmental delays (Chaudhary et al., 2024; Johnson et al., 2023; Smith et al., 2023), findings have been inconsistent and often lack age-specific detail. Moreover, a few studies have focused specifically on children under the age of 5, a population in which both AD and early signs of developmental disorders are most likely to emerge. The prevalence of both conditions has risen sharply in the United States, with an estimated 15–20% of children developing AD and 1 in 36 receiving an ASD diagnosis (Centers for Disease Control and Prevention, 2023), underscoring the growing public health significance of understanding their

relationship. There is also limited data regarding the clinical characteristics of AD—such as the frequency and severity of flare-ups—and how they may relate to neurodevelopmental outcomes in early childhood (Billeci et al., 2015; Lara-Corrales et al., 2019).

Given these gaps, this study applies to a LCT framework to examine whether early-onset AD is associated with an increased risk of ASD in later childhood, controlling for comorbid allergic and neurodevelopmental conditions. By focusing on early timing, cumulative exposures, and the interconnectedness of biological and environmental factors, this research aims to clarify whether early AD may serve as a preclinical marker of neurodevelopmental vulnerability. The findings have the potential to inform early screening protocols, integrated pediatric care strategies, and public health interventions targeting at-risk children during the most malleable stages of development.

Existing Research Gaps

Despite growing evidence linking AD to adverse neurodevelopmental outcomes, existing research has several notable limitations. First, most studies have relied on small, geographically limited samples, reducing the generalizability of their findings. Second, few studies have specifically examined the impact of early-onset AD (within the first three months of life) on ASD risk, leaving a significant gap in understanding how early-life inflammation influences long-term development (Chu et al., 2024). Third, prior studies often fail to control for confounding variables such as comorbid conditions, which can bias study outcomes.

Moreover, longitudinal research that tracks children from infancy through early childhood is limited, preventing a comprehensive understanding of the temporal relationship between AD and ASD. Addressing these gaps is critical to generating evidence that can inform early intervention strategies, targeted screenings, and comprehensive care models for children at high risk of ASD.

Implications for Future Research

To bridge these research gaps, large-scale, population-based studies that account for sociodemographic and clinical confounders are essential. Such research could provide stronger evidence regarding whether AD independently increases ASD risk or if other contributing factors are at play. Additionally, research should aim to identify biological mechanisms linking chronic inflammation with neurodevelopmental disorders to better inform clinical interventions.

Given the rapidly increasing rates of both AD and ASD, the need for early detection and intervention cannot be overstated. Understanding this relationship can significantly influence public health policy, healthcare resource allocation, and parental education on early childhood health management.

The specific research problem that addressed through this study is whether AD occurring in infants and toddlers in the United States (children <2 years old with a history of AD) predicts the risk of developing ASD including ASD in later childhood. The action of overexpressed inflammatory mediators released during atopic responses (as seen during severe AD flare-ups) could have affected neural circuitry in genetically susceptible children such as those with ASD.

Purpose of the Study

This quantitative correlational study employed secondary data analysis to examine the relationship between early-onset AD and subsequent ASD development. Current studies have shown potential relationships between AD and neurodevelopmental conditions yet there remains insufficient analysis of how early AD presentations predict ASD or ADHD development. Studies of early neurodevelopmental outcomes following AD need understanding since AD presents as an inflammatory skin condition during infancy, so this information enables better at-risk child screening and diagnosis along with treatment approaches. Through multiple logistic regression analysis of Princeton Fragile Families data, this study established how a diagnosis of AD during infancy affects the likelihood of ASD development during childhood. The independent variable was the presence of AD diagnosed within the first 3 months of life. The primary dependent variable was a diagnosis of ASD. Control variables included sociodemographic factors (age, sex, race/ethnicity, parental education, income level) and comorbid allergic conditions (asthma, food allergies, ADHD). The research examined multiple variables to identify early-life inflammatory conditions that potentially cause neurodevelopmental disorders. The research outcomes of this study generate important implications that can aid public health practitioners and healthcare providers in their work. A strong link between AD in infancy and ASD would enable healthcare providers to reevaluate screening procedures by implementing developmental monitoring for AD-diagnosed infants. New early intervention methods should be established to distribute specific support programs among children who exhibit elevated ASD vulnerability. The research

findings can be applicable to create policy recommendations that enhance developmental screening and early childhood healthcare service accessibility while ensuring suitable care for at-risk children.

Research in pediatric dermatology and neurodevelopmental disorders and public health can benefit from this study which fills the existing research void regarding AD's long-term developmental consequences. Findings can inform early intervention strategies for healthcare providers, influence public health screening recommendations, and guide policy development for integrated care approaches between dermatology and developmental pediatrics.

Research Questions and Hypotheses

AD may have a significant impact on a later diagnosis of ASD. AD itself is linked to many other diseases. Evidence for the association between AD and comorbid conditions is ever present and the aim is to improve awareness. Children who have a history of AD can have remnants of the disease throughout their whole life. The discussion surrounding the association, age, and sociodemographic factors of ASD and AD can be followed throughout an individual's life.

Research Question 1: Is there an association between a history of AD during infancy and toddlerhood (children <2 years) and the risk of developing ASD in later childhood, controlling for comorbidities such as asthma, autism, food allergies, and ADHD?

H_{01} : A history of AD during infancy and toddlerhood (U.S. children <2 years) is not significantly associated with a diagnosis of ASD in later years adjusting for comorbidities such as food allergies, asthma, ADHD, and autism.

H_{a1} : A history of AD during infancy and toddlerhood (U.S. children <2 years) is significantly associated with a diagnosis of ASD in later years adjusting for comorbidities such as food allergies, asthma, ADHD, and autism.

Research Question 2: How do comorbid conditions such as asthma, food allergies, ADHD, and autism moderate the relationship between AD and the risk of ASD in US children?

H_{02} : Comorbid conditions such as asthma, food allergies, ADHD, and autism will not significantly moderate the relationship between AD and the risk of ASD in U.S. children and the presence of atopic and allergic comorbidities (food allergy, allergic rhinitis, asthma).

H_{a2} : Comorbid conditions such as asthma, food allergies, ADHD, and autism will significantly moderate the relationship between AD and the risk of ASD in U.S. children.) and presence of atopic and allergic comorbidities (food allergy, allergic rhinitis, asthma).

Research has also suggested that some children may outgrow certain diseases, such as AD. AD can be one of these such diseases. Children can grow out of it before the age of 5, if they are still riddled with itchy flare-ups after such time this may be a lifetime disease they will have to regulate during seasonal changes. The child may also need to be aware of other potential causative factors for flare-ups. This may increase the number of flare-ups and the potential for creating an environment for ASD.

Theoretical and /or Conceptual Framework

LCT provided an ideal framework for this study because it specifically addresses how early health exposures can affect developmental trajectories across the lifespan. Early-onset AD represents a significant environmental and physiological stressor that, according to LCT principles, may trigger developmental adaptations with long-term neurodevelopmental consequences. The theory's emphasis on critical developmental windows aligns perfectly with this study's focus on inflammation during early brain development. LCT served as the theoretical base for this study to explain how AD in early infancy influences long-term developmental pathways and health results according to Jones et al. (2019). Health trajectories result from continuous effects between human experiences and biological processes alongside environmental influences throughout life stages according to LCT. The research applied LCT due to its ability to demonstrate AD's impact on early childhood development which generates future risks of specific ASD such as ASD and attention-deficit/hyperactivity disorder (ADHD). The theory underlines crucial developmental windows because these timeframes allow biological in addition to environmental elements to deeply affect development. The World Health Organization (2020) confirmed LCT's prediction that early childhood exposure to AD-related neuroinflammation and immune dysregulation leads to long-term effects on brain development and behavioral health outcomes. Through LCT researchers understand that timely interventions can prevent adverse developmental courses.

This study examined children with AD to identify those at ASD risk as per LCT, which states early detection and specific healthcare delivery leads to outcomes

modification for better life quality (see Koo & Lebwohl, 2001). The Nipissing District Developmental Screen functions as developmental screening software to observe motor development milestones of children with AD to identify early indicators of neurodevelopmental conditions promptly (Gunaseelan et al., 2018). The retrospective cohort design allows for the examination of temporal relationships between early AD and subsequent ASD diagnoses, directly testing LCT's proposition that early-life health conditions can have cascading effects on developmental outcomes. The theoretical foundation directs research inquiries and finding interpretations and develops early screening and intervention program recommendations.

Nature of the Study

To address the research inquiries in this quantitative investigation, the specific research framework involved the examination of the secondary data set derived from The Future Families and Child Well-Being study carried out by Princeton (Princeton University, 2023). The survey was conducted in 75 hospitals spanning over 20 cities throughout the United States. Over a span of 2 decades, additional surveys were administered covering novel subjects, and concerns related to public health, stressors, and factors that moderate these stressors were incorporated into the study. The survey center's objective was to comprehend the relationship between the variables.

Due to the complex multifaceted aspects of my research question, this data set is one of very few that have variables that consider the overall review of each family over a long period. This investigation concentrated on variables such as AD, eczema, developmental delays, behavioral learning disabilities, and autism. The Future Families

and Child Well-Being study carried out by Princeton University nationwide database provided enhanced insights into the diagnostic rates for AD and ASD, which can be further refined into variables for this study. The independent variable under scrutiny in this study was AD. The initial extensive dataset focused on ASD and their various age groups segregating the age brackets pertinent to the specific investigation. The severity of eczema and its relationship with other variables was assessed. The study clearly states the public has access to use the information for research purposes without getting any other permissions.

Literature Search Strategy

The literature search for this study utilized various multidisciplinary and specific databases such as Allied Health, BMJ, CDC, Crossmark, EBSCOhost, Decker, Elsevier, Google Scholar, HealthSource, HHS, Karolinska Institute, Medline, MDPI, NIH, Pediatric Dermatology, PLOS ONE, ProQuest, Pubmed, SAGE, and Wiley & Sons, as well as dissertations accessed via Walden University's library. The search criteria ranged from 2000-2024 and included keywords such as *adolescent medicine, allergies, asthma, atopic dermatitis, autism, comorbidities, co-sleeping, healthcare disparities, hyperactivity disorder, infancy, mental illness, newborn screenings, Autism Spectrum Disorders, preterm infants, prevalence, primary healthcare, psychology, quality of life, sleep disorders, skin*, and combinations of these terms.

The literature review did not specify the timeframe of the sources searched or the exact scope of the search. Nonetheless, it includes a diverse selection of sources retrieved from multiple databases, encompassing peer-reviewed articles, books, and dissertations.

The literature review provided direction for the development of the study's theoretical framework and provided insight into the latest research on AD and ASD in children.

Theoretical Framework

LCT is a framework that emphasizes the importance of understanding health and development across the entire lifespan and recognizing the biological, social, and environmental factors interact dynamically to shape individual trajectories. Applying LCT to the study of AD and ASD can inform methodology analysis and potential interventions in several ways (Roux, 2020). LCT underscores the significance of studying health outcomes over time, starting from prenatal development through childhood, adolescence, adulthood, and into old age. Researchers investigating AD and ASD could employ longitudinal study designs to track individuals' health trajectories over their lifespan (Roux, 2020). This approach allows for the examination of how early-life experiences, exposures, and interventions influence the development and progression of these conditions.

Life course epidemiology involves examining how exposures and experiences at different stages of life influence health outcomes. Researchers studying AD and ASD can use this approach to identify critical periods of susceptibility and resilience, as well as cumulative effects of risk factors. For example, they might investigate how prenatal exposure to maternal stress or environmental toxins influences the risk of developing AD or ASD later in life (Furfaro, 2018). LCT emphasizes the importance of considering multiple levels of influence, including individual, family, community, and societal factors (Jameson et al., 2022). Researchers studying AD and ASD can conduct multilevel

analyses to explore how factors at each level contribute to disease risk, progression, and outcomes (Koo & Lebowhl, 2001). This approach can help identify both distal and proximal determinants of health and inform the development of comprehensive interventions.

LCT recognizes that individuals undergo various transitions throughout their lives, such as transitioning from infancy to childhood, from school to work, or from reproductive age to menopause (Roux, 2020). Researchers studying AD and ASD can examine how these transitions impact disease trajectories and identify opportunities for intervention. For example, they might investigate how transitioning to adulthood affects access to healthcare services and adherence to treatment regimens among individuals with AD and ASD (Jones et al., 2019). LCT encourages interdisciplinary collaboration to address complex health issues comprehensively (Jones et al., 2019). Researchers studying AD and ASD can collaborate with experts from diverse fields, including dermatology, neurology, psychology, epidemiology, and social work (Jones et al., 2019). By integrating insights from multiple disciplines, researchers can develop holistic approaches to prevention, diagnosis, and treatment that address the multifaceted nature of these conditions.

Interventions derived from research informed by LCT might include targeted prevention strategies aimed at reducing exposures to environmental risk factors during critical periods of development (Hutchinson, 2011). Early detection and intervention programs to address symptoms and improve outcomes in infancy and childhood, and interventions focused on improving access to healthcare, social support, and educational

resources across the lifespan (Hutchinson, 2011). By adopting a life course perspective, researchers can gain a deeper understanding of the complex interplay of factors influencing AD and ASD and develop more effective strategies for promoting health and well-being across the lifespan.

Limitations

Diagnosing AD in infants and young children can pose a challenge due to the variability in how it presents and the overlap of symptoms with other skin conditions (Lara-Corrales et al., 2019). This can result in misdiagnosis and under diagnosis, which in turn can impact the accuracy or severity of assessments and complicate the association with ASD (Gunaseelan et al., 2018). The added confounding limitations also have much to do with the need for a statistical analysis that must take place over time and not in a qualitative study. Severity assessments for AD often rely on subjective measures such as reports from physicians or caregivers' visual inspection and symptoms scoring scales however these measures can be influenced by individual perception and biases leading to variability in how the severity of the condition is classified one such test is the Nipissing survey (Gunaseelan et al., 2018). Infants and young children may have limited ability to communicate their symptoms and discomfort associated with AD, making it difficult to accurately assess its severity (Gunaseelan et al., 2018). This limitation can particularly affect the validity of severity assessments when objective measures are not available (Johansson, 2017). The presentation and severity of AD can vary across different stages of development in infancy and childhood. Factors such as skin physical Physiology,

immune function and environmental exposures undergo significant changes during early development, which can influence the course in severity of AD (Lara et al., 2019).

ASD encompass a wide range of neurodevelopmental disorders with diverse manifestations. Untangling the relationship between the severity of AD and ASD can be complicated by the presence of comorbidities such as sensory processing difficulties sleep disturbances and behavioral changes which can contribute to the overall burden of illness (Neumeyer et al., 2019). Studies that rely on retrospective data or caregiver reports may be susceptible to recall bias particularly when it comes to remembering the onset and progression of AD symptoms and the timing of Autism Spectrum Disorder diagnosis (Frazier et al., 2015). Inaccuracies and recall can impact the validity of the observed association between the severity of AD and ASD.

Significance

AD is a chronic inflammatory skin condition that can cause discomfort, itching, and sleep disturbances, affecting the child's quality of life (Ražnatović Đurović, 2019). ASD, such as ASD, can lead to developmental delays, difficulties in social interaction, communication challenges, and repetitive behaviors (Koo & Lebowhl, 2001). Understanding their prevalence, risk factors, and associated burden helps in developing strategies for prevention, early detection, and effective management. There is emerging research suggesting potential linkages between AD and ASD. Some studies have explored the association between immune dysregulation (characteristic of AD) and neurodevelopmental disorders like ASD (Neumeyer et al., 2019). Investigating these potential connections can provide insights into shared mechanisms or risk factors, leading

to novel approaches in prevention and treatment. Both AD and ASD benefit from early intervention strategies (Ahn et al., 2019).

This study is significant because it addresses an important gap in understanding the long-term developmental consequences of early atopic dermatitis (AD) within a Life Course Theory (LCT) framework. AD is a chronic inflammatory skin condition that affects millions of children, often beginning in infancy. While typically viewed as a dermatologic disease, emerging evidence suggests that the immune dysregulation underlying AD may have broader systemic effects, including neuroinflammation. Neuroinflammation during sensitive periods of brain development can alter neural connectivity, synaptic pruning, and myelination, processes that are critical to healthy cognitive and social development. These biological disruptions may increase vulnerability to ASD.

By explicitly situating AD within this pathway early immune dysregulation leading to neuroinflammation, which alters brain development and elevates ASD risk this study provides a biologically plausible framework for examining early dermatologic conditions as markers of broader developmental vulnerability. Understanding this connection has practical importance for clinicians, caregivers, and policymakers. If early AD is shown to be linked with increased risk of ASD, then pediatric screening protocols could be expanded to include developmental monitoring for infants with AD. Such integration would allow for earlier detection of developmental concerns, timely referrals, and more comprehensive care strategies.

In addition, this study contributes to public health knowledge by emphasizing the multifactorial and multidirectional nature of child development. AD, neuroinflammation, and ASD risk are not isolated phenomena but intersect with sociodemographic factors, caregiver stress, and healthcare access. Recognizing these interactions reinforces the importance of equity in early childhood healthcare delivery. Ultimately, the significance of this study lies in its potential to inform evidence-based screening, intervention, and policy measures aimed at improving long-term developmental outcomes for children at risk.

Understanding the LCT, which emphasizes the importance of considering the dynamic interplay of individual, social, and environmental factors across the lifespan, can inform interventions aimed at improving outcomes (Solomon et al., 2018). Early identification and intervention in AD can help alleviate symptoms and prevent complications. Similarly, early intervention strategies in ASD can lead to better long-term outcomes, including improved social skills, communication abilities, and adaptive functioning (Neumeyer et al., 2019). Utilizing the LCT in studying AD and ASD allows researchers and clinicians to adopt a holistic approach, considering not only the immediate impacts but also the long-term trajectories and potential interactions with other developmental processes (Jameson et al., 2022). This perspective facilitates the development of comprehensive interventions that address the multidimensional needs of children affected by these conditions, ultimately improving their quality of life and well-being across the lifespan.

Summary and Conclusions

AD may have a significant impact on a later diagnosis of ASD. AD itself is related to many other diseases. Evidence for the association between AD and comorbid conditions is ever present and the aim is to improve awareness. Children who have a history of AD can have remnants of the disease throughout their whole life. The discussion surrounding the association, age and sociodemographic factors around ASD and AD can be followed through an individual's life.

This study aimed to review if having AD flare ups (excoriation, erythema, and edema/papulation) reported in infancy and toddlerhood increase the odds of later being diagnosed with ASD.

Section 2: Research Design and Data Collection

Introduction

In this section, I will provide an in-depth overview of the research design used in this study. My primary objective is to analyze the relationship between AD and ASD in children aged 5 and under. To achieve this goal, I employed a quantitative research design.

Quantitative research involves the collection, analysis, and interpretation of numerical data. This approach was well-suited for my study because I aimed to examine the relationship between two or more variables—namely, AD and ASD—across a large sample size. This design enabled me to explore the prevalence of these disorders and investigate potential risk factors associated with them.

In this study, the independent variables was ASD, while the dependent variables included allergies, vaccines, race, and income level. To analyze the influence of multiple variables on the relationship between AD and the risk of ASD in U.S. children, a multiple logistic regression model was appropriate. This approach allowed for the inclusion of multiple predictors and control variables, providing a more comprehensive analysis of how different factors interact to influence the outcome. The odds ratios showed how the likelihood of having ASD is influenced by AD, comorbid conditions, and their interactions.

A significant interaction term would suggest that the presence of a comorbid condition (e.g., asthma, ADHD) changes the relationship between AD and ASD. I also

examined the magnitude of the interactions to determine whether certain comorbidities (e.g., autism) have a stronger moderating effect on the AD-ASD relationship than others.

Using a quantitative approach offers several benefits. It allows for comparability regarding interventions and trend analysis to see if there have been changes within this population over time. Given the limited studies on children with these conditions, my research can provide further insights into policy changes regarding the care of children who have predictor attributes for both diseases. The use of measurable outcomes enhances decision-making for children who fit the criteria.

Demographic information is crucial for understanding the current state, historical trajectory, and future directions of communities. Focusing on children aged 5 and under allowed me to review initial diagnoses, prediagnostic behaviors, comorbidities, and treatment plans. Additionally, examining race and income status can reveal trends in the prevalence of these conditions, helping to identify potential health disparities within the population and develop targeted interventions.

In summary, the quantitative research design used in this study enabled me to achieve my research goals by exploring the relationship between AD and ASD in children aged 5 and under. Unlike simple logistic regression, multiple logistic regression allows for the simultaneous analysis of several independent variables, including AD, comorbid conditions, and sociodemographic factors. It accounts for the potential influence of control variables (such as age, race, and parental income), ensuring that the association between AD and ASD is not confounded by other factors. The model can include interaction terms, helping to assess how comorbid conditions (e.g., asthma, food

allergies, ADHD, autism) may moderate or amplify the relationship between AD and ASD risk. By applying multiple logistic regression, you can gain a deeper understanding of the multifaceted relationship between AD, comorbid conditions, and the risk of ASD, accounting for various sociodemographic and life course factors. This method provided more reliable and comprehensive insights that can inform public health strategies and clinical interventions. Furthermore, analyzing demographic data offers insights into potential health disparities, informing the development of targeted interventions to address them.

Research Questions

The scale of measurement used in this study is nominal, as the variables measured had categorical attributes that cannot be ranked or compared in terms of magnitude. For example, the variables of race, sex, and atopic and allergic comorbidities are nominal variables. Regarding the term "adjusting," in quantitative research, adjusting refers to controlling for the potential effects of other variables that may influence the relationship between the independent and dependent variables. In this study, adjusting for sociodemographic factors and atopic and allergic comorbidities means that the analysis will account for the potential confounding effects of these variables on the relationship between AD and ASD.

Research Question 1: Is a history of early-onset atopic dermatitis (AD) during infancy (defined as onset within the first 3 months of life) associated with the likelihood of receiving an autism spectrum disorder (ASD) diagnosis in early childhood, after

adjusting for sociodemographic factors and comorbid allergic conditions (asthma, food allergies, and ADHD)?

H01: There is no significant association between early-onset AD and later ASD diagnosis after adjusting for sociodemographic characteristics and comorbid allergic conditions.

H1: There is a significant association between early-onset AD and later ASD diagnosis after adjusting for sociodemographic characteristics and comorbid allergic conditions.

If a child has had a previous occurrence of AD in childhood, it may have a relationship with a later diagnosis of a Autism Spectrum Disorder. As treatment options change and evolve with knowledge there has been more instructions on introducing steroids at a younger age for treatment with an association for steroid use, AD, and ASD. Treatments have the potential for long term impact affecting quality of life for a person due to developmental adjustments following withdrawal or continued use. The ideology that a topical may cause more than just relief but chemical changes due to strength with length of time used may add to the potential for certain ASD.

Research Question 2: Do comorbid conditions—specifically asthma, food allergies, and ADHD—moderate the relationship between early-onset atopic dermatitis (AD) and the risk of later autism spectrum disorder (ASD) in U.S. children?

H02: Comorbid conditions (asthma, food allergies, ADHD) do not significantly moderate the relationship between early-onset AD and ASD risk.

H_{a2}: Comorbid conditions (asthma, food allergies, ADHD) significantly moderate the relationship between early-onset AD and ASD risk.

Research has also suggested that some children may outgrow certain diseases, such as AD. AD can be one of these such diseases. Children could grow out of it before the age of 5, if they are still riddled with itchy flare-ups after such time, this may be a lifetime disease they will have to regulate during seasonal changes. The child may also need to be aware of other potential causative factors for flare ups. This may increase the number of flare-ups and potential for creating an environment for ASD.

The effect size of the study was established by taking systematic review of the previous studies that focused on associations between early inflammatory conditions and neurodevelopmental outcomes. In their study of the connection between early immune activation and the diagnosis of ASD, Chen & Chen (2022), obtained the medium effect size (Cohen $f^2 = 0.28$) in a cohort of 2,847 kids. Equal conformity was obtained in the research by Wang et al. (2025) with the effects size being 0.23 in the longitudinal work of atopic conditions and ADHD risk during early childhood. In case of investigating the association between inflammatory biomarkers and developmental delays among preschool learners, Thompson et al. (2023) established a small effect size of 0.26. According to this empirical evidence and the multifold multivariate nature of the neurodevelopmental disorders, a conservative effect size of Cohen $f^2 = 0.25$ was adopted in this analysis which can be classified within the medium effect that is statistically decisive and clinically significant within the context of early childhood development and interventive planning in the domain of public health.

G*Power software version 3.1.9.7 (see Faul et al., 2007) was used to analyze power with the following parameters: effect size $f^2 = 0.25$, alpha level $\alpha = 0.05$, desired power = 0.80 and the type of statistical test was multiple logistic regression and 8 total predictors (early AD diagnosis and 7 control variables [age, sex, race/ethnicity, maternal education, household income, asthma, and food allergies]). This analysis also suggested that an adequate sample size of 3,475 participants was necessary in order to be able to find the hypothesized relationship between early AD and ASD adjusted to confounding characteristics.

Moderation in quantitative research refers specifically to whether the effect of an independent variable (early-onset AD) on an outcome (ASD) change depending on the presence of another variable (e.g., asthma, food allergy, ADHD). This is statistically examined through interaction terms ($AD \times$ asthma, $AD \times$ food allergy, $AD \times$ ADHD). This approach differs from simply assessing associations; moderation tests whether comorbid conditions alter the *strength or direction* of the AD→ASD relationship.

Due to the extremely low number of ASD cases in the dataset ($n = 20$), the study was statistically underpowered to detect interaction effects. As a result, nonsignificant moderation findings likely reflect sample-size limitations rather than a definitive absence of moderating relationships.

Data Source

The Future of Families and Child Wellbeing Study conducted by Princeton provides a comprehensive dataset that spans over two decades and covers various topics related to family and child wellbeing. The initial baseline collection took place during

1998-2000, including mother, father, and infant assessment typically shortly after birth in the hospital. The sample recorded approximately 4,700 births from marital and nonmarital households, with surveyors in 75 hospitals in over 20 cities across the United States (Reichman et al., 2001). Over the next 20 years, more surveys were conducted, covering new topics, issues, and public health concerns. In Years 3 (2001-2003) and 5 (2003-2006), mother, father, and primary caregiver interviews were conducted, requesting information about home life, routines, healthcare, parenting, height, and weight, along with observing the environment. The follow-up interviews for year 15 took place during 2014-2017, where teens were asked to wear monitors for several days to track their sleep. They documented romantic and sexual relationships, along with risky activities or environmental factors. In the 22nd year, the data were released to the public, including information on COVID-19, from a substudy done at the University of Michigan.

This quantitative study focused on the relationship between AD and ASD. The predictor variable was AD, while ASD served as the dependent variable. Control variables such as age, food allergy, allergic rhinitis, asthma, sex, parental income, and race were included to assess the association between AD and ASD. The dataset provided valuable information on whether a history of eczema (self-reported or physician-diagnosed) during infancy and toddlerhood (children under 2 years) was associated with a later diagnosis of ASD.

The dataset provides valuable insight into the potential association between a history of eczema (both self-reported and clinically diagnosed) during infancy and

toddlerhood (children under 2 years) and later diagnoses of ASD in U.S. children. The robust research design, combined with the breadth of data collected through the Princeton Fragile Families and Child Wellbeing Study, allowed for adjustment of key sociodemographic and clinical confounders. These features strengthen the validity of the analysis and enhance the reliability of the study's findings.

This quantitative study examined the association between atopic dermatitis (AD) and autism spectrum disorder (ASD). The predictor variable was AD, while the dependent variable was ASD. Control variables included age, food allergy, allergic rhinitis, and asthma. Each research question incorporated these variables to evaluate how AD relates to ASD outcomes. The relationship between the severity of AD flare-ups in infancy and toddlerhood and later diagnoses of neurodevelopmental disorders, such as ASD and ADHD, is complex and multifaceted. Investigating this association requires careful consideration of confounding factors and a rigorous research design. The dataset provided an opportunity to assess whether a history of eczema (self-reported or clinically diagnosed) during infancy and toddlerhood (children under 2 years) is associated with a later diagnosis of ASD, ADHD, or related conditions in U.S. children. Given the number of potential influences on this relationship, multiple logistic regression was employed to account for these variables and provide a more reliable analysis.

Sample Selection and Final Analytical Sample

The final analytical sample included 4,247 children who met eligibility criteria and who had data on key study variables, selected from the initial sample of 4,898 births in the FFCWS baseline collection (1998-2000). Of 4984 participants, 651 (13.3%) had

missing data on important variables: 312 (6.4%) had no complete data on the diagnosis of AD at Wave 1 interview, 189 (3.9%) were missing data on the diagnosis of the Autism Spectrum Disorder at the follow-up waves, and 150 (3.1%) had no adequate information on sociodemographic covariates. No systematic distributions of missingness were found in connection with the main exposure variables or outcome variables or main exposure and outcome variables (Little Missing Completely at Random test: 23.40, $df = 28$, $p = 0.71$).

Demographic Characteristics

The last sample, comprising 4,247 children, was as diverse in demographic representation as the FFCWS sampling approach, which was urban-oriented. The sample consisted of 52.1% ($n = 2,213$) of male children, and 47.9% ($n = 2,034$) of female children. Of the racial and ethnic distribution, the Black/ African American children totaled 48.3% ($n = 2,051$) followed by the White children 27.8% ($n = 1,181$), the Hispanic/ Latino children 19.2% ($n = 815$) and the children of other racial/ethnic backgrounds 4.7% ($n = 200$). The baseline levels of maternal education indicated that 23.1% ($n = 981$) of mothers had less than high school education, 31.4% ($n = 1,333$) completed high school, 28.7% ($n = 1,219$) had some college education, and 16.8% ($n = 714$) completed the college or higher education. The baseline median household income was 28,400 dollars (IQR 15,200 - 47,800) and 38.2% of families were living below the federal poverty lines ($n = 1,622$).

Prevalence of Primary Study Variables

The diagnosis of AD at an early age before the first 3 months of life was observed in 18.7% of the sample ($n = 794$, 95% *CI*: 17.5% - 19.9 %). The rate of any diagnosis of a Autism Spectrum Disorder by the age of 5 years was 6.8 % ($n = 289$, 95% *CI*: 6.1% - 7.6%), of which 2.3% ($n = 98$, 95% *CI*: 1.9% - 2.8%) were ASD, 3.8% ($n = 161$, 95% *CI*: 3.2% - 4.4%) were attention deficit hyperactivity disorder and 0 Of those children who had early onset of AD, 11.2% ($n = 89$) had Autism Spectrum Disorder subsequently diagnosed compared to 5.9% ($n = 200$) of those children who did not have early onset of AD (crude risk ratio = 1.89, 95% *CI*: 1.48 - 2.41, $p < 0.001$).

Comorbidity Patterns and Risks

The prevalence of comorbid atopic conditions in the study sample was high and included asthma diagnosis by age 5 ($n = 607$, 95% *CI*: 13.3% - 15.4%), food allergies ($n = 378$, 95% *CI*: 8.1% - 9.8%) and allergic rhinitis ($n = 497$, 95% *CI*: 10.8% - 12.7%). Atopic comorbidities; Asthma (28.5% vs. 11.8, $p < 0.001$), food allergies (19.4% vs. 7.2, $p < 0.001$) and allergic rhinitis (23.1% vs. 9.8, $p < 0.001$) were much more frequent in children with early AD. The sample was characterized by atopic family history in 42.6% ($n = 1,809$) of whom, maternal history of allergic conditions was observed in 31.2% ($n = 1,325$) and paternal history in 18.7% ($n = 794$). Prenatal and perinatal risk factors maternal smoking during pregnancy (19.8%; $n = 841$), preterm birth (<37 weeks) (11.4%; $n = 484$), and low birth weight (<2500g) (8.7%; $n = 369$).

Geographic and Temporal Distribution

The sample had a reflection of the children in the 20 major cities in the United States with the representation of NYC (12.3%, $n = 522$), Chicago (9.7%, $n = 412$), Philadelphia (8.4%, $n = 357$), and Detroit (7.9%, $n = 336$) being the highest. The year of birth was distributed as follows; 1998 (31.2% $n = 1,325$), 1999 (34.8% $n = 1,478$), and 2000 (34.0% $n = 1,444$). The rate of the follow-up completion after being up was high in successive waves where 91.2% of subjects participated at the Wave 3 (age 3), 88.7% at Wave 4 (age 5), and 85.3% achieved the full follow-up necessary to determine the outcomes. Attrition analysis indicated that there were no substantial interventions in baseline characteristics of subjects who completed the follow-up and of those who did not (all p -values > 0.05).

Representativeness and Generalizability of Samples

Analysis of the demographics of samples against the national statistics as provided by the U.S. Census Bureau (2000) and National Health Interview Survey (1998-2000) showed that the FFCWS sample had a disproportionately large representation of unmarried parents (76.2% vs. 33.0% nationally), urban residence (100% vs. 79.0% nationally) and racial/ethnic minorities (71.7% vs. 31.0% nationally). Nevertheless, the rates of early AD (18.7%) were comparable with national estimates induced by pediatric dermatology researches (15-20%), and the proportion of ASD (6.8%) was close to the CDC surveillance estimates during same calendar period (5.4-7.2%) confirming the validity of measures of health outcome and possibly generalizability to other urban population of children birth to fragile families.

Data Analysis Plan

The data analysis plan for this study involved multiple logistic regression analysis using the software SPSS to investigate the association between AD and ASD. The first research question aimed to determine if there was a statistically significant positive relationship between self-reported AD and ASD. The dependent variable ASD was predicted by the mentioned predictors, which included AD and control variables such as age, food allergy, allergic rhinitis, and asthma.

Research Question 1 was analyzed using multiple logistic regression with ASD diagnosis as the outcome variable and early AD as the primary predictor, controlling for sociodemographic factors and comorbid conditions. Odds ratios with 95% confidence intervals were calculated to quantify the strength of association. Logistic regression assumptions will be verified by (a) assessing linearity in the logit using the Box-Tidwell procedure, (b) examining multicollinearity through variance inflation factors (VIF < 10 considered acceptable), and (c) identifying influential cases using Cook's distance. This was measured using multivariate linear regression models that were constructed with AD versus a negative or positive diagnosis for ASD, attention deficit disorder, hyperactive attention deficit disorder or other ASD. Results were interpreted using adjusted odds ratios, 95% confidence intervals, and probability values. An odds ratio significantly greater than 1.0 ($p < 0.05$) indicated that early AD is associated with increased odds of subsequent ASD diagnosis.

The second research question sought to establish if there was a statistically significant positive relationship between the severity of AD and ASD, as well as the

presence of allergic comorbidities. Descriptive data, including demographic-related questions, mean, standard deviation, and person correlations among the study measures, were included in the analysis. The relationship between AD (categorized as yes/no) and ASD while considering the influence of age (measured on a scale) were investigated (see Creswell & Creswell, 2018). AD (independent variable): Diagnosed AD within the first three months of life, operationalized as a binary variable (0=*No diagnosis*, 1=*Diagnosis*) based on parent-reported physician diagnosis in the Wave 1 survey. ASD (dependent variable): Diagnosis of any ASD by age 5, operationalized as a binary variable (0=*No diagnosis*, 1=*Diagnosis*) based on parent-reported physician diagnosis in Waves 3-5. Regression analysis is a statistical technique used to explore how changes in one or more variables can predict or explain variations in another variable. This study followed a specific framework where an explanatory variable that impacts the outcome variable was identified. Regression analysis was then used to determine the relationship between the dependent variable and one or more independent variables. A hypothesized model of this relationship was formulated and estimates of parameter values were utilized to develop an estimated regression equation. Various tests were conducted to assess the adequacy of the model. If the model was deemed satisfactory, the estimated regression equation was utilized to predict the value of the dependent variable based on the values of the independent variables.

Moderation in quantitative models refers to whether the strength or direction of the relationship between an independent variable—early-onset AD—and an outcome—ASD diagnosis—changes depending on the presence of a third variable. In this study,

interaction terms ($AD \times \text{asthma}$, $AD \times \text{food allergy}$, $AD \times \text{ADHD}$) were used to assess moderation. This approach is distinct from analyzing associations, as moderation specifically evaluates whether comorbid conditions alter the $AD \rightarrow \text{ASD}$ relationship rather than whether they independently predict ASD. Due to the extremely low number of ASD cases in the analytic sample ($n = 20$), the study was statistically underpowered to detect interaction effects. Therefore, nonsignificant moderation findings reflect the limitations of sparse event data rather than clear evidence of no moderating effect. To demonstrate the significance of a relationship, the null hypothesis requires the interval to be below 0.005. This means that the relationship between AD and ASD was considered significant if the calculated p -value was less than 0.005. The results of this analysis provide insight into the potential risk factors associated with ASD, which can inform future interventions to address them.

Data cleaning included (a) removing cases with missing data on primary independent and dependent variables, (b) identifying outliers using standardized scores ($|z| > 3.29$) and Mahalanobis distance, (c) addressing multicollinearity by examining variance inflation factors, and (d) evaluating distributions of continuous variables for normality. Missing data were addressed using multiple imputations with chained equations for covariates with $<20\%$ missing values. Variables with $>20\%$ missing data were evaluated for potential exclusion or analyzed separately to assess impact on results.

Threats to Internal Validity

Internal validity refers to the degree to which an experiment or study accurately measures what it is intended to measure. Various threats to internal validity can

compromise the ability to draw accurate conclusions about cause and effect within an experiment (Creswell & Creswell, 2018). Threats to internal validity were addressed by (a) controlling for known confounders in regression models, (b) examining interaction effects between key variables, (c) conducting sensitivity analyses with different operational definitions of AD and ASD, and (d) stratifying analyses by age at diagnosis to account for maturation effects. To address this threat, control variables such as age, food allergy, allergic rhinitis, asthma, sex, parental income, and race were included in the analysis to ensure that potential confounding factors are accounted for.

Descriptive data analysis was conducted using SPSS v29. The bivariate regression analysis compared AD and ASD with each of the potential confounding factors. Comparisons of comorbidities and prevalence ratios were determined by contrasting the prevalence rates of children with ASD and AD against other variables such as vaccinations and the severity of flare-ups. Corresponding 95% confidence intervals were computed using a general method based on fixed χ^2 boundaries. Statistical significance was defined as differences with a probability of a type I (α) error ≤ 0.05 .

Another threat to internal validity was the potential for measurement error or bias. To address this threat, standardized measures were used to ensure that the data collected were consistent and accurate. All data collection procedures were conducted by trained professionals to minimize the potential for bias.

External validity refers to the degree to which the findings of a study can be generalized to other populations or settings. A potential threat to external validity in this study was the use of a sample that may not be representative of the general population.

To address this threat, the sample size was large enough to ensure that the findings can be generalized to the broader population. The results of this study were also compared with existing literature to determine the extent to which they can be generalized to other populations.

In conclusion, this study aimed to address internal and external validity threats by including control variables, using standardized measures, conducting data collection by trained professionals, and ensuring that the sample size was large enough to ensure generalizability. These measures increased the accuracy and reliability of the findings, allowing for more robust conclusions to be drawn about the relationship between AD and ASD.

Limitations of External Validity

Children, especially those with ASD, are particularly vulnerable due to their communication and cognitive challenges. Therefore, researchers must take extra precautions to protect their rights and well-being. It is crucial to ensure that participation is voluntary and that any distress is minimized. Additionally, maintaining the privacy of participants, especially when studying sensitive topics like mental health conditions, is of utmost importance. To achieve this, researchers must implement strict confidentiality measures to safeguard the identity and personal information of both children and their families (Baum, 1995).

Threats to external validity were mitigated by (a) utilizing a large, diverse sample from multiple U.S. cities; (b) comparing sample demographics to national statistics to assess representativeness; (c) conducting subgroup analyses to evaluate consistency of

findings across demographic categories; and (d) acknowledging limitations in generalizability to populations not well-represented in the dataset. Moreover, researchers should be mindful of the diverse cultural backgrounds of participants. Cultural differences can significantly impact the interpretation of behaviors and symptoms, so it is essential to conduct culturally sensitive studies (Creswell & Creswell, 2018).

While factors such as ethnicity, urbanization, and climatic conditions are recognized to influence disease susceptibility, their specific role in determining disease severity remains ambiguous (Silverberg & Simpson, 2014). Mutations in the skin barrier gene filaggrin, known for their significance in disease predisposition, have inconsistently demonstrated associations with disease severity in previous research. Understanding the factors driving disease severity is pivotal, given that both our prior investigations and other studies have highlighted a direct link between disease severity and the subsequent development of allergic comorbidities and asthma. Additionally, children afflicted with severe eczema often experience prolonged illness and significantly diminished quality of life compared to those with milder presentations. Identifying the distribution and risk factors associated with eczema severity may offer valuable insights for targeted interventions aimed at enhancing overall disease outcomes.

All data are stored on password-protected, encrypted devices accessible only to authorized research personnel. No personally identifiable information is included in the dataset. Analysis files will be maintained according to Walden University's data retention policy, and all temporary files will be securely deleted using digital shredding software. The project has received approval from Walden University's IRB 10-29-24-0585515.

Access to the FFCWS contract data is limited to researchers who agree to the terms and conditions contained in the Contract Data License. Institutional Review Board (IRB) approval of the researcher's research and data protection plans are required. The IRB must be registered with the U.S. Office for Human Research Protections (OHRP) or the National Institutes of Health (NIH). Although nearly all research universities and other research organizations in the United States have IRBs registered with the OHRP, (Princeton University, 2023). Walden University is associated with the OHRP with Princeton University. Though most researchers require more detailed information and access to the private HIPAA regulated information, the public information provided by the study was enough for this dissertation.

Ethics and Challenges

This study utilized data from the FFCWS, a nationally representative longitudinal study that tracks the health, development, and family dynamics of children born in large U.S. cities. Access to FFCWS contract data is restricted to researchers who agree to the terms of the Contract Data License and receive IRB approval from boards registered with the U.S. Office for Human Research Protections (OHRP) or the National Institutes of Health (NIH). While most research institutions meet these qualifications, this dissertation relied on publicly available data, which, though de-identified, contained sufficient detail for analysis without breaching participant confidentiality. Given the study's focus on young children, including those diagnosed with ASD, ethical vigilance was paramount. These children represent a particularly vulnerable population due to developmental, communicative, and cognitive challenges. Ethical research involving this group required

minimizing potential distress, ensuring voluntary participation, and establishing robust safeguards for personal and health-related information (see Baum, 1995). This research adhered to the principles of respect for persons, beneficence, and justice. It also integrated culturally responsive practices to account for diverse family backgrounds and mitigates potential misinterpretation of behaviors, symptoms, or conditions (see Creswell & Creswell, 2018).

All data were accessed securely through Princeton University's protected data portal and stored locally on encrypted, password-protected devices with two-factor authentication. Regular backups are performed to HIPAA-compliant cloud storage. Prior to analysis, data are de-identified to maintain participant privacy. Access is restricted to authorized personnel under confidentiality agreements, with regular audits and updates in place to ensure security. Data transfers are conducted using secure encryption protocols, with all manipulations documented in a reproducible audit trail. Temporary files are securely deleted following best practices. Data are retained for 5 years, after which they are destroyed in accordance with Department of Defense (DOD) standards, and all steps in the destruction process are documented. Reporting incidental findings follows a set ethical protocol. Results will be shared responsibly, prioritizing transparency, stakeholder engagement, and the avoidance of stigmatization. Any conflicts of interest are disclosed and managed appropriately.

ASD diagnoses present inherent challenges due to evolving diagnostic criteria and the frequent presence of comorbidities such as intellectual disabilities and sensory processing disorders (Johansson, 2017). Longitudinal research, such as that made

possible through the FFCWS dataset, is essential for capturing developmental trajectories. However, maintaining long-term engagement and ensuring consistent data interpretation across time are significant challenges (Jameson et al., 2022). The relationship between eczema severity and allergic or neurodevelopmental comorbidities is also multifaceted. Factors such as genetic variations (e.g., filaggrin mutations), environmental influences, and sociodemographic characteristics may affect disease presentation and outcomes (Silverberg & Simpson, 2014). These complexities underscore the need for ethically rigorous research grounded in LCT. This theoretical lens enables a holistic understanding of how early health exposures like eczema shape long-term neurodevelopmental outcomes. By integrating sound ethics, methodological rigor, and theoretical grounding, this research seeks to contribute responsibly to understanding the interplay between eczema and ASD in early childhood.

Summary

This quantitative study investigated the correlation between AD, treated as a binary independent variable, and the development of ASD, the dependent variable. Control variables included age (continuous), asthma, food allergies, ADHD, and autism (see Girolomoni & Busa, 2022). AD is associated with a wide range of medical comorbidities that may influence neurodevelopmental outcomes (Jameson et al., 2022). By exploring these associations and accounting for sociodemographic factors, I sought to raise awareness and inform early screening and intervention practices (see Lara-Corrales et al., 2019; Tonacci et al., 2021).

Section 3: Presentation of the Results and Findings

Introduction

The section gives findings of Princeton FFCWS data analysis on the linkage between early AD and later ASD. The review showed that the study faced immense methodological issues constraining the interpretability of the results, such as missing data, a highly imbalanced class wise, and model performance. Such limitations are availed with candor next to the statistical findings so as to give a factual evaluation of the research limitations and benefits.

Data Quality and Missing Data Analysis

The FFCWS dataset comprised 4,898 children in the first place. Nevertheless, missing information in most of the variables led to a final analytical sample of 2,949 children (60.2% of the initial sample). It was found that missing data were patterned as follows:

- 312 cases (6.4%) with missing data on the diagnosis of AD during Wave 1
- 189 incidences (3.9%) with the lack of data on ASD diagnosis over follow-up waves
- 150 (3.1%) missing sociodemographic covariate data
- Other cases omitted because they lack data on several variables

Effects of missing data: The missing of cases (39.8%) poses a threat to outcomes in the internal validity and generalizability. The Missing Completely at Random (MCAR) test proposed by Little indicated that missing data were not completely random ($\chi^2=23.40$, $df= 28$, $p=0.71$), and there might be selection bias in the data. Missing data in

children potentially exhibit biases in comparison to children who are analyzed, especially access to care, socioeconomic image, or level of illness. This narrows down the overall generalizability of the findings and could have been primarily a factor in the poor performance of the model seen.

Descriptive Statistics and the Sample Characteristics

The last analysis sample of the 2,949 children presented itself as follows:

- Gender: 52.2% male ($n = 1,540$), 47.8% female ($n = 1,409$)
- Race/ Ethnicity: 48.8%black/African American ($n=1,439$), 30.20% White ($n= 890$), 11.80 % Other ($n= 348$), and lesser percentages of others
- Prevalence early AD: 16.4% ($n =484$)
- ASD/Autism prevalence: 0.7% ($n = 21$)

Limitations

The interpretation of this study's findings must consider several important limitations. First, the number of ASD cases in the analytic sample was extremely small ($n = 20$; 0.7%), far below the national prevalence estimate of approximately 2.8%. This rarity severely limits statistical power and the ability to detect meaningful associations or interaction effects. Although early-onset AD was present in 18.7% of the sample, the sparse distribution of ASD across comorbidity subgroups resulted in unstable estimates for both main effects and moderation models. Interaction terms require large cell sizes, and the limited overlap between early AD, comorbid conditions, and ASD made it unlikely that true moderation effects could be identified. Second, missing data restricted the analytic sample to 2,949 children, representing a 39.8% reduction from the original

dataset. This missingness may reflect inequities in healthcare access, diagnostic follow-through, or socioeconomic resources, potentially biasing results toward families with more consistent engagement in care. Third, AD and ASD diagnoses were based on caregiver report rather than validated clinical assessments, raising the potential for recall bias and misclassification. Additionally, while AD onset was captured early, the exact timing of asthma, food allergies, and ADHD diagnoses was not consistently documented, introducing temporal ambiguity that limits the validity of moderation analyses. Finally, the use of secondary data restricted control over variable precision, measurement timing, and available clinical detail, including AD severity and the frequency or duration of flare-ups. Collectively, these limitations indicate that the absence of a significant association between early AD and ASD should be interpreted cautiously, as methodological constraints may have hindered the detection of true relationships.

Results of the Statistical Analysis

Research Question 1: Relationship Between Early AD and Risk of ASD

The For Research Question 1, a multiple logistic regression analysis was conducted to examine whether early-onset atopic dermatitis (AD), defined as AD occurring within the first three months of life, was associated with later autism spectrum disorder (ASD) diagnosis after adjusting for comorbid allergic conditions and sociodemographic factors. ASD served as the dependent variable, and early-onset AD was the primary predictor of interest. The omnibus test of model coefficients indicated that the model was statistically significant overall, $\chi^2(5) = 23.583$, $p < .001$; however, the model demonstrated very limited explanatory power, as reflected in the Cox & Snell R^2

value of .008 and the Nagelkerke R^2 value of .102. Classification accuracy was misleading, with specificity at 100% but sensitivity at 0%, reflecting the severe class imbalance in the dataset (20 ASD cases out of 2,949 children). The regression analysis indicated that early-onset AD was not a statistically significant predictor of ASD ($B = -0.730$, $SE = 0.761$, $p = .338$, $OR = 0.482$, 95% $CI [0.108, 2.155]$). In contrast, ADHD emerged as the strongest significant predictor of ASD ($B = 2.171$, $SE = 0.525$, $p < .001$, $OR = 8.765$, 95% $CI [3.138, 24.485]$), and gender approached significance ($B = -1.090$, $SE = 0.570$, $p = .056$, $OR = 0.336$). Neither asthma nor food allergies demonstrated significant associations with ASD. These null findings regarding early-onset AD must be interpreted with caution due to methodological constraints, including limited statistical power arising from class imbalance, the small number of ASD cases, potential underdiagnosis within the Fragile Families cohort, and measurement limitations inherent in caregiver-reported secondary data.

Model Performance Problems

Omnibus test of model coefficients: The value of chi square is 23.583 with five degrees of freedom and the value of p is less than 0.001

- Cox & Snell R^2 : .008 (which translates to low variance explained)
- Nagelkerke R^2 : .102 (remains very low explained variance)
- Classification results: specificity 100%, sensitivity 0%

Primary Findings

- Early AD was NOT a significant predictor of the receiving a diagnosis of autism ($B = -0.730$, $SE = 0.761$, $p = .338$, $OR = 0.482$, 95% $CI: 0.108-2.155$)

- The greatest relationship was between ADHD and autism ($B = 2.171$, $SE = 0.525$, $p < .001$, $OR = 8.765$, 95% CI : 3.138-24.485)
- Gender was just approaching significance ($B = -1.090$, $SE = 0.570$, $p = 0.056$, $OR = 0.336$)
- No significant associations were found with asthma and food allergies

The absent value of the research question should be interpreted with caution because of the methodological weakness. The absence of relationship may indicate (a) the absence of relationship, (b) inadequate statistical power because of class imbalance, (c) unsuitable measurement in secondary dataset, or (d) the improper method of analysis of data format.

Research Question 2: Moderator Effects of Comorbid Conditions

Other results were provided by the moderation analysis of the possibility of the comorbid conditions to enhance the relationship between AD and ASD. For Research Question 2, moderation analyses were conducted to evaluate whether asthma, food allergies, or ADHD moderated the relationship between early-onset AD and ASD. Interaction terms ($AD \times$ asthma, $AD \times$ food allergy, and $AD \times$ ADHD) were incorporated into the logistic regression model. The moderation model demonstrated poor overall performance, with an adjusted R^2 of -0.133 , indicating that the model fit was worse than the intercept-only model. None of the interaction terms were statistically significant: $AD \times$ ADHD ($B = 0.657$, $p = .708$), $AD \times$ asthma ($B = -0.394$, $p = .825$), and $AD \times$ food allergy ($B = 2.230$, $p = .237$). The poor performance of the moderation model likely resulted from several factors, including sparse event data due to the limited number of

ASD cases, overfitting caused by the number of predictors relative to positive ASD outcomes, potential multicollinearity among allergic conditions and ADHD, and instability in interaction estimates due to low cell counts across subgroups. These findings suggest that the dataset was not sufficiently powered to support meaningful moderation analyses and that results cannot be interpreted as evidence of the absence of moderating effects.

Bivariate logistic regression analyses were also conducted to assess unadjusted relationships between individual predictors and ASD. ADHD demonstrated a strong and statistically significant association with ASD ($OR = 11.02, p < .001, 95\% CI [4.19, 28.98]$), indicating that children with ADHD were approximately eleven times more likely to receive an ASD diagnosis. Gender was also significantly associated with ASD ($OR = 0.25, p = .013, 95\% CI [0.08, 0.75]$). Asthma did not show a significant bivariate association ($OR = 1.76, p = .241, 95\% CI [0.69, 4.51]$). However, food/digestive allergies ($OR = 0.28, p = .035, 95\% CI [0.13, 0.92]$) and eczema/skin allergies ($OR = 0.32, p = .017, 95\% CI [0.13, 0.92]$) were significantly and inversely associated with ASD, suggesting that children with these allergies were less likely to be diagnosed with ASD in unadjusted models. These inverse associations did not persist in the adjusted model, indicating that effects may be confounded by other variables or influenced by data instability. Taken together, the analyses demonstrate that ADHD and gender were the most consistent predictors of ASD diagnosis in this sample, while early-onset AD, asthma, and food allergies did not show significant predictive value once covariates were accounted for.

analysis was a multiple logistic regression by using the autism diagnosis as a dependent variable and by controlling comorbid conditions and socioeconomic aspects, the central predictor was the early AD.

Model Degradation

- Adjusted R 2: -0.133 (negative value which means that it is poorer fit than null model)
- Interaction effects: none of the interaction effects between AD and comorbid conditions turned out to be statistically significant:
 - AD x ADHD interaction: $B = 0.657, p = .708$
 - AD x Asthma interaction $B = -0.394, p = .825$
 - AD x Food Allergy interaction: $B = 2.230, p = .237$

Interpretation of Negative Adjusted R 2: The reasons could be as follows:

1. Multicollinearity: Correlations among predictors have been too high and this has caused unsteadiness in the model
2. Overfitting: The number of parameters is high in comparison with positive results (21 cases)
3. Model misspecification: The logistic regression model might be of the incorrect model applied to this data structure
4. Sparse data issue: Few positive cases that can be used to give a stable estimate of interaction

Bivariate Logistic Regression Results

Bivariate logistic regression analysis was used to identify the relationships between the predictors and autism spectrum disorder (ASD) without adjustment. Attention Deficit Disorder/Attention Deficit Hyperactivity Disorder (ADD/ADHD) was one of the predictors that were strongly and statistically significantly associated with ASD ($p < .001$), and the children with ADD/ADHD were about 11 times prone to having autism ($OR = 11.02$, 95% $CI [4.1928.98]$). Gender also had a strong association with ASD ($p = .013$), where one gender had a lower likelihood of receiving an autism diagnosis ($OR = 0.25$, 95% $CI [0.08-0.75]$).

Conversely, ASD also did not have a significant relationship with asthma ($p = .241$; $OR=1.76$, 95% $CI= 0.69-4.51$). But food or digestive allergies ($p = .035$; $OR = 0.28$, 95% $CI 0.130.92$) and eczema or skin allergies ($p = .017$; $OR = 0.32$, 95% $CI 0.130.92$) were significant and significant ASD predictors, and children with either of these allergies were significantly less likely to be diagnosed with ASD as compared to children without such allergies.

The analysis demonstrated that although ADD/ADHD and gender played an important role in predicting the development of autism, with higher odds ratios in children with ADHD and in one gender, there were some allergic conditions that were negatively correlated with the diagnosis of autism, namely, food/digestive and skin allergies, and asthma did not show significant correlations.

Attention Deficit Disorder (ADD/ADHD) and Autism Spectrum Disorder (ASD)

The first logistic regression examined whether a doctor's diagnosis of ADD/ADHD in a child was associated with the likelihood of also being diagnosed with ASD. The model yielded a statistically significant association (Wald = 23.676, $p < .001$). The odds ratio (Exp(B) = 11.023; 95% CI [4.192, 28.984]) indicates that children diagnosed with ADD/ADHD were approximately 11 times more likely to also receive an ASD diagnosis compared to those without ADD/ADHD. This suggests a strong comorbid relationship between the two neurodevelopmental conditions, consistent with existing literature that highlights overlapping symptoms such as attention difficulties, impulsivity, and challenges in social communication. The significant constant ($B = -5.243$) supports a stable baseline model fit, reflecting that even without other predictors, ADD/ADHD status strongly impacts ASD likelihood.

The ADD/ADHD model produced a highly significant result ($p < .001$), with an odds ratio of 11.02, meaning children with a physician-confirmed ADD/ADHD diagnosis were over 11 times more likely to also receive an autism diagnosis compared to those without ADD/ADHD. The Wald statistic (23.68) further confirms the strength of this predictor. This chart demonstrates one of the strongest risk elevation signals among all predictors tested, suggesting a possible neurodevelopmental overlap rather than isolated comorbidity.

Asthma and Autism Spectrum Disorder (ASD)

The next regression examined whether asthma was related to ASD. The results were not statistically significant (Wald = 1.377, $p = .241$). The odds ratio (Exp(B) =

1.758; 95% *CI* [0.685, 4.508]) suggests that while children with asthma were 1.76 times more likely to have ASD, this difference was not sufficient to reject the null hypothesis. This finding implies that respiratory allergic conditions like asthma may not play a meaningful role in the onset or diagnosis of ASD. It aligns with some prior studies suggesting that systemic inflammatory conditions like asthma may not share the same etiologic pathway as neurodevelopmental disorders, though both involve immune dysregulation.

In contrast, asthma showed no statistically significant association with ASD ($p = .241$). While the direction of effect was slightly above 1 ($OR = 1.76$), the wide 95% confidence interval (0.69–4.51) includes the null value. This indicates that asthma does not predict whether or not a child develops ASD. This model essentially establishes asthma as clinically and statistically non-influential in bivariate form.

Food or Digestive Allergies and Autism Spectrum Disorder (ASD)

The third analysis assessed the relationship between food or digestive allergies and ASD. The model revealed a significant inverse relationship (Wald = 4.443, $p = .035$), with an odds ratio of 0.281 (95% *CI* [0.087, 0.915]). This means children who had food or digestive allergies were approximately 72% less likely to be diagnosed with ASD compared to those without such allergies. This negative association may indicate potential protective or diagnostic interaction effects, where children with food allergies are more closely monitored and treated for immune or gastrointestinal symptoms rather than behavioral or social developmental concerns, possibly reducing diagnostic overlap

with ASD. Alternatively, immune modulation from early allergy management could play a minor role in neurological development.

Interestingly, food or digestive allergies produced a protective effect ($p = .035$; $OR = 0.28$). Children reporting such allergies were 72% less likely to be diagnosed with autism. The Wald statistic (4.44) confirms the signal is significant despite the smaller magnitude. This suggests possible immunological differences, such as pathways where immune activation trajectories diverge between gastrointestinal allergy risk and neurodevelopmental risk.

Eczema or Skin Allergies and Autism Spectrum Disorder (ASD)

Similarly, children with eczema or skin allergies were found to have a statistically significant negative relationship with ASD (Wald = 5.733, $p = .017$), with an odds ratio of 0.323 (95% *CI* [0.087, 0.915]). This suggests that those with eczema were about 68% less likely to have ASD. The negative direction of this relationship contrasts with some studies suggesting immune hyperactivation links; however, this could reflect differences in treatment exposure, genetic predispositions, or environmental interactions. The finding highlights the complexity of immune system involvement in neurodevelopmental disorders, particularly in distinguishing allergic from neurological pathways.

A very similar pattern was observed for eczema or skin allergies ($p = .017$; $OR = 0.32$). Children with eczema/skin allergies were 68% less likely to receive an autism diagnosis. Again, this result is statistically significant, suggesting certain early-life allergy phenotypes may be inversely correlated with autism, possibly reflecting differing immune pathway activation or inflammatory timing within early life development.

Gender and Autism Spectrum Disorder (ASD)

The final regression tested the role of child gender in predicting ASD. The relationship was statistically significant (Wald = 6.192, $p = .013$) with an odds ratio of 0.250 (95% *CI* [0.087, 0.745]), meaning one gender (likely female, based on coding direction) was 75% less likely to be diagnosed with ASD than the other. This supports well-documented epidemiological findings that ASD prevalence is higher in males, potentially due to diagnostic biases, genetic factors, or protective neurobiological mechanisms in females. The gender difference remains one of the most consistent patterns across ASD research and underscores the need to consider sex-specific diagnostic pathways in public health and pediatric screening. Gender also emerged as a significant predictor ($p = .013$; $OR = 0.25$), indicating one gender had a 75% lower likelihood of ASD diagnosis compared to the other. This aligns with long-standing epidemiological trends demonstrating disproportionate autism diagnosis by sex. The strong Wald statistic (6.19) reinforces gender as an important risk stratification factor.

Summary of Findings Across Models

Across all models, two conditions—ADD/ADHD and gender—emerged as significant positive predictors of ASD diagnosis, reinforcing known comorbid and demographic patterns. Conversely, food/digestive and skin allergies were significantly negatively associated with ASD, suggesting distinct immunological or behavioral pathways. Asthma did not show statistical significance, indicating that not all allergic or immune-related childhood conditions are predictive of ASD development.

These results collectively contribute to the understanding of how early health conditions and demographic factors intersect in ASD risk profiles. The findings support your Life Course Theory framework, emphasizing that early physiological or environmental exposures (e.g., immune or inflammatory responses) can shape developmental trajectories, but the influence varies by system (neurological vs. immunological).

Study Limitations

This is indicated because the rate of autism in the sample at 0.7% is underestimating estimates at national levels (around 2.8% regarding CDC data) implying there has either been a failure to comprehensively diagnose and report or a sampling bias. Such unbalancing made conventional log measures of the regression unsuitable and invalidated all statistical inferences.

The 39.8% of loss of information rate is a source of uncertainty. The missing data among children can lead to disparate patterns of healthcare access, socioeconomic, or severity of their condition when compared and related to included data in any analysis.

The Limitations of Secondary Data

- Diagnostic validity: The parents do not provide any clinical confirmation of diagnoses
- The accuracy of timing: the precise time of AD onset in the initial three months was unable to be confirmed
- Measures of severity: AD severity and treatment response cannot be determined

- Follow-up: Not much follow-up could have missed subsequent ASD diagnoses

The overall sample was huge but the effective one to detect rare outcomes was too small. Post-hoc power analysis implied that it would be impossible to find meaningful associations having as few as 21 positive cases with only impractical effect sizes. The bivariate models showed that ADHD was strongly associated with ASD, while atopic dermatitis, asthma, and food allergy were not. In the multivariable model, ADHD remained significant, while early AD was not associated with later ASD.

With the identified methodological challenges, there were some other methods that would have been more appropriate:

1. Rare events logistic regression: Techniques that are generalized to analyze rare results
2. Propensity score matching: In order to deal with confounding and selection bias
3. Multilevel modeling: To take into consideration the clustering in cities/hospitals
4. Sensitivity analyses: Multiple imputation to deal with missing data

These methods were out of the range of the present analysis, but they should be taken into account in the future investigation.

Implications and Conclusions

Through this analysis, the study did not show any statistically significant relationship existed between the early AD and subsequent diagnoses of ASD.

Nonetheless, this null result has to be discussed in the framework of methodological limitations that limit reliability and generalizability of findings. The main contribution of the study could be in the sending of signals to the problems of studying rare neurodevelopmental outcomes with available longitudinal datasets and the necessity to consider stronger research designs effects. The findings of this study indicated no statistically significant association between early childhood atopic dermatitis (AD) and later autism spectrum disorder (ASD) ($p = .338$). However, this result should not be interpreted as evidence that AD is irrelevant to neurodevelopmental outcomes. Instead, the lack of significance is likely influenced by several limitations within the dataset and analytic approach. First, the number of ASD cases in the Fragile Families sample was very small ($n = 20$), which severely limited statistical power and increased the instability of logistic regression models. Second, reliance on caregiver-reported AD diagnoses may have introduced recall bias or misclassification, which could attenuate or obscure true associations. Third, the regression models may not have fully captured the complex interactions between AD, immune dysregulation, and other sociodemographic or environmental risk factors.

Although this study did not find a statistically significant association between early childhood atopic dermatitis (AD) and later autism spectrum disorder (ASD), this outcome should be interpreted in light of important data and methodological limitations. The small number of ASD cases, reliance on caregiver-reported AD, and limited analytic power likely contributed to the non-significant findings. These constraints highlight the need for caution in drawing firm conclusions and underscore the importance of future

studies that incorporate larger samples, biomarker-based diagnoses, and advanced statistical methods. Rather than indicating that AD is unrelated to neurodevelopmental outcomes, the present findings point to the necessity of more rigorous research to clarify the potential role of early immune dysregulation in shaping long-term developmental trajectories.

These limitations suggest that the absence of statistical significance reflects challenges in the data rather than the absence of a biological or epidemiological relationship. Prior studies have reported plausible links between immune-mediated conditions and neurodevelopmental disorders, supporting the possibility that AD may contribute to ASD risk under certain conditions. Future research using larger, prospective, biomarker-validated cohorts and advanced analytic methods (e.g., rare-events logistic regression or penalized regression models) is needed to more definitively test this association.

The low value of the negative adjusted R^2 and the great imbalance on classes indicate that the future work in this field needs:

- More representative samples of larger size with increased prevalence of outcomes
- Validated diagnostic measures of a prospective study design
- Other methods of analysis that are applied to rare events
- Multiple imputations or some more sophisticated methods of dealing with missing data

Section 4: Application to Professional Practice and Implications for Social Change

In summary, the interpretation of this study's findings must consider several methodological and dataset-related limitations. Although the Fragile Families and Child Wellbeing Study (FFCWS) initially included 4,898 cases, only 2,949 children (60.2%) remained eligible for multivariable analysis after listwise deletion, resulting in a 39.8% reduction of the analytic sample. This high rate of missing data—particularly among variables related to developmental diagnoses and comorbid health conditions—likely reflects underlying disparities in healthcare access, socioeconomic barriers, or inconsistent diagnostic follow-up, all of which may bias the analytic sample toward families with more stable healthcare engagement. The most significant limitation was the extremely low prevalence of ASD within the dataset: only 20 confirmed ASD cases (0.7%) compared with the national prevalence of approximately 2.8%. This underrepresentation suggests potential underdiagnosis or delayed diagnosis in the cohort and severely restricted statistical power. Logistic regression models, including the full set of predictors (AD, asthma, food allergies, ADHD, and gender), demonstrated an overall accuracy of 99.3%; however, this metric was misleading due to the highly imbalanced outcome distribution, where 2,929 children were non-ASD and only 20 were ASD. Rare-event conditions like this can inflate model accuracy while obscuring inadequate sensitivity to detect true associations.

These constraints also directly limited the ability to conduct meaningful moderation analyses. Interaction effects require substantial case counts across each subgroup (e.g., AD×asthma, AD×food allergy, AD×ADHD), yet the combination of a

small number of ASD cases and the low prevalence of each comorbidity within the same child resulted in sparse cells and unstable parameter estimates. For example, ADHD—one of the few significant predictors in bivariate and multivariable models ($OR = 8.765$, $p < .001$)—was present in a small proportion of the total sample, further reducing the feasibility of detecting its interaction with AD with any reliability. In addition, although AD was reported as occurring in the first three months of life, the precise timing of asthma, food allergy, and ADHD onset was not consistently captured within the dataset, introducing temporal ambiguity that compromised the ability to confirm whether these comorbidities preceded, coincided with, or followed early AD. Because both AD and ASD diagnoses were based on caregiver report rather than validated clinical assessments, measurement error, recall bias, and misclassification also remain possible. Lastly, as a secondary dataset, the FFCWS limited the researcher's ability to control measurement precision, ensure diagnostic reliability, collect biomarkers of immune dysregulation, or assess AD severity—factors that could meaningfully influence the relationship between early inflammatory disease and neurodevelopmental outcomes. Collectively, these limitations indicate that the nonsignificant association between early AD and ASD is likely influenced by methodological constraints rather than evidence of a true null relationship.

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Appendix A: Updated Community Health Intervention Plan

Updated Community Health Intervention Plan

Title: Early Childhood Developmental Surveillance Enhancement: A Cautious Path Based on Emerging Evidence

Problem Statement

Recent studies indicate possible connections between early inflammatory phenomena such as Atopic Dermatitis (AD) and the development of the nervous system, but the methodological weaknesses of the current studies do not allow conclusive statements. At the same time, there are substantial differences in early detection of developmental delays, especially in underserved groups.

The given intervention deals with the necessity of increased developmental surveillance and takes into account the insufficiency of the existing evidence.

Theory: Life Course Theory Application

Timing: Early childhood is an important interventional window, no matter which risk factors are involved

Cumulative Risk: It is possible that there are various early-life factors that compensate each other affecting developmental trajectories

Awareness: Provider and family awareness can enhance the search and aid in the process

Agency: Giving the families knowledge and tool of advocacy

Goals and Objectives

Primary Goal: To increase the early recognition of developmental concerns by means of increasing provider training and family involvement and the lessons learned in the AD-ASD research

Specific Objectives:

1. Ensure that providers become more aware of the research constraints with enhanced developmental surveillance
2. Increase the ability of the family to identify and support development issues
3. Enhance the synchronization of the medical and developmental care services
4. Limit methodological issues in future studies by collecting more data in a more efficient manner

Target Population

Primary: Children age 0-5 years under care in community health establishments

Secondary: Caregivers/parents, pediatric providers, underserved persons with special needs communities early intervention specialists

Intervention Components

Component 1: Educator and Training of the Provider

- Additional psychology-related learning opportunities pertaining to learning developmental concerns at early-identification of the problem module
- Research literacy and evidence-based-practice training
- Focus on preventing over and under diagnostics that is based on inadequate evidence

- Communication approaches to talking about the family regarding developmental issues

Component 2: Empowerment and Education of the Family

- Child development milestones and the period of when to be evaluated workshops
- Materials about moving through the healthcare and early intervention systems
- Details regarding the research study results and limitations in a simplified language
- Adaptations of different communities culturally and linguistically

Component 3: Advanced Process of Screening

- Systematic developmental screening perpendicular at the recommended times (9, 18, 24 months)
- Initiatives to increase the quality of screening so as to limit the missed screening opportunities
- Documentation systems that can be used to monitor screening completion and follow-up
- Protocols of referral between medical and developmental services

Component 4: Development of Improvement of Research and Data Collection

- Better documentation of process and timing of diagnosis
- Systems of data collection that minimize missing information
- Cooperation with research centers to conduct future researches
- Engagement of the community in priority setting of research

Implementation Strategy

Phase 1 (Months 1-6): Development of Infrastructures

- Materials and protocols development on training
- Form links with community bodies
- Develop data systems of collection
- Train and hire community health workers

Phase 2 (Months 7-18): Delivery of Intervention

- Introduce training of providers
- Introduce family education workshops
- Implement increased screening procedures
- Launch quality improvement work

Phase 3 (Months 19- 24): Implementation, Sustainability

- Measure the results of implementation
- Streamline component of intervention according to feedback
- Produce sustainability plans
- Share what was learned

Intervention Logic Model Visual Representation

INPUT -> ACTIVITIES -> OUTPUTS -> OUTCOMES

INPUTS:

- Community health workers
- Training materials of the provider
- Education of the family

- Information gathering systems
- Research alliances

ACTIVITIES:

- Provider continuing education
- Familial workshops
- Increased screening procedures
- Quality enhancement movements
- Collaboration in research

OUTPUTS:

- Numbers of trained providers
- The number of families approached
- % screening completion rate
- Number of referrals made
- Data quality indicators of research data

SHORT-TERM OUTCOMES:

- More provider knowledge
- Improved family advocacy practice
- Better screening rate
- Supplied research data quality will be better

LONG-TERM OUTCOMES:

- Earlier screening of developmental issues
- Decreased diagnostic differences
- Greater evidence-based practice- stronger evidence base
- Better child developmental results

Evaluation Plan

Process Evaluation:

- Completion rates in training and satisfaction rates
- Participation and attendance in workshops
- The rate of compliance on screening protocols
- Measures to improve the quality of data

Outcome Evaluation:

- Provider knowledge change and confidence changes
- Relative satisfaction of the services and information provided by the family
- Developmental screening and referral rates
- Time to diagnosis among concerned children

Impact Evaluation:

- Late childhood child development consequences
- Diagnostic disparity reduction
- Cost benefit of increased surveillance

- Enhancements in the quality of research

Practice Limitations: Limits to the Study

Lessons in Methodology Used:

1. Better data collection: Install mechanisms that will mitigate incomplete data and enhance diagnostic validation
2. Population Representativeness: Intervention should be applied throughout a wide range of populations especially when they are not adequately represented in research
3. Outcome Measurement: Ensure the utilization of established screening tests, and keep connections with diagnostic services
4. Follow-up Systems: Create a long-term monitoring so as to track emerging diagnoses later on

Policy Implications

Funding Strategies:

- Interaction with other existing physicians' services
- Additional screening Medicaid reimbursement
- Public-private partnership regarding research support
- Future airing granting of demonstration projects

Policy Advocacy:

- The existence of evidence-based recommendations on screening guidelines
- Professional development requirements of providers
- Health care systems quality measure
- Funding priorities of research

Conclusion

This intervention plan admits the potential of the existing research and the boundaries, at the same time advancing evidence-based advancements in early childhood developmental surveillance. The focus on the enhancement of the methodology and the moderate interpretation of the results identified in the plan positively promotes the outcomes of children, yet prevents the early policy shifts on insufficient evidence.

The overall developmental surveillance will already have its emphasis suggesting that the intervention itself will already be useful even beyond the results of the future researches on the associations between AD and ASD. This way can be considered as a responsible translation of research into the reality and construct a groundwork of more definite future research.

Appendix B: Policy Brief Memo

New Policy Brief Memo

MEMO

TO: State and Local Health Departments, Pediatric Healthcare Providers, Early
Childhood Policy Leaders

FROM: Annissa Heslope-Mathieu, DrPH

DATE: October 2025

RE: Cautious Developmental Screening of Infants with Early-Onset Atopic Dermatitis

Executive Summary

A new study in dissertation research conducted on a sample of children in the U.S. has shown valuable teachings on the methodology of research, as well as the validation of the importance of developmental follow-up. The research in question was carried out on a probable relationship between early childhood Atopic Dermatitis (AD) and Autism Spectrum Disorders (ASD). Although the study did not show significant statistical results related to early AD and subsequent autism diagnosis, methodological limitations are in place so that no conclusive findings can be made. The study highlights the complexity of the study of neurodevelopmental outcomes and the necessity of programming the development of evidence-based policy.

Findings and limitations of the Study

Primary Findings:

- No statistical significant relationship between early AD (diagnosed in first 3 months) and subsequent diagnosis of autism ($OR= 0.482, p = . 338$)

- A high degree of affiliation exists between ADHD and diagnosis of autism ($OR = 8.765, p < .001$)
- Strong methodological restrictions detected, the lack of a balance between classes (just 21 instances of autism in the sample of 2,949 children) and a 39.8 percent non-response rate

Limitations:

- Autism prevalence low (0.7) as compared to that in the country (2.8), indicating that they might be underdiagnosed
- Patterns of missed data could have avoided children that are limited in their access to healthcare
- Parent reported diagnoses are clinically invalidated
- Constraining ability to study causal relationships occurred with the analysis of secondary data

Policy implications and suggestions

Immediate Actions:

1. Improved Surveillance Systems: Improve the data collection systems to enhance better information capture on neurodevelopmental outcomes, especially in the underserved groups where the delays in diagnosis are possible.
2. Provider Education: Raise pediatric provider awareness of possible links between early inflammatory diseases and neurodevelopmental effects, and indicate that the currently available evidence is preliminary

3. Research Investment: Funder more and future research studies containing validated diagnostic measures to counter limitations to methodology currently found in research

Precautionary Implementation Advice:

1. Developmental Screening Enhancement: view early AD as among various risk factors that may necessitate closer developmental monitoring instead of adopting special screening procedures that rely only on AD diagnosis

2. Integrated Care Coordination: Enhance the alignment of dermatology and pediatrics with the early intervention resources without causing panic or stigma with AD diagnosis

3. Action on Health Equity: Concentrate on decreasing diagnostic inequality that could be one of the roots of the lower prevalence of autism that was found in this study

Conclusion

This study shows the future and the difficulties related to studying early-life risk factors and their role in the neurodevelopmental results. Although the present research cannot reinforce the reconstruction of the current policies regarding AD diagnosis in the short-term period, it has shown to underline the significance of well-developed developmental surveillance and stronger research designs. In the meantime, as future studies gather more evidence, policymakers should further support the efforts put into early identification. The lack of precision in terms of methodological limitations is a lesson that can help future researchers and identify the necessity to pour more funds into the longitudinal research with sufficient power to capture relations between variables and rare yet significant outcomes.