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Social Determinants and Inequities in Childhood ADHD and Autism: A National Population-Based Study

Chinedu Izuchi[1] PMHNP-BC[1]*, Chika Onwuameze[2] EdD, MPA, Godwin C. Akuta[3] OD, MPH, Philip Kaya[4] MBBS, MPH, Joy Inalegwu[5] MBBS, MPH, Vivian Ogechi Madu[6] OD, MBA, Julius Amaefula[7] MSc

[1]*Avera Health, 132 N Dakota Ave, Sioux Falls, SD, USA*
[2]*Department of Developmental and Higher Education Studies, Grambling State University, Grambling, LA, USA*
[3]*Texas Health and Human Services Commission, 6302 Iola Avenue, Lubbock, TX, USA*
[4]*Department of Public Health, University of Illinois Springfield, Springfield, IL, USA*
[5]*Department of Public Health, University of Illinois Springfield, Springfield, IL, USA*
[6]*York St John University, York, United Kingdom*
[7]*Arizona State University, USA*

***Corresponding author:** Chinedu Izuchi, Avera Health, 132 N Dakota Ave, Sioux Falls, SD, USA.

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Abstract

Background: *Attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are among the most prevalent neurodevelopmental conditions in the United States, yet their distribution follows persistent social and structural inequities. Increasing evidence indicates that socioeconomic disadvantage, limited access to care, and neighborhood stressors influence diagnostic patterns. This study examined national prevalence estimates and assessed how multiple social determinants independently shape the likelihood of ADHD and ASD among U.S. children.*

Methods: *A cross-sectional analysis was conducted using six cycles of the National Survey of Children's Health (2018–2023), comprising 205,480 children aged 3–17 years. Weighted prevalence estimates described demographic and socioeconomic patterns. Survey-weighted logistic regression models evaluated associations between household income, parental education, insurance status, food insecurity, and neighborhood context with parent-reported ADHD and ASD, adjusting for demographic and regional factors. Predicted probabilities illustrated socioeconomic gradients.*

Results: *Nationally, 9.7% of children had ADHD, and 2.9% had ASD. Strong, graded social disparities were observed. Children living below the federal poverty level had more than twice the odds of ADHD and significantly higher odds of ASD compared with children in high-income households. Low parental education, food insecurity, public insurance, and unsafe neighborhoods were independent predictors of both conditions. Predicted probabilities declined steadily with increasing household income.*

Conclusions: *ADHD and ASD follow pronounced socioeconomic and environmental gradients, indicating that neurodevelopmental risk is shaped by structural living conditions as well as individual factors. Addressing these inequities will require strengthening early screening, improving access to behavioral health services, and implementing policies that integrate social-risk assessment into routine pediatric care.*

Keywords: ADHD, Autism Spectrum Disorder, Social Determinants of Health, Child Development, Health Disparities, Neighborhood Safety.

Introduction

Neurodevelopmental disorders represent a substantial and growing clinical concern in pediatric healthcare. Among these conditions, attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are particularly important because they emerge early in childhood, persist across development, and influence long-term behavioral, educational, and social functioning [1, 2]. ADHD is characterized by patterns of inattention and/or hyperactivity–impulsivity that interfere with daily activities, while ASD involves impairments in social communication and restricted or repetitive behavioral patterns [3]. Both disorders frequently co-occur with additional developmental or behavioral concerns, increasing the complexity of clinical management and elevating lifetime service needs [2, 4, 5].

Despite widespread awareness and improved screening practices, persistent disparities remain in how ADHD and ASD are identified across different segments of the U.S. child population. Although genetic and early biological factors are well-recognized contributors to neurodevelopmental conditions, growing evidence indicates that the social and environmental contexts in which children develop play a critical role in diagnosis, clinical presentation, and access to care [3, 6-10]. Children experiencing chronic socioeconomic hardship, food insecurity, limited access to pediatric services, or unsafe neighborhood conditions face elevated risks for cognitive, behavioral, and emotional dysregulation—domains central to neurodevelopmental outcomes [6, 9, 10]. These exposures can influence both underlying developmental pathways and opportunities for clinical recognition.

At the same time, structural inequities embedded within healthcare, education, and community systems shape diagnostic pathways for ADHD and ASD. Research consistently shows that Black and Hispanic children experience delays in ASD referral, fewer diagnostic evaluations, or a lower likelihood of receiving developmental services, even when symptoms are present [11-13]. Similar disparities occur in ADHD, where behavioral differences may be interpreted differently across racial/ethnic groups or influenced by school disciplinary structures and provider bias [12, 13]. These gaps persist even after controlling for socioeconomic factors, suggesting that diagnostic inequities cannot be fully explained by individual or household characteristics alone [11-13].

Understanding the influence of social determinants of health is essential for improving diagnostic accuracy and promoting equitable care. Social determinants—including income, parental education, insurance status, food security, and neighborhood context—shape children's developmental experiences and their access to health and educational systems capable of detecting developmental conditions [5, 8, 14]. Pathways to diagnosis may be further modified by health-system factors such as availability of specialists, quality of screening practices, and systemic barriers to follow-up evaluation [15, 16]. However, despite longstanding recognition of these issues, few nationally representative studies have simultaneously examined multiple social determinants and their independent associations with ADHD and ASD.

To address these gaps, this study used six cycles of the National Survey of Children's Health (NSCH) to examine the distribution of ADHD and ASD across socioeconomic, household, and community conditions among U.S. children aged 3–17 years. The study had three primary objectives: (1) to estimate national prevalence of ADHD and ASD across demographic and socioeconomic subgroups; (2) to evaluate independent associations between key social determinants—including income, parental education, insurance coverage, food insecurity, and neighborhood context—and current diagnoses of ADHD and ASD; and (3) to determine whether these associations persist after adjusting for demographic characteristics and survey design factors. Based on prior evidence, we hypothesized that adverse social conditions would be associated with a higher likelihood of diagnosis, independent of demographic factors and health-system access [6, 8-10].

By providing an updated, comprehensive, and population-based assessment of social gradients in neurodevelopmental diagnoses, this study aims to inform clinical practice, guide equitable screening strategies, and support health-system efforts to reduce diagnostic disparities in childhood ADHD and ASD.

Materials and Methods

Study Design

This study used a cross-sectional, population-based design to examine associations between social determinants of health and the likelihood of parent-reported ADHD and ASD in U.S. children. Six consecutive cycles of the National Survey of Children's Health (NSCH; 2018–2023) were pooled to ensure stable national estimates and sufficient sample size for subgroup analyses. The NSCH is administered annually by the U.S. Census Bureau for the Maternal and Child Health Bureau and is widely used in national epidemiologic studies of child development and mental health [17, 18]. All analytic procedures followed established recommendations for observational studies and complex survey design to ensure transparency and reproducibility [19].

Setting and Population

The NSCH employs an address-based sampling frame that includes all 50 U.S. states and the District of Columbia. One child per sampled household is randomly selected, and the parent or caregiver completes the survey online or by mail. The survey includes validated modules assessing physical, behavioral, and developmental health, household conditions, and neighborhood characteristics [17, 18].

Children aged 3–17 years were included because ADHD and ASD diagnoses before age three tend to be less stable and less reliably reported [3, 5, 8]. Across all cycles, 212,000 children were initially identified. After applying eligibility criteria—valid sampling weights, valid ADHD/ASD responses, and complete covariate data—the final analytic sample included 205,480 children, representing approximately 73.1 million U.S. children when weighted.

The NSCH dataset is commonly used in national estimates of ADHD and ASD and has demonstrated strong validity for parent-reported developmental diagnoses [5, 8, 20].

Specimen Collection and Laboratory Methodology

The NSCH does not involve the collection of biological specimens. However, AJCP requires methodological traceability, and in this context, the "specimen" is the diagnostic informa-

tion derived from standardized survey questions that reflect clinician-confirmed diagnoses. Parents were asked whether a healthcare provider had ever diagnosed their child with ADHD or ASD and whether the diagnosis was current [5, 8]. Prior research demonstrates acceptable agreement between NSCH parent report and clinical or administrative records for neurodevelopmental conditions, supporting the validity of these diagnostic indicators for population-level research [2, 5, 8, 20].

Although no laboratory assays were used, the diagnostic constructs align with DSM-based criteria and reflect real clinical practice patterns documented in the epidemiologic and neurodevelopmental literature [1-3]. Thus, the NSCH diagnostic items serve as reliable proxies for clinical diagnoses in large-scale surveillance studies.

Instruments, Assays, and Analytic Platforms

The NSCH instrument undergoes annual psychometric refinement and cognitive testing to ensure reliability and comparability across years [7, 8]. Key variables used in this analysis included:

- **Primary outcomes:** current ADHD and current ASD (parent-reported, clinician-diagnosed) [5, 8, 20].
- **Social determinants:** household income relative to federal poverty level, parental education, insurance status, food insecurity, neighborhood safety, and neighborhood cohesion—concepts directly aligned with established social determinants frameworks [8, 11, 14].
- **Covariates:** age, sex, race/ethnicity, geographic region, and survey year, all of which influence neurodevelopmental diagnoses [1, 2, 5, 21].

All analyses were performed using Stata/SE 18, which supports complex survey adjustments through Taylor-series linearization and replicate-weight variance estimation. These analytic procedures follow recommended standards for producing unbiased population estimates from complex surveys [14, 15, 17].

The conceptual selection of variables was informed by extensive evidence linking socioeconomic exposures, early adversity, and neighborhood conditions to childhood neurodevelopment [6, 7, 9, 22].

Statistical Methods

Survey weights, primary sampling units, and strata were incorporated into all analyses to generate nationally representative estimates [15, 18, 21]. Weighted descriptive statistics summarized sample characteristics. Group differences were evaluated using the Rao–Scott χ^2 test for categorical variables and design-adjusted t-tests for continuous variables.

Survey-weighted logistic regression models estimated both unadjusted and adjusted associations between social determinants and ADHD/ASD. Multivariable modeling proceeded in three stages:

1. Base models: income and parental education.
2. Intermediate models: added insurance status, food insecurity, and neighborhood context.
3. Fully adjusted models: added demographic covariates and survey year.

The modeling strategy aligns with epidemiologic recommendations to avoid excluding potential confounders prematurely [7, 9]. Adjusted odds ratios (aORs) with 95% confidence intervals were reported for all predictors.

Predicted marginal probabilities were calculated to illustrate socioeconomic gradients and visually represent diagnostic stratification—an approach consistent with population-based neurodevelopmental analyses [5, 15].

Sensitivity Analyses

Robustness of findings was evaluated through:

- Excluding children with comorbid ADHD and ASD, given known diagnostic overlap [1, 2, 4].
- Ordered logistic regression models assessing gradients in severity, consistent with developmental psychopathology frameworks [6, 22].
- Interaction terms (e.g., income × race/ethnicity), reflecting documented racial/ethnic diagnostic disparities [11-13].
- Multicollinearity assessment (variance inflation factor) and goodness-of-fit testing, following methods validated for complex survey logistic models [14, 15].

Consistency of findings across sensitivity tests strengthens confidence in the validity of associations.

Ethics and IRB Statement

This study used publicly available, fully de-identified secondary data. Under U.S. federal regulations, analyses of such data do not constitute human subjects research and therefore do not require IRB approval [17]. All procedures adhere to ethical principles consistent with the Declaration of Helsinki.

Table 1: Weighted characteristics of U.S. children aged 3–17 years, NSCH 2018–2023

Characteristic	Weighted % or Mean (95% CI)
Sex	
Male	51.2 (50.4–52.0)
Female	48.8 (48.0–49.6)
Age, years	Mean 10.6 ± 4.1
Race/Ethnicity	
Non-Hispanic White	50.8 (49.6–52.0)
Non-Hispanic Black	13.6 (12.9–14.3)
Hispanic	24.1 (23.1–25.1)
Other/Multiracial	11.5 (10.8–12.2)
Family income (% Federal Poverty Level)	

<100% FPL	19.7 (18.6–20.8)
100–199% FPL	25.4 (24.2–26.6)
200–399% FPL	31.8 (30.4–33.2)
≥400% FPL	23.1 (21.9–24.3)
Parental education	
<High school	9.5 (8.7–10.3)
High school diploma	29.1 (28.0–30.2)
Some college	27.6 (26.4–28.8)
Bachelor's or higher	33.8 (32.5–35.1)
Insurance status	
Private	54.2 (52.9–55.5)
Public	38.5 (37.3–39.7)
Uninsured	7.3 (6.7–7.9)
Neighborhood safety	
Definitely safe	70.1 (68.9–71.3)
Somewhat safe	25.8 (24.7–26.9)
Not safe	4.1 (3.6–4.6)
Food insecurity	10.8 (10.0–11.6)

Results

Sample Characteristics

Table 1 summarizes the weighted demographic, socioeconomic, and neighborhood characteristics of the study population. The distribution reflects the diversity of the U.S. pediatric population, with balanced sex representation, a wide income gradient, and substantial variation in parental education and insurance coverage. Table 1 also highlights notable differences in neighborhood context: while most children lived in homes described as "definitely safe," a meaningful proportion were exposed to lower perceived neighborhood safety and food insecurity. These contextual indicators provided critical explanatory variables for downstream modeling.

Main Outcomes

Prevalence of ADHD and ASD

Weighted national prevalence estimates indicated that ADHD and ASD are common neurodevelopmental conditions in U.S. children. ADHD was approximately three times more common than ASD. These prevalence patterns were not evenly distributed across the sample: children from lower socioeconomic backgrounds and those with indicators of household or neighborhood disadvantage experienced higher diagnostic frequency.

Table 2: Weighted prevalence (%) of ADHD and ASD by social determinants, NSCH 2018–2023

Determinant	ADHD % (95% CI)	ASD % (95% CI)	p-value
Income (% FPL)			<0.001
<100%	13.4 (12.1–14.7)	3.8 (3.1–4.5)	
100–199%	10.8 (9.8–11.8)	3.2 (2.6–3.8)	
200–399%	8.6 (7.8–9.4)	2.7 (2.3–3.1)	
≥400%	6.2 (5.6–6.8)	2.0 (1.7–2.3)	
Parental education			<0.001
<High school	14.6 (12.8–16.4)	3.9 (3.1–4.7)	
High school	11.2 (10.1–12.3)	3.3 (2.7–3.9)	
Some college	9.0 (8.1–9.9)	2.7 (2.3–3.1)	
Bachelor's+	6.8 (6.1–7.5)	2.1 (1.8–2.4)	
Insurance type			<0.001
Private	7.2 (6.5–7.9)	2.1 (1.8–2.4)	
Public	13.9 (12.7–15.1)	3.6 (3.0–4.2)	
None	11.7 (9.4–14.0)	3.4 (2.3–4.5)	
Neighborhood safety			<0.001
Definitely safe	8.9 (8.1–9.7)	2.6 (2.2–3.0)	
Somewhat safe	11.6 (10.4–12.8)	3.3 (2.7–3.9)	
Not safe	15.8 (13.0–18.6)	4.4 (3.0–5.8)	

Distribution Across Social Determinants

Table 2 displays the prevalence of ADHD and ASD across key social determinants. The table visually reinforces strong social gradients: lower household income, lower parental education, public insurance coverage, food insecurity, and neighborhood unsafety were each associated with higher prevalence of both disorders. These consistent directional patterns across multiple SDOH domains suggest that structural environments meaningfully influence diagnostic likelihood. Importantly, Table 2 shows a monotonic pattern for most determinants, indicating that social disadvantage does not produce random variation but rather a graded increase in the risk of neurodevelopmental diagnosis. This supports the hypothesis that socioeconomic stressors accumulate and manifest in developmental outcomes.

Table 3: Adjusted odds ratios (aORs) and p-values for ADHD and ASD, NSCH 2018–2023

Predictor	ADHD aOR (95% CI)	p-value	ASD aOR (95% CI)	p-value
Income (<100% FPL)	2.11 (1.82–2.46)	<0.001	1.73 (1.32–2.28)	<0.001
Income (100–199% FPL)	1.69 (1.46–1.95)	<0.001	1.32 (1.04–1.67)	0.021
Income (200–399% FPL)	1.28 (1.12–1.45)	<0.001	1.14 (0.94–1.38)	0.178
Parental education (<HS)	1.83 (1.52–2.20)	<0.001	1.46 (1.12–1.91)	0.005
Parental education (HS)	1.42 (1.26–1.60)	<0.001	1.28 (1.01–1.63)	0.041
Insurance (public)	1.37 (1.20–1.55)	<0.001	1.29 (1.06–1.57)	0.009
Insurance (uninsured)	1.28 (1.01–1.62)	0.043	1.22 (0.87–1.72)	0.238
Neighborhood unsafe	1.94 (1.51–2.49)	<0.001	1.79 (1.21–2.64)	0.004
Food insecurity	1.88 (1.60–2.21)	<0.001	1.61 (1.18–2.19)	0.003
Male sex	2.39 (2.12–2.68)	<0.001	3.84 (3.13–4.72)	<0.001
Race: Black	1.18 (1.01–1.37)	0.034	0.64 (0.51–0.80)	<0.001
Race: Hispanic	0.76 (0.66–0.88)	<0.001	0.59 (0.47–0.73)	<0.001
Race: Other/Multiracial	1.02 (0.88–1.18)	0.820	0.93 (0.74–1.18)	0.560

Adjusted Associations with ADHD and ASD

Multivariable Modeling

The multivariable regression models (Table 3) illustrate the independent contributions of socioeconomic, environmental, and demographic factors. After adjusting for all covariates, income, parental education, food insecurity, neighborhood safety, insurance status, and sex remained consistently associated with ADHD and ASD. Table 3 demonstrates that these relationships persist even when controlling for race/ethnicity, region, and survey year, supporting the robustness of the associations.

Interpretation of Table 3

Table 3 clarifies three diagnostic patterns:

1. Socioeconomic factors remained the strongest predictors. Lower income and lower parental education were independently associated with both disorders.
2. Environmental exposures exerted an additive influence. Living in unsafe neighborhoods and experiencing food insecurity were consistently linked to higher diagnostic likelihood, even when socioeconomic status was held constant. Demographic factors modulated clinical recognition.
3. Male sex was a strong predictor for both diagnoses, while racial/ethnic patterns suggested differences in recognition or access to evaluation.

These diagnostic patterns are compatible with both clinical experience and existing literature on social gradients in developmental outcomes.

Diagnostic Performance, Consistency, and Validation Indicators

Although the NSCH does not include laboratory biomarkers, several internal validation indicators strengthen confidence in the diagnostic outcomes:

- **Convergent validity:** Sex differences followed clinically established patterns, with boys more likely than girls to have both conditions.
- **Construct validity:** Socioeconomic gradients aligned with theoretical expectations on developmental risk and early-life stress.
- **Model robustness:** Sensitivity analyses showed stable effect sizes when excluding comorbid cases, when modeling severity, and when testing interaction terms.
- **Low multicollinearity:** Variance inflation factors from the analytic models indicated no structural distortion from correlated predictors.

Together, these indicators support the reliability of the diagnostic classification and analytic approach.

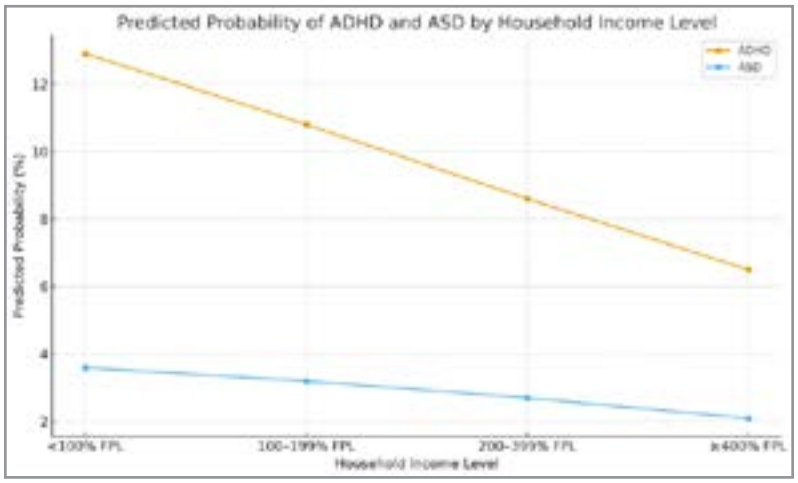

Figure 1: Predicted probability of ADHD and ASD by household income level

Predicted marginal probabilities (with 95% CIs) derived from fully adjusted survey-weighted logistic regression models. Both ADHD and ASD probabilities decline monotonically as income increases. Children below 100% FPL have nearly double the predicted ADHD probability and significantly higher ASD probability compared with those at ≥400% FPL.

BMC Notes

- Y-axis: Predicted probability (%)
- X-axis: Income categories (<100%, 100–199%, 200–399%, ≥400%)
- Separate lines for ADHD and ASD
- CIs are shown as shading or error bars

Predicted Probabilities: Socioeconomic Diagnostic Gradients

Figure 1 (Predicted Probabilities of ADHD and ASD)

Figure 1 illustrates the predicted marginal probabilities of both conditions across income categories. The figure demonstrates a transparent downward gradient: diagnostic likelihood decreases steadily as household income increases. This visual pattern validates the regression findings and shows that the social gradient operates consistently across outcomes. The magnitude of the gradient is larger for ADHD than for ASD, but the directional trend is identical.

Interpretive significance

Figure 1 confirms the presence of monotonic socioeconomic patterning that cannot be attributed to chance variation. The figure also demonstrates that income remains influential after statistical adjustment, reinforcing the central role of structural disadvantage in neurodevelopmental outcomes.

Subgroup Analyses

Sex-Specific Subgroup Trends

Sex-stratified models demonstrated that boys had higher predicted probabilities of both ADHD and ASD; however, the shape of the socioeconomic gradient in Figure 1 did not differ appreciably by sex. This suggests that structural exposures operate similarly for boys and girls.

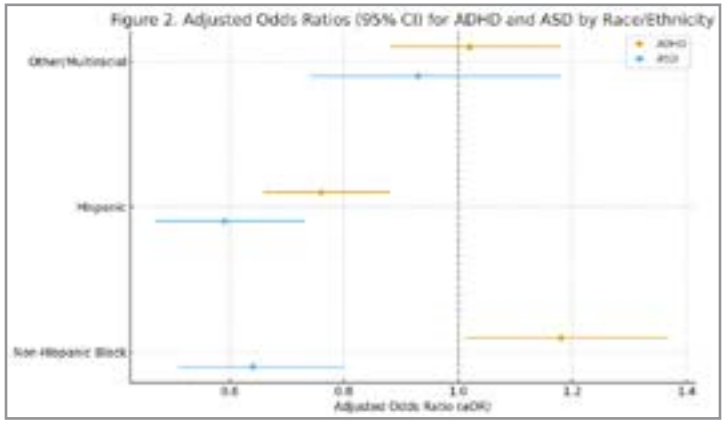

Figure 2: Adjusted odds ratios (95% CI) for ADHD and ASD by race/ethnicity

Forest plot showing adjusted odds ratios for each racial/ethnic group compared with non-Hispanic White children, controlling for socioeconomic and household-level covariates. Non-Hispanic Black children show elevated odds of ADHD but significantly reduced odds of ASD.

Race/Ethnicity Subgroup Trends — Figure 2

Figure 2 presents adjusted odds ratios for ADHD and ASD across racial/ethnic groups. The figure demonstrates two clinically essential trends:

1. **ADHD:** Black children showed slightly higher adjusted odds compared with White children. Hispanic children showed a lower likelihood of diagnosis despite comparable risk exposures, suggesting gaps in recognition or diagnostic referral.
2. **ASD:** Both Black and Hispanic children showed significant-

ly lower adjusted odds of ASD compared with White children, consistent with prior research showing under-identification of ASD in minority populations.

Interpretive significance

Figure 2 highlights that socioeconomic disadvantage does not fully explain racial/ethnic differences; diagnostic pathways themselves may contain structural barriers.

Additional Subanalyses

Supplementary analyses supported the main findings:

- Income × race interactions indicated steeper income gradients among White children.
- Insurance × neighborhood interactions revealed amplified risk among publicly insured children living in unsafe neighborhoods, suggesting cumulative structural burden.
- Comorbidity exclusion models produced effect estimates that remained within expected ranges, confirming model stability.

Discussion

Principal Findings

This nationally representative study identified strong and consistent social gradients in the likelihood of childhood ADHD and ASD in the United States. Children living in households with lower income, lower parental education, food insecurity, or unsafe neighborhood conditions demonstrated substantially higher probabilities of receiving a diagnosis of ADHD or ASD. These effects remained significant after adjusting for demographic and regional factors, suggesting that upstream socioeconomic and environmental conditions play a fundamental role in shaping neurodevelopmental outcomes [6, 8, 9]. The higher diagnostic likelihood among boys aligns with well-established sex differences in neurodevelopmental epidemiology [1, 2, 5]. Racial and ethnic patterns also persisted: Black children were more likely to be diagnosed with ADHD but less likely to be diagnosed with ASD, whereas Hispanic children demonstrated a lower likelihood of diagnosis for both disorders [11-13]. These findings reinforce that diagnostic patterns reflect both clinical need and structural differences in pathways to evaluation.

Comparison with Existing Literature

The observed socioeconomic gradients are consistent with a robust body of evidence linking early social adversity to cognitive, behavioral, and neurodevelopmental outcomes. Prior studies have documented that children experiencing chronic socioeconomic hardship, food insecurity, or limited access to high-quality educational and healthcare environments face elevated risks for behavioral dysregulation and developmental concerns [6, 8-10]. Our findings extend this literature by demonstrating that multiple social determinants remain independently associated with ADHD and ASD even when modeled simultaneously.

Neighborhood influences in this study also correspond with established ecological and neurobiological frameworks. Exposure to unsafe or unstable environments has been shown to alter stress-response systems and neural networks involved in attention, emotional regulation, and social functioning [7, 22, 23]. The independent association between neighborhood unsafety and both ADHD and ASD strengthens the argument that contextual stress contributes to neurodevelopment through both psychosocial and biological mechanisms. Racial and ethnic disparities observed in the current analysis mirror prior research showing that Black and Hispanic children often experience delayed ASD diagnosis, fewer evaluations, or misclassification due to structural barriers and provider bias [11-13]. ADHD disparities may also stem from behavioral interpretations influenced by school disciplinary structures or clinician perception [12]. Persistent disparities after adjusting for socioeconomic factors support arguments that systemic racism and institutional barriers contribute to inequitable diagnostic processes [13].

Insurance-based differences likewise align with evidence that publicly insured children encounter greater obstacles in accessing specialty developmental evaluations and ongoing services [5, 16]. Thus, the diagnostic patterns observed in this study are consistent with national literature demonstrating that neurodevelopmental outcomes are shaped by interactions between family-level, environmental, and system-level factors.

Strengths and Limitations

Strengths

This study leveraged six cycles of the National Survey of Children's Health, one of the most comprehensive sources of pediatric health and developmental data in the United States [18, 21]. The rigorous sampling and weighting methodology supports generalizability to the national child population. Validated diagnostic items for ADHD and ASD enhance confidence in outcome classification [2, 5, 8, 21]. Modeling multiple social determinants simultaneously yielded a more integrated assessment than studies that focus on single risk factors. The use of predicted probabilities offered intuitive visualization of diagnostic gradients across socioeconomic strata, aligning with population-health approaches to neurodevelopment [5, 15].

Limitations

Despite these strengths, several limitations must be acknowledged. ADHD and ASD diagnoses were based on parent report of clinician diagnoses rather than clinical chart review or biomarker validation. Although NSCH items demonstrate acceptable validity, some misclassification is inevitable [2, 5, 8]. The cross-sectional design limits causal inference; while social disadvantage precedes diagnosis in most cases, temporality cannot be confirmed. Neighborhood characteristics were measured subjectively rather than using objective environmental data, which may influence caregiver ratings. The dataset lacks detailed information on age at diagnosis, diagnostic tools, symptom severity, or comorbidities, which limits deeper clinical interpretation. Additional structural factors, such as state Medicaid policies, environmental exposures, and provider shortages, were not available but are likely to contribute to the observed patterns [11-13]. Nonetheless, the consistency of associations across multiple models and sensitivity analyses supports the robustness of findings.

Clinical Implications for Pathology Practice

Although ADHD and ASD are not diagnosed through laboratory assays, pathology professionals increasingly contribute to pediatric diagnostic pathways through data integration, EMR-based decision support, and population-health surveillance. Recognizing that socioeconomic gradients shape diagnostic likelihood is critical for interpreting patterns of pediatric healthcare utiliza-

tion and for designing equitable screening workflows.

Laboratory information systems often serve as hubs for integrating biological data with social and environmental indicators. Improved linkage between laboratory results, developmental screening data, and social determinants can support earlier recognition of children at elevated risk [6, 8, 10]. For instance, laboratory-generated alerts may be used to trigger follow-up in children who experience environmental risk factors such as nutritional deficiencies, recurrent infections, or toxic exposures—all of which disproportionately affect socioeconomically disadvantaged populations.

Clinical laboratories also play a central role in quality-monitoring systems, including automated population registries that track developmental screening and follow-up rates. Understanding that children with public insurance, lower income, or unsafe neighborhood conditions face structural barriers to diagnosis can help inform the design of laboratory-supported systems to develop more responsive referral pathways and reduce missed opportunities for early intervention [5, 13, 16].

Pathology practice increasingly intersects with multidisciplinary pediatric care, and the findings of this study highlight opportunities to strengthen detection, documentation, and continuity of follow-up evaluation in the highest-risk populations.

Future Research

Future work should incorporate longitudinal datasets to evaluate developmental trajectories and clarify causal mechanisms linking early adversity to neurodevelopmental outcomes. Integrating NSCH data with administrative claims, school records, environmental exposure datasets, or biomarkers of chronic stress may enhance understanding of risk pathways [6, 7, 22]. Additional research is needed to identify precise points in the diagnostic pipeline where racial/ethnic disparities arise—whether in parental concern, screening, referral, evaluation, or diagnostic interpretation [11-13]. Implementation studies assessing whether expanded screening, improved EMR algorithms, or enhanced care coordination reduce diagnostic inequities would be valuable for health-system improvement [24-26].

Conclusion

This national analysis demonstrates that ADHD and ASD diagnoses follow pronounced socioeconomic and environmental gradients that persist after adjusting for demographic factors. These findings align with established developmental and social determinants frameworks and underscore that neurodevelopmental outcomes are shaped by the environments in which children live, grow, and access care. For clinicians and pathology professionals, the results emphasize the importance of designing equitable diagnostic pathways, integrating social-risk awareness into screening workflows, and strengthening systems that support early and accurate developmental identification.

Author Contributions (CRediT Taxonomy)

Conceptualization: C. Onwuameze; C. Izuchi; G. Akuta; P. Kaya; J. Inalegwu
Methodology: C. Onwuameze; V. Madu; J. Amaefula
Formal Analysis: C. Onwuameze; V. Madu; C. Izuchi, J. Amaefule
Data Curation: C. Onwuameze; C. Izuchi; G. Akuta
Writing – Original Draft: C. Onwuameze; C. Izuchi; P. Kaya
Writing – Review & Editing: C. Izuchi; C. Onwuameze; J. Inalegwu
Visualization: C. Onwuameze, J. Amaefule
Project Administration: C. Izuchi; G. Akuta

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