Research Square

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Distinct school functioning profiles associated with co-occurring ADHD and learning disability among U.S. children with autism spectrum disorder: a repeated cross-sectional study

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Research Article

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Abstract

Background:

School functioning among autistic children is heterogeneous. Although co-occurring attention-deficit/hyperactivity disorder (ADHD) and learning disability (LD) may identify children with differing educational needs, national evidence that distinguishes academic grades from school–family problem communication is limited. We examined associations of current ADHD and LD, separately and jointly, with two parent-reported school-functioning outcomes among U.S. children with current autism spectrum disorder (ASD).

Methods:

We pooled 2022–2024 National Survey of Children's Health data for children aged 6–17 years with current ASD. Current ADHD and LD formed four mutually exclusive groups: neither, ADHD only, LD only, and ADHD + LD. The primary outcome was mostly B/C grades or lower among letter-grade recipients. A secondary, hypothesis-generating outcome was school contact with the household about problems two or more times in the past 12 months among children with a valid response. Survey-weighted logistic models were age-stratified (6–11 and 12–17 years) and adjusted for chronological age, ASD severity, sex, race/ethnicity, survey year, current intellectual disability, caregiver education, and family poverty ratio. Six poverty-ratio implicates were combined using Rubin's rules.

Results:

Of 4,713 children with current ASD, 3,294 received letter grades and 3,233 were included in extended grade models; 4,542 were included in extended school-contact models. Relative to neither condition, LD only and ADHD + LD were associated with higher odds of mostly B/C grades or lower in both age strata (adjusted odds ratios [aORs] 2.99–4.77 for ADHD + LD and 3.02–3.71 for LD only). ADHD only was associated with lower grades among adolescents (aOR 2.08, 95% confidence interval [CI] 1.30–3.31), but not younger children. ADHD only and ADHD + LD were associated with two or more school contacts in both age strata (aORs 2.01–2.51); LD only was not.

Conclusions:

Co-occurring ADHD and LD identified distinct parent-reported school-functioning profiles among U.S. children with current ASD: LD-related groups showed stronger associations with lower grades, whereas ADHD-related groups showed more frequent school–family problem communication. These associations are not causal and should not be interpreted as evidence about educational services or accommodations.

Introduction

Educational functioning is a central but heterogeneous domain for autistic children [1–4]. Recent work using school records has shown that co-occurring neurodevelopmental conditions can be more informative for academic performance than a single diagnostic category alone [1,5]. In the United States, population-based research among autistic children has also linked adverse childhood experiences and mental health conditions with broad school-success measures, including grade progression, attendance, and engagement [6]. However, national studies rarely distinguish a grade-based outcome from the related, but non-equivalent, construct of school contact with a family about problems.

Current ADHD and current LD are common concerns in autistic children and may be associated with different school-facing patterns. Grades primarily capture parent-reported academic performance within a grading system. In contrast, school contact about problems reflects a school–family communication process that may be influenced by classroom functioning, parent availability, school policy, and school resources. Neither outcome establishes the child's standardized achievement, clinical behavior, or the effectiveness of an IEP or other school support.

Using recent National Survey of Children's Health (NSCH) data, we examined whether four current ADHD/LD configurations—neither condition, ADHD only, LD only, and ADHD + LD—were associated with two parent-reported school-functioning outcomes among children with current ASD. We hypothesized that the association pattern would vary by outcome and developmental stage. The grade outcome was the primary outcome. The school-contact outcome was added during protocol refinement before the final extended models were run; because the analysis was not preregistered, it is explicitly interpreted as secondary and hypothesis generating.

Methods

Study design and data source

We conducted a repeated cross-sectional analysis of the 2022, 2023, and 2024 NSCH topical public-use files. The NSCH is an annual, nationally representative U.S. household survey of children aged 0–17 years that is completed by a parent or caregiver [7,8]. The Census Bureau provides public-use files, variable lists, a multi-year analytic guide, and a guide to multiply imputed data analysis [8,10]. This secondary analysis used de-identified public-use data.

Participants and exposure definition

Children aged 6–17 years with current ASD (K2Q35B) were eligible. Current ADHD was derived from the ever-diagnosed item (K2Q31A) and current-condition follow-up (K2Q31B); current LD was derived analogously from K2Q30A and K2Q30B). Children whose caregiver reported no prior diagnosis were

coded as not currently having that condition in accordance with NSCH skip logic. We created mutually exclusive categories: neither condition (reference), ADHD only, LD only, and ADHD + LD.

Outcomes

The primary outcome was mostly B/C grades or lower versus mostly A/A–B grades among children whose schools provided letter grades. The GRADES item was introduced in 2022. Children whose schools did not provide letter grades were not coded as having lower grades and were excluded from grade models. They are described only in supplementary analyses because non-provision of letter grades is an educational-setting or measurement characteristic, not academic performance.

The key secondary outcome was school contact with the household about problems two or more times during the past 12 months (K7Q04R_R), compared with no contact or one contact. The item is defined only for children with a valid response; children not enrolled in school or with no valid response were excluded from this outcome-specific analysis. The NSCH variable list distinguishes none, one time, and two or more times [9]. This outcome is interpreted as a parent-reported school–family problem-communication marker, not as a direct behavioral diagnosis or measure of school quality.

Covariates

Core models adjusted for chronological age in years within each stratum, parent-reported ASD severity (mild, moderate, or severe), child sex, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic other), and survey year. Extended models additionally included current intellectual disability, caregiver education, and family poverty ratio (< 200% versus ≥ 200% of the federal poverty level). The latter was represented using the six NSCH poverty-ratio implicates. These covariates assess robustness of associations, not causal identification. Intellectual disability, language/cognitive functioning, mental health, access to diagnostic assessment, medications, school context, and family–school communication practices may remain unmeasured or imperfectly measured.

Statistical analysis

Analyses incorporated NSCH household clustering, strata, and annualized pooled weights (final child weight divided by three) [10]. We stratified analyses by age 6–11 and 12–17 years because school grading and school demands differ by developmental stage and additionally adjusted for chronological age in years within each stratum. Survey-weighted logistic regression estimated aORs and 95% CIs. Extended-model estimates were combined across the six poverty-ratio implicates using Rubin's rules [10]. Benjamini–Hochberg false-discovery-rate (FDR) q values were calculated separately for the six exposure-by-age contrasts within each outcome family as a transparent multiplicity check; they do not convert this non-preregistered observational analysis into a confirmatory study.

Supplementary analyses included ordered and cumulative grade-threshold models, the stricter mostly C/D grades-or-lower threshold, no-letter-grade status, and survey-period interaction tests. We do not use these analyses to enlarge the primary claim. Analyses were performed in R with the survey package. We report two-sided P values, CIs, and effect sizes; $P < 0.05$ was interpreted as compatible with an association rather than proof of an effect.

Use of AI-assisted tools

OpenAI's ChatGPT/Codex was used for language editing, manuscript organization, and assistance with reproducible R code preparation. The authors independently verified all analyses, results, references, figures, and interpretations and take full responsibility for the final manuscript content.

Results

Sample and outcome availability

The pooled dataset included 160,640 children, of whom 105,534 were aged 6–17 years and 4,713 had current ASD. Of the 4,713 children with current ASD, 4,648 had a grade response and 3,294 received letter grades. The extended grade models included 1,162 children aged 6–11 years and 2,071 aged 12–17 years (total n = 3,233). The extended school-contact models included 2,127 children aged 6–11 years and 2,415 aged 12–17 years (total n = 4,542; Fig. 1). These are distinct analytic samples and should not be treated as interchangeable.

Grade outcome

Among letter-grade recipients, the weighted prevalence of mostly B/C grades or lower was 25.7%, 33.6%, 60.6%, and 49.7% in the neither, ADHD-only, LD-only, and ADHD + LD groups, respectively, among children aged 6–11 years. Corresponding estimates among those aged 12–17 years were 23.5%, 35.9%, 50.9%, and 58.5%.

In extended models, LD only and ADHD + LD were associated with higher odds of mostly B/C grades or lower in both age strata (Table 1; Fig. 2). For ages 6–11 years, aORs were 3.71 (95% CI 1.83–7.50) for LD only and 2.99 (1.46–6.13) for ADHD + LD. For ages 12–17 years, aORs were 3.02 (1.71–5.33) for LD only and 4.77 (2.97–7.66) for ADHD + LD. ADHD only was associated with lower grades among adolescents (aOR 2.08, 95% CI 1.30–3.31), but not younger children (aOR 1.45, 95% CI 0.69–3.01). All associations except ADHD only in the younger stratum retained FDR $q < 0.004$.

Table 1
Adjusted associations with mostly B/C grades or lower among letter-grade recipients

Age	Group	aOR	95% CI	P value	FDR q
6–11	Neither	1.00	Reference	—	—
6–11	ADHD only	1.45	0.69–3.01	0.324	0.324
6–11	LD only	3.71	1.83–7.50	< 0.001	< 0.001
6–11	ADHD + LD	2.99	1.46–6.13	0.003	0.003
12–17	Neither	1.00	Reference	—	—
12–17	ADHD only	2.08	1.30–3.31	0.002	0.003
12–17	LD only	3.02	1.71–5.33	< 0.001	< 0.001
12–17	ADHD + LD	4.77	2.97–7.66	< 0.001	< 0.001

Extended survey-weighted models adjusted for chronological age, ASD severity, child sex, race/ethnicity, survey year, current intellectual disability, caregiver education, and family poverty ratio. Six NSCH poverty-ratio implicates were combined using Rubin's rules. FDR correction was applied within the six grade outcome contrasts. aOR, adjusted odds ratio; CI, confidence interval; FDR, false discovery rate; LD, learning disability.

School-contact outcome

The weighted prevalence of school contact two or more times was 27.0%, 47.3%, 36.1%, and 43.7% across the neither, ADHD-only, LD-only, and ADHD + LD groups among children aged 6–11 years. Corresponding estimates among those aged 12–17 years were 25.9%, 44.7%, 29.7%, and 48.0%.

Compared with neither condition, ADHD only was associated with school contact two or more times in both age strata (ages 6–11: aOR 2.51, 95% CI 1.43–4.39; ages 12–17: aOR 2.11, 95% CI 1.33–3.33). ADHD + LD was also associated with this outcome in both strata (ages 6–11: aOR 2.33, 95% CI 1.35–4.02; ages 12–17: aOR 2.01, 95% CI 1.32–3.08). LD only was not associated with frequent school contact in either stratum (Table 2; Fig. 2). The four ADHD-related associations had FDR q ≤ 0.004.

Table 2
Adjusted associations with school contact two or more times about problems

Age	Group	aOR	95% CI	P value	FDR q
6–11	Neither	1.00	Reference	—	—
6–11	ADHD only	2.51	1.43–4.39	0.001	0.003
6–11	LD only	1.55	0.92–2.64	0.102	0.123
6–11	ADHD + LD	2.33	1.35–4.02	0.002	0.003
12–17	Neither	1.00	Reference	—	—
12–17	ADHD only	2.11	1.33–3.33	0.001	0.003
12–17	LD only	0.83	0.50–1.37	0.463	0.463
12–17	ADHD + LD	2.01	1.32–3.08	0.001	0.003

Extended survey-weighted models adjusted for chronological age, ASD severity, child sex, race/ethnicity, survey year, current intellectual disability, caregiver education, and family poverty ratio. Six NSCH poverty-ratio implicates were combined using Rubin's rules. FDR correction was applied within the six school-contact outcome contrasts. This secondary outcome was not preregistered and is interpreted as hypothesis generating.

Supplementary analyses

Ordered and cumulative-threshold grade models had generally similar directions, but associations varied by threshold and the lowest grade categories were sparse. The stricter mostly C/D grades-or-lower outcome was uncommon; only the ADHD + LD association among adolescents was estimated with reasonable precision. No-letter-grade status had a different pattern from grades and is retained only as a supplementary educational-setting analysis. There was no evidence that primary grade associations varied between 2022–2023 and 2024.

Discussion

In this national, repeated cross-sectional sample of children with current ASD, current ADHD and LD configurations were associated with different parent-reported school-functioning outcomes. LD-related groups had the strongest associations with lower reported grades, whereas ADHD-only and ADHD + LD groups had more frequent school contact with households about problems. This distinction is important: grades and school–family communication are related but are not interchangeable outcomes.

The grade result is consistent with literature showing that co-occurring neurodevelopmental conditions can be associated with poorer academic performance [1]. However, the LD association requires particularly cautious interpretation. An LD diagnosis and lower grades are conceptually adjacent and may partly share identification pathways. Our results do not show that LD causes lower grades, nor do

they establish a new mechanistic link. The more defensible interpretation is descriptive risk stratification within the population of children already reported to have current ASD.

Frequent school contact may capture concern about classroom functioning or academic problems, but it also depends on family availability, caregiver reporting, school policy, and local resources. Its association with ADHD-related groups should not be mischaracterized as a clinical measure of behavior or as evidence of ineffective educational services. The NSCH does not provide current IEP content, service intensity, classroom placement, teacher report, standardized achievement testing, medication use, or school-level support quality. Although an ever IFSP/IEP item is available, it cannot support an effectiveness or inclusion claim and was not used as an exposure or mediator.

The findings complement prior NSCH work on school success in autistic children [6] by focusing on current ADHD/LD configurations and separating grades from school–family problem communication. They do not imply that the two outcomes form a causal sequence. Future work should use longitudinal linked educational and clinical data, standardized achievement, teacher reports, detailed support information, and school context to examine whether modifiable supports are associated with improved outcomes.

Strengths and limitations

Strengths include recent national data, explicit treatment of NSCH diagnostic skip logic, survey-design-aware estimation, age stratification, use of all six poverty-ratio implicates, outcome-specific sample definitions, and a restrained interpretation of a secondary outcome. Limitations are substantial. ASD, ADHD, LD, grades, school contact, severity, and covariates are caregiver reported. Cross-sectional data preclude temporal ordering and causal inference. Grade results are restricted to letter-grade recipients and may be affected by grading policies, course demands, accommodations, school context, and parent knowledge. The school-contact outcome may be affected by communication practices and unmeasured family and school characteristics. Residual confounding and diagnosis-selection bias remain likely, and the secondary outcome was not preregistered. Finally, diagnostic–outcome conceptual overlap is particularly relevant for LD and grades.

Conclusions

Among U.S. children with current ASD, co-occurring ADHD and LD were associated with distinct parent-reported school-functioning profiles. LD-related groups were more strongly associated with lower reported grades, while ADHD-related groups were more strongly associated with frequent school–family problem communication. The results support cautious identification of heterogeneous support needs, not causal claims or conclusions about special-education effectiveness.

Abbreviations

ADHD

attention-deficit/hyperactivity disorder
aOR
adjusted odds ratio
ASD
autism spectrum disorder
CI
confidence interval
FDR
false-discovery rate
IEP
individualized education program
LD
learning disability
NSCH
National Survey of Children's Health.

Declarations

Ethics approval and consent to participate: This secondary analysis used de-identified, publicly available National Survey of Children's Health data. No direct participant contact occurred and no identifiable information was accessed. Ethical approval and informed consent were not required for this analysis of public-use de-identified data; the authors will verify this determination under their institutional policies before submission.

Consent for publication: Not applicable. The study used de-identified public-use data and does not report identifiable individual information.

Availability of data and materials: The 2022–2024 NSCH public-use datasets and technical documentation are available from the U.S. Census Bureau at https://www.census.gov/programs-surveys/nsch/data/datasets.html. Analysis code and non-identifiable derived summary outputs are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: Xiaorui Shan and Yan Yan contributed equally and share first authorship. Xiaorui Shan and Yan Yan contributed to conceptualization, methodology, formal analysis, and writing the original draft. Guangyuan Zhou contributed to conceptualization, supervision, and writing review and editing. All authors read and approved the final manuscript.

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Figures

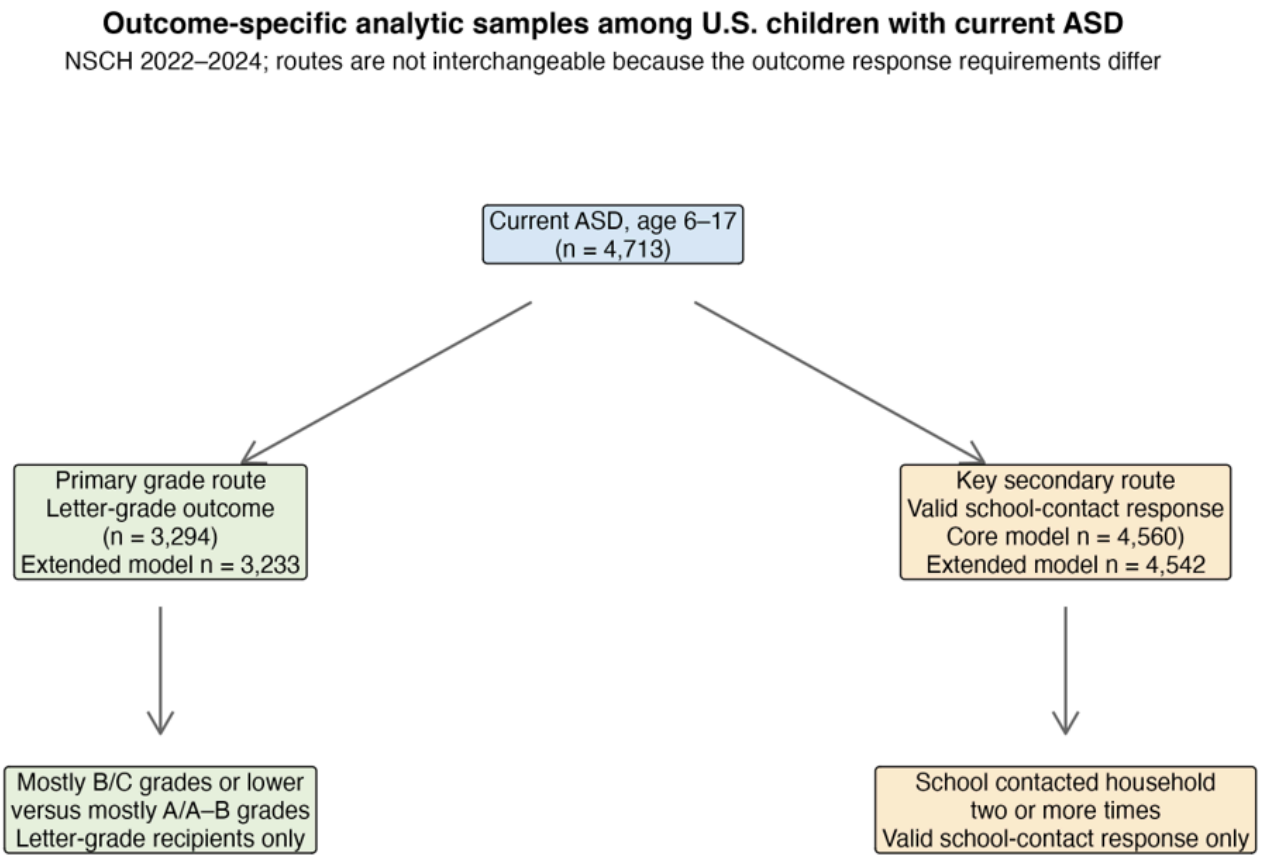


Figure 1

Outcome-specific analytic flow

The grade and school-contact analyses share a current-ASD cohort but apply different valid-response criteria. The grade outcome is restricted to letter-grade recipients. The school-contact outcome is restricted to children with a valid school-contact response. Neither route evaluates IEP content, services, or placement.

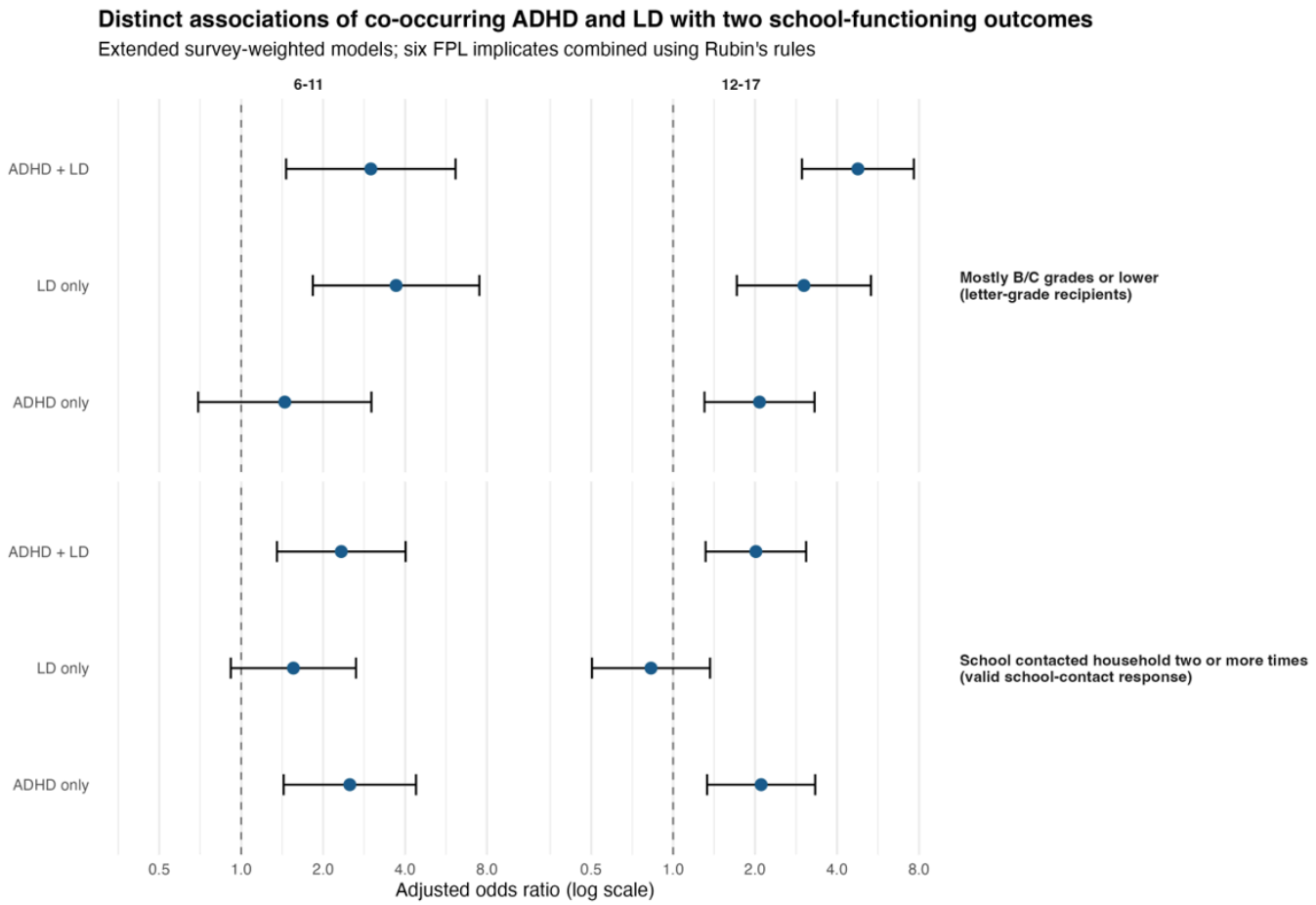


Figure 2

Adjusted associations with two school-functioning outcomes

Extended survey-weighted models. The vertical dashed line indicates the null. Family poverty ratio was estimated across six NSCH implicates and combined using Rubin’s rules. Outcome-specific samples are shown in Figure 1.