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Developmental Autopilot Dominance Index and ADHD Prevalence and Severity Among U.S. Children and Adolescents: A Cross-Sectional Study

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Research Article

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Posted Date: November 16th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11450601/v1

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Additional Declarations: No competing interests reported.

TITLE PAGE

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Article Information

Total Word in Abstract: 250
Total Word in Main Text: 3450
Number of Figure: 4
Number of Table: 3
Supplementary Files: Attached for review

Developmental Autopilot Dominance Index and ADHD Prevalence and Severity Among U.S. Children and Adolescents: A Cross-Sectional Study

Abstract

Background: Attention-deficit/hyperactivity disorder (ADHD) is associated with multiple behavioral and sleep-related characteristics, yet these domains are often examined separately. This study developed the Developmental Autopilot Dominance Index (DADI), a multidimensional behavioral composite, and examined its associations with current ADHD, ADHD severity, and sleep rhythm profiles among U.S. children.

Methods: This cross-sectional study analyzed 2021-2023 National Survey of Children's Health data from 90,790 children aged 6-17 years. DADI integrated recreational screen exposure, physical inactivity, and nonparticipation in sports, organized activities, and enrichment activities. Survey-weighted logistic regression examined associations with current ADHD and severity. Age- and sex-specific associations were evaluated, and exploratory mediation analysis assessed the statistical contribution of sleep rhythm profiles combining sleep duration and bedtime regularity.

Results: The survey-weighted prevalence of current ADHD was 12.4%. Each standard deviation increase in DADI was associated with higher odds of current ADHD (adjusted odds ratio [aOR]=1.29;95%CI:1.24-1.34). Compared with the lowest DADI category, the highest category had greater odds of ADHD (aOR=1.86;95%CI:1.65-2.10), with adjusted probabilities of 7.7% and 13.5%, respectively. Associations increased across mild (aOR=1.16), moderate (aOR=1.33), and severe ADHD (aOR=1.64) and were stronger among adolescents than younger children (P

for interaction=0.002). Sleep rhythm profiles statistically accounted for 8.5% (95%CI:5.7%-12.0%) of the DADI-ADHD association.

Conclusions: Higher DADI scores were associated with current ADHD and greater reported ADHD severity, particularly among adolescents. Sleep rhythm profiles accounted for a modest proportion of this association. DADI may offer a multidimensional framework for investigating behavioral engagement in childhood ADHD, although independent validation and longitudinal research are needed.

Keywords: Attention-deficit/hyperactivity disorder; Developmental Autopilot Dominance Index; sleep rhythm profiles; screen time; physical activity

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disorder characterized by persistent inattention and/or hyperactivity-impulsivity, with consequences extending to academic performance, social relationships, behavioral regulation, and everyday functioning among children and adolescents [1, 2]. These difficulties occur within a broader developmental context in which daily routines increasingly reflect choices and opportunities involving recreational screen use, physical activity, sports, organized and enrichment activities, and sleep [3, 4]. This context is particularly relevant across childhood and adolescence, when executive control, self-regulation, autonomy, and patterns of daily activity undergo substantial change [5, 6]. Although screen exposure, physical activity, and sleep have each been linked to ADHD-related outcomes, they are commonly examined as separate exposures despite being interconnected within the same daily behavioral environment. Examining these behaviors collectively may therefore provide a more comprehensive understanding of behavioral patterns associated with ADHD and how these patterns vary across development.

A central limitation of existing behavioral research is that screen exposure, physical activity, and participation in structured activities are commonly examined as separate correlates, although children allocate these behaviors within the same finite daily environment. The 24-hour movement behavior framework provides a conceptual basis for a more integrated approach by recognizing physical activity, sedentary behavior, and sleep as interdependent components of daily time use [7, 8]. This perspective may be particularly relevant to ADHD, for which emerging research supports considering combinations of movement behaviors, while most studies of neurodiverse children continue to evaluate individual behaviors in isolation [9, 10]. Structured physical and cognitively engaging activities may also support executive processes implicated in ADHD, including inhibitory control, working memory, and cognitive flexibility [11]. Building on these complementary perspectives, we conceptualized developmental autopilot dominance score as a broader behavioral configuration characterized by greater recreational screen exposure alongside physical inactivity and reduced participation in sports, organized activities, and enrichment activities. The Developmental Autopilot Dominance Index (DADI) score was therefore developed to quantify this multidimensional configuration on a common continuum, providing a parsimonious framework for examining whether the collective organization of everyday behaviors is associated with ADHD beyond any single behavioral component.

Sleep may represent an important behavioral and neurobiological pathway linking DADI score with ADHD. Behavioral patterns characterized by greater screen engagement and lower physical or structured activity may coincide with insufficient or irregular sleep, while sleep and circadian disturbances are common among children and adolescents with ADHD [3, 12].

Insufficient or irregular sleep may affect attention, executive control, emotional regulation, and daytime arousal through disrupted sleep–circadian processes [12, 13]. These relationships may also be bidirectional, as ADHD-related difficulties can themselves disrupt daily routines and sleep. Jointly characterizing age-specific sleep duration and bedtime regularity as Sleep Rhythm Profiles (SRPs) may therefore capture sleep organization more comprehensively and provide a theoretically grounded framework for examining whether sleep statistically accounts for part of the DADI-ADHD association.

To address these gaps, we introduce the Developmental Autopilot Dominance Index (DADI) score and examined its association with ADHD among U.S. children and adolescents aged 6-17 years using nationally representative 2021-2023 National Survey of Children's Health data. We evaluated associations with current ADHD and ADHD severity, heterogeneity by age groups, sex, and survey year, and SRPs as a potential statistical mediator. We further examined the robustness of DADI across alternative weighting and component specifications. We hypothesized that higher DADI score would be associated with greater likelihood and severity of ADHD, that associations would vary across developmental subgroups, and that less favorable SRPs would partially account for the DADI-ADHD association.

Methods

Study Design and Population

This cross-sectional study used pooled data from the 2021–2023 National Survey of Children's Health (NSCH), a nationally representative survey of noninstitutionalized U.S. children. The study used previously developed NSCH questionnaires administered by the U.S. Census Bureau; no new questionnaire was developed or administered. The original questionnaires are publicly available through the NSCH survey documentation [14]. The analysis included children and

adolescents aged 6–17 years with complete information on the study variables (N = 90,790; 2021: n = 27,930; 2022: n = 31,714; 2023: n = 31,146). Data were harmonized across survey cycles, and analyses incorporated the complex survey design to support population-level inference. Additional information on data harmonization and sample selection is provided in Figure 1 and Supplementary Methods S1.

Developmental Autopilot Dominance Index

The Developmental Autopilot Dominance Index (DADI) was newly developed for this study using items from the previously established 2021-2023 NSCH questionnaires; no new questionnaire was administered. DADI was constructed as a multidimensional behavioral composite comprising five components: recreational screen exposure, physical inactivity, sports nonparticipation, organized activity nonparticipation, and enrichment activity nonparticipation. Each component was directionally coded and transformed to a 0-1 scale, with higher values indicating greater behavioral disengagement. The DADI was calculated as the equal-weighted mean of the five components and standardized for regression analyses. It was also categorized into four distribution-based groups (Q1-Q4), preserving identical scores within categories. Internal structure and measurement properties were evaluated using component-total correlations, internal consistency coefficients, principal component analysis, factor analysis, and component-deletion diagnostics. Detailed scoring procedures and measurement evaluations are provided in Supplementary Methods S2 and S12–S19 and Supplementary Tables 1 and 13.

Sleep Rhythm Profiles

Sleep Rhythm Profiles (SRPs) were derived by combining caregiver-reported weeknight sleep duration and bedtime regularity. Age-specific sleep adequacy and bedtime regularity classifications generated four mutually exclusive profiles: Regular-Adequate, Regular-

Insufficient, Irregular-Adequate, and Irregular-Insufficient. Regular-Adequate served as the reference category. Detailed derivation procedures are provided in Supplementary Methods S3.

ADHD Outcomes

Current attention-deficit/hyperactivity disorder (ADHD) was identified using caregiver reports of a healthcare professional's diagnosis and current condition status. ADHD severity was classified as mild, moderate, or severe among children with current ADHD. Children without current ADHD served as the reference group for severity-specific comparisons. Detailed outcome definitions are provided in Supplementary Methods S4.

Covariates

Prespecified covariates included age, sex, race, ethnicity, household income, household education, family structure, household food security, and survey year. Variables were harmonized across survey cycles and included in multivariable models to account for potential confounding. Detailed definitions and categorization procedures are provided in Supplementary Methods S5.

Statistical Analysis

Survey-weighted descriptive statistics summarized participant characteristics, and design-based tests evaluated differences across survey years. Associations between DADI and current ADHD were examined using survey-weighted multivariable logistic regression, with DADI modeled continuously per standard deviation and categorically across quartiles. Adjusted odds ratios (ORs), 95% confidence intervals (CIs), trend tests, and covariate-standardized predicted probabilities were reported.

ADHD severity associations were evaluated using survey-weighted severity-specific binary logistic regression models, comparing each severity category with no current ADHD. The

proportional-odds assumption was assessed before selecting the final modeling approach. Effect modification by age, sex, and survey year was evaluated using interaction terms.

Associations between DADI, SRPs, and current ADHD were examined using multivariable regression models. Exploratory counterfactual mediation analysis estimated total, natural direct, and natural indirect effects on the absolute risk-difference scale, with confidence intervals obtained through resampling. Given the cross-sectional design, mediation estimates were interpreted as statistical decomposition rather than evidence of causality.

Sensitivity analyses assessed alternative DADI weighting, leave-one-component-out indices, and individual behavioral components. Analyses not incorporating the complex survey design were considered supportive. All statistical tests were two-sided, with $P < 0.05$ considered statistically significant. Analyses were performed using R version 4.5.2. Detailed model specifications, statistical procedures, and sensitivity analyses are provided in Supplementary Methods S6-S11.

Results

Study Population and Characteristics

The final analytic sample included 90,790 children and adolescents aged 6–17 years from the 2021–2023 NSCH (Table 1). The mean age was 11.57 years, 51.1% were male, and 70.8% were White. Overall, 67.0% lived in households below 400% of the federal poverty level, and 32.1% experienced household food insecurity. The mean DADI score was 0.55 (SD, 0.26), decreasing from 0.57 in 2021 to 0.53 in 2023 ($P < 0.001$). Regular-Adequate was the most prevalent sleep rhythm profile (58.6%), followed by Regular-Insufficient (26.7%), Irregular-Insufficient (8.4%), and Irregular-Adequate (6.3%). The survey-weighted prevalence of current ADHD was 12.4%,

with no significant variation across survey years (P = 0.20). Additional characteristics and DADI distributions are presented in Table 1, Supplementary Table 8, and Supplementary Figure 1.

Association Between DADI and Current ADHD

Higher DADI scores were associated with greater odds of current ADHD. In the fully adjusted survey-weighted model, each 1-SD higher DADI score was associated with 29% higher odds of current ADHD (OR = 1.29; 95% CI, 1.24-1.34). Compared with the lowest DADI category (Q1), adjusted odds were higher in Q3 (OR = 1.35; 95% CI, 1.20-1.51) and Q4 (OR = 1.86; 95% CI, 1.65-2.10), whereas Q2 showed no statistically significant difference (OR = 1.07; 95% CI, 0.96-1.20; P for trend < 0.001). Correspondingly, the adjusted probability of current ADHD increased from 7.7% (95% CI, 6.9%-8.6%) in Q1 to 13.5% (95% CI, 12.5%-14.6%) in Q4 (Table 2; Figure 2). Full model estimates and comparisons with conventional analyses are provided in Supplementary Tables 2 and 11.

DADI and ADHD Severity

The magnitude of the DADI–ADHD association increased across severity categories. Compared with children without current ADHD, each 1-SD higher DADI score was associated with greater odds of mild (OR = 1.16; 95% CI, 1.09-1.24), moderate (OR = 1.33; 95% CI, 1.26-1.41), and severe ADHD (OR = 1.64; 95% CI, 1.46-1.85) in separate survey-weighted binary logistic regression models (Table 2; Figure 3). Model-based probabilities showed a corresponding increase in moderate and severe ADHD across higher DADI levels (Figure 4). The proportional-odds assumption assessment and complementary severity-model results are presented in Supplementary Tables 5 and 11.

Effect Modification by Age and Sex

The association between DADI and current ADHD differed by age group. Each 1-SD higher DADI score was associated with higher odds of current ADHD among children aged 6–11 years (OR = 1.16; 95% CI, 1.08-1.24) and adolescents aged 12-17 years (OR = 1.40; 95% CI, 1.33-1.47), with evidence of effect modification by age (P for interaction = 0.002). Associations were also observed among males (OR = 1.33; 95% CI, 1.27-1.40) and females (OR = 1.22; 95% CI, 1.14-1.30), with modest evidence of sex-related heterogeneity (P for interaction = 0.031). No significant overall interaction was observed by survey year (P = 0.202). Additional subgroup estimates are provided in Figure 3 and Supplementary Table 6.

Sleep Rhythm Profiles and Exploratory Mediation

Higher DADI scores were associated with less favorable sleep rhythm profiles, which were also associated with current ADHD (Supplementary Tables 7 and 9; Supplementary Figure 2). The overall DADI-by-sleep rhythm profile interaction was not statistically significant (P = 0.079; Supplementary Table 10).

In exploratory survey-weighted mediation analysis, increasing DADI from its mean to 1 SD above the mean corresponded to a total absolute difference of 2.79 percentage points in the predicted probability of current ADHD (95% CI, 2.30-3.29). The estimated direct component was 2.55 percentage points (95% CI, 2.05-3.05), whereas the indirect component through sleep rhythm profiles was 0.24 percentage points (95% CI, 0.17-0.33), corresponding to 8.5% (95% CI, 5.7%-12.0%) of the total association. These estimates represent exploratory statistical decomposition rather than evidence of causal mediation (Table 3). Supporting standardized probabilities are provided in Supplementary Table 12.

Sensitivity and Robustness Analyses

The positive association between DADI and current ADHD persisted across alternative index specifications, including PCA-weighted and leave-one-component-out indices. Component-level analyses also showed positive associations for recreational screen exposure, physical inactivity, sports nonparticipation, organized activity nonparticipation, and enrichment activity nonparticipation, although their magnitudes varied. These conventional-model sensitivity findings were directionally consistent with the primary survey-weighted analysis (Supplementary Tables 3-4; Supplementary Figures 3-4).

Discussion

In this nationally representative study of U.S. children and adolescents, higher Developmental Autopilot Dominance Index (DADI) scores were consistently associated with greater odds of current ADHD, with a graded pattern across increasing DADI levels. Associations were stronger for more severe ADHD and among adolescents compared with younger children, with modest differences by sex. Sleep rhythm profiles (SRPs) statistically accounted for a relatively small proportion of the DADI-ADHD association, while most of the association was not accounted for by sleep. Findings were also consistent across alternative DADI weighting approaches and leave-one-component-out analyses, suggesting that the overall association was not driven exclusively by a single behavioral component. Collectively, these findings provide preliminary population-level evidence that DADI may be useful for characterizing multidimensional behavioral patterns associated with ADHD and its severity during childhood and adolescence.

The observed associations are consistent with an integrated perspective on childhood behavior, in which daily activities are interconnected rather than independent. The 24-hour movement behavior framework similarly recognizes physical activity, sedentary behavior, screen exposure, and sleep as interrelated components of daily life, with time allocated to one activity

potentially influencing participation in others [8, 9, 15]. This perspective is particularly relevant to ADHD, given that its behavioral and functional correlates extend across physical activity, sedentary behavior, and sleep. Previous research has also emphasized the importance of examining these behaviors collectively among children with ADHD [7, 16]. DADI builds on this perspective by incorporating sports, organized activities, and enrichment participation alongside screen exposure and physical inactivity, thereby characterizing both sedentary behavioral patterns and reduced structured developmental engagement. These domains may be related through shared processes involving executive functioning and behavioral self-regulation. Previous studies have associated greater physical activity and adequate sleep with more favorable executive functioning, whereas excessive screen-centered activities may coincide with reduced opportunities for physical, social, educational, and sleep-related engagement [17, 18]. The observed associations with ADHD prevalence, severity, and sleep profiles, together with consistent findings across alternative index specifications, provide preliminary support for the relevance of this multidimensional behavioral composite. Nevertheless, these findings should not be interpreted as establishing formal construct validity, which requires additional external and longitudinal evaluation.

The increasing magnitude of associations across mild, moderate, and severe ADHD suggests that the behavioral characteristics represented by DADI may be more pronounced among children with greater reported ADHD severity. The association was also stronger among adolescents aged 12-17 years than among children aged 6-11 years. One possible explanation is that adolescents generally experience greater independence in managing digital media use, sleep schedules, and discretionary activities, potentially contributing to differences in daily behavioral organization. Research on integrated movement behaviors similarly highlights the

interdependence of screen exposure, physical activity, and sleep and their variation across developmental stages [19, 20]. Although associations were somewhat stronger among males than females, this difference was modest and should be interpreted cautiously. Importantly, these findings do not establish the direction of the observed relationships. ADHD-related symptoms and functional difficulties may influence behavioral engagement, behavioral patterns may coexist with factors associated with ADHD, or both may reflect shared developmental, familial, and environmental influences.

Sleep rhythm profiles (SRPs) provide additional insight into the association between DADI and ADHD. Sleep and circadian disturbances are common among children with ADHD and have been linked to impaired attention, executive functioning, and behavioral regulation [12, 15, 21]. By jointly considering sleep duration and bedtime regularity, our findings showed that higher DADI scores were associated with less favorable sleep profiles, which were also associated with current ADHD. These relationships may reflect interconnected behavioral and neurobiological processes, including potentially bidirectional associations between sleep disturbances and ADHD [3, 12]. Exploratory mediation analysis indicated that SRPs statistically accounted for 8.5% of the DADI–ADHD association, while the overall DADI-by-SRP interaction was not significant. Given the cross-sectional design, these findings represent statistical associations rather than evidence of causal mediation.

These findings underscore the importance of considering interconnected behavioral patterns in ADHD research. By integrating screen exposure, physical inactivity, and reduced structured activity participation, DADI captures multiple dimensions of daily behavioral engagement. This approach aligns with evidence linking physical activity and structured exercise to executive functioning and ADHD-related outcomes [17, 19] and supports further investigation

of integrated behavioral patterns rather than isolated activities. Accordingly, prevention research may benefit from considering the balance and organization of daily activities rather than targeting individual behaviors in isolation [9, 22]. However, DADI demonstrated modest internal consistency and should be regarded as a multidimensional behavioral composite rather than a validated psychometric or clinical screening instrument. Longitudinal and external validation, including comparisons with objectively measured behaviors, is warranted.

Study strengths include the large nationally representative sample across three NSCH cycles, comprehensive assessment of behavioral domains, survey-weighted analyses, evaluation of ADHD severity and developmental differences, and multiple sensitivity analyses. However, the cross-sectional design limits temporal and causal interpretation and permits reverse associations. Caregiver-reported behavioral, sleep, and ADHD measures may introduce reporting bias, while residual confounding and broad racial categorization may obscure underlying heterogeneity. Additionally, DADI was developed from available survey indicators and requires independent validation. The exploratory mediation findings should therefore be interpreted cautiously.

Overall, higher DADI scores were associated with current ADHD, with stronger associations among adolescents and across increasing ADHD severity. Sleep rhythm profiles accounted for a small proportion of this association. These findings suggest that multidimensional behavioral engagement may be a useful focus for future longitudinal research on ADHD and related developmental outcomes.

Declarations

Ethics approval and consent to participate

The original survey collected information from parents or caregivers about their children, including those younger than 16 years. The present study involved secondary analysis of public-use data without direct participant contact or access to identifiable private information. No separate institutional review board approval was obtained, and no additional informed consent was sought for this secondary analysis.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability

The 2021–2023 National Survey of Children's Health (NSCH) public-use datasets analyzed in this study are publicly available through the U.S. Census Bureau at https://www.census.gov/programs-surveys/nsch/data/datasets.html. The corresponding questionnaires and supporting documentation are available through the Health Resources and Services Administration at https://mchb.hrsa.gov/national-survey-childrens-health-questionnaires-datasets-supporting-documents. Analytic code is available from the corresponding author upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used Microsoft Copilot and ChatGPT to assist with sentence restructuring and improving readability. All authors subsequently reviewed, edited, and approved the content and take full responsibility for the final manuscript.

References

1. CDC (2026) Attention-Deficit / Hyperactivity Disorder (ADHD). In: Attention-Deficit / Hyperactivity Disorder (ADHD). https://www.cdc.gov/adhd/index.html. Accessed 7 Aug 2026

2. Faraone SV, Banaschewski T, Coghill D, et al (2021) The World Federation of ADHD International Consensus Statement: 208 Evidence-based conclusions about the disorder. Neuroscience & Biobehavioral Reviews 128:789–818. https://doi.org/10.1016/j.neubiorev.2021.01.022

3. Becker SP (2020) ADHD and sleep: recent advances and future directions. Current Opinion in Psychology 34:50–56. https://doi.org/10.1016/j.copsyc.2019.09.006

4. Franke B, Michelini G, Asherson P, et al (2018) Live fast, die young? A review on the developmental trajectories of ADHD across the lifespan. Eur Neuropsychopharmacol 28:1059–1088. https://doi.org/10.1016/j.euroneuro.2018.08.001

5. Avni E, Ben-Itzchak E, Zachor DA (2018) The Presence of Comorbid ADHD and Anxiety Symptoms in Autism Spectrum Disorder: Clinical Presentation and Predictors. Front Psychiatry 9:. https://doi.org/10.3389/fpsyt.2018.00717

6. Dahl RE (2004) Adolescent Brain Development: A Period of Vulnerabilities and Opportunities. Keynote Address. Annals of the New York Academy of Sciences 1021:1–22. https://doi.org/10.1196/annals.1308.001

7. Kracht CL, Burkart S, Groves CI, et al (2024) 24-hour movement behavior adherence and associations with health outcomes: an umbrella review. J Act Sedentary Sleep Behav 3:25. https://doi.org/10.1186/s44167-024-00064-6

8. Rosenberger ME, Fulton JE, Buman MP, et al (2019) The 24-Hour Activity Cycle: A New Paradigm for Physical Activity. Med Sci Sports Exerc 51:454–464. https://doi.org/10.1249/MSS.0000000000001811

9. Fan C, Liu P, Yang Z, et al (2025) Twenty-Four-Hour Movement Behaviors and Social Functions in Neurodiverse Children: A Scoping Review. Behav Sci (Basel) 15:592. https://doi.org/10.3390/bs15050592

10. Garner AA, O'connor BC, Narad ME, et al (2013) The relationship between ADHD symptom dimensions, clinical correlates, and functional impairments. J Dev Behav Pediatr 34:469–477. https://doi.org/10.1097/DBP.0b013e3182a39890

11. Homan P, Argyelan M, DeRosse P, et al (2019) Structural similarity networks predict clinical outcome in early-phase psychosis. Neuropsychopharmacol 44:915–922. https://doi.org/10.1038/s41386-019-0322-y

12. Bondopandhyay U, McGrath J, Coogan AN (2024) Associations between sleep problems in children with ADHD and parental insomnia and ADHD symptoms. PLOS ONE 19:e0298377. https://doi.org/10.1371/journal.pone.0298377

13. Lok R, Deshpande N, Nair S, et al (2025) The sleep–circadian connection: pathways to understanding and supporting autistic children and adolescents and those with attention-deficit hyperactivity disorder. The Lancet Child & Adolescent Health 9:868–879. https://doi.org/10.1016/S2352-4642(25)00211-1

14. NSCH Codebook. https://www.census.gov/data-tools/demo/uccb/nschdict. Accessed 14 Dec 2025

15. Tremblay MS, Carson V, Chaput J-P, et al (2016) Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. Appl Physiol Nutr Metab 41:S311-327. https://doi.org/10.1139/apnm-2016-0151

16. Li J, Chen Y, Herold F, et al (2025) Linking 24-hour movement behaviour guidelines to core symptoms and school engagement of youth with moderate/severe ADHD. J Affect Disord 372:422–430. https://doi.org/10.1016/j.jad.2024.12.039

17. Song Y, Fan B, Wang C, Yu H (2023) Meta-analysis of the effects of physical activity on executive function in children and adolescents with attention deficit hyperactivity disorder. PLOS ONE 18:e0289732. https://doi.org/10.1371/journal.pone.0289732

18. Stiglic N, Viner RM (2019) Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews. BMJ Open 9:e023191. https://doi.org/10.1136/bmjopen-2018-023191

19. Chong KH, Parrish A-M, Cliff DP, et al (2020) Changes in physical activity, sedentary behaviour and sleep across the transition from primary to secondary school: A systematic review. Journal of Science and Medicine in Sport 23:498–505. https://doi.org/10.1016/j.jsams.2019.12.002

20. Hossian M, Mielke GI, Nisar M, et al (2025) Global research on 24-hour movement behaviours guidelines in children and adolescents: a systematic review. Int J Behav Nutr Phys Act 22:108. https://doi.org/10.1186/s12966-025-01809-5

21. Lunsford-Avery JR, Krystal AD, Kollins SH (2016) Sleep disturbances in adolescents with ADHD: A systematic review and framework for future research. Clin Psychol Rev 50:159–174. https://doi.org/10.1016/j.cpr.2016.10.004

22. Leite Â, Vieira da Silva C (2025) Trends in Homelessness and Social Sustainability: Veterans vs. Non-Veterans in the US. Healthcare (Basel) 13:967. https://doi.org/10.3390/healthcare13090967

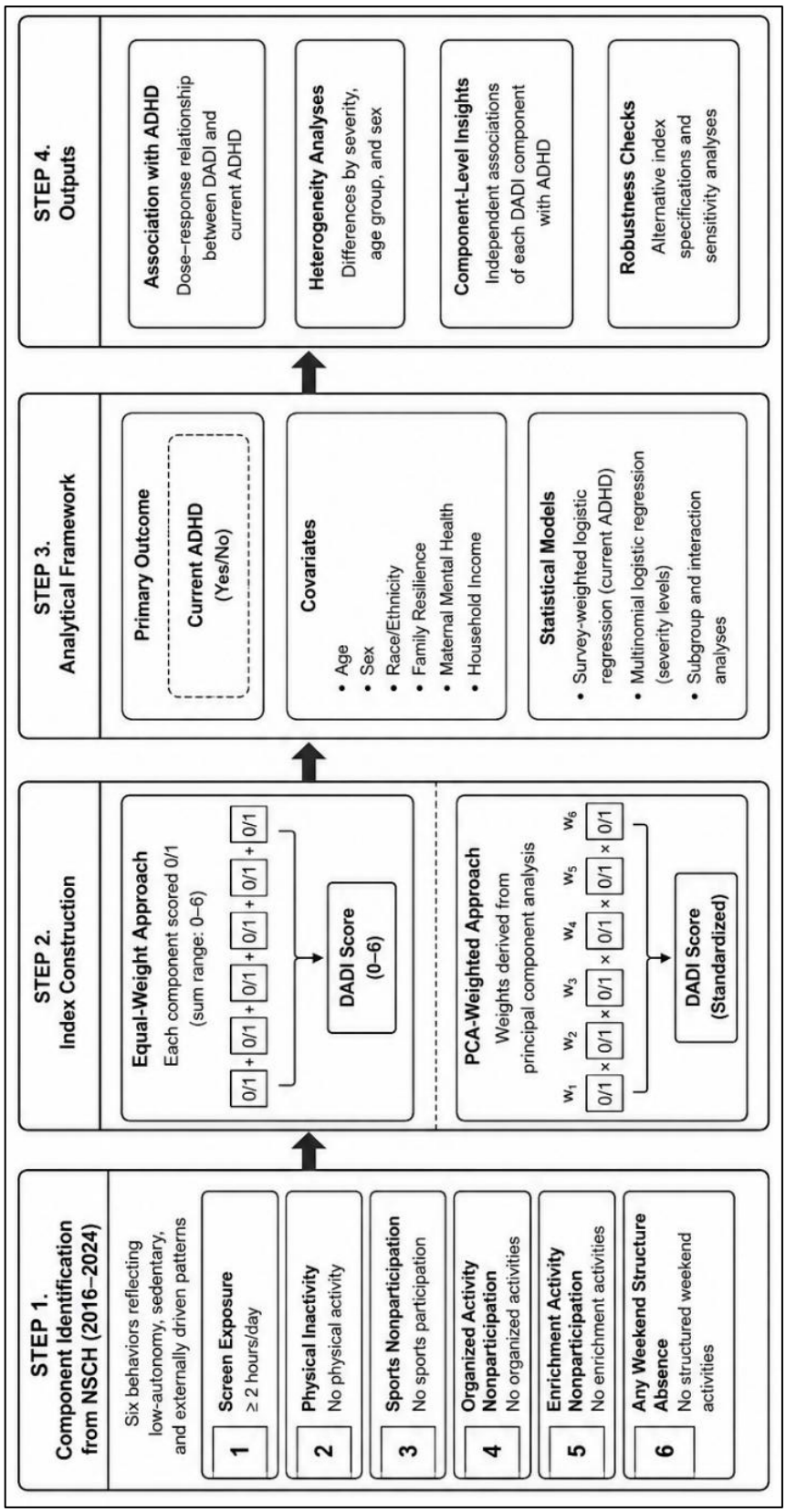


Figure 1. Development and Analytical Framework of the Developmental Autopilot Dominance Index.

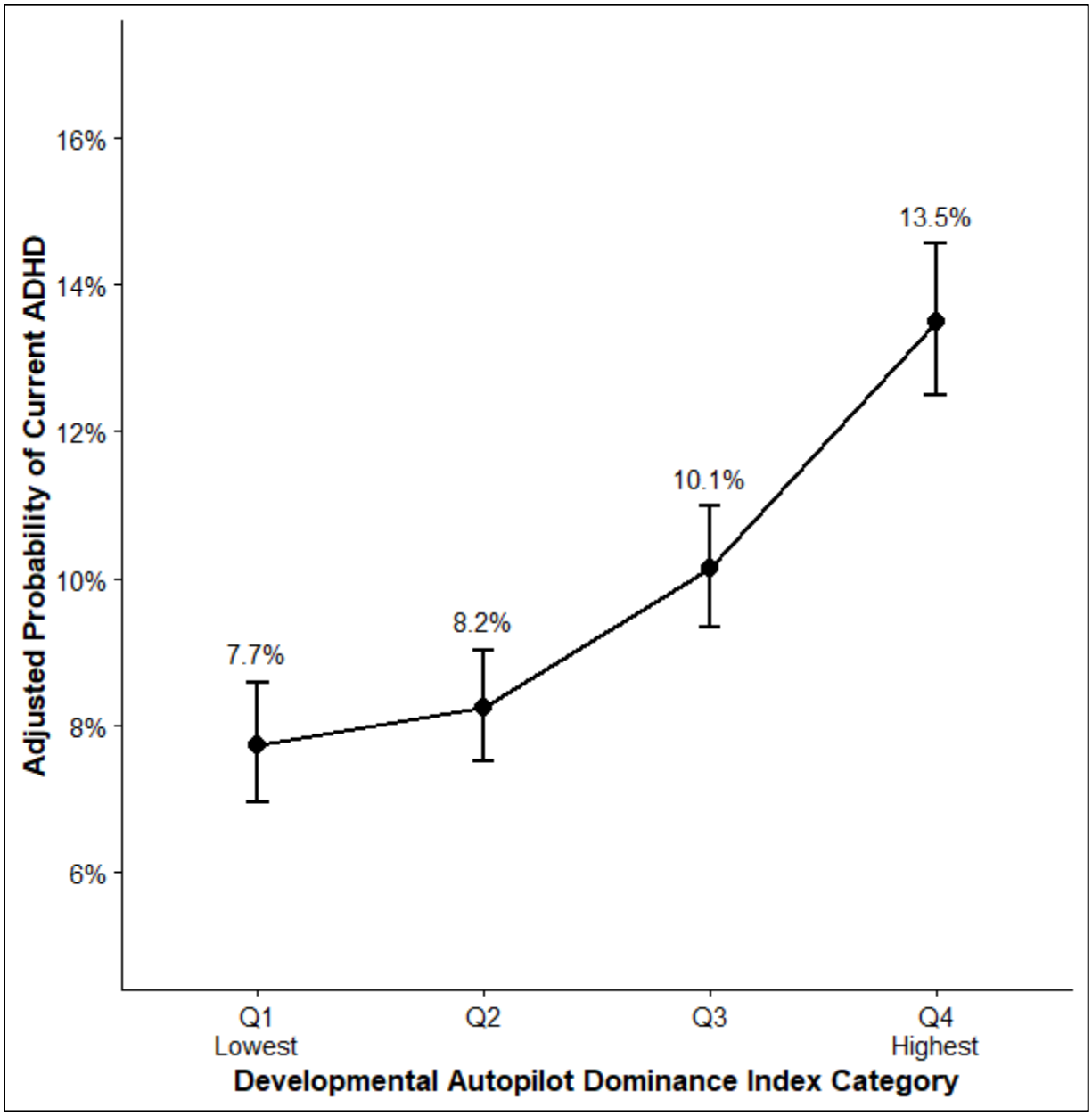


Figure 2. Survey-Weighted Adjusted Probability of Current ADHD Across Developmental Autopilot Dominance Index Categories.

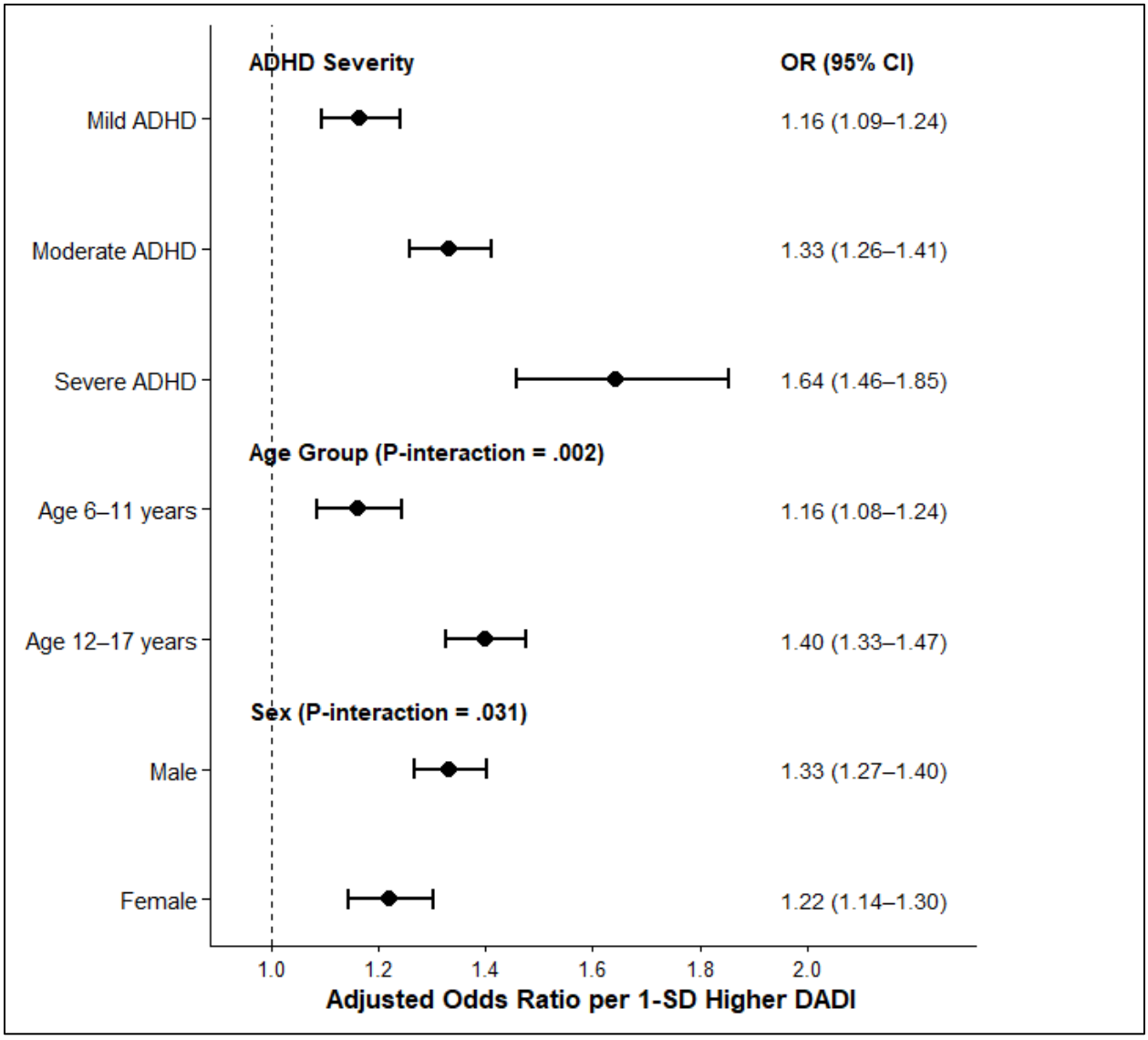


Figure 3. Survey-Weighted Associations Between the Developmental Autopilot Dominance Index and ADHD Across Severity, Age, and Sex Groups.

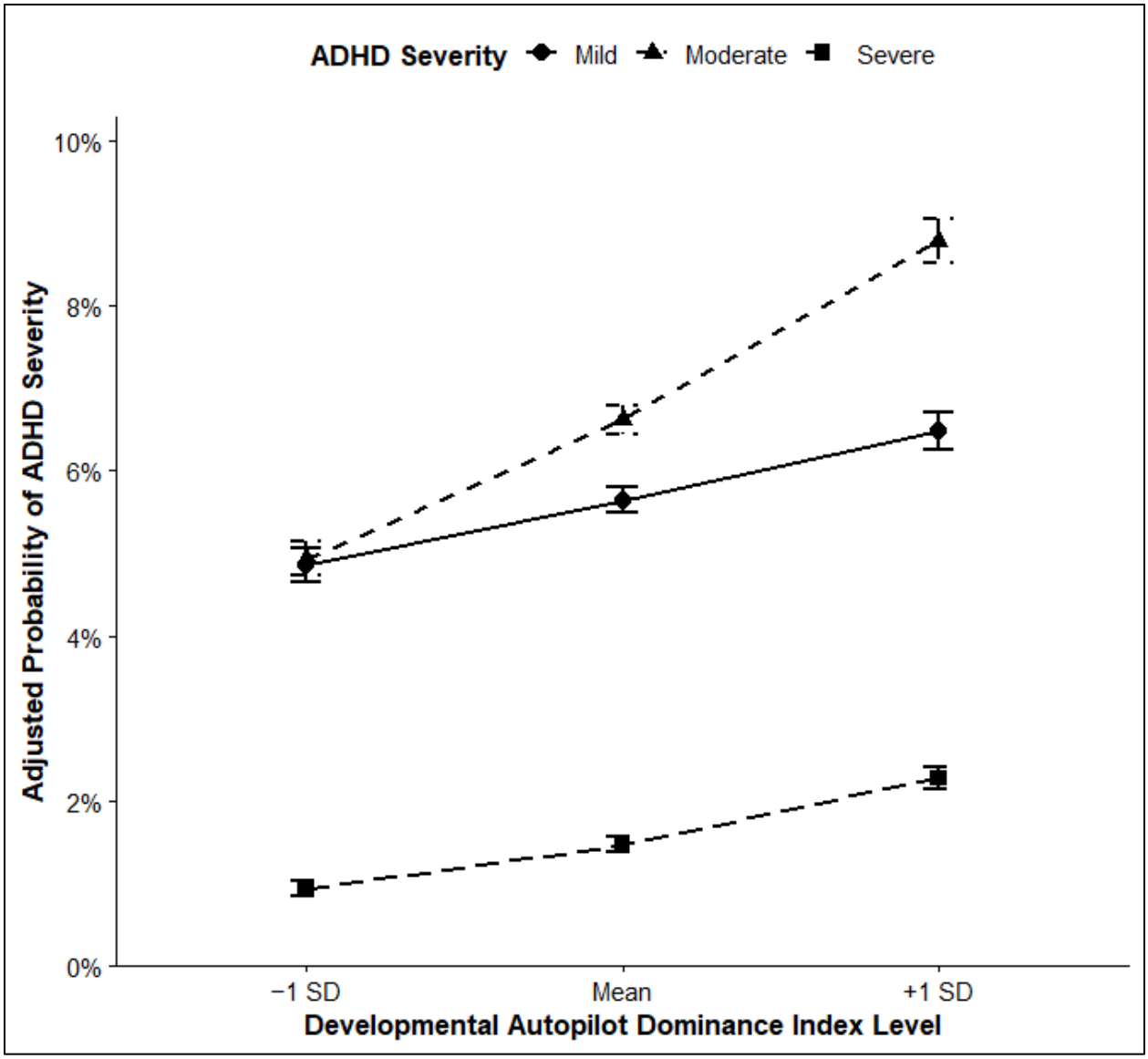


Figure 4. Adjusted Probabilities of Mild, Moderate, and Severe ADHD Across Developmental Autopilot Dominance Index Levels.

Supplementary Files

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