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Health Risk Factors and Attention-Deficit/Hyperactivity Disorder (ADHD): New Findings from the Community-Based Replication Project to Learn About Youth-Mental Health (Re-PLAY-MH)

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Abstract

Objective: ADHD is a commonly diagnosed neurodevelopmental disorder in the U.S., with symptoms including hyperactivity, inattention, and impulsivity. These symptoms can lead to increased engagement in unhealthy behaviors. The current study examined the associations between health risk factors and ADHD among a community-based sample of 345 students (4th–12th grade) by ADHD alone or with co-occurring disorders, ADHD medication use, and ADHD symptom count. Distinct from prior studies, our analysis also examined associations among pairs of health risk factors by ADHD diagnostic criteria.

Method: Data came from the Replication Project to Learn About Youth—Mental Health, using a two-stage design, incorporating teacher, parent, and student reported data.

Result: Students with ADHD experienced a higher prevalence of not using a bike helmet (prevalence ratio [PR] = 1.17, 95% confidence interval [CI] [1.01, 1.35]), being bullied, threatened, or feeling unsafe at school (PR = 1.83, 95% CI [1.02, 3.30]) carrying a weapon (PR = 7.02, 95% CI [2.58, 19.08]), and feeling sad or hopeless within the past 2 weeks (PR = 2.74,

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Samuel M. Katz: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Writing – original draft. Abby de Arellano, Yvette Rother, and Sydney Levine: Conceptualization, Investigation, Writing – review & editing. Angelika H. Claussen: Conceptualization, Investigation, Methodology, Supervision, Writing – review & editing. Melissa L. Danielson: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Validation, Writing – review & editing. Kate Flory: Conceptualization, Methodology, Supervision, Project administration, Validation, Writing – review & editing. Brooke Staley: Validation.

Competing interests:

The authors have no relevant financial or non-financial interests to disclose.

Ethical approval:

All study documents and procedures were approved by the University of South Carolina's Institutional Review Board, Protocol #Pro00051361. The study used passive parental consent in Stage 1 and active parental permission in Stage 2 for study participation and youth completed informed assent before participating in the surveys.

Disclaimer:

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

95% CI [1.01, 7.47]) compared to those with no disorder. Students with ADHD exhibited different risk associations compared to those with no disorder, specifically for interpersonal violence risk. Medication treatment for ADHD was not associated with fewer health risks, except that students taking ADHD medication were less likely to skip breakfast (PR = 0.40, 95% CI [0.20, 0.78]) compared to those without ADHD. Higher ADHD symptom counts were associated with elevated television screen time, stimulant medication misuse, physical fight involvement, and carrying a weapon ($p < .05$).

Conclusion: Evaluating participation in health risk factors and developing tailored interventions may benefit youth with ADHD, regardless of treatment status.

Keywords

ADHD; Stimulant Medication; Health Risk Factors; ADHD Diagnosis; Mental Disorders

Introduction

ADHD is the most common neurodevelopmental disorders experienced by youth in the United States, with 10.5% of youth ages 3 to 17 years diagnosed (Danielson et al., 2024). Core ADHD symptoms include difficulties with inattention (e.g., being easily distracted and forgetful in daily activities), hyperactivity (e.g., difficulty remaining seated), and impulsivity (e.g., having trouble taking turns). ADHD is also associated with executive function challenges such as difficulties with attentional control, working memory, inhibition, problem solving, planning, emotion regulation, and consideration of consequences (Baggetta & Alexander, 2016), which contribute to impairments in various life domains. Many children with ADHD continue to experience significant symptoms and impairments into adolescence and adulthood (Di Lorenzo et al., 2023), and behavioral economists have estimated the annual economic burden of ADHD among children and adults in the U.S. to be approximately \$240 billion (Schein et al., 2022; Zhao et al., 2019).

ADHD-related characteristics such as disinhibition and difficulty considering consequences put individuals at risk for engagement in a variety of unhealthy behaviors that increase the chances of illness, injury, and death (Reimann et al., 2020). ADHD poses a particular risk for these behaviors given challenges with the ability to manage one's behavior and making healthy behavior choices (Holton & Nigg, 2020). Additionally, core ADHD symptoms such as forgetfulness and poor self-regulation can create barriers for individuals to consistently engage in healthy behaviors, such as eating nutritious meals and participating in regular physical activity (Bowling et al., 2017; Cappelli et al., 2019). Neurocognitive deficits in ADHD can directly impact health behaviors through internal self-regulation challenges, such as difficulties with managing emotions and planning, as well as challenges in responding to external regulation such as reward and consequences (Nigg, 2017). Biopsychosocial models of the mechanisms underlying these increased risks in individuals with ADHD describe a direct link between neurocognitive deficits and health behaviors, as well as indirect links, with the association of neurocognitive deficits and behavioral outcomes mediated by psychosocial impairments and environmental stressors, such as ADHD-related academic functioning impairments and parenting challenges (Schoenfelder & Kollins, 2015). The combined impact of increased engagement in risky behaviors and inconsistent engagement

in healthy behaviors could contribute to the higher morbidity and mortality rates among individuals with ADHD than among those without the disorder (Diallo et al., 2022).

Several studies have examined the relation between ADHD and health risk factors, such as factors that contribute to unintentional injuries (Ruiz-Goikoetxea et al., 2018); screen time, sleep, dietary behaviors, and physical activity (Holton & Nigg, 2020); substance use (Groenman et al., 2017); and interpersonal violence factors (Ahmed et al., 2022). However, these studies generally focused on specific domains of functioning (e.g., only substance use) rather than a comprehensive investigation of risk factors across multiple domains. The biopsychosocial model of ADHD describes both direct and mediated effects of ADHD across health outcomes and points to the benefit of examining a full range of health behaviors rather than individual domains. Investigating the patterns of associations among different domains of risk factors and how such patterns for youth with ADHD may differ from those without ADHD can inform prevention and intervention efforts to address risk behaviors in this population (Schoenfelder & Kollins, 2015). There is currently limited information on health promotion for youth with ADHD (Schoenfelder & Kollins, 2015). Understanding risk factors across domains could be used to enhance support systems, such as school accommodations and mental health services, to reduce distress, negative health outcomes, and economic burden.

Further, ADHD diagnosis is based on meeting the threshold of six or more symptoms included in the DSM-5 criteria (American Psychiatric Association, 2022), and research has demonstrated that experiencing ADHD symptoms below the clinical threshold may also be associated with functional impairment (Hong et al., 2014). Therefore, in addition to comparing youth with and without ADHD diagnosis, the association between cumulative number of ADHD symptoms and engagement in health risk factors among youth across domains may also inform prevention and intervention, but such research is limited.

In general, mental health difficulties can increase health risk factors among children and adolescents. Disorders such as depression and anxiety may be associated with health risk factors, such as excessive screen time, sleep problems, and interpersonal difficulties, when compared to no disorder (Luo et al., 2020). However, compared to other mental disorders such as depression and anxiety, ADHD may be associated with a unique risk of engagement in unhealthy behaviors given the nature of the core symptoms of the disorder (e.g., behavioral disinhibition) and the central role of executive functioning deficits (e.g., inability to plan ahead and consider consequences) in both ADHD and risky behaviors (Pollak et al., 2019; Rooney et al., 2015; Shoham et al., 2021). Therefore, comparing health risk factors between youth with ADHD with or without co-occurring disorders compared to those who meet no disorder criteria may provide additional information that can be used to enhance support systems, such as school accommodations and mental health services, to reduce distress, morbidity/mortality, and economic burden.

Treatments for ADHD can potentially reduce impairment related to the disorder by lessening symptoms. Prescription medication, typically a psychostimulant (e.g., methylphenidate, amphetamine), is the most common approach for managing ADHD symptoms, with an estimated 53.6% of children and adolescents with ADHD taking medication (Danielson et

al., 2024). Although medication treatment has been shown to improve some of the core symptoms of ADHD, such as inattention and difficulty concentrating (Wolraich et al., 2019), the association of ADHD medication use with health risk factors specifically is not well understood. The present study aimed to provide additional information by investigating engagement in health risk factors as related to currently receiving medication for ADHD compared to meeting diagnostic criteria for ADHD but not receiving medication. In a correlational study, conclusions about medication effectiveness in reducing engagement in health risk factors cannot be drawn due to selection bias (e.g., healthy user bias, confounding factors) but findings can be used to inform future research to understand the association between medication and health risk behavior.

In sum, the current study aimed to address gaps in the existing literature on the association between ADHD and health risk factors among students by examining: (1) the occurrence of health risk factors among students meeting diagnostic criteria for ADHD overall (with or without a co-occurring disorder) as well as among those meeting criteria for ADHD only (without a co-occurring disorder) compared to those who meet no disorder criteria, (2) the pair wise associations among health risk factors for students meeting diagnostic criteria for ADHD compared to those with no disorder, (3) the distribution of health risk factors among students meeting ADHD criteria and currently taking prescription medication, compared to students with ADHD and not taking medication and those with no diagnosis, and (4) the association between cumulative number of ADHD symptoms and health risk factors in students. Based on findings from prior research, we hypothesized that students with ADHD would endorse more engagement in health risk factors than students without ADHD and that a greater number of ADHD symptoms would be associated with more engagement in health risk factors. The analyses for how medication status would impact the association between ADHD and health risk factors, and for the nature of the pattern of associations among health risk factors for students with and without ADHD were exploratory rather than hypothesis driven, given the dearth of prior research in these areas.

Methods

Participants

The current study used data from the Replication Project to Learn About Youth—Mental Health (Re-PLAY-MH), funded through an agreement between the US Centers for Disease Control and Prevention (CDC)’s National Center on Birth Defects and Developmental Disabilities and the Disability Research and Dissemination Center, with four study sites in Colorado, Florida, Ohio, and South Carolina. The original community-based PLAY-MH study examined mental disorder prevalence and related factors among children in kindergarten through 12th grade within a school district at each of the four sites. The current analysis utilized the second wave of data, Re-PLAY-MH, which was conducted solely at the South Carolina (SC) site and additionally included measures to assess youth risk factors. Data were collected between December 2015 and September 2017 from 20 schools within a suburban/rural SC school district. Informed consent, assent, and other study procedures were reviewed and approved by the Institutional Review Board of the University of South Carolina.

Of the 385 children who completed Stage 2 data collection (described below), 345 students were included in our analysis. We excluded those with incomplete data for the health risk questions (N = 5) and those without ADHD who had a mental disorder (N = 35) from our analysis. Students included in study analyses were 54.7% male, 60.7% non-Hispanic White, 77.6% in grades 6 to 12, 76.5% with highest household education level beyond high school, and 55.7% had a free or reduced school lunch (see Table 1 for full demographic characteristics).

Procedure and Measures

The full procedures for the Re-PLAY-MH study have been previously published (Wanga et al., 2022) and are briefly outlined here. The study used a two-stage design for data collection, in which all students within the district (N = 10,454) were enrolled in the study unless they were opted out by a parent or guardian. Stage 1 involved a teacher screener, composed of the Strengths and Difficulties Questionnaire (Goodman, 2001) and/or the BASC-2 Behavioral and Emotional Screening System (Kamphaus & Reynolds, 2007), to determine which students were at high or low risk for a mental disorder, with a completion rate of 71.4% (N = 6,886) among those who did not opt out (N = 9,648). For Stage 2, a sample (N = 2,999) stratified based on risk status, student sex, and grade level was invited to complete in-person data collection that included parent interviews, parent-report questionnaires, and child-report questionnaires. The response rate for Stage 2 was 19.1% overall (N = 572). Due to the grade limits of the health risk behavior measure used and our exclusion criteria, 345 students in grades 4 to 12 were included in our analysis.

During Stage 2, parents completed the Diagnostic Interview Schedule for Children Version IV (DISC-IV; Shaffer et al., 2000), a structured diagnostic assessment tool to identify children meeting DSM-IV criteria (American Psychiatric Association, 1994) for selected mental disorders in the past 12 months. The DISC has shown moderate to good diagnostic reliability, agreement with clinician diagnoses, as well as modest to good internal consistency varying by diagnosis citations in comment (Cree et al., 2023; Rolon-Arroyo et al., 2016; Shaffer et al., 2000). The DISC-IV modules that were included assessed for externalizing disorders (ADHD, oppositional defiant disorder [ODD], conduct disorder [CD]) and internalizing disorders (obsessive-compulsive disorder [OCD], post-traumatic stress disorder [PTSD], mania and/or hypomania disorder, generalized anxiety disorder [GAD], social phobia, separation anxiety, panic disorder, agoraphobia, and major depressive and/or dysthymic disorder). The DISC-IV assigns an ADHD diagnosis based on having met the symptom criteria (≥ 6 inattentive and/or ≥ 6 hyperactive/impulsive), several symptoms occurring in two or more settings, and the age of onset (before age 7 years). For our ADHD study diagnosis, the age of onset was updated to include those up to 12 years of age to match the changes from DSM-IV to DSM-5 (American Psychiatric Association, 1994, 2022).

Parents also completed a questionnaire, developed for the PLAY-MH study, on their children's mental health, previous diagnoses, and current treatment. The parent was asked, "Has your child ever been diagnosed with a mental, emotional, or behavioral disorder?" and then asked to select relevant disorders from a list. For each disorder, the parent was also asked about the age at diagnosis, if the child currently had the disorder, and if the

child was currently taking medication for the disorder. The disorders included in this analysis were developmental, learning, or language disorders (autism spectrum disorder, pervasive developmental disorder, intellectual disability, learning disability, speech or other language problems, or other developmental delays) and mental, emotional, or behavioral disorders (ADHD, Tourette Syndrome, ODD, CD, depression, mania, bipolar disorder, anxiety disorder [e.g., phobia, panic, separation, and GAD], PTSD, OCD, trichotillomania, and intermittent explosive disorder). ADHD medication status was also included in the analyses. Information on demographic variables (i.e., sex, race/ethnicity, grade level, highest household education level, academic performance, and free and/or reduced lunch status) was obtained from parents, teachers, and school district records.

Students attending grades 4 to 12 completed an adapted version of the 2013 Youth Risk Behavior Survey (YRBS; Brener et al., 2013), which assesses factors that contribute to unintentional injuries and violence, substance use, unhealthy dietary intake, and physical inactivity in all age groups. The YRBS has shown substantial to higher test-retest reliability ($\kappa = 61\%–100\%$) among students in grades 7 to 12 and efforts are made each even-numbered year to make minor improvements to the questionnaire (Brener et al., 2013). Middle and high school surveys included questions on driving, e-cigarettes, other tobacco products, stimulant diversion and misuse, and other drug use; sexual behavior questions were omitted for the Re-PLAY-MH study. Questions on sleep problems were asked of all students. The all-ages version was used for grades 4 to 5. The middle and high school version was used for grades 6 to 12, with the omission of driving questions in grades 6 to 8. The sample sizes for each question varied due to age group and skip patterns (e.g., children who did not ride a bike were not asked about bike helmet usage). Standard YRBS benchmarks were used to create cut points for these factors whenever possible; otherwise composites were created by a “yes” response to any within a group (1+ sleep issues, any substance use, etc.).

Health risk factors analyzed included factors that contributed to unintentional injury risk (not always using a seatbelt, never or rarely wearing a bike helmet), screen time (>2 hr daily: overall, television time, video games), sleep (insufficient sleep duration, any sleep problems), dietary¹ (lack of daily fruit/vegetable consumption in past week, any soda consumption in past week, ≥ 1 skipped breakfast(s) a week), physical activity¹ (overall physical inactivity, >2 days physically inactive a week), substance use¹ (any substance use, ever used tobacco/nicotine, ever drank any alcohol, ever used marijuana, ever misused stimulant medication), and interpersonal violence risks¹ (bullied, threatened, or feeling unsafe at school, been in a physical fight in past year, carried a weapon in past 30 days) and felt sad in past 2 weeks. Supplemental Table 1 summarizes the questions and how the variables were coded for analysis.

Health risk factors were examined across three sets of diagnostic groupings. The first set of analyses used the DISC-IV study criteria to group children into two mutually exclusive groups: (1) meeting diagnostic criteria for ADHD overall (with or without co-occurring anxiety [agoraphobia, GAD, OCD, panic, PTSD, separation anxiety, social phobia], mood

¹These health risk factors were only asked about in middle and high school surveys.

[depressive, manic], disruptive [ODD, CD] disorders), (2) not meeting criteria for any mental disorder; with a third group composed of a subset of those who met the diagnostic criteria for ADHD only (without a co-occurring disorder). The second set of analyses examined current ADHD medication use based on parent report in three mutually exclusive groups: (1) ADHD diagnosis and taking medication, (2) ADHD diagnosis without taking medication, and (3) no ADHD diagnosis. For this grouping, we used an expanded ADHD diagnosis definition to include students who met DISC-IV ADHD criteria and students with a current parent-reported ADHD diagnosis who were not identified as having ADHD using the DISC-IV. This was done because students previously diagnosed with ADHD and receiving ADHD treatment may have had reduced symptoms at the time of the study and thus failed to meet the DISC-IV criteria. For the third set of analyses, we examined the relation of health risk factors and ADHD on a continuous scale using DISC-IV ADHD symptom count among all students in our sample.

Data Analysis

Weighted frequency estimates were calculated for DISC-IV diagnosed disorders (ADHD overall, ADHD only, and no disorder) overall and by demographic and clinical subgroups: sex (female, male), race and ethnicity (White non-Hispanic, non-White [includes Hispanic]), highest attained household education level (up to or through high school, more than high school), receipt of free/reduced school lunch (yes, no), teacher report of academic performance (first quartile [lowest], second quartile, third quartile, fourth quartile [highest]), and any current parent-reported mental disorder diagnosis (any mental, behavioral, or developmental disorders which includes the subcategory of any developmental, learning, or language disorders and the subcategory of any mental, emotional, or behavioral disorders; ADHD diagnosis; ADHD medication). Chi-square tests with an α of .05 were used to determine differences between all with ADHD and those with no disorder.

Weighted prevalence estimates and 95% Clopper-Pearson confidence intervals (95% CI) were calculated for the percentage of students with each health risk behavior stratified by the DISC-IV diagnostic criteria (ADHD overall, ADHD only, and no disorder) and ADHD medication groupings (ADHD and taking medicine, ADHD and not taking medicine, and no ADHD diagnosis). To examine associations between health risk factors, weighted prevalence estimates and standard errors were calculated for the percentage of students with risk for each pair of health risk factor categories between students with ADHD overall and students with no disorder. Chi-square tests with an α of .05 were used to determine differences across groups. To analyze the relation between continuous ADHD symptom count (exposure) and health risk factors (outcome), we conducted unadjusted logistic regressions with odds ratios (OR) summarizing the change in odds of each outcome with an increase of 1 ADHD symptom are presented. Due to few events per risk status ($N < 5$) or unstable estimates (relative standard errors $> 50\%$), some estimates are not shown. Students with a missing value were excluded from analyses including that variable. All weighted analyses accounted for the complex sample design and incorporated sample weights designed to produce estimates representative of the school district population (Wanga et al., 2022) and were conducted using SAS v9.4 survey procedures (SAS Institute, Cary, NC) and SAS-callable SUDAAN v11.0.1 (RTI International; Cary, NC).

Results

Sample Characteristics

Of the 345 students included in our analyses, 18.9% met DISC-IV criteria for ADHD overall (with or without a co-occurring disorder), 11.6% met the criteria for ADHD only, and 81.1% met no disorder criteria. Based on parent report, 34.9% of the students had a previously diagnosed mental, behavioral, or developmental disorder; 18.8% had a developmental, learning, or language disorder; 27.1% had a mental, emotional, or behavioral disorder; 23.7% had an ADHD diagnosis; and 16.6% were taking ADHD medication. Female students less often met the DISC-IV criteria for ADHD (9.6%) than did male students (26.6%; $p = .001$). Teachers' reports of academic performance differed significantly between the groups; 30.8% of students in the lowest quartile of performance had ADHD and only 4.7% of students in the highest quartile had ADHD ($p < .001$). The DISC-IV disorder prevalence did not differ by race and ethnicity, grade level, highest household education level, and free or reduced school lunch status.

Health Risk Factors Among Students Who Met Diagnostic Criteria for ADHD

Students who met the DISC-IV criteria for ADHD overall (with or without co-occurring disorders) and only ADHD more often reported health risk factors in several of the categories examined (Table 2). Not wearing a bike helmet was significantly more common among students with ADHD overall compared to students with no disorder ($PR = 1.17$, 95% CI [1.01, 1.35]). Interpersonal violence risks were significantly more common among students with ADHD overall than among students without a disorder, including being bullied, threatened, or feeling unsafe at school ($PR = 1.83$, 95% CI [1.02, 3.30]), and carrying a weapon in the past 30 days ($PR = 7.02$, 95% CI [2.58, 19.08]). Feeling sad or hopeless in the past 2 weeks ($PR = 2.74$, 95% CI [1.01, 7.47]) was also more common among students with ADHD overall than those without a disorder. Compared to students without a disorder, students with ADHD overall more often had sleep problems ($PR = 1.13$, 95% CI [0.99, 1.29]), drank any soda in the past week ($PR = 1.19$, 95% CI [0.99, 1.42]), and participated in a physical fight in the past year ($PR = 1.78$, 95% CI [0.96, 3.30]); however, 95% CIs included 1.0. While not statistically different, these results were trending to significance.

Similarly, students with ADHD only more often drank any soda in the past week ($PR = 1.21$, 95% CI [1.01, 1.46]), carried a weapon in the past 30 days ($PR = 10.31$, 95% CI [4.01, 26.55]), and felt sad or hopeless in the past 2 weeks ($PR = 3.24$, 95% CI [1.03, 10.15]) compared to those with no disorder. Not wearing a bike helmet was more common among students with ADHD only compared to students with no disorder ($PR = 1.15$, 95% CI [0.96, 1.37]); however, 95% CIs included 1.0 and was not statistically different.

Associations Among Health Risk Factors

We also examined whether associations among pairs of health risk factors differed for students who had ADHD overall (with or without co-occurring disorders) compared to those who did not. Results revealed some significant associations between health risk factors when stratified by ADHD diagnosis status (Table 3). Specifically, different association patterns

for those with ADHD compared to no disorder were seen for students with elevated risk for interpersonal violence and the following risk factors that contribute to unintentional injury (65.5% vs. 25.3%, $p = .0001$), >2 hr screen time on school days (44.1% vs. 16.8%, $p = .003$), sleep problems (68.7% vs. 29.0%, $p = .001$), and no daily serving of fruit and vegetables (55.3% vs. 25.4%, $p = .015$); as well as for those with high screen time and feeling sad or hopeless (14.0% vs. 3.2%, $p = .050$). Additionally, while not statistically different, interpersonal violence and insufficient sleep (45.4% vs. 22.8%, $p = .072$) and interpersonal violence and substance use (34.9% vs. 13.1%, $p = .094$) were trending to significance for those with ADHD compared to those with no disorder. There were no significant differences between ADHD status and the associations of other pairs of health risk factors.

Health Risk Factors by ADHD Diagnosis and Medication Status

Students who either met the DISC-IV criteria or had a parent-reported ADHD diagnosis and were receiving ADHD medication had a higher prevalence of certain health risk factors than students with ADHD without medication and students with no ADHD diagnosis, as shown in Table 4. Students receiving medication for ADHD had a higher prevalence of > 2 hr of daily TV compared to students without ADHD (PR = 1.91, 95% CI [1.23, 2.95]). Students with ADHD taking medication were more likely to report drinking any soda in the past week compared to those without ADHD (PR = 1.29, 95% CI [1.07, 1.56]), and trending toward significance when compared to those with ADHD without medication (PR = 1.06, 95% CI [0.95, 1.18]).

However, skipping breakfast once a week or more was less common among students with ADHD taking medication compared to students with ADHD not taking medication (PR = 0.31, CI [0.15, 0.61]) and students without ADHD (PR = 0.40, 95% CI [0.20, 0.78]). Being in a physical fight in the past year (PR = 3.04, 95% CI [1.54, 6.01]), carrying a weapon in the past 30 days (PR = 4.99, 95% CI [1.42, 17.52]), and feeling sad or hopeless in the past 2 weeks (PR = 4.20, 95% CI [1.63, 10.86]) were significantly more common among students with ADHD taking medication compared to students without ADHD, but were no more common than among students with ADHD without medication.

Health Risk Factors and ADHD Symptom Count

The results of logistic regression analyses of health risk factors associated with ADHD symptom counts are presented in Table 5. For every additional ADHD symptom reported, the odds of watching > 2 hr of daily TV (OR = 1.09, 95% CI [1.04, 1.15]), stimulant medication misuse (OR = 1.13, 95% CI [1.04, 1.23]), being in a physical fight (OR = 1.10, 95% CI [1.03, 1.17]), and carrying a weapon in the past 30 days (OR = 1.20, 95% CI [1.11, 1.29]) increased. Increases in ADHD symptoms were also associated with higher odds of drinking soda at least once a week (OR = 1.12, 95% CI [0.99, 1.26]), and having been bullied, threatened, or feeling unsafe at school (OR = 1.06, 95% CI [0.99, 1.13]), but the lower 95% CIs crossed 1.0 and were not statistically different.

Discussion

Understanding patterns of health risk behaviors among students with ADHD and learning more about their elevated risk across multiple types of risk factors can inform interventions to reduce the morbidity and mortality associated with the disorder (Diallo et al., 2022). Weighted analyses produced estimates of associations between ADHD and a constellation of health risk factors representative of a suburban/rural school district population in South Carolina.

We found significant differences in the prevalence of selected health risk factors among students who met the criteria for ADHD diagnosis (with or without a co-occurring disorder) and those without a disorder. In particular, the results revealed that several health risk factors were more common among students with ADHD overall than among those with no disorder, specifically not wearing a helmet when biking, being bullied, threatened, or feeling unsafe at school, carrying a weapon, and feeling sad or hopeless. In addition, having sleep problems, drinking any soda, and participating in a physical fight were close to being significantly more often reported for students with ADHD overall than among those with no disorder. We also looked at students with ADHD only, without any co-occurring disorders, and found very similar results across categories. Our findings of increased health risk among students with ADHD are consistent with prior research that examined separate health risk behavior categories (Ahmed et al., 2022; Groenman et al., 2017; Ruiz-Goikoetxea et al., 2018).

In addition to differences in health risk factors when examined individually, we also found different association patterns among pairs of health risk factors among children with ADHD compared to those with no mental disorders. Specifically, students with ADHD more often reported interpersonal violence risk with factors that contribute to unintentional injury, high screen time, sleep problems, and having no daily fruit or vegetable serving than children with no disorder; as well as reporting high screen time with feeling sad or hopeless more often. These factors have previously been individually associated with ADHD (Bowling et al., 2017; Iz & Ceri, 2018; Tandon et al., 2019), but ours is one of the first studies to examine associations of pairs of health risk factors. While explanations of these findings are complex and multifaceted, and our data do not allow examination of causality, the impulsive and inattentive behaviors associated with ADHD may increase the likelihood of engaging in activities that lead to unintentional injuries and contribute to poor decision-making (Franken et al., 2008; Romer, 2010). However, these risk factor associations may also represent a reaction to stress from mental health factors and compounding environmental stressors. Experience of bullying and peer rejection may lead to feelings of depression, sleep difficulties, getting into fights, and spending more time on screens. Prior research on gun carrying and associated risk factors noted that individuals who view themselves as being potential victims of bullying or violence are more likely to carry a weapon for self-protection, rather than being perpetrators of violence against others (Simon et al., 2022). Our findings that ADHD is associated with patterns of risk across domains are consistent with models that describe the relation of neurocognitive deficits to health behaviors such as Schoenfelder and Kollins' (2016) biopsychosocial model and Nigg's (2017) description of self-regulatory processes. Further research can examine whether these associations can be replicated in a larger sample, but the emergence of such patterns underscores the potential

benefits of examining risk factors simultaneously rather than in isolation. Additionally, these can inform intervention and prevention work targeting multiple risk factors among youth with ADHD.

We also found that the prevalence of most health risk factors was similar among students with ADHD who did and did not take medication. Compared to their peers without ADHD, adolescents receiving medication for ADHD reported watching TV more frequently, drinking soda more often, more frequently carrying a weapon, more frequently experiencing a physical fight, and more frequently feeling sad or hopeless. Medication is the most common treatment for ADHD among youth, with over 50% of those with ADHD currently taking medication (Danielson et al., 2024). Clinical trials have found significant benefits of medication in reducing health risk outcomes, such as car crashes among people with ADHD (Barkley & Cox, 2007; Chang et al., 2014), likely due to improvements in attention and concentration. However, medication treatment receipt is associated with having more severe ADHD symptoms and co-occurring disorders (Jensen et al., 2001); therefore, the results cannot be interpreted as a lack of treatment effectiveness. Additionally, examining side effects on emotions, such as increased risk of irritability among students taking psychostimulants, particularly amphetamine-derived medications, may help to understand potential risk (Stuckelman et al., 2017). In contrast to those without ADHD and those with ADHD who did not take medications, students with ADHD who took medication reported skipping breakfast less frequently. Loss of appetite is a common side effect of prescription stimulant medication (Gillberg et al., 1997); therefore, breakfast may become an important meal for those who take medication, with the appetite suppressing effect of medication setting in after breakfast is completed. Our results are inconsistent with prior literature demonstrating that youth with ADHD are more likely to skip regular meals, including breakfast, and adhere to irregular eating schedules (Ptacek et al., 2016; San Mauro Martin et al., 2018). Assessing breakfast as an indicator of healthy nutrition may have different implications among youth with ADHD than in the population of youth overall.

We also found that total ADHD symptom count is associated with some health risk factors. While ADHD diagnosis is a categorical label, the underlying symptoms may function in a more linear fashion, indicating an increased detrimental impact on functioning with increased symptoms (Hong et al., 2014). Our findings suggest that, as the number of ADHD symptoms increases, the odds of engagement in several health risk factors also increase, including elevated amounts of TV screen time, misusing stimulant medications, having been in a physical fight, and carrying a weapon. Specific efforts to prevent health risk factors may benefit from identifying children who have an elevated number of ADHD symptoms regardless of whether they have an ADHD diagnosis.

Limitations

The present study has several limitations. First, the study design was cross-sectional; therefore, the associations between ADHD, health risk factors, and other factors examined in the study cannot be used to draw causal inferences. Future studies on engagement in health risk factors among youth with ADHD and other mental disorders could consider using a longitudinal design and assessing a variety of health risk and protective factors

over time to better inform possible causality. Second, adolescents may underreport or overreport their engagement in health risk factors due to social desirability bias, recall bias, or misunderstanding of the questions. Additionally, report of ADHD symptoms relied solely on parent report rather than using multiple informants as is recommended for diagnosis based on clinical guidelines (Wolraich et al., 2019). Future research could incorporate multi-informant approaches, including reports from parents, teachers, and peers, as well as objective measures to validate self-reported behaviors.

Third, health risk behavior questions differed in time span covered by the question and thus may have affected recall and reporting. The generalizability of results may be affected by the inclusion of only one school district in South Carolina, as well as potential response bias given a low participation rate within the study. Findings on interpersonal violence risks such as fighting or carrying weapons are limited by the lack of contextual factors in the data to examine reasons for these behaviors in youth. The interpretation of the findings warrant caution, and a larger sample would allow for more stable estimates with greater power to detect modest differences and the ability to adjust for potential confounders.

Fourth, our sample size did not provide enough power to explore the effects specific co-occurring disorders to determine whether health risk factors are associated with disorders that often co-occur with ADHD (e.g., conduct disorder and depression), or whether there may be a synergistic effect of ADHD and the co-occurring disorder on health risk factors. Further, in addition to selection bias for medication use, there were no data on medication dosage or adherence data such as medication breaks on weekends or during school breaks; the findings regarding medication are descriptive rather than causal in nature.

Lastly, although our sample was relatively diverse with respect to biological sex (48% female) and race/ethnicity (39% from minoritized race/ethnicity backgrounds), because of the sample size, we were unable to examine our research questions by sex, race, or ethnicity. Future research can examine whether specific groups who also have ADHD report engagement in more health risk factors.

Implications

This study's findings have several implications. As discussed, individuals with ADHD had a higher prevalence of engagement in a variety of health risk factors and had decreased engagement in healthy behaviors compared to those with no disorder. However, there were few differences in the prevalence of health risk factors among those with ADHD only compared to those with ADHD overall (with or without a co-occurring disorder), indicating an overall association between ADHD and health risk factors. Difficulties with consistently avoiding risk and engaging in healthy behaviors associated with ADHD may also be affected by general emotional and behavioral challenges present in many mental disorders (Vermeulen-Smit et al., 2015). Youth with co-occurring disorders have the greatest levels of impairment in daily functioning (Becker & Fogleman, 2020), including factors associated with health risks, which may in part explain the elevated risk factors in this group. Future research with a larger sample could examine the impact of co-occurring disorders among youth with ADHD.

Findings from the examination of medication status as related to health risk factors suggest that students with ADHD may still engage in elevated risk behaviors compared to their peers without ADHD, even when receiving medication. This study is cross-sectional and medication use is impacted by selection bias, thus, the direction of the association between medication and health risks cannot be inferred. Nonetheless, these findings highlight the potential role of interventions for youth with ADHD in addition to psychopharmacological treatments in alignment with current treatment guidelines. The recommended treatment for school-aged children and adolescents with ADHD includes psychosocial treatment, such as behavioral parent training or cognitive-behavioral therapy, in combination with medication (Wolraich et al., 2019). While the effects of ADHD medication are only present when the individual has the medication in their system, psychosocial treatments have the potential to teach skills and impact behavioral change, such that improvements are maintained even after the treatment has ended (Hinshaw et al., 2015). Individuals with ADHD may benefit from adding psychosocial treatment focused on reduction of health risk factors and enhancement of healthy behaviors in addition to medication treatment.

These results point to an opportunity for mental health practitioners to assess patients' engagement in health-related factors and address them directly in treatment if warranted. Manualized approaches that address health risk factors such as Thriving in College with ADHD (Canu et al., 2023) have been demonstrated as effective for young adults transitioning to next steps in life. Thriving in College with ADHD includes a module on healthy lifestyles (i.e., improving sleep, increasing physical activity, healthy eating, and reducing substance use), and may function as a model for clinicians working with youth with ADHD and/or other disorders. Another opportunity to address health risks is to support parents, who often make decisions that impact health, such as deciding what foods the family will eat, setting a good sleep schedule, encouraging regular exercise, and generally modeling healthy behaviors. It is important to note that, due to the strong heritability of ADHD, many children and adolescents with ADHD also have parents who meet criteria for the disorder (Faraone & Larsson, 2019), who may therefore experience many of the same health risk factors as their child. Therefore, family-focused interventions to improve health and reduce engagement in health risk behaviors may be most effective for these youth and their parents. Public health resources such as those from the Centers for Disease Control and Prevention (CDC, 2024) on healthy routines can provide support for parents. Additionally, some researchers have begun to develop and test family-centered interventions for children with ADHD to address specific aspects of health behaviors. For example, the Lifestyle Enhancement for ADHD Program (LEAP) has shown promise in increasing physical activity among children with ADHD (Ola et al., 2021).

These data also suggest that some negative health risk factors experienced by youth increase linearly with the increase in ADHD symptoms; therefore, assessing engagement in these factors among youth with subclinical symptoms and including them in intervention efforts when warranted may be helpful.

The results of this study help advance our understanding of the comprehensive patterns of health risks, including physical and mental health factors, in students with

ADHD. Assessing involvement in health-related factors and the development of tailored interventions may provide clinical benefits for youth with ADHD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Weighted Percentage of Students Who Met Diagnostic Criteria for ADHD Overall (With or Without a Co-occurring Disorder), ADHD Only, Or No Disorder, by Demographic and Clinical Characteristics, Replication Project to Learn about Youth Mental Health, 2015 to 2017.

Demographics and clinical characteristics	Total sample N (wt %)	Meets diagnostic criteria (DISC-IV) ^{a, b}			χ^2 p-value ^d
		ADHD criteria		No disorder criteria met N (wt %)	
		ADHD overall ^c N (wt %)	ADHD only N (wt %)		
Overall	345 (100)	85 (18.9)	46 (11.6)	260 (81.1)	
Sex					
Female	155 (45.3)	16 (9.6)	7 (4.2)	139 (90.4)	.001 **
Male	190 (54.7)	69 (26.6)	39 (17.7)	121 (73.4)	
Race and ethnicity					
White (non-Hispanic)	181 (60.7)	50 (19.7)	30 (13.4)	131 (80.3)	.686
Non-White (incl. Hispanic)	164 (39.3)	35 (17.6)	16 (8.9)	129 (82.4)	
Grade Level					
Elementary (4 th -5 th)	119 (22.4)	28 (19.2)	18 (11.9)	91 (80.8)	.939
Middle or high school (6 th -12 th)	226 (77.6)	57 (18.8)	28 (11.6)	169 (81.2)	
Highest household education level					
≤ High school	87 (23.5)	25 (19.4)	11 (7.7)	62 (80.6)	.921
> High School	257 (76.5)	60 (18.8)	35 (12.9)	197 (81.2)	
Free/reduced school lunch					
No	127 (44.3)	28 (15.7)	19 (12.1)	99 (84.3)	.311
Yes	218 (55.7)	57 (21.5)	27 (11.2)	161 (78.5)	
Teacher report of academic performance					
First quartile (lowest)	88 (20.6)	33 (30.8)	16 (14.1)	55 (69.2)	<.001 **
Second quartile	55 (14.5)	18 (28.2)	7 (16.7)	37 (71.8)	
Third quartile	78 (22.5)	22 (27.5)	14 (22.1)	56 (72.5)	
Fourth quartile (highest)	116 (42.4)	10 (4.7)	8 (3.3)	106 (95.3)	
Child mental disorder (parent-report) ^e					
Any current mental, behavioral, or developmental disorder diagnosis	148 (34.9)	64 (37.8)	34 (23.2)	84 (62.2)	<.001 **
Any current developmental, learning, or language disorder diagnosis	80 (18.8)	34 (35.9)	17 (17.8)	46 (64.1)	.002 **
Any current mental, emotional, or behavioral disorder diagnosis	115 (27.1)	56 (41.7)	28 (24.3)	59 (58.3)	<.001 **
ADHD diagnosis	106 (23.7)	56 (47.6)	28 (27.7)	50 (52.4)	<.001 **
ADHD medication	73 (16.6)	36 (45.3)	19 (30.4)	37 (54.7)	.005 **

Note. wt = weighted

^aDiagnostic Interview Schedule for Children, IV (DISC-IV) modules for ADHD, oppositional defiant (ODD), conduct, generalized anxiety (GAD), social phobia, separation anxiety, panic, obsessive-compulsive (OCD), agoraphobia, post-traumatic stress (PTSD), major depressive, dysthymic, mania, and hypomania.

^bExcluding those who did not meet the DISC-IV criteria for ADHD, but did meet the criteria for another disorder (N = 35).

^cMeets diagnostic criteria for ADHD, with or without a co-occurring DISC-IV disorder.

^dChi-square p-value between all ADHD and no disorder criteria met.

^eParent reports a current diagnosis of at least one DLLD: autism spectrum disorder, intellectual disability, developmental disability, learning disability, speech/language disorder; or MEB: ADHD, Tourette syndrome, GAD, OCD, bipolar disorder, PTSD, trichotillomania, depressive, manic, ODD, conduct disorder, intermittent explosive disorder.

^{**}
p-value < .05.

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Table 2.

Distribution of Students Who Meet Diagnostic Criteria for ADHD Overall (With or Without a Co-Occurring Disorder), ADHD Only, or No Disorder by Health Risk Factors, Replication Project to Learn About Youth Mental Health, 2015 to 2017.

Health risk factors	Meets diagnostic criteria (DISC-IV) <i>a, b</i>			ADHD overall ^c compared to no disorder PR (95% CI)	ADHD only compared to no disorder PR (95% CI)
	ADHD Criteria		No disorder criteria met wt % (95% CI)		
	ADHD overall ^c wt % (95% CI)	ADHD only wt % (95% CI)			
Unintentional injury risk factors					
Doesn't always use a seatbelt	20.8 (11.3, 33.3)	17.2 (6.8, 33.3)	27.2 (18.5, 37.4)	0.76 (0.42, 1.39)	0.63 (0.28, 1.41)
Never/rarely wears a bike helmet	87.6 (76.0, 94.9)	85.9 (69.2, 95.5)	74.8 (66.1, 82.2)	1.17 (1.01, 1.35) **	1.15 (0.96, 1.37) *
Screen time factors					
> 2 hr of daily screen time ^d	61.6 (43.2, 77.8)	56.5 (30.7, 79.9)	51.9 (42.3, 61.3)	1.19 (0.86, 1.65)	1.09 (0.68, 1.74)
> 2 hr of daily tv	36.4 (23.7, 50.6)	27.2 (13.6, 45)	24.7 (18.4, 31.9)	1.47 (0.94, 2.31)	1.10 (0.59, 2.06)
> 2 hr of daily video games	44.8 (27.7, 62.9)	37.1 (17.3, 60.7)	40.8 (31.4, 50.7)	1.10 (0.70, 1.72)	0.91 (0.49, 1.69)
Sleep factors					
Insufficient sleep duration ^e	70.6 (56.8, 82.1)	72.8 (53.1, 87.6)	74.7 (67.5, 81.0)	0.94 (0.78, 1.15)	0.97 (0.76, 1.25)
≥ 1 Sleep problems ^d	87.7 (78.1, 94.2)	85.6 (72, 94.2)	77.5 (68.8, 84.8)	1.13 (0.99, 1.29) *	1.10 (0.94, 1.29)
Dietary factors ^f					
No daily fruit and vegetable in past week ^d	81.6 (66.1, 92.1)	85.2 (65.5, 96.1)	84.6 (77.9, 90.0)	0.96 (0.82, 1.14)	1.01 (0.84, 1.21)
Drinks soda at least once a week	90.6 (79.9, 96.7)	92.8 (76.4, 99.1)	76.4 (61.6, 87.7)	1.19 (0.99, 1.42) *	1.21 (1.01, 1.46) **
≥ 1 Skipped breakfast(s) a week	46.3 (27.9, 65.5)	39.5 (17.7, 64.9)	48.5 (37.3, 59.8)	0.96 (0.61, 1.51)	0.81 (0.43, 1.54)
Physical activity ^f					
Overall physical inactivity ^d	13.2 (5.7, 24.8)		13.0 (8.1, 19.5)	1.01 (0.46, 2.24)	
>2 days physically inactive a week	39.7 (22.8, 58.6)	34.5 (14.8, 59)	50.5 (39.9, 61.1)	0.79 (0.48, 1.29)	0.68 (0.35, 1.35)
Substance use ^f					
Any substance use ^d	46.8 (27.3, 67.1)	53.6 (27.7, 78.2)	37.0 (26.0, 49.0)	1.27 (0.76, 2.13)	1.45 (0.82, 2.56)
Ever drank any alcohol	33.2 (13.3, 58.8)		21.7 (14.7, 30.1)	1.53 (0.72, 3.24)	
Ever used tobacco or nicotine	14.5 (4.8, 31.0)		11.4 (5.6, 19.9)	1.28 (0.45, 3.59)	

Health risk factors	Meets diagnostic criteria (DISC-IV) ^{a, b}			ADHD overall ^c compared to no disorder PR (95% CI)	ADHD only compared to no disorder PR (95% CI)
	ADHD Criteria		No disorder criteria met wt % (95% CI)		
	ADHD overall ^c wt % (95% CI)	ADHD only wt % (95% CI)			
Ever used marijuana	28.3 (9.0, 56.0)		15.5 (5.9, 30.6)	1.83 (0.61, 5.51)	
Ever misused stimulant medication	12.1 (5.0, 23.5)		6.7 (2.9, 12.9)	1.81 (0.68, 4.83)	
Interpersonal violence risk factors^f					
Bullied, threatened, or feeling unsafe at school ^d	35.6 (20.8, 52.8)	33 (14.8, 56)	19.5 (12.4, 28.3)	1.83 (1.02, 3.30) ^{**}	1.70 (0.81, 3.55)
Been in a physical fight in past year	32.9 (18.7, 49.8)	35.1 (15.1, 59.9)	18.5 (11.6, 27.2)	1.78 (0.96, 3.30) [*]	1.90 (0.89, 4.06)
Carried a weapon in past 30 days	33.1 (13.9, 57.7)	48.7 (22.1, 75.9)	4.7 (1.9, 9.7)	7.02 (2.58, 19.08) ^{**}	10.31 (4.01, 26.55) ^{**}
Felt sad or hopeless in past 2 weeks^f	28.1 (9.5, 54.6)	33.2 (7.7, 69.2)	10.2 (4.7, 18.7)	2.74 (1.01, 7.47) [*]	3.24 (1.03, 10.15) ^{**}

Note. Shaded boxes are unstable results. wt = weighted; CI = confidence interval; PR = prevalence ratio.

^aDiagnostic Interview Schedule for Children, IV (DISC-IV) modules for ADHD, oppositional defiant (ODD), conduct, generalized anxiety (GAD), social phobia, separation anxiety, panic, obsessive-compulsive (OCD), agoraphobia, post-traumatic stress (PTSD), major depressive, dysthymic, mania, and hypomania.

^bExcluding those who did not meet the DISC-IV criteria for ADHD, but did meet the criteria for another disorder (N = 35).

^cMeets diagnostic criteria for ADHD, with or without a co-occurring DISC-IV disorder.

^dComposite variable, see Supplemental Table 1 for detailed coding.

^eInsufficient sleep duration benchmarks differed by age, see Supplemental Table 1 for detailed coding.

^fThese health risk factors were only asked about in middle and high school surveys.

^{**}p-value < .05;

^{*}.05 < p-value < .1.

Table 3.

Associations Among Health Risk Factors Among Middle and High School Students Who Met Diagnostic Criteria for ADHD Overall (With or Without a Co-occurring Disorder) and No Disorder^a, Replication Project to Learn about Youth Mental Health, 2015 to 2017.

	High screen time ^c	Insufficient sleep ^d	Sleep problems	No daily fruit & vegetable	Physical inactivity	Substance use ^c	Interpersonal violence ^c	Feeling sad or hopeless ^c
	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)		% (SE)
Unintentional injury								
ADHD ^b	44.6 (9.4)	44.8 (10.0)	66.9 (8.2)	58.9 (8.9)	7.5 (3.4)	35.6 (10.6)	65.5 (8.3)**	26.4 (11.2)
No disorder	32.1 (4.5)	46.7 (5.5)	57.8 (5.4)	55.0 (5.4)	9.7 (2.4)	28.7 (5.6)	25.3 (4.3)**	7.3 (3.1)
High screen time^c								
ADHD ^b		36.5 (8.9)	58.3 (10.3)	46.1 (9.6)	10.1 (3.9)	30.0 (8.6)	44.1 (9.4)**	14.0 (5.4)*
No disorder		38.0 (5.4)	41.0 (5.2)	46.1 (5.7)	7.5 (2.2)	18.5 (3.5)	16.8 (3.2)**	3.2 (1.3)*
Insufficient sleep								
ADHD ^b			58.0 (8.8)	50.2 (9.7)	8.0 (3.6)	29.7 (11.5)	45.4 (10.0)*	23.8 (11.4)
No disorder			55.1 (5.4)	60.5 (4.9)	8.9 (2.3)	27.9 (5.7)	22.8 (4.0)*	7.9 (3.2)
Sleep problems								
ADHD ^b				68.7 (7.8)	11.6 (4.2)	43.8 (10.2)	68.7 (8.1)**	28.1 (11.1)
No disorder				64.2 (5.1)	8.4 (2.2)	34.5 (5.7)	29.0 (4.5)**	9.6 (3.2)
No daily fruit/vegetable								
ADHD ^b					11.5 (4.2)	42.7 (10.4)	55.3 (9.3)**	
No disorder					11.7 (2.6)	33.1 (5.7)	25.4 (4.3)**	8.5 (3.2)
Physical inactivity								
ADHD ^b							9.5 (3.7)	
No disorder						4.5 (1.7)	5.0 (1.8)	3.0 (1.5)
Substance use^c								
ADHD ^b							34.9 (10.7)*	
No disorder							13.1 (3.1)*	3.1 (1.4)

	High screen time ^c	Insufficient sleep ^d	Sleep problems	No daily fruit & vegetable	Physical inactivity	Substance use ^c	Interpersonal violence ^c	Feeling sad or hopeless ^c
	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)		% (SE)
Interpersonal violence ^c								
ADHD ^b								28.1 (11.1)
No disorder								7.7 (3.1)

Note. Shaded boxes are unstable results. wt = weighted; SE = standard error.

^aElementary students were excluded to have a sample with complete data for all indicators, as well as those who did not meet the DISC-IV criteria for ADHD, but did meet the criteria for another disorder (N = 35).

^bDiagnostic Interview Schedule for Children, IV (DISC-IV) module for ADHD (with or without co-occurring disorders).

^cComposite variable with one or more risky responses to the questions within the category, see Supplemental Table 1 (available online).

^dInsufficient sleep duration benchmarks differed by age, see Supplemental Table 1 for detailed coding.

p-value < .05;
* .05 < p-value < .1.

Table 4.

Distribution of Students With Medicated ADHD, Unmedicated ADHD, and No ADHD Diagnosis, by Health Risk Factors, Project to Learn about Youth Mental Health Replication Study, 2015 to 2017.

Health risk factors	Any ADHD diagnosis ^b		No ADHD diagnosis wt % (95% CI)	ADHD w/ medication compared to	
	ADHD medication wt % (95% CI)	No ADHD medication wt % (95% CI)		ADHD w/o medication PR (95% CI)	No ADHD diagnosis PR (95% CI)
Unintentional injury risk factors					
Doesn't always use a seatbelt	31.6 (14.9, 52.8)	22.8 (11.8, 37.4)	25.3 (16.0, 36.6)	1.39 (0.63, 3.05)	1.25 (0.62, 2.52)
Never/rarely wears a bike helmet	74.3 (48.4, 91.7)	85.0 (69.3, 94.6)	76.5 (68.3, 83.5)	0.87 (0.64, 1.19)	0.97 (0.72, 1.30)
Screen time factors					
> 2 hr of daily screen time ^d	49.6 (31.7, 67.6)	70.1 (55.9, 82.0)	51.6 (41.0, 62.1)	0.71 (0.48, 1.05)	0.96 (0.64, 1.44)
> 2 hr of daily tv	44.8 (30.8, 59.5)	25.8 (13.1, 42.5)	23.5 (16.8, 31.4)	1.74 (0.92, 3.28)	1.91 (1.23, 2.95) **
> 2 hr of daily video games	37.7 (21.6, 56.2)	47.2 (28.8, 66.2)	41.5 (31.0, 52.5)	0.80 (0.44, 1.45)	0.91 (0.55, 1.52)
Sleep factors					
Insufficient sleep duration ^e	80.4 (67.9, 89.7)	67.9 (52.3, 81.1)	73.6 (65.5, 80.6)	1.18 (0.93, 1.51)	1.09 (0.93, 1.29)
≥ 1 Sleep problems ^d	84.2 (73.3, 91.9)	86.3 (73.0, 94.6)	77.0 (67.0, 85.2)	0.98 (0.83, 1.14)	1.09 (0.94, 1.28)
Dietary factors ^c					
No daily fruit and vegetable in past week ^d	91.6 (79.9, 97.6)	79.4 (60.0, 92.2)	83.1 (75.5, 89.2)	1.15 (0.93, 1.43)	1.10 (0.98, 1.24) *
Drinks soda at least once a week	94.9 (84.4, 99.2)	89.8 (75.1, 97.3)	73.5 (57.4, 86.0)	1.06 (0.95, 1.18) *	1.29 (1.07, 1.56) **
≥ 1 Skipped breakfast(s) a week	20.4 (9.2, 36.3)	66.6 (47.8, 82.1)	51.3 (39.2, 63.4)	0.31 (0.15, 0.61) **	0.40 (0.20, 0.78) **
Physical activity ^c					
Overall physical inactivity ^d	16.8 (7.0, 31.6)		12.4 (7.3, 19.5)		1.35 (0.58, 3.13)
>2 days physically inactive a week	43.0 (21.1, 67.2)	50.0 (30.5, 69.5)	49.5 (38.1, 60.9)	0.86 (0.45, 1.65)	0.87 (0.49, 1.55)
Substance use ^c					
Any substance use ^d	32.0 (10.9, 60.4)	39.5 (20.6, 61.0)	40.3 (28.3, 53.3)	0.81 (0.32, 2.03)	0.79 (0.35, 1.80)
Ever drank any alcohol	24.3 (5.0, 56.9)	28.3 (10.8, 52.3)	23.0 (15.2, 32.4)	0.86 (0.24, 3.05)	1.06 (0.35, 3.17)
Ever used tobacco or nicotine		17.8 (5.1, 39.3)	11.9 (5.5, 21.6)		
Ever used marijuana		20.4 (5.6, 45.0)	16.6 (5.9, 33.7)		

Health risk factors	Any ADHD diagnosis ^b		No ADHD diagnosis wt % (95% CI)	ADHD w/ medication compared to	
	ADHD medication wt % (95% CI)	No ADHD medication wt % (95% CI)		ADHD w/o medication PR (95% CI)	No ADHD diagnosis PR (95% CI)
Ever misused stimulant medication		13.9 (4.7, 29.5)	7.2 (2.9, 14.3)		
Interpersonal violence risk factors^c					
Bullied, threatened, or feeling unsafe at school ^d	33.8 (13.7, 59.3)	34.6 (18.8, 53.3)	17.7 (11.4, 25.7)	0.98 (0.43, 2.22)	1.91 (0.89, 4.09)
Been in a physical fight in past year	43.7 (21.6, 67.8)	29.5 (14.8, 48.2)	14.4 (8.7, 21.9)	1.48 (0.69, 3.18)	3.04 (1.54, 6.01)**
Carried a weapon in past 30 days	25.5 (6.0, 56.8)		5.1 (1.9, 10.8)		4.99 (1.42, 17.52)**
Felt sad or hopeless in past 2 weeks^c	35.2 (11.5, 65.9)		8.4 (4.2, 14.5)		4.20 (1.63, 10.86)**

Note. Shaded boxes are unstable results. wt = weighted; CI = confidence interval; PR = prevalence ratio.

^aExcluding those who did not meet the DISC-IV criteria for ADHD, but did meet the criteria for another disorder (N = 35).

^bMeet the criteria for the diagnostic Interview Schedule for Children, IV (DISC-IV) module for ADHD, or by parent-report of a current diagnosis.

^cThese health risk factors were only asked about in middle and high school surveys.

^dComposite variable, see Supplemental Table 1 for detailed coding (available online).

^eInsufficient sleep duration benchmarks differed by age, see Supplemental Table 1 for detailed coding.

** p-value < .05;

* .05 < p-value < .1.

Table 5.

Logistic Regression Analysis of ADHD Symptom Count, Project to Learn About Youth Mental Health Replication Study, 2015 to 2017.

Health risk factors	ADHD symptom count (DISC-IV) <i>a, b</i>			
	β	Odds ratio	(95% CI)	p-value
Unintentional injury risk factors				
Doesn't always use a seatbelt	-0.02	0.98	(0.92, 1.06)	0.657
Never/rarely wears a bike helmet	0.06	1.06	(0.98, 1.15)	0.134
Screen time factors				
> 2 hr of daily screen time <i>c</i>	0.03	1.03	(0.97, 1.10)	0.134
> 2 hr of daily tv	0.09	1.09	(1.03, 1.15)	0.001 **
> 2 hr of daily video games	0.02	1.02	(0.96, 1.09)	0.451
Sleep factors				
Insufficient sleep duration <i>d</i>	-0.02	0.98	(0.92, 1.04)	0.471
≥ 1 Sleep problems <i>c</i>	0.06	1.06	(0.98, 1.15)	0.149
Dietary factors^e				
No daily fruit and vegetable in past week <i>c</i>	-0.01	0.99	(0.91, 1.07)	0.766
Drinks soda at least once a week	0.15	1.16	(1.00, 1.34)	0.047 **
≥ 1 Skipped breakfast(s) a week	-0.01	0.99	(0.92, 1.06)	0.767
Physical activity^e				
Overall physical inactivity <i>c</i>	0.05	1.05	(0.99, 1.13)	0.112
>2 days physically inactive a week	-0.03	0.97	(0.91, 1.04)	0.430
Substance use^e				
Any substance use <i>c</i>	0.02	1.03	(0.95, 1.11)	0.516
Ever drank any alcohol	0.04	1.04	(0.96, 1.12)	0.516
Ever used tobacco or nicotine	0.04	1.04	(0.95, 1.14)	0.401
Ever used marijuana	0.02	1.02	(0.90, 1.16)	0.714
Ever misused stimulant medication	0.11	1.12	(1.03, 1.22)	0.007 **
Interpersonal violence risk factors^e				
Bullied, threatened, or feeling unsafe at school <i>c</i>	0.09	1.09	(1.02, 1.17)	0.133
Been in a physical fight in past year	0.09	1.1	(1.03, 1.18)	0.014 **
Carried a weapon in past 30 days	0.17	1.18	(1.10, 1.28)	0.006 **
Felt sad or hopeless in past 2 weeks^e	0.07	1.08	(0.98, 1.19)	<0.001 **

^aDiagnostic Interview Schedule for Children, IV (DISC-IV) module for ADHD, with 18 symptom questions.

^bExcluding those who did not meet the DISC-IV criteria for ADHD, but did meet the criteria for another disorder (N = 35).

^cComposite variable, see Supplemental Table 1 for detailed coding (available online).

^dInsufficient sleep duration benchmarks differed by age, see Supplemental Table 1 for detailed coding.

^eThese health risk factors were only asked about in middle and high school surveys.

p-value < .05.

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