Adolescent outcomes of childhood attention-deficit/hyperactivity disorder in a diverse community sample

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Abstract

Objective—To describe adolescent outcomes of childhood attention deficit-/ hyperactivity disorder (ADHD) in a diverse community sample.

Method—ADHD screening of a school district sample of 1,615 students ages 5 to 11 years was followed by a case-control study 8 years later. High risk youths meeting full (n=94) and subthreshold (n=75) DSM-IV ADHD criteria were matched with demographically similar low risk peers (n=163). Outcomes domains included symptoms; functional impairment; quality of life; substance use; educational outcomes; and juvenile justice involvement.

Results—44% of youths with childhood ADHD had not experienced remission. Compared to unaffected peers, adolescents with childhood ADHD were more likely to display oppositional defiant disorder (OR=12.9; 95% CI 5.6-30.0), anxiety/depression (OR=10.3; 95% CI 2.7-39.3), significant functional impairment (OR=3.4; 95% CI 1.7-6.9), reduced quality of life (OR=2.5, 95% CI 1.3-4.7), and to have been involved with juvenile justice (OR=3.1; 95% CI 1.0-9.1). Subthreshold ADHD, but not full ADHD, increased the risk of grade retention, whereas both conditions increased the risk of graduation failure. Oppositional defiant disorder (ODD), but not childhood ADHD, increased the risk of cannabis and alcohol use. None of the adolescent outcomes of childhood ADHD were moderated by gender, race or poverty.

Conclusions—ADHD heralds persistence of ADHD and comorbid symptoms into adolescence, as well as significant risks for functional impairment and juvenile justice involvement. Subthreshold ADHD symptoms typically do not qualify affected students for special educational interventions,

yet increase the risk for adverse educational outcomes. Findings stress the importance of early ADHD recognition, especially its comorbid presentation with ODD, for prevention and intervention strategies.

Keywords

attention-deficit/hyperactivity disorder; diverse sample; adolescent outcomes; functional impairment; quality of life

Introduction

Early observational studies of the developmental course and of adolescent or adult outcomes of attention deficit/ hyperactivity disorder (ADHD) suggested frequent symptom persistence into adulthood, and dysfunctional outcomes in the domains of psychological adjustment, interpersonal relationships, and work performance. [1, 2] A recent international investigation by Lara and associates, [3] based on the World Health Organization World Mental Health Survey, reported that half of the cases of childhood ADHD persisted into adulthood and that persistence was highest for the attentional plus impulsive-hyperactive type. The presence of ADHD symptoms is associated with concurrent significant functional impairment in home, school, and peer domains. [4] Thus, it is not surprising that a recent review by Danckaerts et al. [5] concludes that ADHD has a significant negative impact on quality of life comparable to that of other mental disorders and severe physical disorders, particularly as reported from the perspective of parents.

ADHD has been linked to increased risk for substance use disorders (SUD). [6-8] Molina et al. propose that a childhood ADHD diagnosis is as strong a risk factor for substance use and abuse as a positive SUD family history, and that the risk cuts across alcohol, tobacco, marijuana, and other drugs. [9] Previous studies have revealed conflicting findings regarding the risk for alcohol use disorder (AUD) outcomes among children with ADHD, [7, 10, 11] but have established that patients with ADHD are more likely to initiate cigarette smoking, appear at higher risk for the development of nicotine dependence and may have more difficulty with smoking cessation. [6-8, 11]

ADHD is associated with poor grades, lowered reading and math standardized test scores, higher grade retention, and increased rates of detention and expulsion which eventually result in lower rates of high school graduation and postsecondary education. [12] Longitudinal studies indicate that students with ADHD tend to achieve at lower levels than would be predicted based on intellectual ability. [13] The importance of considering learning disabilities in ADHD outcome studies is emphasized by Faraone and associates who reported that among children with ADHD, those with comorbid LD at baseline had higher rates of grade retention, in-school tutoring, and placement in special education classes at follow-up. [14]

Furthermore, studies spanning several decades have found that ADHD is associated with increased rates of delinquency and arrest. [15] More recently, The Multisite Multimodal Treatment Study of Children with ADHD examined a range of symptom and outcome variables in a cohort diagnosed with ADHD as well as a local normative comparison group and reported higher rates of police contact and arrests among cohort members with ADHD. [16]

Our study seeks to address gaps in current knowledge by providing naturalistic ADHD outcome data from an epidemiologically derived diverse school district sample followed over an eight year period. The study expands on previous research because the sample is not restricted to particular ADHD subtypes, includes a large number of females and African American youth, and a prospectively identified matched local comparison group. We provide observational

outcome data in the domains of 1) psychopathology; 2) functioning and quality of life; 3) rates of smoking, alcohol and substance use; 4) educational outcomes, including achievement, grade point averages, special education service use, graduation rates and grade retentions; and 5) involvement with the juvenile justice system. Furthermore, this study also examines whether the relationship between adolescent outcomes and ADHD status differs by gender, race or poverty, by examining moderation effects.

Method

Participants and Procedures

This research uses observational data from the study "ADHD: Detection and Service Use." [17] A random sample of children, oversampling girls by a factor of two, was derived from public school records of 12,009 kindergarten through fifth graders from a North Florida school district. Of 1,615 children screened, 29.5% (n=476) were identified high risk for ADHD, because they were either 1) already diagnosed or treated for ADHD; 2) suspected by parent or school of having ADHD; or 3) elicited parent or school concern about behavior problems and parent scores of the Swanson-Nolan-and Pelham-IV (SNAP-IV), a standardized ADHD screening measure, [18] were elevated 1.5 standard deviations above the norm. As shown in Figure 1, between 1998 and 2008 a cohort of high risk children participated in four subsequent waves of data collection (66% participation rate) before completing a Wave 6 outcomes assessment and matched sample of low risk children participated in the outcomes assessment. Among all high risk participants 274 were found to be eligible to participate in Wave 6. Of those, 169 participated (62%), 12 declined (4%), and 93 could not be contacted (34%). Non-participants did not differ from participants by race, but were more likely to include females than males (44% vs. 29%, chi-square (1 df) 6.153, p=.013) and poor children than non-poor peers (46% vs. 30%, chi-square (1 df) 7.435, p=.0064). For Wave 6, 163 peers classified as low risk in Wave 1 were matched to the high risk participants by gender, race, poverty status and age to serve as the outcome comparison group. The total sample of 332 Wave 6 study participants were on average 17 years old (range 14 to 21 years, SD=1.4); they included 120 (36%) African Americans, and 167 (50%) received lunch subsidies, an indicator of poverty. Of the 187 (56%) females, 92 were in the high risk and 95 in the comparison group. Separate personal interviews were conducted by trained research assistants with parents and adolescents in homes, community locations, or at our research center. The study was approved by the University Institutional Review Board and the school district research office. Informed consent (parents and young adults) or child assent (adolescents) were obtained from all subjects, who received a stipend of $40 (parents) or $30 (adolescents) for their participation.

Assessment instruments

Predictor Measures—Sociodemographic information about child age, gender, race, and poverty status was obtained from school registration records and verified during interviews.

DSM-IV diagnoses were assigned based on parental interviews conducted by trained graduate research assistants in clinical or educational psychology with documented reliability using the Diagnostic Interview Schedule for Children, Version 4.0 (DISC-4), administered at Wave 2 and the Kiddie-SADS-Present and Lifetime Version (K-SADS PL), administered at Waves 4 or 6. [19, 20] The diagnostic assessment for the low-risk group was conducted at Wave 6, concurrently with the outcome assessment. We chose the semi-structured K-SADS-PL for Wave 6 because we considered it more sensitive than the DISC-IV to ascertain lifetime prevalence for ADHD, a condition that may have been outgrown by late adolescence. We constructed an ADHD variable distinguishing three groups, high risk adolescents meeting full (n=94) or subthreshold (n=75) DSM-IV criteria for ADHD diagnosis, and the local low risk comparison group (n=163) without ADHD. The diagnostic assignments are supported by the

finding that Mean (SD) of inattention/hyperactivity teacher SNAP-IV scores at Wave 1 differed significantly (p<.0001) among these three groups (1.4(0.89) / 1.0 (0.81); 1.2(0.92) / 0.8(0.76); and 0.3(0.47) / 0.2(0.41); respectively.

Outcome Measures

Psychopathology: The Vanderbilt ADHD Diagnostic Parent Rating Scale (VADPRS) was used at Wave 6 to assess symptoms of ADHD, oppositional defiant disorder (ODD), conduct disorder (CD), anxiety and depression. The reliability, factor structure, and concurrent validity have been found to be acceptable and consistent with the DSM-IV and other accepted measures of ADHD. [21] VADPRS screens are positive for combined subtype of ADHD if at least 6 inattentive and 6 hyperactive/impulsive symptoms were endorsed as 2 (often) or 3 (very often) and performance was rated as 4 (somewhat of a problem) or 5 (problematic) in at least one home, school or social setting; inattentive and hyperactive-impulsive subtypes are constructed commensurately, and we constructed a subclinical ADHD outcome variable if 4 or 5 instead of 6 symptoms were endorsed. In similar fashion a positive ODD screen required at least 4 out of 8 ODD symptoms rated as occurring often or very often, a CD screen 3 out of 14 CD symptoms, and the combined anxiety/depression screen 3 out of 7 respective symptoms.

Adolescents completed the Self-Report of Personality of the Behavior Assessment System for Children (BASC SRP), an instrument with established psychometric characteristics which yields 3 composite subscores, School Maladjustment, Clinical Maladjustment, Personal Adjustment, and an overall summary score, the Emotional Symptom Index (ESI); *t*-scores above 70 are considered clinically relevant. [22]

Functioning and Quality of Life: To assess child functional impairment parents and adolescents completed the Columbia Impairment Scale (CIS), a measure with acceptable psychometric characteristics. [23] CIS scores above 14 are considered clinically relevant; parent and adolescent responses were combined so that scores above 14 by one or both respondents were classified as functional impairment.

To assess quality of life parents completed the 28-item version of the Child Health Questionnaire (CHQ), which has been found to be reliable, valid, and responsive to changes in ADHD symptoms, supporting its use as outcome measure for ADHD populations. [24] The CHQ yields summary scores for physical and emotional/behavioral health, with higher scores indicating better quality of life. Scores below the 25th percentile for the US population provided in the User's Manual (page 340) were classified as low quality of life. [24]

Adolescents completed the Youth Quality of Life (YQOL) questionnaire. [25] The 13-item survey version (YQOL-S) contains 5 contextual items and 8 perceptual items. YQOL scales have shown to be reliable and valid. [26] Scores below the 25th percentile for our sample were classified as low quality of life.

Alcohol and substance use: Adolescents completed 33 items from the Youth Risk Behavior Survey that assess tobacco, alcohol, and drug use. [27] Parents reported on adolescent risk behavior by completing 5 items adapted from the Pride Questionnaire for Parents regarding tobacco, alcohol, and drug use. [28] Parent and adolescent answers were combined so that endorsements by one or both respondents were classified as positive use response. We did not obtain laboratory confirmation and may therefore underestimate actual usage.

Educational outcomes: Florida Comprehensive Achievement Test (FCAT) Norm Referenced Test (NRT) scores based on the Stanford Test of Achievement (SAT-10) scores, [29] grade point averages (GPA), and information about retentions, graduation, and receipt of special education services were obtained with written parental permission from school records. This study

utilized FCAT NRT achievement scores for reading and mathematics and unweighted cumulative high school GPA Scores. Graduation rate was calculated according to the formula used by the Florida Department of Education as the percentage of graduation eligible students (n=136) who actually graduated. Receipt of special education services included all services rendered under the Individuals with Disabilities Education Act (IDEA). [30] Services under the category of learning disabilities (LD) were also included. For this study we used the school LD designation as a proxy for learning disability prevalence, with the understanding that this approach under-identifies true cases of learning disabilities.

Mental health service use, ADHD medications and involvement with juvenile justice: To assess services, including those rendered through the juvenile justice setting, parents completed the Child and Adolescent Services Assessment (CASA), [31] which identifies mental health treatment in inpatient and outpatient settings and includes inquiry about medication use. Medication information obtained in up to six waves of data collection was integrated to identify use of stimulant medication, ADHD medications (stimulants, atomoxetine, alpha agonists, bupropion if used for ADHD, tricyclic antidepressants if used for ADHD), and "other" psychotropic medications (atypical antipsychotics, selective serotonin reuptake inhibitors, mood stabilizers, other). Involvement with juvenile justice was identified through parent reports on the CASA, distinguishing residential stay in detention from outpatient involvement with a probation officer or juvenile corrections counselor.

Statistical analyses

The independent variable was childhood ADHD status, consisting of three subgroups (1=childhood ADHD, 2=childhood subthreshold ADHD, 3=non-ADHD comparison group) and allowing for three contrasts (1 vs.2, 1 vs. 3, and 2 vs. 3). Chi- square, Fisher's exact test and ANOVA procedures were used to examine differences in relationship between ADHD risk group status and our 35 outcome variables, grouped into 4 domains. Level of significance was set at 0.05; all tests were two-tailed. For significant Pearson chi-square or ANOVA findings we conducted 2×2 chi-square tests or Tukey's post hoc comparisons, respectively, for each subgroup contrast. We used a Bonferroni correction (i.e., the level of significance was set at 0.017, .05 divided by 3 comparisons) for the multiple comparisons tests made using 2×2 chi-square tests. We used Tukey's multiple comparisons procedure since the simultaneous Type I error rate is less than 0.05 when group sample sizes are unequal.

To establish effect sizes we calculated Cohen's d for continuous variables and odds ratios for categorical variables. For all outcome variables multiple logistic regression was used to determine independent prediction by ADHD risk group status, controlling for the sociodemographic characteristics age, gender, race and poverty. For non-psychopathology outcomes the full prediction model also controlled for ODD and depression/anxiety comorbidities ascertained at Wave 6. Therefore, these analyses also provided estimates of the independent contribution of ODD and anxiety/depression to the outcomes in question. Furthermore, because the relationship between ADHD and two school outcomes, grade retention and failure to graduate, may be confounded by comorbid learning disabilities we ran two additional analyses, adding LD classification as a covariate to the full prediction model. Moderation of outcomes by gender, race and poverty was tested by including interaction term in prediction models.

Results

Bivariate group outcome comparisons

Details of group comparisons for all domains at provided in Table 1. At the final study wave significantly (p<.0001) more youth with childhood ADHD scored positive for ADHD on the

VADPRS (44%, n=41), than those who only had subthreshold symptoms in childhood (15%, n=11) or were in the comparison group (2%, n=4). For all other parent reported (prevalence of ODD, CD, Anxiety/Depression) and adolescent outcomes (BASC-SRP t-scores) youth with childhood ADHD had significantly higher proportions and means than peers who only exhibited subthreshold symptoms or no ADHD in childhood; the latter two groups did not differ from each other.

Parents and adolescents reported more functional impairment and lower quality of life for youth with childhood ADHD than peers with subthreshold or no ADHD. However, use of cigarettes, cannabis or alcohol did not differ by childhood ADHD status.

Adolescents with childhood ADHD and subthreshold ADHD differed from unaffected peers in all educational outcomes, showing higher likelihood to receive services for learning disabilities, to be retained and experience graduation failure. As detailed in Table 1, childhood ADHD and subthreshold ADHD were associated with lower standardized achievement scores in reading and mathematics compared to students without ADHD, as well as lower grade point averages. Similarly, adolescents with childhood ADHD or subthreshold ADHD were significantly more likely to have poor outcomes in the juvenile justice domain than peers without ADHD, as indicated by higher rates of detention sentences or probation officer involvement.

Mental health services use

Adolescents with childhood ADHD were more likely than peers with subthreshold ADHD and unaffected peers to have ever received inpatient (19% vs. 11% and 2%, respectively; p<.0001) or outpatient mental health treatment (68% vs. 44% and 23%; p<.0001). One-half of adolescents with childhood ADHD had ever been treated with ADHD medications (n=47; 50%), mostly stimulant preparations (n=43; 46%), and one-fifth (n=21; 22%) had received other psychotropic medications. None of the unaffected peers ever received ADHD medications and only 2 (1%) received other psychotropics. One-quarter of adolescents with subthreshold ADHD reported being medicated for ADHD (n=18; 24%), including with stimulants (n=15; 20%), and 11% (n=8) had received other psychotropics.

Multivariate outcome prediction

As shown in detail in Table 2, childhood ADHD and subthreshold childhood ADHD symptoms increased the odds of adolescent ADHD presentations. Relative to the unaffected comparison group those with childhood ADHD, but not with subthreshold ADHD, had significantly increased odds of ODD and depression/anxiety. Females had higher odds of anxiety/depression than males (OR=5.4; 95% CI=[1.5-19.5]).

Childhood ADHD, but not subthreshold ADHD, and the presence of adolescence ODD increased the odds of poor functioning and reduced quality of life. Of the sociodemographic covariates only age had a significant relationships, with increasing age raising the odds of poor quality of life.

ADHD risk status did not predict any of the risk outcomes. Increasing age raised the odds of all substance/alcohol risk behaviors. Females had lower odds of cannabis use (OR=0.5; 95% CI=[0.2-0.8]) and African American background reduced the odds of all substance/alcohol risk behaviors. Poverty increased the odds of cigarette use. Adolescent ODD symptoms more than tripled the odds of cannabis and alcohol use.

Childhood ADHD and subthreshold ADHD increased the odds of graduation failure, and subthreshold ADHD increased the odds of grade retention. These relationships continued after adjusting for potential confounding by learning disabilities. Increasing age and poverty, but

not gender or race, raised the odds of grade retention and graduation failure. ODD significantly increased the odds of grade retention, but not of graduation failure.

Childhood ADHD and childhood subthreshold ADHD tripled the odds of juvenile justice involvement. Juvenile justice involvement did not vary by age, gender and race, but odds increased for children in poverty and for those with ODD.

Gender, race and poverty as adolescent ADHD outcome moderators

Gender, race and poverty were not found to moderate adolescent ADHD outcomes; the interaction effects of gender, race and poverty with ADHD risk status were not statistically significant.

Discussion

Our study results from a diverse community sample replicate findings of pervasive differences in adolescent psychopathology, functioning and risk profiles between children with childhood ADHD and a local normal comparison group reported in other longitudinal studies. [16, 32] Our outcome findings expand on previous observational studies because we included youth of all ADHD subtypes and had sufficient participant diversity to allow for an examination of potential moderating effects of gender, race and poverty on various outcomes. However, findings have to be considered in the context of several study limitations. While representative of the school district, our sample is a regional sample and our findings, especially those related to race and sociodemographic variables, may not generalize to other geographic areas. Our comparison group, while prospectively identified as low ADHD risk at study baseline, underwent the childhood ADHD diagnostic assessment retrospectively, at the point of outcome assessment. Moreover, analyses did not control for baseline comorbidities, retention rates were moderate, resulting in sample sizes that may have been insufficient to detect interaction effects and multiple tests of hypotheses were conducted which increase the chance of spurious findings. Also, about 20% of study participants were younger than 16 years at follow-up and may not have manifested certain outcomes yet.

Psychopathology

In line with other studies who reported ADHD persistence rates into late adolescence/early adulthood ranging between 26% to 46%, [3, 16] over 40% of youth with childhood ADHD still met ADHD criteria by age 16 in our cohort, confirming that a considerable proportion of childhood ADHD persists into adolescence. The current study replicated findings that childhood ADHD is associated with elevated rates of adolescent disruptive and internalizing disorders. [33-35] Of note, adolescents with childhood ADHD in our study portrayed themselves as well-adjusted in their daily lives, including in the school environment, consistent with other reports of overly positive self perceptions and positive illusory bias in adolescents with ADHD. [36] Other longitudinal studies examining psychiatric outcomes of childhood ADHD reported that ADHD was predictive of ODD, [34] and that comorbid ODD at baseline was associated with increased risk for ODD, conduct disorder, major depression and bipolar disorder at follow-up. [37] Our findings of increased rates of depression/anxiety are commensurate to findings from other studies [33, 34, 37]. These findings, however, do not imply that ADHD and depression are epiphenomenal or that ADHD causes ODD. Past studies investigating these associations have found that the relationship between ADHD and depression and ODD may be mediated by several factors, including parent behavior management and locus of control [35], ADHD subtype [38], and family environment factors [39].

Functioning/quality of life

Our findings are consistent with other studies reporting that childhood ADHD is associated with significant functional impairment. [5] It is noteworthy that our adolescents with ADHD acknowledged high rates of functional impairments, even though their psychopathology self-reports placed them in the normative range. Possible explanations for this discrepancy may be adolescents' sense of stigma associated with acknowledging psychiatric symptoms, and their shifting perspectives on their own illness career related to ADHD. [40] If confirmed in other studies, our finding may support efforts to obtain adolescent functioning ratings as part of response monitoring in clinical ADHD care. More focused integration of functional assessment during ADHD treatment may bring in valuable adolescent perspectives, which in turn may help to improve subsequent treatment adherence and outcomes.

Risk behaviors

Our study found no association between childhood ADHD and adolescent use of cigarettes or cannabis. These findings contrast with studies that have reported higher rates of substance use [8] and cigarette use. [7, 11] However, our age specific findings are consistent with results reported by Molina et al., [41], and observed lowered odds of alcohol use among those with childhood ADHD have also been reported by Flory et al. [7] Consistent with our findings, August et al, have reported increased risk of smoking, cannabis and alcohol use associated with ODD. [6] Hypotheses have been advanced that oppositional defiant behaviors result in peer rejection and thus contribute towards deviant peer relationships and escalating problem behaviors via social reinforcement and modeling by poor role models. [8]

Adverse educational outcomes

Whereas childhood ADHD, but not subthreshold ADHD symptomatology, predicted poor functioning and lowered quality of life outcomes, both ADHD groups had poorer educational outcomes compared to unaffected peers, with effects sizes for reading and math scores comparable to those reported other studies. [16, 32] Interestingly, graduation rates were lowest for our subthreshold ADHD group, which may reflect lack of special educational supports for students who do not qualify for special school services absent of a full ADHD diagnosis. In a recent study conducted in Puerto Rico, Bauermeister et al. found that students with ADHD had more suspensions, but not more grade failure than non-affected peers and suggested that ADHD may protect against grade failure because students with ADHD qualify for more services. [42] Our findings on the role of comorbid learning disabilities are consistent with other reports suggesting that LD predicts further impaired academic outcomes for children with ADHD. [14]

Juvenile justice involvement

Childhood ADHD and subthreshold ADHD status independently predicted involvement with the juvenile justice system, tripling the odds of this undesirable and costly societal outcome. [43] Our findings of an association of ADHD and legal involvement are similar to those reported in other longitudinal studies. [15, 16, 44] In our sample poverty independently tripled the odds of juvenile justice involvement. Poverty and delinquency have been shown to be related in large scale national U.S. studies as well. [45] Interestingly, our study found no significant differences by gender or race/ethnicity for juvenile justice involvement. This is surprising because it is generally well accepted that involvement in the juvenile justice system is more common for boys and African-Americans. [46] However, the number of girls involved in the juvenile justice system has been reportedly climbing at a rapid rate and a recent article by Tracy et al. purports that female and male juvenile delinquents are now more similar than they are different with respect to arrest rates. [47]

Mental health service use

Treatment data for this cohort showed that one-half of those with childhood ADHD and one-quarter of those with subthreshold symptoms had ever received any ADHD medications by late adolescence. These findings are consistent with reports of possible ADHD undertreatment co-existing with medication use in the absence of a full ADHD diagnosis. [48] Our findings are also comparable to MTA reports of 59% ADHD medication use by the community care group at the 3 year follow-up. [16] Rates of lifetime psychiatric hospitalizations in our ADHD risk group were higher than in the non-affected comparison group, consistent with studies finding higher inpatient and outpatient service utilization and medical cost for those with ADHD. [49]

Gender, race and poverty effects

Our study did not find any interaction effects of gender, race and poverty with childhood ADHD status on adolescent ADHD outcomes. However, as expected, sociodemographic characteristics by themselves did emerge as independent predictors of certain outcomes. Similar to other studies, [50, 51] we found that females were more likely to experience anxiety and depression. Our study also found that African-Americans were far less likely to engage in smoking, cannabis and alcohol use than were their white counterparts. This finding is in line with a recent study by Watt and Rogers that indicates that African-American youth are significantly less likely to use alcohol than white children irrespective of gender. [52] The authors speculate that factors such as African American children having less disposable income and higher religious involvement than white children as possible explanations.

Poverty, as documented in other studies, [45, 53] increased the risks for adverse adolescent educational and juvenile justice outcomes. Poverty disadvantages children in multiple domains, including prenatal stressors, nutrition, housing, education and access to health care. In particular, children from disadvantaged SES backgrounds experience higher levels of toxic stress and have been shown to display heightened activation of stress-responsive systems which may result in lasting alterations of subsequent disease risk. [54]

In summary, our findings replicate findings that childhood ADHD heralds significant risks for symptom persistence, development of depression, functional impairment, lower educational achievement and juvenile justice involvement in late adolescence. Findings furthermore stress the importance of early recognition of childhood ADHD and its subthreshold presentations, especially when comorbid with ODD, for prevention and intervention strategies. Future research is needed to determine whether ADHD plus ODD represent a distinct subtype and to develop interventions that yield long-term improvement not only in ADHD symptomatology but also in relevant functional domains, especially educational outcomes and legal system involvement, outcomes of particular relevance to families and society as a whole.

Acknowledgments

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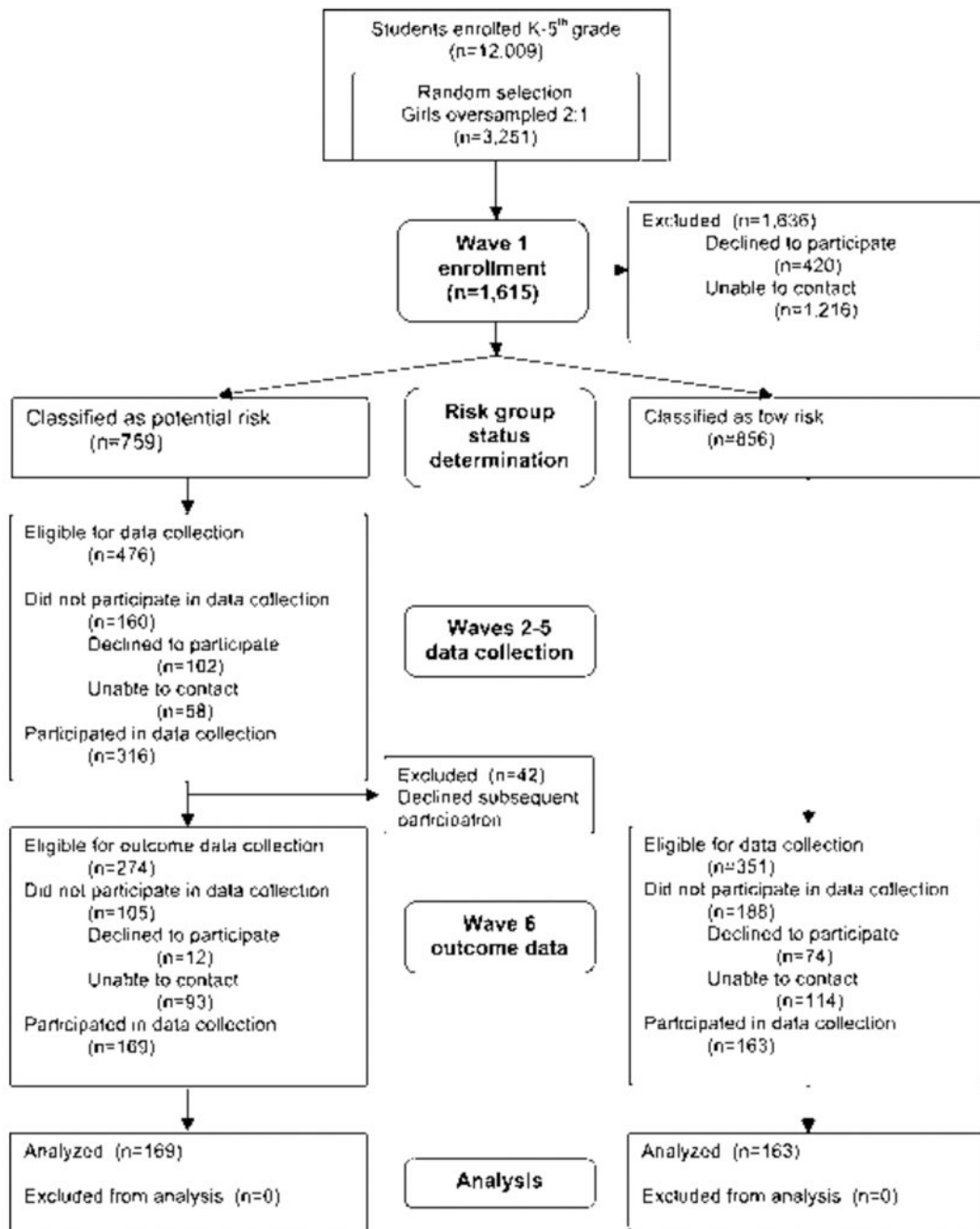
Figure 1.
Study Design and Participation

Table 1

Adolescent outcomes in five domains by childhood ADHD status

	ADHD (1) N=94		Subthreshold (2) N=75		Comparison (3) N=163		p-value[1,2]	Effect Sizes[3]		
	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%		1 vs 2	1 vs 3	2 vs 3
Psychopathology Outcomes										
(P) VADPRS										
ADHD	41[a]	44%	11[b]	15%	4[c]	2%	<0.0001	4.5	30.8	6.8
Subclinical ADHD	7	7%	7	9%	5	3%				
No ADHD	46	49%	57	76%	154	94%				
Subtype (of those with ADHD)							-			
Inattentive	27	66%	11	100%	2	50%				
Hyperactive/impulsive	4	10%	0	0%	1	25%				
Combined	10	24%	0	0%	1	25%				
ODD	37[a2]	39%	7[b]	9%	8[b]	5%	<0.0001	6.3	12.6	2.0
CD	10[a]	11%	0[b]	0%	3[b]	2%	0.0003		6.3	
Anxiety/Depression	12[a]	13%	4[b]	5%	3[b]	2%	0.0013	2.6	7.8	3.0
(A) BASC-SRP *t*-scores										
Emotional Symptom Index	49.3[a]	9.6	45.4[b]	8.6	44.3[b]	7.0	<0.0001	0.4	0.6	0.2
Clinical Maladjustment	50.1[a]	10.1	45.0[b]	8.6	44.2[b]	7.3	<0.0001	0.5	0.7	0.1
School Maladjustment	50.1[a]	8.2	45.9[b]	8.2	46.3[b]	8.0	0.0012	0.5	0.5	0.0
Functioning/Quality of life										
(P) Parent CIS>14	51[a]	54%	15[b]	20%	24[b]	15%	<0.0001	4.7	6.9	1.5
(A) Child CIS>14	32[a]	40%	14[b]	20%	25[b]	16%	0.0001	2.7	3.6	1.3
(P) CHQ										
Physical Summary	49.7	12.6	52.0	12.1	52.2	9.4	0.2005			
Psychosocial Summary	44.0[a]	12.2	51.3[b]	9.7	55.6[c]	8.6	<0.0001	-0.9	-1.2	-0.2
(A) Youth Quality of Life	79.7[a]	20.4	86.2[b]	15.8	85.6[b]	14.8	0.0193	-0.4	-0.3	0.0
Risk behaviors										
(P and A) Ever used cigarettes	44	47%	32	43%	58	36%	0.1676			
(P and A) Ever used cannabis	31	33%	23	31%	57	35%	0.8069			

	ADHD (1) N=94		Subthreshold (2) N=75		Comparison (3) N=163		p-value[1,2]	Effect Sizes[3]		
	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%		1 vs 2	1 vs 3	2 vs 3
(P and A) Ever used alcohol	61	66%	49	65%	110	67%	0.9273			
(P and A) Alcohol abuse now	12	15%	9	13%	37	23%	0.1125			
Educational outcomes										
Identified ESE	52^a	57%	27^b	39%	14^c	9%	<0.0001	2.0	13.5	6.7
Identified SLD	30^a	33%	17^a	25%	2^b	1%	<0.0001	1.5	38.0	25.7
Retention	28^a	30%	27^a	39%	18^b	11%	<0.0001	0.7	3.4	5.0
Failure to graduate[4]	10^a	26%	11^a	37%	5^b	8%	<0.0016	0.6	4.3	7.2
Standardized testing										
8th grade FCAT Reading	684.2^a	48.5	694.5^a	40.6	716.1^b	41.1	<0.0001	-0.2	-0.7	-0.6
8th grade FCAT Math	682.1^a	41.2	686.5^a	44.4	718.9^b	41.1	<0.0001	-0.1	-0.9	-0.8
GPA	2.2^a	0.9	2.4^a	0.8	2.9^b	0.7	<0.0001	-0.2	-0.9	-0.7
Juvenile Justice										
(P) Jail/Probation	19^a	20%	10^a	13%	6^b	4%	0.0001	1.6	6.6	4.0

Note. A = adolescent reported; ADHD = Attention-Deficit/Hyperactivity Disorder; BASC-SRP = the Self-Report of Personality of the Behavior Assessment System for Children; CIS = Columbia Impairment Scale; CHQ = Child Health Questionnaire; ESE = Exceptional Student Education for students with disabilities; FCAT = Florida Comprehensive Assessment Test; VADPRS = Vanderbilt ADHD Diagnostic Parent Rating Scale; GPA = grade point average high school years; P = parent reported; S = School data base derived; SLD = Specific Learning Disability.

[1] Significance: Pearson chi-square statistic and Fisher's Exact Test for categorical variables; ANOVA for continuous variables.

[2] Significant differences in means according to Tukey's post hoc comparison or 2×2 chi-square tests are indicated by different superscripts (^{a,b,c}); means with same letter are not significantly different.

[3] Effect sizes: for continuous variables Cohen's *d* and for categorical variables odds ratios.

[4] Failure to graduate based on 136 participants determined to be eligible for high school graduation per Florida Department of Education criteria

Table 2

Childhood ADHD status as predictor of adolescent outcomes in five domains, controlling for demographics and adolescent comorbidity

| | ADHD Risk Status | | | | Age (years) | | Race (AA) | | Poverty (poor) | | ODD | |
| | ADHD vs Comparison | | Subthreshold vs Comparison | | | | | | | | | |
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Psychopathology												
ADHD	**31.0**	**[10.5-91.6]**	**6.8**	**[2.1-22.2]**	0.9	[0.7-1.1]	0.6	[0.2-1.3]	1.1	[0.5-2.3]	-	N/I
ODD	**12.9**	**[5.6-30.0]**	1.9	[0.7-5.6]	0.9	[0.7-1.2]	1.4	[0.6-3.2]	1.2	[0.5-2.6]	-	N/I
Anxiety/Depression	**10.3**	**[2.7-39.3]**	3.1	[0.7-14.4]	1.0	[0.7-1.5]	2.4	[0.7-8.2]	0.6	[0.2-2.1]	-	N/I
Function/Quality of Life												
CIS (>14)	**3.4**	**[1.7-6.9]**	1.4	[0.7-2.8]	1.1	[0.9-1.4]	0.9	[0.5-1.9]	1.5	[0.8-3.0]	**38.4**	**[11.0-134.0]**
QOL (<25th %ile)	**2.5**	**[1.3-4.7]**	1.4	[0.7-2.7]	**1.2**	**[1.0-1.4]**	0.8	[0.4-1.5]	1.5	[0.8-2.8]	**11.8**	**[5.0-28.3]**
Substances/alcohol												
Cigarette use ever	1.4	[0.7-2.5]	1.4	[0.8-2.5]	**1.4**	**[1.2-1.7]**	**0.5**	**[0.3-0.9]**	**2.0**	**[1.1-3.5]**	1.9	[0.9-3.9]
Cannabis use ever	0.7	[0.4-1.3]	0.9	[0.5-1.7]	**1.7**	**[1.4-2.1]**	**0.5**	**[0.2-0.9]**	1.3	[0.7-2.3]	**3.3**	**[1.6-7.2]**
Alcohol use ever	0.7	[0.4-1.3]	0.9	[0.5-1.7]	**1.8**	**[1.5-2.3]**	**0.5**	**[0.3-1.0]**	0.6	[0.3-1.1]	**4.6**	**[1.8-11.5]**
Alcohol abuse now	0.5	[0.2-1.1]	0.5	[0.2-1.1]	**1.6**	**[1.3-2.0]**	**0.3**	**[0.2-0.8]**	1.1	[0.6-2.3]	2.1	[0.8-5.3]
Educational												
Grade retention	1.4	[0.6-3.4]	**6.1**	**[2.7-13.5]**	**1.5**	**[1.2-1.9]**	1.1	[0.5-2.2]	**8.7**	**[3.7-20.7]**	**7.5**	**[3.1-18.2]**
Grade retention (w/LD) [1]	0.9	[0.3-2.2]	**4.5**	**[2.0-10.4]**	**1.5**	**[1.1-1.9]**	1.1	[0.5-2.3]	**9.2**	**[3.7-22.5]**	**8.1**	**[3.2-20.7]**
Failure to graduate [2]	**5.2**	**[1.3-21.6]**	**11.2**	**[2.7-47.3]**	**2.0**	**[1.0-4.1]**	1.0	[0.3-3.4]	**4.7**	**[1.3-17.2]**	0.9	[0.2-3.9]
Failure to graduate (w/LD) [1]	**5.1**	**[1.2-22.5]**	**11.0**	**[2.5-48.6]**	**2.0**	**[1.0-4.1]**	1.0	[0.3-3.4]	**4.7**	**[1.3-17.1]**	0.9	[0.2-3.9]
Juvenile Justice												
Probation/ Detention (ever)	**3.1**	**[1.0-9.1]**	**3.8**	**[1.3-11.1]**	1.1	[0.8-1.5]	1.2	[0.5-2.9]	**3.3**	**[1.2-9.4]**	**4.6**	**[1.8-11.5]**

Note. Covariates also included anxiety/depression (not shown because no significant relationships found) and gender (2 relationships reported in text). **Bolding** indicates statistical significance of Odds Ratio estimate as shown in 95% Confidence Interval. AA = African American; ADHD = Attention-Deficit/Hyperactivity Disorder; CIS = Columbia Impairment Scale score above 14 on parent or adolescent rating; N/I = not included in model; QOL = Quality of Life, summary variable based on cutpoints below 25th percentile on either Child Health Questionnaire or Youth Quality of Life measure.

[1] Covariates also included Learning Disability (LD) assignation; for grade retention LD OR = 4.1, p<.0011 and for failure to graduate LD OR = NS

[2] Failure to graduate was based on 136 participants determined to be eligible for high school graduation.