

Adolescent ADD/ADHD and Risky Behavior: Prevalence, Odds, and Health-Care Costs

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Background

Attention deficit/hyperactivity disorder (ADD/ADHD) is a commonly diagnosed childhood behavioral disorder, estimated to affect 3 to 5 percent of school-age children and leading to numerous pathological outcomes including higher rates of injury, problems in school, family and societal disruptions.¹ Less is known about ADD/ADHD during adolescence, in part because all major diagnostic criteria have been developed on younger children.¹ Longitudinal population-based cohort estimates of adolescent ADD/ADHD in individuals who were diagnosed during childhood suggest that about 5 to 7 percent of adolescents are affected by ADD/ADHD, depending on whether probable or definite diagnoses are made.² Other estimates of adolescent ADD/ADHD vary more broadly based on whether school-based or community-based samples are drawn.³ ADD/ADHD is thought to develop early and, contrary to previous beliefs, often persists into adolescence and adulthood.⁴

As children with ADD/ADHD grow older, they become at increased risk for substance abuse, teenage pregnancy, delinquent and antisocial behavior, and injuries of all sorts, particularly if the condition remains untreated.^{5,6,7,8} A previous study revealed that healthcare costs are substantially higher for low-income adolescents engaging in risky behavior versus those that do not, and that these adolescents have a higher proportion of health care in Emergency Department (ED) settings than adolescents who do not engage in risky behavior.⁹ Because of demonstrated links between ADD/ADHD and risky behavior,^{5,6,7,8} analyses in the current paper investigate the probability of engaging in risky behavior for adolescents diagnosed with ADD/ADHD compared to those who are not, and examine the concomitant healthcare costs associated with ADD/ADHD and risky behavior.

Interestingly, while the increased use of mental health, social and special education services for children with ADD/ADHD have been well documented,^{5,10} as have the social, behavioral, and academic consequences of ADD/ADHD,^{10,11} with few exceptions, the use and

costs of medical care for individuals with ADD/ADHD remains overlooked.^{2,8} Adolescents, particularly those engaging in risk-taking behaviors and those with special health care needs such as ADD/ADHD, require an array of preventive care, diagnostic, and treatment services. Thus, analyses of healthcare use and costs are greatly needed in order to ensure that adequate financing, provider network and service delivery systems are developed to best meet the needs of the adolescent population, especially those at risk for high-cost health care.

The goals of the present study were to investigate: (a) the prevalence of ADD/ADHD in a general pool of low-income adolescents enrolled in Medicaid; (b) the probability of risky behavior and of inpatient and ED use, based on ADD/ADHD diagnosis; and (c) the concomitant health-care charges for those engaging in risky behavior.

Method

Data Sources

Study participants were adolescents (aged 11.5 to 19 years of age) enrolled in the Florida Medicaid Program during FY 2002 and FY 2003, who had at least one encounter with the medical system. The Florida Agency for Health Care Administration provided person-level enrollment, claims, and encounter data for use in these analyses. The enrollment files contained the adolescents' age, gender, and number of months enrolled in the program. The claims and encounter files contained *International Classification of Diseases 9th Revision Clinical Modification* (ICD-9-CM) codes, *Physician's Current Procedural Terminology* (CPT) codes, inpatient hospitalization codes, and dates that the health care services were provided.

Description of Variables Used

Identification of Adolescents with ADD/ADHD and Risky Behaviors

Adolescents who had at least one contact with the medical system during the time period were included in this study. Adolescents with ADD/ADHD were identified by searching

the claims and encounter data for at least two independent occurrences of the ICD-9-CM code (314.0) for ADD/ADHD. Two occurrences were imposed to guard against rule-out visits.

Adolescents engaging in risky behaviors were identified using ICD-9-CM codes found in the claims and encounter data.⁹ A panel of three physicians at the University of Florida developed a list of ICD-9-CM codes that might be indicative of risky behavior, such as alcohol or drug treatment, injuries, and sexually transmitted infections. It should be noted that there is a fair degree of controversy about whether normal pregnancy should be indicative of a “risky behavior” or not. On the one hand, it is a prevalent diagnosis for older adolescents; on the other hand, given the well documented maladaptive outcomes of teenage pregnancy, particularly for single mothers, it can be considered a risky behavior. In this study, given the prevalence of pregnancy, especially in later adolescence, we chose *not* to include it in the list of diagnoses indicative of risky behavior. As a check, however, we re-ran all multivariate analyses both ways, and the direction of effects was identical whether pregnancy was included or not, although the descriptive information and magnitude of effects differed somewhat. Thus, in this study, risky behavior identification does not include pregnancy.

The list was reviewed by an expert at the National Association of Children’s Hospitals and Related Institutions (NACHRI) and further refined. The final list contained 2,199 diagnostic codes indicative of risk-taking behaviors. Single diagnostic codes were used to define risky behaviors. Mental health and substance abuse services were included as risky behavior diagnoses, although mental health services linked to mental disorder (such as schizophrenia) were considered a special health care need rather than a risky behavior and were therefore not included as risky behaviors. In addition, to avoid a potential tautology owing to the fact that mental health services are part of ongoing treatment for many with ADD/ADHD, mental health visits that contained an ICD-9-CM code of ADD/ADHD were not considered as indicative of risky behavior.

Health Care Charges

Monthly health care charge rates were developed for each adolescent using the claims and encounter data. Outpatient encounters included all preventive and acute care services in office, clinic, and hospital settings. Physical, occupational, and speech therapies, as well as home health, mental health and substance abuse services were included in both outpatient and inpatient settings. Emergency department (ED) and inpatient charge rates were developed using the presence of an ED code or a hospital admission date in the records.

Health care charge data were calculated using the Medicaid fee schedule. Per person charge variables were expressed as dollars per adolescent per month (i.e., monthly per person inpatient, outpatient, ED, and total charges).

Analysis Plan

Charge variables were expressed as dollars per adolescent per month. Monthly rates were computed because of variability in enrollment. These rates were compared using Wilcoxon rank sum tests between adolescents with no ADD/ADHD or risky behavior condition and adolescents with ADD/ADHD, adolescents with risky behavior, and adolescents with both ADD/ADHD and risky behavior. Odds of risky behavior and of hospital inpatient and Emergency Department visits were calculated using logistic regression.

Results

Table 1 presents sample characteristics for adolescents with ADD/ADHD, adolescents engaging in risky behaviors, adolescents with both diagnoses, and adolescents with neither diagnosis. From the population of adolescents enrolled during FY 2002 and FY 2003 in the Florida Medicaid Program who had at least one contact with the medical system (n= 284,882), 11,262 (3.95%) adolescents were identified as having ADD/ADHD. Males were over-represented in the ADD/ADHD group, as compared to the group with no ADD/ADHD diagnosis.

Overall, 32.14% of the total pool (n=91,569) was identified as engaging in risky behavior. Females were more likely to be identified as engaging in risky behavior than males. When separated by whether or not adolescents had ADD/ADHD, 40.45% of those with ADD/ADHD had risky-behavior diagnoses, as compared to 31.80% of those without ADD/ADHD.

Table 1. <u>Study Population Characteristics</u>				
Characteristic	Adolescents with ADD/ADHD		Adolescents with No ADD/ADHD	
	Risky Behavior	No Risky Behavior	Risky Behavior	No Risky Behavior
N (%)	4,555 (40.45%)	6,707 (59.55%)	87,014 (31.80%)	186,606 (68.20%)
Gender: Female	1,305 (28.65%)	1,320 (19.68%)	61,541 (70.73%)	99,585 (53.37%)
Male	3,250 (71.35%)	5,387 (80.32%)	25,473 (29.27%)	87,016 (46.63%)
Mean Age in Years (Std. Dev.)	13.33 (1.68)	12.97 (1.62)	15.27 (2.09)	14.29 (2.17)
Mean Months Enrolled (Std. Dev.)	22.10 (4.13)	20.48 (5.64)	18.00 (6.89)	15.14 (7.64)

Odds of Engaging in Risky Behavior

Logistic regression was used to predict the odds of engaging in risky behavior based on ADD/ADHD diagnosis, after controlling for age, gender, and months enrolled in the program. As seen in Table 2, after controlling for age, gender, and enrollment months, adolescents with ADD/ADHD were about twice as likely to engage in risky behavior as those who did not have a diagnosis of ADD/ADHD.

Table 2. Odds Of Risky Behavior Based On ADD/ADHD Diagnosis

<u>Effect</u>	<u>Point Estimate</u>	<u>Confidence Intervals</u>	<u>Significance</u>
Age	1.250	1.245, 1.255	.0001
Gender	0.523	0.514, 0.533	.0001
Months Enrolled	1.069	1.068, 1.070	.0001
ADD/ADHD	1.950	1.871, 2.032	.0001
Notes. Age and months enrolled are continuous variables. Gender is coded 1= male, 0=female. ADD/ADHD is coded 1=ADD/ADHD, 0= no ADD/ADHD.			

Odds of Inpatient and ED Use

Since inpatient use and emergency room visits are relatively rare events in the adolescent population, the odds that adolescents with ADD/ADHD, especially those engaging in risky behavior, would use these categories of service were computed. Logistic regression was used to predict the odds of having an Emergency Department (ED) visit (Table 3) or inpatient stay (Table 4) based on age, gender, risky behavior and diagnosis of ADD/ADHD. As seen in Table 3, having a diagnosis of ADD/ADHD slightly increased the odds of an ED visit. Those with risky behavior were more than four times as likely as those without risky behavior to have an ED visit. The odds of an ED visit were highest for those adolescents with ADD/ADHD and engaging in risky behavior: more than 6 times as likely to have an ED visit as all others.

With respect to inpatient utilization, those with ADD/ADHD were somewhat more likely to have an inpatient stay than those without ADD/ADHD. The odds of an inpatient stay were about two times higher for those engaging in risky behavior as compared to those who were not, and the odds of inpatient utilization for those with ADD/ADHD and engaging in risky behavior were about twice those of all others (see Table 4).

Table 3. Odds of Emergency Department Visit Based on ADD/ADHD and Risky Behavior

<u>Effect</u>	<u>Point Estimate</u>	<u>Confidence Intervals</u>	<u>Significance</u>
Age	1.023	1.019, 1.027	.0001
Gender	1.175	1.154, 1.977	.0001
Months Enrolled	1.048	1.047, 1.049	.0001
ADD/ADHD	1.094	1.034, 1.158	.01
Risky Behavior	4.439	4.358, 4.523	.0001
ADD/ADHD and Risky Behavior	6.655	6.239, 7.099	.0001

Notes. Age and months enrolled are continuous variables. Gender is coded 1= male, 0=female. ADD/ADHD is coded 1=ADD/ADHD, 0= no ADD/ADHD. Risky Behavior is coded 1=risky behavior, 0=no risky behavior. ADD/ADHD and Risky Behavior is coded 1=both diagnoses, 0=everyone else.

Table 4. Odds of an Inpatient Stay Based on ADD/ADHD and Risky Behavior

<u>Effect</u>	<u>Point Estimate</u>	<u>Confidence Intervals</u>	<u>Significance</u>
Age	1.152	1.147, 1.156	.0001
Gender	0.751	0.738, 0.764	.0001
Months Enrolled	1.010	1.009, 1.011	.0001
ADD/ADHD	1.282	1.211, 1.357	.0001
Risky Behavior	2.041	2.005, 2.078	.0001
ADD/ADHD and Risky Behavior	1.995	1.875, 2.123	.0001

Notes. Age and months enrolled are continuous variables. Gender is coded 1= male, 0=female. ADD/ADHD is coded 1=ADD/ADHD, 0= no ADD/ADHD. Risky Behavior is coded 1=risky behavior, 0=no risky behavior. ADD/ADHD and Risky Behavior is coded 1=both diagnoses, 0=everyone else.

Health Care Charges

The next set of analyses examined the average monthly health care charges (outpatient, inpatient, and emergency department charges, and their total) of adolescents with and without ADD/ADHD and, further, between those who engaged in risky behavior and those who did not. As seen in Table 5, the average monthly per person total health-care charges were highest for adolescents with ADD/ADHD who were engaging in risky behavior. However, the highest ED and inpatient charges were for those who were engaging in risky behavior; however, there was no difference in ED and inpatient charges for those engaging in risky behavior based on ADD/ADHD diagnosis.

Dollars/person/month: Mean (Std. Dev.)	Adolescents with ADD/ADHD		Adolescents with no ADD/ADHD	
	Risky Behavior	No Risky Behavior	Risky Behavior	No Risky Behavior
Outpatient	\$198.45 (\$214.10)	\$135.59 (\$179.42)	\$95.04 (\$158.18)	\$56.47 (\$143.41)
Inpatient	\$86.77 (\$201.92)	\$26.17 (\$147.18)	\$95.65 (\$379.43)	\$48.42 (\$334.96)
Emergency Department	\$3.88 (\$4.38)	\$1.06 (\$2.62)	\$3.91 (\$7.16)	\$1.36 (\$5.34)
Total	\$289.10 (\$330.24)	\$159.82 (\$249.22)	\$194.6 (\$458.59)	\$106.25 (\$407.62)

Notes. Using Wilcoxon rank sum tests, all pairwise comparisons to the group with no ADD/ADHD and no risky behavior were significant at $p < .05$.

Moderation by Medication

The purpose of the last set of analyses was to examine medication use in this population, both descriptively and as a moderator of the effect of ADD/ADHD on the odds of risky behavior. Of the adolescents with ADD/ADHD, about 69.93% ($n=7,876$) had prescriptions for at least one medication for ADD/ADHD. Table 7 provides a descriptive summary of the type of medication prescribed for ADD/ADHD. The majority of those receiving medication were receiving stimulants (75.08%). About 9% received anti-depressants, and about 16% received

prescriptions for both. Considering the total number of prescriptions for ADD/ADHD, stimulants accounted for about 80% of filled prescriptions. Average per capita costs for ADD/ADHD medication were \$21.05 (sd=\$27.93) per month.

Table 7. <u>Medications Prescribed for Treatment of ADD/ADHD</u>		
Medication	Number (%) Adolescents with ADD/ADHD Receiving this Drug	% of All Prescriptions for ADD/ADHD
Stimulants	5,914 (75.08%)	81.07%
Anti-Depressants	688 (8.74%)	18.93%
Both	1,274 (16.18%)	--

Next, we examined the probability of engaging in risky behavior for adolescents diagnosed with ADHD on medication compared to those with ADHD who are not on medication. Accordingly, a logistic regression was run using the sample of those adolescents who were diagnosed with ADD/ADHD. The outcome variable was the odds of risky behavior. The predictors were age, gender, months enrolled, and whether they were on medication or not. As seen in Table 8, contrary to expectations, medication use did not cut the odds of engaging in risky behavior for those with ADD/ADHD. Instead, medication use was associated with a higher likelihood of being identified as engaging in risky behavior.

Because this was an unexpected finding, we also considered the medication type (stimulant, anti-depressant, or both) and re-ran the analysis using medication type as a predictor. As seen in Table 9, when compared to non-medicated adolescents with ADD/ADHD, those on medication have higher odds of risky behavior, with the highest odds associated with the use of anti-depressants. These two analyses may indicate that adolescents with more severe symptomatology may be placed on medication for their ADD/ADHD. However, because

this is a correlational study, we have no way of ascertaining the direction of effects. Clearly, this is an area that requires further study.

Table 8. <u>Odds of Risky Behavior Diagnosis for Adolescents with ADD/ADHD</u>			
<u>Effect</u>	<u>Point Estimate</u>	<u>Confidence Intervals</u>	<u>Significance</u>
Age	1.165	1.138, 1.193	.0001
Gender	0.607	0.555, 0.664	.0001
Months Enrolled	1.070	1.061, 1.079	.0001
Medication Use	1.240	1.138, 1.352	.0001

Notes. Age and months enrolled are continuous variables. Gender is coded 1= male, 0=female. Medication use is coded 1=yes, 0=no.

Table 9. <u>Odds of Risky Behavior Diagnosis for Adolescents with ADD/ADHD by Specific Medication Class</u>			
<u>Effect</u>	<u>Point Estimate</u>	<u>Confidence Intervals</u>	<u>Significance</u>
Age	1.161	1.134, 1.189	.0001
Gender	0.612	0.559, 0.670	.0001
Months Enrolled	1.069	1.060, 1.078	.0001
Anti-Depressants	1.676	1.415, 1.986	.0001
Stimulants	1.136	1.038, 1.244	.01
Both	1.557	1.361, 1.781	.0001

Notes. Age and months enrolled are continuous variables. Gender is coded 1= male, 0=female. Medication use is coded: Stimulants 1=yes, 0=no; Anti-depressants 1=yes, 0=no; both 1=yes, 0=no; the referent medication group is "none".

The last analysis compared the costs of ADD/ADHD and risky behavior based on whether the adolescent was receiving medication for ADD/ADHD or not. As seen in Table 10, the mean total charges (sum of inpatient, outpatient, and ED) for those with ADD/ADHD and who were treated with medication were less than those who were not receiving medication, although this was not a statistically significant difference. For those with ADD/ADHD who were engaging in risky behavior, the same pattern held, but was a statistically significant difference ($t=5.19, p < .0001$). Thus, even though medication use did not reduce the odds of risky behavior, it did reduce the costs of risky behavior. This perhaps suggests that, if it is the case that the more severe adolescents are placed on medication, the significance of their symptomatology and the severity of their risky behavior is reduced. Again, this needs further study.

Table 10. <u>Costs of ADD/ADHD and Risky Behavior, by Drug Use</u>		
	Mean Total Charges	
	On Medication	No Medication
Adolescents with ADD/ADHD	\$206.69 (\$273.62)	\$224.70 (\$329.78)
Adolescents with ADD/ADHD and Risky Behavior	\$274.39 (\$313.33)	\$327.98 (\$367.67)

Conclusions

The purpose of this study was to investigate: (a) the prevalence of ADD/ADHD in a general pool of low-income adolescents enrolled in Medicaid; (b) the probability of risky behavior and of inpatient and ED use, based on ADD/ADHD diagnosis; and (c) the concomitant health-care charges for those engaging in risky behavior. The results of this study underscore links between ADD/ADHD, risky behavior, and health-care costs.

Using data from the Florida Medicaid program, these analyses documented that roughly four per cent of the adolescents using health care services had ADD/ADHD. This prevalence

rate is close to, but slightly less than, that generally reported for children and adolescents.^{1,2} Prevalence comparisons across studies are complicated, however, due to a number of factors. Some of the differences are due to different sampling strategies and populations studied. In addition, differences emerge because of variations in the methodology for identifying individuals with ADD/ADHD – claims and encounter versus parent report versus standardized clinical protocols. Further, there is currently no diagnostic “gold standard” specific to adolescents and adults; diagnostic criteria are extrapolated from those developed for children. This, too, contributes to the inconsistency among prevalence reports.

Two additional factors specific to our methodology may also deflate the prevalence rate, relative to other population based studies. First, our analyses were restricted to health-care users; thus, adolescents who were enrolled in the program but had no contact with the health-care system during the study period are not represented in this estimate. Second, we relied on submitted claims and encounter data. This methodology allows for the study of large pools of individuals. However, the validity of the data is only as good as what is originally coded for reimbursement. Thus, diagnoses that appear in charts but are not coded for reimbursement are not represented in this estimate.

The second and third goals of this study were to examine the odds of risky behavior and the odds of infrequently used – but high cost – categories of service for individuals with and without ADD/ADHD, and their concomitant charges. This study showed that adolescents diagnosed with ADD/ADHD were at heightened risk for engaging in risky behavior, demonstrating two-fold odds of risky behavior compared to adolescents who did not have ADD/ADHD. Moreover, the health-care charges attributable to ADD/ADHD, especially in combination with risky behavior, were substantially higher when compared to those with out ADD/ADHD and not engaging in risky behavior.

Three previous studies have examined the health-care use and costs patterns for children and adolescents with ADD/ADHD compared to those without, with mixed results. One

study found no differences in the likelihood of ambulatory care visits during the prior six months between children with and without ADD/ADHD.¹² A second study, using data from a large national survey, found that children with ADD/ADHD had more physician visits than non-ADHD children, but there were no differences in hospitalizations between those with and without ADD/ADHD.⁶ The third, and most comprehensive, of these studies was a large population-based cohort study of 4,880 children followed during a 9-year period.² These researchers found by searching medical billing records that individuals with ADD/ADHD had a higher likelihood of hospital inpatient, hospital outpatient, and ED admissions, and median costs were more than double the costs of individuals without ADD/ADHD. The differences were similar for males and females, and across all age groups, including adolescents. The results of the current study build on this work. Using claims and encounter methodology similar to that used by Leibson et al.,² our analyses show higher odds of and charges associated with inpatient and ED use for adolescents with ADD/ADHD, but further, that the odds and costs associated with ADD/ADHD are exacerbated by its link with risky behavior.

Notably, in this paper, risky behavior is considered a broad-band composite, reflecting many different specific risky behaviors. This is not to argue that a focus on specific risky behaviors is not useful, but rather that the experience of programs serving diverse, basically healthy populations, is likely to reflect a broad sampling of risky behavior. Thus, this “non-categorical,” broad-band approach to defining risky behaviors should be of use to insurers, practitioners and health plans, as well as policy-makers who design health care programs. At the same time, however, a generalist approach to defining risky behaviors masks the relative associations between ADD/ADHD and specific risky behaviors, and understanding the specific risky behaviors associated with ADD/ADHD not only has implications for use and cost patterns, but also has significant implications for prevention efforts. Thus, future research is needed to stratify risky behaviors and their links with ADD/ADHD.

The current study has several limitations. First, we did not assess adolescents' unmet health care needs. The benefit package for Medicaid is rich and provides inpatient, outpatient, emergency room care, and mental health services. However, it is possible that adolescents did not receive all needed health care services and thus our health care use and charge calculations may underestimate their true needs. Second, adolescents were categorized as "engaging in risky behaviors" based on particular diagnoses. Those at risk who have not yet manifested a diagnostic outcome in the claims and encounter data are underrepresented in our analysis. Furthermore, because little information is available on what the right rate of use or cost is for this population, caution is warranted in drawing conclusions about anticipating future costs. An important next step would be to compare use and charges to standards of care where they exist in order to benchmark the magnitude of increased use and charges for adolescents with special health care needs, such as ADD/ADHD, or risky behavior. Finally, several cautions are needed regarding the use of claims and encounter data. Diagnostic codes in claims and encounter data are subjective, leading to potential biases in defining use and charges.

However, despite these limitations, this study has a number of important strengths, including the following: (1) This study is among few population-based studies of adolescent ADD/ADHD and among the first to examine health care use and charges for adolescents with ADD/ADHD who are enrolled in Medicaid. (2) As opposed to parent or adolescent report, diagnostic criteria from claims and encounter data were used to define groups, and thus allowed analysis of a large pool of individuals. (3) In addition to total use and charges, charges were calculated by category of service (outpatient, inpatient, ED). (4) Finally, all health care charges and utilization were examined, not just that related to ADD/ADHD or to risky behavior. Thus, these analyses reflect a total health-care portrait, as opposed to a condition-specific analysis.

In summary, the purpose of this study was to examine health care use and charge patterns for a pool of adolescents with and without ADD/ADHD who were enrolled in Medicaid services. The data indicated that adolescents with ADD/ADHD manifested higher odds of and

charges associated with inpatient and ED use, but further, that the odds and costs associated with ADD/ADHD were magnified by its link with risky behavior. This study underscores the importance of considering the unique needs of adolescents, including specific diagnostic conditions and their association with costly medically-related behaviors, to ensure that adequate financing, provider network and service delivery systems are developed to best meet the needs of the adolescent population.

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