

Research Paper



ADHD in adults and criminal behavior: The role of psychiatric comorbidities and clinical and sociodemographic factors in a clinical sample

Martina Nicole Modesti^{a,*}, Silvia Gubbini^b, Pietro De Rossi^c, Agostino Manzi^b, Giuseppe Nicolò^b, Barbara Adriani^{b,d}, Simone Pallottino^b, Giovanna Parmigiani^e, Antonio Del Casale^f, Cecilia Guariglia^{a,g}, Stefano Ferracuti^h

^a Department of Psychology, Faculty of Medicine and Psychology, Sapienza University of Rome, Italy

^b Department of Mental Health and Addiction Services, Local Health Unit of Roma 5, 00034, Colleferro, Rome, Italy

^c Child and Adolescence Neuropsychiatry Unit, I.R.C.C.S. Bambino Gesù Children's Hospital, Viale Ferdinando Baldelli n. 41, 00174 Rome, Italy

^d Department of Neuroscience, Mental Health, and Sensory Organs (NESMOS), Faculty of Medicine and Psychology, Sapienza University of Rome, Italy

^e Department of Law, University of Modena and Reggio Emilia, Modena, Italy

^f Department of Dynamic and Clinical Psychology and Health Studies, Faculty of Medicine and Psychology, Sapienza University of Rome, Italy

^g Cognitive and Motor Rehabilitation and Neuroimaging Unit, "Santa Lucia" Scientific Institute for Research, Hospitalization and Healthcare (IRCCS), Rome, Italy

^h Department of Human Neuroscience, Faculty of Medicine and Dentistry, Sapienza University of Rome, Italy

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ABSTRACT

Introduction: ADHD is a neurodevelopmental disorder associated with functional, behavioral, and relational difficulties. Its onset is in childhood, before the age of 12, and it often persists into adulthood. This study investigates the link between ADHD in adulthood, psychiatric comorbidities, and the risk of criminal behavior, analyzing the impact of clinical and sociodemographic variables.

Methods: This cross-sectional study included a sample of 308 patients diagnosed with ADHD, treated at the ADHD Outpatient Clinic of SS Gonfalone Hospital in Monterotondo between 2019 and 2024. Diagnoses and comorbidities were assessed through structured interviews and standardized diagnostic tools (ASRS, DIVA-5). Information on legal status and types of crimes was collected through individual interviews. Statistical analysis was performed using *t*-tests, chi-square tests, and stepwise logistic regression models.

Results: In the sample, 8.1 % of patients with ADHD had committed crimes, with a male prevalence (92 %). Significant predictors of criminal behavior included male gender (OR = 1.899, *p* = 0.004) and alcohol use disorder (OR = 4.59, *p* = 0.002). Additionally, oppositional defiant disorder, ADHD diagnosis before the age of 18, and unemployment showed a potential association with risky criminal behavior. Lifetime prescription of antipsychotics (61.4 %) and antiepileptics (48.7 %) was more frequent among participants who committed crimes, while no significant differences were found in the use of atomoxetine and methylphenidate.

Conclusions: Adult ADHD, particularly in males, with combined presentation and in the presence of comorbidities such as oppositional defiant disorder and alcohol use disorder, is associated with an increased risk of criminal behavior. The findings highlight the need for personalized and multimodal interventions to mitigate these risks. Future studies should adopt longitudinal designs to explore causal dynamics and evaluate the effectiveness of therapeutic strategies in forensic contexts.

1. Introduction

ADHD (Attention Deficit Hyperactivity Disorder) is a chronic neuropsychiatric disorder that manifests in childhood and can persist

into adulthood, with a global prevalence estimated between 2 % and 7 % (Polanczyk et al., 2014; Song et al., 2021). ADHD is associated with neurobiological dysfunctions, particularly in the regulation of the dopaminergic and noradrenergic systems, as well as functional deficits

* Corresponding author.

E-mail address: martinicole.modesti@uniroma1.it (M.N. Modesti).

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in executive control and attention networks (Biederman, 2005). These alterations contribute to the core symptoms of the disorder, such as inattention, impulsivity, and hyperactivity. Although ADHD has traditionally been linked to academic and relational difficulties, increasing attention is being given to its long-term implications, including the risk of antisocial behaviors and criminality. This connection appears especially evident in the presence of psychiatric and neuropsychiatric comorbidities that amplify symptoms of impulsivity and emotional dysregulation, thereby increasing the risk of problematic behaviors and recidivism (Schiweck et al., 2021; Young & Cocallis, 2021).

The literature highlights that ADHD rarely presents as an isolated clinical entity. Psychiatric comorbidities, such as oppositional defiant disorder (ODD), conduct disorder (CD), mood disorders, and substance use disorders, are frequently associated with ADHD and are significant predictors of antisocial behaviors (Schiweck et al., 2021; Young & Cocallis, 2021). Specifically, ODD, characterized by persistent defiance toward authority and oppositional behaviors, is considered an important prodromal condition for conduct disorder, which is, in turn, associated with a high risk of criminal activity (Barra et al., 2022; Nourredine et al., 2021). It is therefore crucial to emphasize that ADHD often coexists with other neurodevelopmental and mental disorders, increasing its negative impact on overall functioning and complicating clinical management (Schoechlin & Engel, 2005).

Additionally, neurological and psychiatric comorbidities, such as epilepsy and autism spectrum disorders (ASD), can further complicate the clinical profile of ADHD, increasing the likelihood of antisocial behaviors and recidivism (Sandstrom et al., 2021; Wang et al., 2023). These disorders contribute to emotional and cognitive dysfunctions, exacerbating the behavioral regulation difficulties typical of ADHD. This heterogeneous clinical scenario poses significant challenges for treatment and prevention of negative long-term outcomes.

Although ADHD is primarily diagnosed in childhood, it can persist into adulthood in a significant proportion of cases, with substantial impacts across various life domains. Approximately 50–65 % of children with ADHD continue to exhibit symptoms into adulthood, with an adult prevalence estimated between 2.5 % and 4.4 % (Kooij, Bejerot, et al., 2010; Polanczyk et al., 2014). In adults, symptoms of inattention and impulsivity tend to predominate over motor hyperactivity, making the disorder more difficult to recognize. Furthermore, ADHD has a high heritability rate, with genetics estimated to account for 70–80 % of individual variation in the disorder's manifestation (Retz et al., 2012). Additionally, environmental risk factors, such as low birth weight and prenatal events, may play a role in the development of ADHD (Faraone et al., 2021).

Adult ADHD is often underdiagnosed or poorly managed (Ginsberg et al., 2014), partly due to symptom overlap with other psychiatric disorders, limited awareness among healthcare professionals, and challenges in accessing appropriate treatment, therefore causing negative consequences extending far beyond the clinical context. Individuals with untreated ADHD experience greater difficulties in interpersonal relationships, academic and job instability, and an increased risk of developing psychiatric comorbidities, including mood disorders, anxiety, substance use disorders, and personality disorders (Gallo & Posner, 2016; Schiweck et al., 2021). These comorbidities further complicate the clinical picture, exacerbating symptoms of emotional dysregulation and impulsivity, which are central characteristics of adult ADHD. Untreated ADHD imposes significant costs on healthcare systems and society due to increased demand for clinical resources, loss of productivity, and higher rates of legal and relational problems (Faraone et al., 2021).

Numerous studies have documented an association between ADHD and involvement in legal issues. Mohr-Jensen and Steinhausen (2016) reported that youths with ADHD have a threefold higher risk of arrests and convictions compared to neurotypical peers, while Choi et al. (2022) highlighted a higher prevalence of substance use disorders in individuals with ADHD, a factor that may contribute to an increased risk of substance-related criminal behaviors. However, not all individuals

with ADHD follow a trajectory associated with criminal behavior. Protective factors, such as timely and integrated treatment, can mitigate the risk. Carlander et al. (2024) demonstrated that pharmacological treatments, such as methylphenidate and atomoxetine, can improve impulse control and reduce the risk of recidivism.

This study hypothesizes that the risk of antisocial and criminal behaviors in patients with ADHD is significantly influenced by the presence of psychiatric and neuropsychiatric comorbidities, as well as sociodemographic factors. Furthermore, it is hypothesized that pharmacological and psychotherapeutic treatments may play a protective role in reducing such behaviors, but their effectiveness depends on the specificity of the comorbidities and the individual clinical profile.

In light of current evidence, this study aims to explore the associations between ADHD and criminality, focusing on psychiatric comorbidities and the sociodemographic and clinical variables influencing the risk of antisocial behaviors and criminal recidivism. Identifying predictive factors for criminality in patients with ADHD could support the development of targeted and precise interventions to reduce societal costs and improve clinical and social outcomes for this vulnerable population.

2. Materials and methods

2.1. Study design

The study was conducted using a cross-sectional research design with retrospective and partially prospective data collection to identify associations between sociodemographic and clinical variables and criminal behavior in a sample of participants with specific neuropsychiatric characteristics. The study sample consisted of 308 participants evaluated at the ADHD Outpatient Clinic of SS Gonfalone Hospital in Monterotondo between 2019 and 2024, who were residents across the entire Lazio region. Inclusion criteria included a formally recognized clinical diagnosis of ADHD and willingness to participate in the study through written informed consent. Participants with severe cognitive or neurological deficits that could compromise the validity of the results were excluded.

2.2. Data collection

Data were collected through structured and semi-structured interviews, complemented by standardized tools for ADHD assessment. The Adult ADHD Self-Report Scale (ASRS) (Kessler et al., 2005) was used as a screening tool to identify individuals likely to have ADHD, while the DIVA-5 (Diagnostic Interview for ADHD in Adults) (Kooij, Francken, et al., 2010) was employed for formal diagnosis and phenotypic characterization, as it evaluates the presence of symptoms in both childhood and adulthood according to DSM-5 criteria. Psychopathological comorbidities were diagnosed based on DSM-5 criteria (American Psychiatric Association and American Psychiatric Association (A. c. Di), 2013). To ensure diagnostic accuracy, all patient diagnoses were confirmed through the administration of the Structured Clinical Interview for DSM-5, clinician version (SCID-5-CV) (First et al., 2016) and at least one psychiatric evaluation. Only participants who met all DSM-5 diagnostic criteria for ADHD as assessed through the DIVA-5 and psychiatric evaluation were included in the study. As the DIVA-5 explicitly investigates the presence of ADHD symptoms before the age of 12 (Criterion B), all included participants retrospectively met this requirement, even if only 24 % had received a formal diagnosis before age 18. Childhood symptom onset was further corroborated through clinical interviews and, when available, additional historical information from family members or past medical records.

Information regarding criminal history was gathered through individual interviews with participants, who provided details about the types of crimes committed, detention modalities, and any alternative measures applied.

Sociodemographic variables analyzed included gender, age, education level, employment status, and family history of neuropsychiatric disorders. Clinical variables included ADHD diagnosis and phenotypes, diagnoses of ODD, mood disorders, substance use disorders, and other mental health conditions. Dependent variables included the presence or absence of documented criminal behavior, along with a qualitative description of the types of crimes (e.g., offenses against persons, property crimes, drug-related offenses).

2.3. Statistical analysis

Statistical analyses were performed using JASP software (v. 0.16.4) (JASP Team, 2024). Chi-square (X^2) tests with un-exponentiated/log odds were initially conducted to evaluate associations between categorical variables and criminal behavior in patients diagnosed with ADHD. Variables analyzed included sociodemographic characteristics such as age, gender, employment status, education level, and marital status. Clinical variables included ADHD presentation (predominantly inattentive, hyperactive-impulsive, or combined), family history of ADHD, age at diagnosis, presence of psychiatric comorbidities (e.g., ODD, bipolar disorder, borderline personality disorder, major depressive disorder, anxiety disorders), and substance use disorders involving alcohol, THC, cocaine, MDMA, hallucinogens, and opioids.

Variables related to pharmacological treatment were also analyzed, including lifetime prescriptions of antipsychotics, antidepressants, benzodiazepines, lithium, antiepileptics, atomoxetine, and methylphenidate, as well as ongoing psychotherapeutic treatments.

Stepwise logistic regression analysis was subsequently applied to identify the most relevant independent predictors. Each step was evaluated using the chi-square test for model improvement (ΔX^2), and odds ratios (OR) with 95 % confidence intervals (CI 95 %) were calculated. Indicators of the final model's adequacy included Deviance, AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion), and variance explanation coefficients such as McFadden's R^2 , Nagelkerke's R^2 , and Tjur's R^2 .

Variables showing significant associations in chi-square tests were included in a stepwise logistic regression model to identify the main predictors of criminal behavior. The dependent variable in the model was the presence or absence of criminal behavior (yes/no), while independent variables included gender, lack of education beyond 8 years, unemployment, ADHD diagnosis before 18 years of age, ADHD clinical phenotype (combined, inattentive, or hyperactive), comorbidity with ODD in childhood, and alcohol use disorder in adulthood.

Overall, this methodological approach provided a robust and detailed analysis of the associations between sociodemographic and clinical variables and the risk of criminal behavior, contributing to a better understanding of associated factors and potential intervention strategies.

2.4. Ethical considerations

Confidentiality was ensured through anonymous coding of each participant and the separate storage of sensitive information from the study data. The study was conducted in accordance with current ethical regulations, in compliance with the Declaration of Helsinki, and received approval from the local Ethics Committee (protocol no. 477 dated 14/03/2019 – CE Lazio 1). Written informed consent was obtained from all participants prior to their inclusion in the study.

3. Results

In the total sample of 308 patients diagnosed with ADHD, the mean age was 34.02 years, with a standard deviation of 12.01 years. Males constituted 65.6 % of the participants (202 patients), while females accounted for 34.4 % (106 patients). Age distribution showed that 52.3 % of patients were over 30 years old (161 patients). Regarding the

clinical presentation of the disorder, diagnosis was made before the age of 18 in 24 % of cases (74 patients), with 75.9 % of patients presenting a combined form, 23.7 % a predominantly inattentive form, and only 0.3 % a predominantly hyperactive-impulsive form. Bipolar disorder (type I or II) was diagnosed in comorbidity in 21 patients out of 308, with a prevalence of 6.82 % in our sample. The prevalence of psychotic spectrum disorders in the study sample was 1.30 % (4 out of 308 patients).

From a familial and developmental perspective, 4.9 % of patients were adopted (15 patients), and 27.7 % reported a family history of ADHD (82 patients).

In terms of employment status, 19.7 % of patients were unemployed (58 patients), while 80.3 % were either employed or enrolled in an educational program (236 patients). Regarding educational attainment, 14.7 % of patients had only completed lower secondary education (44 patients), while 85.3 % had pursued education beyond this level (264 patients). Table 1 summarizes the main sociodemographic characteristics of the study sample.

In the sample of participants taking psychotropic medications, the analysis of prescriptions revealed a diverse distribution across different therapeutic classes.

In the total sample, the lifetime distribution of prescriptions showed a heterogeneous prevalence among various pharmacological classes and psychotherapy. Antipsychotics were the most frequently prescribed class of drugs (61.4 %), followed by methylphenidate (55.5 %), atomoxetine (52.9 %), and antiepileptics (48.7 %). Prescriptions for antidepressants (45.5 %), psychotherapy (38.4 %), and benzodiazepines (32.1 %) showed moderate prevalence, while lithium (18.2 %) and other classes of drugs (25.6 %) were less represented. Lifetime prescriptions of both atomoxetine and methylphenidate were observed in 22.3 % of the sample.

Within the sample, 25 participants (8.1 %) were criminal offenders. Among these, 92 % were males ($n = 23$). 6 out of 25 participants with a history of criminal offenses (24 %) had a comorbid diagnosis of ODD. The analysis of crime-related characteristics revealed a variety of offenses among the participants who had committed crimes. The sample included individuals with no prior convictions alongside participants who had been incarcerated in correctional facilities, either following a definitive conviction or awaiting trial. Drug-related crimes and offenses against persons were identified, including possession, dealing, or use of illegal substances, as well as acts of physical violence or harm against others.

Some individuals had convictions for robbery, characterized by the taking of goods through force, threats, or intimidation. Others had committed offenses such as assault and resisting a public officer, often associated with drug possession. In some cases, driver's licenses were revoked for driving under the influence of drugs, coinciding with drug possession offenses. Cases of attempted robbery, contempt of public officials, property crimes, and vandalism were also reported, often accompanied by prior detention experiences. Some individuals had committed both drug dealing and robbery, while others were convicted for drug possession. Among younger participants, probation during adolescence for drug possession was observed as an alternative to

Table 1
Sociodemographic characteristics of the study population.

Variable	N (%) or Mean (SD)
Gender (Males)	202 (65,6 %)
Mean Age (years)	34,02 (12,01)
Age at diagnosis < 18	74 (24 %)
ADHD (Inattentive Presentation)	73 (23,7 %)
ADHD (Combined Presentation)	234 (75,9 %)
Oppositional Defiant Disorder	22 (7,1 %)
Recurrent alcohol use	102 (33,1 %)
Unemployment	58 (19,7 %)
Substance use	193 (62,7 %)
Criminal offenders, N (%)	25 (8,1 %)

incarceration.

The data analysis revealed several significant associations between individual variables and criminal behavior, initially explored using chi-square tests.

Gender was found to be a significant factor ($\chi^2 = 8.411, p = 0.004$), with an odds ratio (OR) of 6.68 (95 % CI = 1.54–28.92), indicating a relevant association between male gender and the likelihood of committing crimes.

Diagnosis before the age of 18 was also more common among offenders compared to non-offenders ($\chi^2 = 5.947, p = 0.015$; OR = 2.74; 95 % CI = 1.19–6.34).

ADHD with a combined presentation emerged as another significant factor ($\chi^2 = 5.978, p = 0.014$; OR = 8.34; 95 % CI = 1.11–62.79), suggesting an increased risk in individuals with this condition.

Additionally, ODD ($\chi^2 = 11.657, p < 0.001$; OR = 5.27; 95 % CI = 1.85–15.00) and alcohol use disorder ($\chi^2 = 14.474, p < 0.001$; OR = 5.18; 95 % CI = 2.06–13.05) were more prevalent in the group of participants who had committed crimes (Table 2).

We conducted an additional analysis excluding the six patients with ODD, which revealed that male gender ($\chi^2 = 8.198; p = 0.004$; OR = 10.96; 95 % CI = 1.44–83.26), ADHD combined presentation ($\chi^2 = 4.173; p = 0.041$; OR = 6.4; 95 % CI = 0.84–48.81), and comorbid alcohol use disorder ($\chi^2 = 8.551; p = 0.005$; OR = 3.89; 95 % CI = 1.48–10.26) remained significantly associated with crime commission.

The analysis of differences in therapy prescriptions in relation to the legal status of patients revealed statistically significant differences for only a few pharmacological classes. Specifically, prescriptions for antipsychotics ($p < 0.001$) and antiepileptics ($p < 0.001$) were significantly more frequent among patients with a history of offenses compared to those without. Conversely, prescriptions for antidepressants ($p = 0.404$), Benzodiazepines ($p = 0.206$), lithium ($p = 0.429$), other drugs ($p = 0.387$), atomoxetine ($p = 0.748$), and methylphenidate ($p = 0.103$) did not show significant variations between patients with an active legal status and those without. Similarly, access to psychotherapy ($p = 0.854$) did not differ between the two groups (Table 3).

Subsequently, we conducted a stepwise logistic regression to identify factors associated with belonging to the group of patients who had committed offenses.

Across five steps, the significant model used as a reference was the fourth ($\Delta X^2 = 5.146, p = 0.023$). Overall, this final model demonstrated good predictive capacity, with deviance values of 134.786, AIC of 142.786, and BIC of 157.507, along with a Nagelkerke R^2 of 0.204.

The predictive variables for belonging to the group of ADHD patients who committed offenses were alcohol use disorder ($\beta = 1.562$; OR = 4.766; $p = 0.001$) and male gender ($\beta = 1.697$; OR = 5.456; $p = 0.026$).

Within the overall significance of the model, a potentially involved factor in the risk of offending was the combined presentation of ADHD ($\beta = 1.836$; OR = 6.27; $p = 0.079$).

In the subsequent regression model, unemployment emerged as a potential factor, albeit with low probability ($\beta = 0.795$; OR = 2.215; $p = 0.102$). Table 4 summarizes the results of logistic regression. Fig. 1

Table 2

Significant differences between study variables, offenders vs. non-offenders; *Significant for p -values < 0.05 .

Variable	χ^2	p-value	Odds Ratio (OR)	CI 95 %
Gender (M)	8.411	0.004*	6.68	1.54–28.92
ADHD diagnosis age < 18	5.947	0.015*	2.74	1.19–6.34
ADHD (Combined Presentation)	5.978	0.014*	8.34	1.11–62.79
Major Depressive Disorder (MDD)	3.024	0.082	0.29	0.07–1.27
Oppositional Defiant Disorder	11.657	<0.001*	5.27	1.85–15.00
Alcohol Use Disorder	14.474	<0.001*	5.18	2.06–13.05

Table 3

Differences in prescriptions between offenders and non-offenders. Significant for p -values < 0.05 .

Pharmacological Class	Chi-square	p-value
Antipsychotics	13.183	<0.001*
Antidepressants	0.698	0.404
Benzodiazepines	1.598	0.206
Lithium	0.625	0.429
Antiepileptics	15.1	<0.001*
Other drugs	0.748	0.387
Atomoxetine	0.103	0.748
Methylphenidate	2.654	0.103
Psychotherapy	0.034	0.854

provides a visual summary of the predictive factors of criminal behavior in individuals with ADHD.

The overall results indicate that alcohol use disorder and gender are the most robust independent predictors of criminal behavior, while combined ADHD presentation showed a marginally significant association, and unemployment did not demonstrate a statistically significant contribution.

4. Discussion

4.1. Association between ADHD and criminality

The results of our study highlight a complex relationship between ADHD, psychiatric comorbidities, and the likelihood of committing offenses. The prevalence of offenses in our sample (8.1 %) reflects rates reported in the literature, with a male predominance (92 %). For comparison, the mean general crime rate in the Lazio region from 2013 to 2023 was 4923,39 per 100,000 inhabitants, therefore showing a prevalence of 4.92 % (Regione Lazio, 2024). These data confirm that ADHD is a significant risk factor for involvement in the judicial system, often amplified by the presence of comorbidities and unfavorable social conditions.

A recent meta-analysis also estimated that the prevalence of ADHD in incarcerated populations is significantly higher than in the general population, with a fivefold increase in young detainees (30.1 %) and a tenfold increase in adults (26.2 %) (Young et al., 2015). Young and Cocallis (2021) highlighted that nearly all detainees with ADHD (96 %) have comorbidities, including substance abuse and mood disorders, which significantly increase the risk of recidivism. This aligns with our findings, showing that alcohol use disorder (33.1 %) and substance use (38.3 %) are strongly associated with criminality. Barra et al. (2022) emphasized the role of adverse childhood experiences and social context in shaping antisocial behaviors in individuals with ADHD, reflecting dynamics observed in our analysis.

Schiweck et al. (2021) reported that mood disorders are frequent comorbidities in individuals with ADHD, and this combination amplifies the risk of emotional dysregulation and problematic behaviors. Similarly, Fluyau et al. (2021) noted that substance use exacerbates the impulsivity typical of ADHD, increasing the risk of antisocial behaviors.

In Italy, judicial data are not systematically collected by race or ethnicity. Adoption status was included as a sociodemographic variable due to its potential link to early-life adversities, but it did not emerge as a significant predictor in our regression model.

4.2. Comorbidities and types of offenses

In our study, offenders were involved in a variety of crimes, including drug dealing, driving under the influence of substances, offenses against persons, and property crimes. These findings align with data from Mohr-Jensen and Steinhausen (2016), who found that individuals with ADHD have a threefold increased risk of being arrested for violent or property-related crimes.

Table 4

Results of logistic regression. Dependent variable: commission of offenses; independent variables: gender, years of education <9, unemployment, age at diagnosis <18, combined ADHD presentation, inattentive ADHD presentation, comorbidity with alcohol use disorder; #Reference statistical model; Significant for p-values <0.05.

Model	DevianCE	AIC	BIC	GL	ΔX^2	p	Nagelkerke R ²
1	161.201	163.201	166.881	292			
2	148.385	152.385	159.745	291	12.816	< 0.001*	0.101
3	139.932	145.932	156.972	290	8.453	0.004*	0.165
4#	134.786	142.786	157.507	289	.,146	0.023*	0.204
5	132.237	142.237	160.637	288	2.549	0.11	0.222

Model	Parameter	Esteem	Standar Error	Odds Ratio	z	Wald's statistic	p
1	(Intercept)	-2.463	0.217	0.085	-11.339	128.566	< 0.001*
2	(Intercept)	-3.274	0.385	0.038	-8.504	72.318	< 0.001*
	Alcohol use disorder	1.604	0.472	4.975	3.401	11.567	< 0.001*
3	(Intercept)	-4.667	0.783	0.009	-5.961	35.534	< 0.001*
	Alcohol use disorder	1.554	0.477	4.731	3.255	10.598	0.001*
	Gender (male)	1.786	0.757	5.966	2.36	5.569	0.018*
4	(Intercept)	-6.221	1.266	0.002	-4.915	24.156	< 0.001*
	Alcohol use disorder	1.562	0.482	4.766	3.242	10.51	0.001*
	Gender (male)	1.697	0.762	5.456	2.227	4.958	0.026*
	ADHD Combined Presentation	1.836	1.045	6.27	1.757	3.086	0.079
5	(Intercept)	-6.266	1.262	0.002	-4.965	24.655	< 0.001*
	Alcohol use disorder	1.524	0.485	4.59	3.142	9.872	0.002*
	Gender (male)	1.591	0.766	4.906	2.076	4.308	0.038*
	ADHD Combined Presentation	1.758	1.048	5.803	1.678	2.815	0.093
	Unemployed	0.795	0.486	2.215	1.635	2.673	0.102

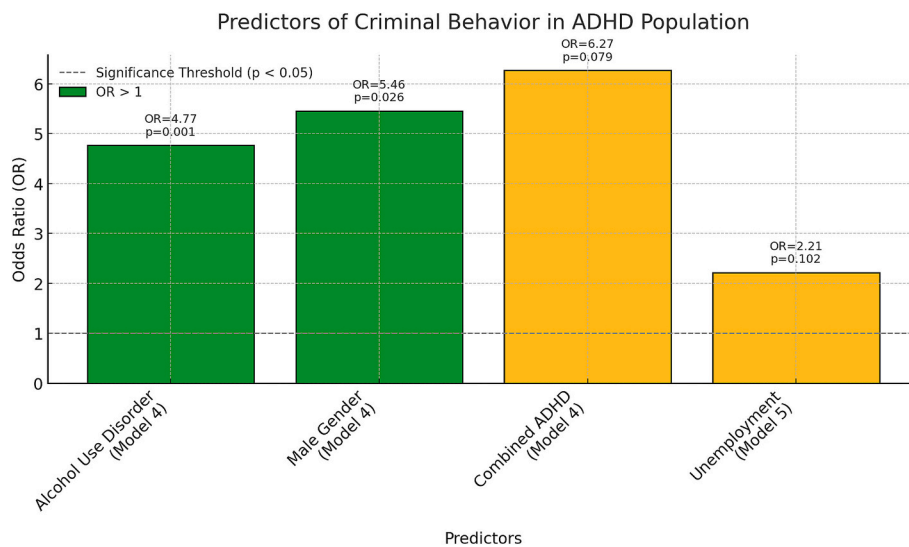


Fig. 1. Predictive factors for offenses in the ADHD population.

Impulsivity and inattention, hallmarks of ADHD, play a decisive role: [Dagistan et al. \(2022\)](#) demonstrated that the combination of hyperactivity and impulsivity increases the likelihood of violent crimes, while inattention is more frequently associated with economic or negligence-related offenses. [Choi et al. \(2022\)](#) also noted that young adults with ADHD show a significantly higher prevalence of substance use disorders compared to their non-ADHD peers, contributing to greater involvement in crimes related to possession and trafficking of substances. The association with violent crimes, such as assaults or resisting a public official, can be explained by emotional dysregulation, as described by [Paulus et al. \(2021\)](#).

Our analysis supports these observations, emphasizing that offenses against persons and property are common in individuals with ADHD, especially in those with combined ADHD presentation and comorbidities such as ODD (7.1 %). Notably, our study did not identify significant associations between criminal behavior and ADD in patients younger than 18 years in the absence of ODD. This finding suggests that ODD

comorbidity may play a crucial role in the link between early ADHD diagnosis and criminal behavior, highlighting the importance of accounting for co-occurring disorders when assessing long-term outcomes.

[Sandstrom et al. \(2021\)](#) further highlighted that the interaction between ADHD and mood disorders might contribute to more aggressive behaviors. In our study, comorbidity with mood disorders did not emerge as a predictive factor for criminal behavior. However, in our sample, MDD in comorbidity was less represented in the subgroup of individuals who had committed offenses compared to those with no prior convictions.

4.3. ADHD and alcohol use disorder (AUD)

Alcohol use during adolescence exacerbates existing difficulties in individuals with ADHD, as it has been shown to reduce gray matter volume, impair white matter growth, and lead to deficits in cognitive domains such as attention, working memory, and cognitive control

(Squeglia et al., 2015; Squeglia & Gray, 2016). These deficits significantly overlap with the neuropsychological impairments characteristic of ADHD, resulting in even more pronounced cognitive and developmental difficulties in frequent alcohol users.

In this study, alcohol use disorder (AUD) showed higher prevalence in the group of ADHD patients who committed offenses compared to non-offenders and emerged as a significant predictor of criminal behavior. These findings align with several studies in the literature. The worsening of ADHD symptoms, such as inattention, and behavioral problems associated with conduct disorder, such as delinquency, have been linked to an increased risk of binge drinking and substance use in adulthood (Howard et al., 2015).

As recently highlighted (Luderer et al., 2021), the impulsivity and emotional dysregulation characteristic of ADHD contribute to risky decision-making and a dysfunctional reward system, making these individuals particularly vulnerable to developing AUD. Moreover, up to 43 % of individuals with ADHD develop AUD, and the concomitant presence of conduct disorder or ODD further exacerbates this vulnerability.

Our results also align with studies by Eme (2009) and Zaso et al. (2020), which emphasized the importance of multimodal treatments and the use of extended-release medications to reduce the risk of substance abuse and improve therapeutic outcomes.

In summary, the interaction between ADHD, AUD, and impulsive or antisocial behaviors underscores the importance of early identification and treatment of these comorbidities to reduce long-term negative outcomes.

4.4. Role of pharmacological treatment

The analysis of prescriptions in our sample showed a predominant use of antipsychotics (61.4 %) and antiepileptics (48.7 %) in offenders, likely to manage aggressive behaviors or severe comorbidities. However, no significant differences were observed in the use of medications such as atomoxetine and methylphenidate between participants with and without a criminal record. These data suggest that therapeutic choices are often guided by specific clinical needs rather than the patient's legal status. Considering that over 50 % of our sample was on methylphenidate and/or atomoxetine therapy, it can be hypothesized that some patients were exposed to a pharmacological protective factor against antisocial behaviors. The results suggest that therapeutic decisions regarding the use of most psychotropic drugs and psychotherapy are not influenced by the legal status of the patients but rather reflect specific clinical needs. However, the higher prevalence of antipsychotics and antiepileptics prescription in patients with a history of offenses may indicate a more prominent role for these pharmacological classes in managing problematic or antisocial behaviors.

Indeed, a study by Carlander et al. (2024) highlighted that pharmacological treatments, such as methylphenidate and atomoxetine, can improve impulse control and reduce antisocial behaviors. However, Widding-Havneraas et al. (2024) emphasized that only an integrated approach, combining pharmacological therapy and psychotherapeutic support, can maximize benefits in ADHD patients. Further longitudinal studies are needed to clarify these aspects using antisocial behavior as a dependent variable.

4.5. ADHD combined presentation and male gender

Male gender emerged as a significant predictor of criminal behavior in our sample, being over four times more frequent in offenders according to the regression model. The combined presentation of ADHD showed a significant difference between the two groups and a potential predictive role according to the significant logistic regression model, with an approximately sixfold increased risk.

These findings align with studies by Dagistan et al. (2022) and Carabellese et al. (2016) demonstrating a higher incidence of antisocial

behaviors in males with ADHD compared to females, especially in individuals with combined symptoms of hyperactivity and inattention.

4.6. ADHD and unemployment

Although unemployment did not emerge as a significant variable in our model, it appears as a potentially relevant factor in understanding the risk of criminal behavior among patients with ADHD, with a risk more than double compared to employed individuals. As highlighted by Jangmo et al. (2021), individuals with ADHD experience a significantly higher annual average number of unemployment days compared to controls (12.19 more days), a condition closely linked to educational difficulties and the presence of psychiatric comorbidities. Unemployment may therefore act as a vulnerability amplifier, contributing to increased risk behaviors, even though its effect did not reach statistical significance in our sample.

This observation is further corroborated by the importance of executive functions, which play a crucial role in maintaining employment. A recent study by Halleland et al. (Halleland et al., 2019) found that a subset of adults with ADHD and executive function deficits (EFD) have a significantly higher risk of unemployment compared to those without such deficits, demonstrating how cognitive difficulties can aggravate job instability and, consequently, the risk of negative social and behavioral outcomes.

In summary, unemployment may not act as a direct factor but rather as a risk mediator, amplifying the effects of cognitive and behavioral difficulties typical of ADHD.

4.7. Prevention and early intervention

Prevention is a crucial strategy to reduce the risk of criminal behavior in individuals with ADHD. Based on the results of our study, preventive interventions should consider specific risk factors such as alcohol use disorder, male gender, and combined ADHD presentation. In particular, alcohol use disorder, identified as a significant predictor, requires targeted interventions at an early age to reduce substance use through school and family prevention programs supported by individualized psychotherapeutic interventions to promote emotional regulation and impulse control.

The gender differences observed in our study indicate the need to tailor interventions to the specific characteristics of males with ADHD, who show a significantly higher risk of engaging in antisocial behaviors. For this population, it is essential to integrate educational programs with therapies focused on improving social skills and developing strategies to address risky situations.

A recent meta-analysis by Maher et al. (2024) demonstrated that early childhood interventions aimed at mitigating exposure to environmental factors and addressing psychiatric comorbidities can significantly reduce the risk of antisocial behaviors in adulthood. For individuals with combined ADHD presentation, it is particularly important to implement interventions targeting both inattention and hyperactivity/impulsivity symptoms, combining pharmacological treatments with cognitive-behavioral training aimed at improving executive functions and emotional regulation.

In our sample, early identification of ODD could represent an opportunity to intervene before antisocial behaviors emerge, as this disorder was significantly more frequent among offenders. Early interventions aimed at managing ODD, through programs focused on conflict management and teaching social and coping skills, could reduce the risk of escalation toward criminal behaviors.

Another area of intervention concerns the promotion of occupational support, given the potentially mediating role of unemployment as a risk amplifier. Programs aimed at improving job access for individuals with ADHD, through specific skills training and professional mentoring, can help reduce vulnerabilities linked to social marginalization. Additionally, interventions promoting educational attainment, such as

personalized educational support, could mitigate the impact of academic difficulties observed in individuals with ADHD, improving occupational and social outcomes.

In conclusion, an effective preventive approach must be multidimensional, integrating psychological, educational, and social support, with specific programs to reduce the impact of psychiatric comorbidities, promote social and occupational inclusion, and improve developmental trajectories in individuals with ADHD. Addressing the risk factors identified in our study through personalized and evidence-based strategies represents a fundamental step to reduce social costs and improve the quality of life for this population.

5. Strengths and limitations

This study has several strengths. Firstly, the integration of data collected through structured interviews and standardized diagnostic tools, such as the ASRS and DIVA-5, ensures high diagnostic reliability. The structured clinical interviews conducted in a public and voluntary setting minimize the risk of manipulation of self-reported information, especially regarding criminal behavior. Furthermore, the robust analytical approach, including chi-square tests and stepwise logistic regression, allows for the identification of relevant independent predictors, providing a solid foundation for interpreting the associations between ADHD and criminality. This stepwise approach highlighted the importance of clinical and sociodemographic variables in understanding the risk factors associated with criminal behavior. The large sample of 308 participants is another strength of the study, offering a significant perspective on the associations between ADHD, comorbidities, and antisocial behaviors, despite the relative rarity of the diagnosis in the general population.

Another strength lies in the attention to psychiatric comorbidities and sociodemographic variables, such as unemployment and adoption, which were analyzed for their role in modulating the risk of criminal behavior. This integration of clinical and contextual factors provides a more comprehensive understanding of the risk trajectories associated with ADHD. Additionally, the use of stepwise logistic regression models enabled the evaluation of the independent influence of clinical and sociodemographic variables, highlighting not only significant factors but also potentially relevant interactions.

However, the study has some limitations. The results may be affected by biases due to the disproportionate size of the subsample of offenders compared to non-offenders, which could impact the generalizability of the findings. Despite methodological rigor, the effects of ongoing pharmacological treatments could represent a potential confounding factor, although this was mitigated by the lack of lifetime prescription differences for methylphenidate and atomoxetine between the two subsamples.

The cross-sectional design limits the ability to establish causal relationships between the variables analyzed and the commission of crimes, emphasizing the need for future longitudinal studies to explore causal dynamics. Moreover, data collection on criminal history relies on clinical interviews, which could be associated with recall or dissimulation biases. An unexplored aspect concerns the influence of dynamic environmental factors, such as changes in working or family conditions, which could further modulate the risk of antisocial behaviors over time.

Despite these limitations, the study represents an important contribution to understanding the interactions between ADHD, sociodemographic factors, psychiatric comorbidities, and criminal behavior. It highlights the complexity of these relationships and provides valuable insights for the development of targeted interventions and prevention strategies.

6. Conclusions

This study highlights the significant association between ADHD, psychiatric comorbidities, and the risk of antisocial and criminal

behaviors, confirming the central role of the disorder in shaping problematic developmental trajectories. The prevalence of offenses among individuals with ADHD, combined with the frequent presence of comorbidities such as alcohol use disorder, underscores the need for integrated and targeted strategies to reduce associated risks and improve psychosocial outcomes.

The data from our study suggest that ADHD interacts with socio-demographic, emotional, and behavioral aspects, profoundly influencing the risk of encountering legal issues. The higher prevalence of offenses among males with alcohol use disorder and combined ADHD presentation highlights specific vulnerability profiles requiring personalized and timely interventions.

Psychiatric comorbidities, particularly substance use disorders and ODD, emerge as key predictors of criminal behavior, reinforcing the importance of early diagnosis and preventive interventions that address not only ADHD but also associated conditions. Our findings suggest that, while the importance of pharmacological therapy is established, therapeutic approaches should not be limited to managing ADHD symptoms. Instead, they should integrate psychotherapeutic interventions and social support to address comorbidities and psychosocial factors.

Pharmacological management, with frequent use of antipsychotics and antiepileptics among offenders, highlights the clinical complexity of these patients and the need for specific therapeutic strategies to reduce impulsive and aggressive behaviors. However, the lack of significant differences in the use of drugs such as methylphenidate or atomoxetine between individuals with and without criminal records suggests that current therapeutic strategies may not be optimized to address the risk of criminality.

An aspect which has not sufficiently been explored is the role of occupational difficulties, which, although not a direct predictor in our model, may act as mediators of criminal risk by aggravating the vulnerabilities associated with ADHD's cognitive and behavioral challenges. Specific interventions to support job inclusion and improve executive skills could help mitigate negative outcomes related to unemployment.

The practical implications of these findings are numerous. Early interventions in childhood and adolescence that combine psychological, educational, and family support represent a crucial opportunity to prevent the development of antisocial trajectories. Moreover, specific screening programs for individuals with ADHD and their comorbidities can help identify at-risk individuals early and reduce their involvement with the judicial system.

Finally, the need for an integrated approach involves not only the healthcare system but also educational and welfare policies that ensure opportunities and resources for individuals with ADHD, reducing barriers to accessing treatments and social interventions. Greater attention to the social context could enhance the effectiveness of therapeutic and prevention strategies, improving long-term outcomes.

In conclusion, managing the risk of criminal behavior in individuals with ADHD requires a multidisciplinary and integrated approach that considers the multiple factors underlying antisocial behavior. A joint effort among the healthcare, educational, and judicial systems could not only reduce the social costs of criminality but also improve the quality of life and opportunities for social inclusion for these vulnerable individuals.

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CRediT authorship contribution statement

Martina Nicole Modesti: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Silvia Gubbini:** Writing – review & editing,

Writing – original draft, Investigation, Data curation, Conceptualization. **Pietro De Rossi:** Investigation, Data curation. **Agostino Manzi:** Writing – review & editing, Data curation. **Giuseppe Nicolò:** Writing – review & editing, Validation, Supervision. **Barbara Adriani:** Writing – review & editing, Investigation, Data curation. **Simone Pallottino:** Writing – review & editing, Investigation, Data curation. **Giovanna Parmigiani:** Writing – review & editing, Validation. **Antonio Del Casale:** Writing – review & editing, Validation, Supervision, Methodology. **Cecilia Guariglia:** Writing – review & editing, Validation, Supervision. **Stefano Ferracuti:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

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