



## Psychiatric diagnoses and criminal convictions in youth: A population-based study of comorbidities of diagnoses

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### ABSTRACT

**Background:** Psychiatric diagnoses are important risk factors for criminal convictions, but few longitudinal studies have examined comorbidity patterns in relation to youth criminal convictions.

**Aim:** To explore associations between specific psychiatric diagnoses (substance use disorder (SUD), ADHD, depression, PTSD, intellectual disabilities (ID), and autism spectrum disorders (ASD)) and comorbidities of internalizing, externalizing, or neurodevelopmental diagnoses (NDD) in relation to risk of non-violent or violent criminal convictions in youth, including potential sex differences.

**Methods:** Data on 1,411,538 individuals born in Sweden (1985–1998) were obtained from national population-based registers. Exposure was psychiatric diagnoses and outcome was criminal convictions between ages 15 and 20.

**Results:** 17% of individuals had a psychiatric diagnosis, of whom 20% were convicted of a crime. All diagnoses, except ID and ASD, increased the risk of non-violent and violent crimes. Comorbidities of externalizing and internalizing diagnoses heightened the risk compared to single diagnoses. NDD increased the risk among SUD, depression, and PTSD, while NDD comorbid with another NDD decreased the risk for criminal convictions.

**Conclusion:** Of the three comorbidity categories, externalizing disorders heightened risk the most, followed by internalizing disorders. This study highlights specific risk patterns for criminal convictions related to comorbidities, and to crime type and sex.

### 1. Background

Previous research has put forth strong evidence that various psychiatric diagnoses are important risk factors for criminal offending. Some studies have demonstrated a four times higher risk for criminal convictions among individuals diagnosed with any psychiatric disorder compared to individuals without diagnoses of psychiatric disorders (e.g., Moore et al., 2019). Among specific psychiatric diagnoses, attention deficit hyperactivity disorder (ADHD; Erskine et al., 2016; Mohr-Jensen & Steinhausen, 2016; Mohr-Jensen, Müller Bisgaard, Boldsen, & Steinhausen, 2019), substance misuse (Bennett, Holloway, & Farrington,

2008; Duke, Smith, Oberleitner, Westphal, & McKee, 2018; Fazel, Smith, Chang, & Geddes, 2018), depression (Fazel et al., 2015), and post-traumatic stress disorder (PTSD; Paulino et al., 2023; Peltonen, Eilonen, Pitkänen, Aaltonen, & Martikainen, 2020) have all been shown to increase the risk for criminal convictions, independent of confounding factors and across various types of criminal offenses. Other psychiatric diagnoses including autism spectrum disorders (ASD) or intellectual disability (ID) have been found to be associated with increased risk for criminal convictions (Heeramun et al., 2017; Latvala et al., 2022). However, further investigations have suggested that associations between these two diagnoses and crime partly reflects comorbid

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conditions (Heeramun et al., 2017; Latvala et al., 2022; Lundström et al., 2014; Mohr-Jensen et al., 2019; Whiting, Lichtenstein, & Fazel, 2021). For example, individuals diagnosed with ID and a comorbid psychiatric disorder had a higher risk for criminal convictions than individuals diagnosed with ID without comorbid disorders (Fogden, Thomas, Daffern, & Ogloff, 2016; Latvala et al., 2022; Thomas, Nixon, Ogloff, & Daffern, 2019). Similar results have been shown for individuals diagnosed with ASD, where for example comorbid ADHD explained the association between ASD and violent criminal convictions (e.g., Heeramun et al., 2017).

Comorbidity across diagnoses is more common rather than unusual (Kessler et al., 2012; Plana-Ripoll et al., 2019), and the presence of multiple diagnoses is known to increase the risk of criminal offending even further than having only one diagnosis (Van Dorn, Volavka, & Johnson, 2012). For example, one study found that individuals diagnosed with both ADHD and substance use disorders (SUD) had a higher risk of committing crimes compared to those diagnosed with ADHD alone (Mohr-Jensen et al., 2019). Another study found that individuals having multiple psychiatric diagnoses (both substance use and mental health disorders) were found to have an even higher risk of incarceration (26%) compared to those diagnosed with only SUD (23%) or only mental health disorders (8%), respectively (Moore et al., 2019). This suggests that comorbidity of diagnoses is highly important to consider in the study of risk for criminal offending. A recent review on mental disorders among juvenile offenders concluded that although research is unambiguous that various psychiatric diagnoses are highly prevalent in juvenile offenders, comorbidity patterns among these diagnoses needs to be further examined (Beaudry, Yu, Långström, & Fazel, 2021). Not only could this improve our understanding of criminogenic risks (i.e., risk factors for criminal convictions), but it could also be informative to improve clinical treatment efforts.

Although there is conclusive evidence of a link between comorbidities of psychiatric diagnoses and criminal offending, there are few large longitudinal population-based studies on this topic. Earlier work has suffered from important methodological limitations and could be complemented in several ways. First, most studies used restricted samples of clinical or incarcerated populations, with mainly adults. The prevalence of psychiatric diagnoses among youth offenders has been shown to differ from adult offenders (Beaudry et al., 2021), which motivates a need to examine youth specifically. Second, most studies have mainly focused on males or included few females and thereby not examined potential differences by sex. Since studies showed that female offenders had higher rates of psychiatric diagnoses than male offenders (Beaudry et al., 2021; Copeland, Miller-Johnson, Keeler, Angold, & Costello, 2007), there is a need to include females and separate analyses by sex. Third and last, most studies to date have focused on severe or violent crimes only (Fazel et al., 2015; Fazel et al., 2018; Whiting et al., 2021), whereas the majority of crimes committed by youth are less serious (Lai, Zeng, & Chu, 2016). The studies that did examine various forms of criminal offenses among youth diagnosed with psychiatric disorders were inconclusive, probably due to small sample sizes (e.g., Copeland et al., 2007). It is therefore important to examine the risk for both violent and non-violent crimes among youth diagnosed with psychiatric disorders using a longitudinal population-based sample to better understand the associations between psychiatric diagnoses and crime.

### 1.1. Aim

In this population-based cohort study, the overall aim was to examine the prospective associations between psychiatric diagnoses and the risk for non-violent and/or violent criminal convictions in youth, and to examine how different patterns of comorbidities contribute to these associations. More specifically, we first aimed to examine the associations between specific individual psychiatric diagnoses (SUD, ADHD, depression, PTSD, ID, and ASD) and non-violent or violent criminal convictions in youth. Second, we aimed to examine how

different patterns of comorbidities of internalizing (internalizing disorders here consists of depression, PTSD, and/or anxiety), externalizing (externalizing disorders here consists of SUD, ADHD, and/or conduct disorders), or neurodevelopmental diagnoses (NDD; that here consists of ID, ASD, and/or tic disorders) contributes to the risk for non-violent or violent criminal convictions in youth among the individual psychiatric diagnoses. An additional aim was to assess any potential differences by sex.

## 2. Method

The present study used a cohort design and linkage of data from several Swedish population-based registers. All these registers are linked via the unique personal identity number (PIN) that every individual in Sweden is assigned at birth or upon immigration to Sweden (Ludvigsson, Otterblad-Olausson, Pettersson, & Ekblom, 2009). The linkage of registers and this study was approved by the Regional Ethics Review Board in Stockholm (2013/862–31/5).

### 2.1. Study population

We used the Total Population Register, which contains demographic information on all Swedish residents born since 1932 (Ludvigsson et al., 2016), to identify all individuals born between 1985 and 1998 ( $N = 1,844,773$ ). We excluded those who had ever immigrated ( $n = 383,897$ ), had emigrated before their 15th birthday ( $n = 29,089$ ), or had died before age 15 years ( $n = 10,738$ ). We also used the Multi-Generation Register which identifies the biological and adoptive parents of every person born in 1932 or later to exclude individuals that had missing information on their mother and father ( $n = 9511$ ). This procedure was done to avoid information bias on family factors due to missing information. This resulted in a total cohort of 1,411,538 individuals.

### 2.2. Exposure

The National Patient Register (NPR) was used to define psychiatric diagnoses and contains complete information on diagnoses based on the Swedish versions of the International Classification of Diseases (ICD), including ICD-9 (1987–1996) and ICD-10 (since 1997), from inpatient care since 1987 and specialist outpatient care from 2001 (diagnoses from primary care are not included; Ludvigsson et al., 2011).

To examine associations between individual psychiatric diagnoses and non-violent or violent criminal convictions, we identified individuals diagnosed before they were convicted of a crime or censored from the study (see details about outcome and follow-up time under section 2.4) with any of the following specific psychiatric diagnoses: SUD, ADHD, depression, PTSD, ID, and ASD. The selection of diagnoses was determined by their relevance in context of age of onset since we study youth (see Sun et al., 2019), and their associations with criminal offending, based on previous research (Beaudry et al., 2021; Fazel et al., 2015; Fazel et al., 2018; Heeramun et al., 2017; Latvala et al., 2022; Mohr-Jensen et al., 2019; Paulino et al., 2023).

Next, to explore how patterns of comorbidities contributed to the risk for non-violent and violent criminal convictions among individuals with psychiatric diagnoses, we created the following categories of comorbidity diagnoses: internalizing diagnoses (here consisting of depression, anxiety, and/or PTSD), externalizing diagnoses (here consisting of SUD, ADHD, and/or CD/ODD), and neurodevelopmental diagnoses (NDD; here consisting of ID, ASD, and/or tic disorders). Anxiety and tic disorders were not included as individual diagnoses due to insufficient power. However, due to their relevance to both youth and criminal offending, we chose to include them in the comorbidity categories. Conduct disorder (CD) was not included as an individual diagnosis because it is often considered as a precursor to, and thereby act as a proxy for, criminal behavior. CD is therefore a less informative diagnosis on its own but was included in comorbidity categories since previous

research has shown that psychiatric disorders comorbid with conduct disorders increase the risk for criminal convictions (e.g., Copeland et al., 2007). All ICD-codes for the diagnoses can be found in supplementary material, table S1.

Comorbidity was defined as having one of the specific individual psychiatric diagnoses listed above and at least one of the diagnoses included in the comorbidity categories. For the purpose of this study, the timing of these diagnoses was not taken into consideration. Therefore, if an individual had one of the specific individual diagnoses and one of the other diagnoses listed in the comorbidity categories, irrespective of the order of occurrence, the individual was classified as having a comorbidity of diagnoses. It should be noted that the same individual could have multiple diagnoses, leading to their inclusion in more than one specific diagnosis and/or comorbidity category (i.e., comorbidity groups were not mutually exclusive).

### 2.3. Outcome

In Sweden, individuals convicted of a crime on or after their 15th birthday and before their 21st birthday are considered youth offenders (Eriksson, 2012; SFS 1964:167, n.d.). Following this definition, we used the National Crime Register (NCR), which contains information on all criminal convictions in lower courts in Sweden since 1973, to define individuals first criminal conviction between the ages of 15 and 20 years.

We further defined whether their first conviction was for a non-violent or a violent crime. We defined violent crimes as convictions for homicide, manslaughter, assault, kidnapping, illegal confinement, unlawful coercion, gross violation of a person's integrity, unlawful threats, intimidation, robbery, arson, and threats and violence against an officer (Frisell, Lichtenstein, & Långström, 2011). We also included sexual crimes in the violent-crime definition (Berg, Rostila, Arat, & Hjern, 2019), including rape, sexual abuse, sexual molestation, and sexual crimes against children (non-contact offenses such as possession of extreme images were not included in violent crimes). Non-violent crimes were defined as all other crimes not included in the violent crime definition (Frisell et al., 2011; Kuja-Halkola, Pawitan, D'Onofrio, Långström, & Lichtenstein, 2012).

### 2.4. Follow-up time

All individuals were followed from their 15th birthday (the minimum age for criminal responsibility in Sweden) until the date of a criminal conviction (outcome), death, emigration, end of study (31st of December 2013), or their 21st birthday (the oldest age for being considered a youth offender in Sweden). Information about psychiatric diagnoses was retrieved from birth, meaning that individuals that had a diagnosis before their 15th birthday entered the follow-up period as exposed and remained fixed until end of follow-up. For individuals that did not have a psychiatric diagnosis before their 15th birthday, psychiatric diagnoses were modeled as a time-varying exposure. That is, individuals entered the follow-up period as unexposed and were defined as unexposed until (1) the end of follow-up (i.e., outcome or censoring) or (2) until they received a diagnosis of the psychiatric disorders of interest. From the date of diagnosis, they were defined as exposed until the end of follow-up.

### 2.5. Covariates

We adjusted for birth year to account for cohort effects (Askari, Mauro, Kaur, & Keyes, 2022; Keyes et al., 2014). Socio-economic status (SES) can be a potential confounder in the association between psychiatric diagnoses and criminal convictions (Sariaslan et al., 2021). Since our study population was young, we adjusted for childhood family SES. This was done by using the Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) which contains yearly

assessments of income, employment status, and education levels for all individuals aged 16 years or older since 1990 (Ludvigsson, Svedberg, Olen, Bruze, & Neovius, 2019). We defined childhood/family SES as parent's highest educational level before the index person's 15th birthday (categorized as  $\leq 9$  years (primary or lower secondary), 10–12 years (upper secondary), and  $12 <$  years (post-secondary or post-graduate) of education).

Research has shown that familial factors (i.e., genetic and shared environmental factors) can confound associations between diagnoses and behavioural outcomes (Frisell et al., 2011; Sariaslan, Larsson, & Fazel, 2016). Thus, we adjusted for parental criminal convictions and parental psychiatric diagnoses. To do this, we used the Multi-Generation Register to link biological mothers and fathers to each individual in the cohort (Ekbom, 2011). We then used the NCR to identify whether an index person had a parent that had been convicted of a crime before the index person's 15th birthday. Similarly, we used the NPR to identify whether the index person's biological mother or father had been diagnosed with any psychiatric disorder before the index person's 15th birthday.

### 2.6. Statistical analysis

All data management and analyses were performed using SAS software version 9.4 (SAS Institute Inc, 2013) and R 3.6.1 (R Development Core Team, 2020). First, we calculated the cumulative incidence rate (which is an estimation of the probability of an individual to experience the outcome during a specified period). This was done for each individual psychiatric diagnosis, for non-violent and violent convictions, and for males and females separately. These cumulative incidence rates are illustrated in supplementary material, figs. S1-S3.

To examine the associations between individual psychiatric diagnoses and the first non-violent or violent criminal conviction in youth, we used Cox proportional hazard regression models to estimate the hazard ratios (HR) and 95% confidence intervals (CI) for each specific individual diagnosis and the two crime outcomes separately, with age as the underlying time scale. In each regression model, individuals with a specific diagnosis were compared to individuals without that diagnosis. We initially adjusted for childhood family SES and birth year (model 1), and then subsequently adjusted for parental criminal convictions and parental psychiatric diagnoses (model 2). We stratified all analyses by sex. Additionally, we conducted Wald's test to examine if the HR estimates for males and females were significantly different, thereby exploring potential gender-specific associations.

Next, to examine the association between each psychiatric diagnosis with comorbid internalizing, externalizing, or neurodevelopmental diagnoses and the first non-violent or violent criminal conviction in youth, we used Cox proportional hazard regression models to estimate HR with 95% CIs. In these models, we estimated the associations for each individual psychiatric diagnosis in relation to the three different comorbidity categories and the risk for non-violent and violent crimes. That is, we obtained one estimate for each combination of individual psychiatric diagnosis and comorbidity category, and the two crime outcomes. In each regression model, individuals with the specific combination of diagnoses were compared to individuals without that combination of diagnoses (i.e., those without psychiatric diagnoses or those with other diagnoses). We excluded the specific individual diagnoses from the comorbidity category it falls into when analyzed. For example, when the specific diagnosis of SUD was analyzed together with comorbid externalizing diagnoses, SUD was removed from the externalizing comorbid category which then only consisted of ADHD and/or CD/ODD. These models were all adjusted for childhood family SES and birth year (model 1), and parental criminal convictions and parental psychiatric diagnoses (model 2). These analyses were stratified by sex, and we used Wald's test to statistically test if the HR for males and females were significantly different.

### 2.7. Sensitivity analysis

To address potential issues of multiple comparisons, we utilized the Benjamini-Hochberg procedure to control the False Discovery Rate (FDR; Benjamini & Hochberg, 1995). The FDR is a statistical measure quantifying the proportion of false positives within the set of test results. The procedure works by adjusting the significance threshold for each test based on its rank or *p*-value and then selecting tests that surpass a predetermined threshold to control the FDR. In the present study, all reported significant results have been appropriately adjusted using FDR corrections, indicating that the likelihood of false positives among our findings is minimal (we used 0.05 or 5% FDR).

## 3. Results

### 3.1. Descriptive statistics

Out of the 1,411,538, individuals in the cohort, 17% had a diagnosis of a psychiatric disorder and the mean age at the first diagnosis was 15.01 years (SD = 3.71). Table 1 displays descriptive statistics of the cohort. The most prevalent psychiatric diagnoses were SUD, ADHD, and depression (all around 3% each). Approximately 9.5% of all individuals in the cohort had been convicted of a crime between their 15th and 21st birthday, where 84% of all convictions were non-violent crimes. The mean age for the first conviction was 16.76 years (SD = 1.56). Of the total cohort, 27% had a parent who was convicted of crime before the index person turned 15 years of age, and 17% of the cohort had a parent who was diagnosed with a psychiatric disorder before the index person turned 15 years.

### 3.2. Cumulative incidence

The cumulative incidence for each diagnosis, type of criminal conviction, and sex are displayed in Table 2. At the end of follow-up, the highest cumulative incidence for non-violent convictions was for individuals diagnosed with SUD (29.7% for males and 15.7% for females), followed by ADHD, PTSD, and depression. These diagnoses all had higher cumulative incidences than for individuals without psychiatric diagnoses (11.5% for males and 5.1% for females). Individuals diagnosed with ASD or ID had similar or lower cumulative incidences for non-violent convictions than individuals without psychiatric diagnoses.

For violent convictions, all psychiatric diagnoses had higher cumulative incidences than those without any psychiatric diagnoses (2.3% for males and 0.5% for females). SUD and ADHD had the highest cumulative incidence rates, followed by PTSD and depression, and ID and ASD had the lowest rates.

**Table 1**  
Descriptive statistics for the total population, by crime status and sex

	Not convicted				Non-violent crime				Violent crime				Total	
	Males		Females		Males		Females		Males		Females		N	%
	n	%	n	%	n	%	n	%	n	%	n	%		
Crime status	631,037	45	645,049	46	78,279	6	35,878	3	16,895	1	4400	0.3	1,411,538	100
Parent education														
≤9 years	24,528	39	27,420	44	6055	10	2570	4	1778	3	499	1	62,850	4
10–12 years	299,764	43	312,797	45	45,440	7	20,111	3	10,706	2	2906	0.4	691,724	49
13 ≤ years	306,670	47	304,731	46	26,763	4	13,189	2	4397	1	992	0.2	656,742	47
Parent criminal conviction	157,761	40	188,450	48	27,640	7	14,512	4	6559	2	2084	1	390,842	27
Parent psychiatric diagnoses	101,067	42	106,268	44	18,381	8	8989	4	5091	2	1567	1	241,363	17
Any psychiatric diagnosis	87,087	37	102,986	44	21,840	9	12,892	5	7118	3	2958	1	234,881	17
SUD	11,830	32	16,376	44	4491	12	2770	7	1350	4	714	2	37,531	3
ADHD	19,286	50	11,784	30	4209	11	1294	3	1651	4	464	1	38,688	3
Depression	12,266	27	27,783	61	1879	4	2137	5	651	1	504	1	45,220	3
PTSD	425	14	2097	70	80	3	249	8	49	2	75	3	2975	0.2
ID	7496	53	5362	38	601	4	199	1	273	2	83	1	14,014	1
ASD	11,514	60	5889	31	864	5	303	2	379	2	130	1	19,079	1
Other	24,270	31	33,695	44	9716	13	5940	8	2765	4	988	1	77,374	3

### 3.3. Individual psychiatric diagnoses

Results from the stratified Cox proportional hazard models for each specific individual psychiatric diagnosis and non-violent and violent crime are presented in Tables 3 and 4.

For non-violent crimes, we found that SUD, ADHD, depression, and PTSD were all associated with an increased risk for non-violent criminal convictions among both males and females, even after adjustment for potential confounders (except for depression and PTSD which became non-significant among males in model 2). ID was associated with a decreased risk for non-violent crimes among both males and females. ASD was associated with a decreased risk for non-violent crimes among males, but no such association was found among females. Significant differences between males and females were found for depression, PTSD, and ASD where females with these diagnoses had a higher risk for non-violent crimes than males with these diagnoses.

For violent crimes, all psychiatric diagnoses were associated with an increased risk for violent convictions among males and females, even in fully adjusted models (except for ID which became non-significant among males in model 2). We found significant sex differences in all psychiatric diagnoses except for PTSD, females with these diagnoses had higher risk for violent convictions than males with these diagnoses.

### 3.4. Psychiatric comorbidities

The results for associations between individual psychiatric diagnoses with different comorbidities and non-violent and violent crimes, for males and females separately, are presented in Table 5. To assess how comorbidities contributed to the risk for criminal convictions among specific psychiatric diagnoses, we illustrate all estimates in Fig. 1 (males) and Fig. 2 (females) together with the estimates from model 2 in Table 3 and Table 4 (i.e., without comorbidities) for reference.

#### 3.4.1. Comorbid internalizing diagnoses

When comorbid with internalizing diagnoses, all individual psychiatric diagnoses were associated with an increased risk for both non-violent and violent crimes among both sexes, with the exception of ID which was non-significant and ASD which was associated with a decreased risk among males (see Table 5). Results from comparisons between sexes showed that females had higher estimates than males, except the estimates for SUD in relation to non-violent crimes and ID in relation to both crime outcomes.

Compared to the estimates for each individual diagnosis without comorbidities (see Figs. 1 and 2), the associations increased in magnitude when comorbid with internalizing diagnoses (except for males with PTSD in relation to violent crimes). However, the magnitude of increase



**Table 2**  
Cumulative Incidence of psychiatric diagnoses for males and females separately

		Population in each group, N		Number in each group		Follow-up time in person-years	Cumulative incidence of first criminal conviction in % at age 21	
							Non-violent	Violent
				Non-violent	Violent			
No psychiatric diagnosis	males	629,071		59,997	11,245	2,850,170	11,5	2,3
	females	584,269		25,317	2,239	2,735,034	5,1	0,5
SUD	males	17,671		4490	1350	77,815	29,7	9,6
	females	19,860		2770	714	96,810	15,7	4,2
ADHD	males	25,146		4209	1651	84,400	25,1	10,2
	females	13,542		1294	464	52,711	13,4	4,7
Depression	males	14,796		1879	651	67,497	15,8	5,5
	females	30,424		2137	504	147,043	8,4	2,0
PTSD	males	554		80	49	2175	18,9	11,4
	females	2421		249	75	10,952	12,5	3,8
ID	males	8370		601	273	35,711	9,5	4,4
	females	5644		199	83	25,892	4,5	1,8
ASD	males	12,757		864	379	50,835	9,4	4,2
	females	6322		303	130	26,837	6,3	2,7

**Table 3**  
Hazard Ratios with 95% CI from Cox proportional hazard regression models for each diagnosis and violent crimes in males and females separately

	Non-violent criminal convictions				
	Males		Females		p-values sex difference
	Model 1	Model 2	Model 1	Model 2	
SUD	2.38 (2.32; 2.46)	2.16 (2.10; 2.23)	2.59 (2.49; 2.70)	2.26 (2.17; 2.34)	0.09
ADHD	1.95 (1.89; 2.02)	1.70 (1.65; 1.75)	2.12 (2.01; 2.24)	1.81 (1.71; 1.91)	0.06
Depression	1.15 (1.10; 1.20)	1.03 (0.99; 1.08)	1.30 (1.25; 1.36)	1.17 (1.12; 1.22)	<0.001
PTSD	1.40 (1.12; 1.74)	1.16 (0.93; 1.45)	1.96 (1.73; 2.21)	1.66 (1.47; 1.88)	<0.01
ID	0.62 (0.57; 0.67)	0.56 (0.52; 0.61)	0.64 (0.55; 0.73)	0.57 (0.50; 0.66)	0.82
ASD	0.68 (0.64;0.73)	0.62 (0.58; 0.67)	0.99 (0.89; 1.11)	0.90 (0.80; 1.01)	<0.001

**Note:** Model 1: Adjusted for birth year and childhood family SES. Model 2: Adjusted for birth year, childhood family SES, parental criminal convictions, and parental psychiatric diagnoses. P-values are from Wald tests of differences in HR between males and females.

varied among the diagnoses and some comparisons had overlapping CIs, indicating that they may not reflect a true increased magnitude. The strongest association with non-overlapping CIs was found for individuals with SUD and comorbid externalizing diagnoses. We found that ID and ASD with comorbid internalizing diagnoses resulted in a change of direction among females, moving from being associated with a decreased risk to instead being associated with an increased risk for non-violent crimes. Among males, the association for ID went from a decreased risk to non-significant for non-violent crimes, and from non-significant to an increased risk for violent crimes when comorbid with internalizing diagnoses.

**3.4.2. Comorbid externalizing diagnoses**

All individual psychiatric diagnoses comorbid with externalizing diagnoses were associated with an increased risk for both non-violent and violent convictions for both males and females (Table 5). For violent crimes, females had higher risk than males (except for females with PTSD), whereas for non-violent crimes, females with depression, ID or ASD and comorbid externalizing diagnoses had a higher risk than males.

**Table 4**  
Hazard Ratios with 95% CI from Cox proportional hazard regression models for each diagnosis and violent crimes in males and females separately

	Violent criminal convictions				
	Males		Females		p-values sex difference
	Model 1	Model 2	Model 1	Model 2	
SUD	3.34 (3.16; 3.53)	2.86 (2.71; 3.03)	5.76 (5.31; 6.24)	4.57 (4.21; 4.95)	<0.001
ADHD	3.59 (3.41; 3.78)	2.90 (2.75; 3.06)	6.30 (5.71; 6.95)	4.83 (4.37; 5.34)	<0.001
Depression	1.85 (1.71; 2.01)	1.57 (1.45; 1.70)	2.61 (2.38; 2.86)	2.14 (1.96; 2.36)	<0.001
PTSD	3.60 (2.70; 4.79)	2.69 (2.02; 3.58)	4.48 (3.56; 5.64)	3.39 (2.69; 4.27)	0.21
ID	1.20 (1.06; 1.35)	1.03 (0.91; 1.16)	1.94 (1.56; 2.42)	1.60 (1.29; 1.98)	<0.001
ASD	1.38 (1.25; 1.53)	1.19 (1.07; 1.32)	3.44 (2.89; 4.10)	2.87 (2.41; 3.42)	<0.001

**Note:** Model 1: Adjusted for birth year and childhood family SES. Model 2: Adjusted for birth year, childhood family SES, parental criminal convictions, and parental psychiatric diagnoses. P-values are from Wald tests of differences in HR between males and females.

When compared to the estimates for individual diagnoses without comorbidities, all estimates increased substantially in magnitude when comorbid with externalizing diagnoses (see Figs. 1 and 2). The highest estimates were found for SUD and ADHD for violent convictions where females had estimated HRs above 11 and males had HR estimates between 7 and 8. Change of direction from decreased to increased risk were found for ID and ASD for non-violent crimes among both males and females.

**3.4.3. Comorbid neurodevelopmental diagnoses**

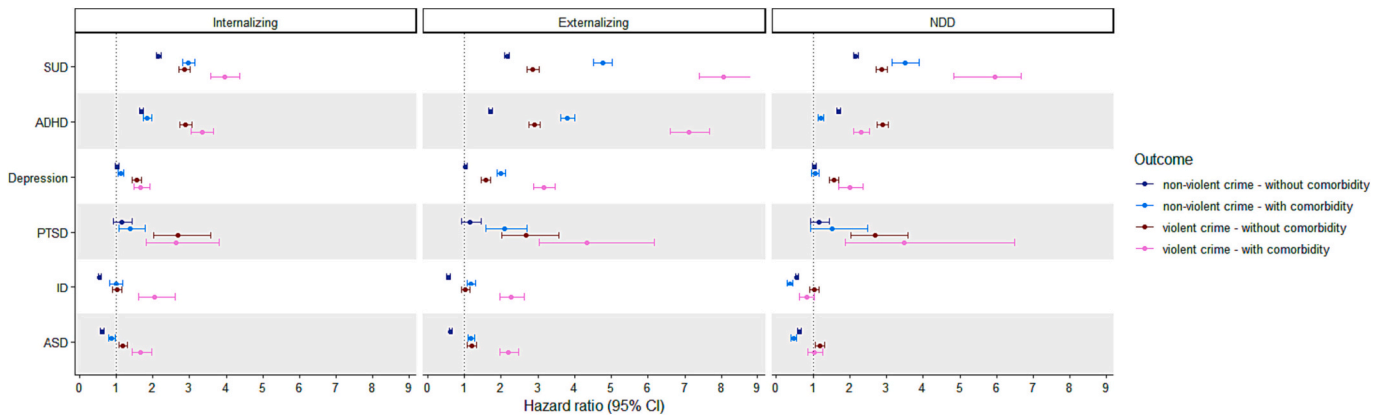
Psychiatric diagnoses with comorbid NDD showed varied patterns of associations. Among females, SUD, ADHD, depression, and PTSD with comorbid NDD were associated with an increased risk for both non-violent and violent crimes. Females with ID or ASD and comorbid NDD had a decreased risk for non-violent crimes, but an increased risk for violent crimes. Among males, SUD and ADHD with comorbid NDD had an increased risk for both non-violent and violent crimes, whereas depression and PTSD with comorbid NDD only had an increased risk for violent crimes, but not non-violent crimes. Males with ID or ASD and

**Table 5**

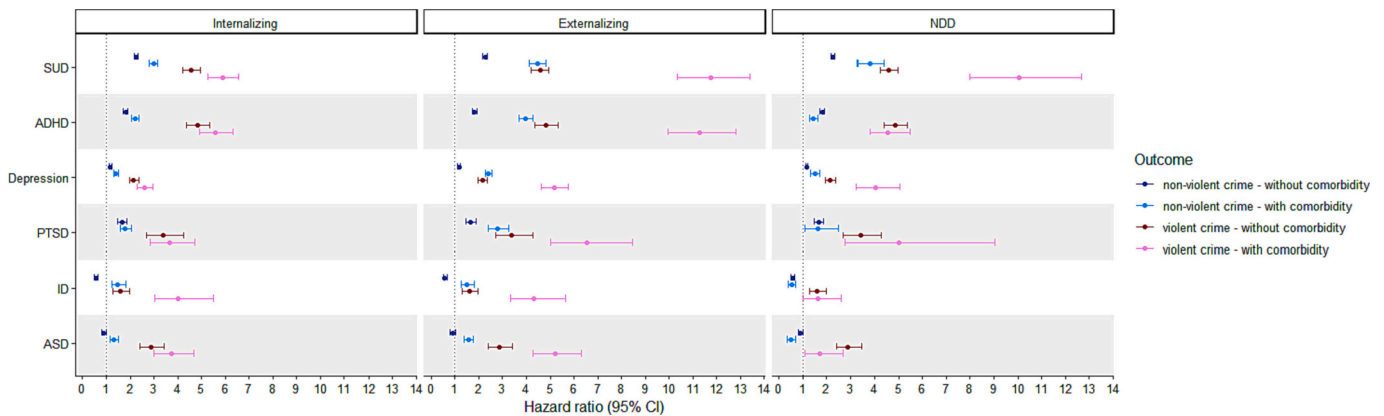
HR with 95% CI from Cox regressions for each individual psychiatric diagnosis in relation to each category of comorbidity, for non-violent and violent crimes, and males and females separately

	Non-violent crimes			Violent crimes		
	Males	Females	p-value sex difference	Males	Females	p-value sex difference
<b>Comorbidity: Internalizing diagnoses</b>						
SUD	2.97 (2.81; 3.15)	2.98 (2.82; 3.15)	0.93	3.95 (3.57; 4.37)	5.89 (5.28; 6.57)	<0.001
ADHD	1.85 (1.75; 1.97)	2.23 (2.07; 2.39)	<0.001	3.34 (3.05; 3.65)	5.57 (4.93; 6.31)	<0.001
Depression	1.14 (1.05; 1.22)	1.40 (1.32; 1.49)	<0.001	1.68 (1.48; 1.92)	2.61 (2.31; 2.95)	<0.001
PTSD	1.38 (1.07; 1.79)	1.80 (1.57; 2.06)	0.07	2.64 (1.82; 3.82)	3.68 (2.86; 4.74)	0.14
ID	1.00 (0.84; 1.19)	1.48 (1.22; 1.81)	0.003	2.05 (1.62; 2.60)	4.01 (3.04; 5.52)	<0.001
ASD	0.89 (0.80; 0.98)	1.32 (1.15; 1.51)	<0.001	1.68 (1.43; 1.97)	3.75 (2.99; 4.70)	<0.001
<b>Comorbidity: Externalizing diagnoses</b>						
SUD	4.76 (4.50; 5.03)	4.47 (4.13; 4.84)	0.20	8.05 (7.38; 8.79)	11.77 (10.33; 13.40)	<0.001
ADHD	3.81 (3.63; 4.01)	3.97 (3.67; 4.29)	0.40	7.11 (6.60; 7.66)	11.30 (9.97; 12.81)	<0.001
Depression	2.00 (1.89; 2.12)	2.40 (2.26; 2.54)	<0.001	3.16 (2.88; 3.46)	5.16 (4.62; 5.75)	<0.001
PTSD	2.08 (1.59; 2.71)	2.80 (2.40; 3.27)	0.06	4.33 (3.04; 6.16)	6.53 (5.03; 8.46)	0.07
ID	1.17 (1.06; 1.30)	1.50 (1.25; 1.80)	0.02	2.27 (1.96; 2.62)	4.32 (3.32; 5.63)	<0.001
ASD	1.18 (1.09; 1.28)	1.56 (1.37; 1.78)	<0.001	2.20 (1.96; 2.48)	5.20 (4.27; 6.32)	<0.001
<b>Comorbidity: NDD</b>						
SUD	3.50 (3.16; 3.88)	3.78 (3.26; 4.37)	0.40	5.69 (4.84; 6.67)	10.05 (7.98; 12.67)	<0.001
ADHD	1.21 (1.13; 1.29)	1.45 (1.28; 1.64)	0.01	2.32 (2.11; 2.55)	4.54 (3.77; 5.47)	<0.001
Depression	1.05 (0.95; 1.17)	1.52 (1.33; 1.73)	<0.001	2.00 (1.70; 2.35)	4.04 (3.24; 5.04)	<0.001
PTSD	1.52 (0.93; 2.49)	1.65 (1.09; 2.49)	0.80	3.48 (1.87; 6.48)	4.99 (2.76; 9.02)	0.41
ID	0.37 (0.31; 0.44)	0.52 (0.37; 0.71)	0.08	0.82 (0.64; 1.04)	1.62 (1.01; 2.61)	0.01
ASD	0.47 (0.41; 0.55)	0.50 (0.36; 0.68)	0.76	1.04 (0.85; 1.27)	1.72 (1.10; 2.70)	0.05

**Note:** These models are adjusted for childhood family SES, birth year, parental criminal convictions, and parental psychiatric diagnoses. P-values are from Walds test of differences in HR between males and females.



**Fig. 1.** Forest plot with results from Cox proportional hazard regression models for each individual diagnosis in relation to each comorbid category and non-violent and violent crimes among males.



**Fig. 2.** Forest plot with results from Cox proportional hazard regression models for each individual diagnosis in relation to each comorbid category and non-violent and violent crimes among females.

comorbid NDD had a decreased risk for non-violent crimes, but the association was not significant for violent crimes (Table 5). Significant sex differences were found for ADHD and depression for non-violent crimes, whereas all diagnoses except PTSD showed sex differences for violent crimes. Overall, females had higher estimates than males.

Compared to the estimates for individual diagnoses without comorbidities, SUD with comorbid NDD increased in magnitude compared to SUD alone. Similar results were found for individuals diagnosed with depression or PTSD and comorbid NDD. In contrary to the other two comorbidity categories, ADHD, ID, or ASD with comorbid NDD had a decreased magnitude than estimates for these diagnoses alone.

#### 4. Discussion

In this nation-wide population-based study, we found that individual psychiatric diagnoses, and in particular comorbidities of psychiatric diagnoses, were associated with non-violent and violent criminal convictions in youth. Consistent with prior research (Fazel et al., 2015; Fazel et al., 2018; Fazel, Wolf, Fimińska, & Larsson, 2016; Mohr-Jensen et al., 2019; Paulino et al., 2023; Peltonen et al., 2020) we found that individual psychiatric diagnoses including SUD, ADHD, depression, and PTSD were associated with an increased risk for criminal convictions, whereas other disorders including ID and ASD were differently associated with criminal convictions depending on crime type and sex. The main finding in the present study was that out of the three comorbidity categories, comorbid externalizing diagnoses had the greatest impact on increasing the risk of criminal convictions among individual psychiatric diagnoses. Comorbidities with internalizing diagnoses also heightened the magnitude of associations between individual psychiatric diagnoses and criminal convictions, compared to estimates of individual psychiatric diagnoses without comorbidities. Comorbidities with NDD displayed varied patterns, where the comorbidities heightened the risk for certain individual psychiatric diagnoses (SUD, depression, and PTSD), while attenuating the magnitudes for other individual psychiatric diagnoses (ADHD, ID, and ASD). We also add to the existing literature by demonstrating that associations between different comorbidities of psychiatric diagnoses and criminal convictions can vary depending on type of crime (non-violent or violent crime) and sex. Importantly, it is noteworthy that the large majority (>80%) of individuals diagnosed with a psychiatric disorder in our study had not been convicted of a crime in youth.

##### 4.1. Individual psychiatric diagnoses

Among the individual psychiatric diagnoses, SUD and ADHD had the highest estimates for criminal convictions (both non-violent and violent) in males and females. This aligns with previous work indicating a 1.5 to 4 times higher risk for criminal convictions among individuals with ADHD or SUD (Fazel et al., 2016; Mohr-Jensen et al., 2019; Mohr-Jensen & Steinhausen, 2016; Sariaslan, Arseneault, Larsson, Lichtenstein, & Fazel, 2020). Thus, our study corroborates these findings, demonstrating that SUD and ADHD remain robust risk factors for criminal convictions even after accounting for confounding factors.

Depression and PTSD were both associated with increased risk for non-violent crimes among females, and violent crimes in both males and females. This is consistent with prior studies linking these conditions to violent convictions among adults (e.g., Donley et al., 2012; Fazel et al., 2015; Sariaslan et al., 2020). Previous work has also demonstrated an association between depression and violence among youth (Yu et al., 2017), but less is known about PTSD and violence among youth specifically. Thus, we extend previous findings among adults by showing that the association between PTSD and violent crimes is also observed among youth. Limited research exists on the risk of non-violent crimes among individuals with depression or PTSD. While a prior study on youth did not find an association between depression and less severe crimes (Copeland et al., 2007), our results align with this finding for

males (non-significant in model 2). However, among females, we discovered an increased risk for non-violent crimes, thereby contributing to the literature by demonstrating the association between depression and PTSD with non-violent crimes specifically in females. Previous work on depression or PTSD and crime has mainly focused on violent crime and has provided even fewer potential explanations for sex differences that could help us understand the higher risk for non-violent crimes among females. Thus, more research is needed to confirm these associations between depression or PTSD and non-violent crimes among both males and females, and to indicate any underlying mechanisms to the observed findings in this study.

ID and ASD were associated with reduced risk for non-violent crimes in both males and females (although not statistically significant for ASD among females in model 2), while showing an increased risk for violent crimes (not statistically significant for ID among males in model 2). Although our results align with previous research regarding violent crimes (Heeramun et al., 2017; Latvala et al., 2022), we found that the directions of associations differed between non-violent and violent criminal convictions. One explanation could lie in the various features of ASD or ID. On one hand, individuals diagnosed with these disorders tend to have literal adherence to legal norms. More severe forms of these diagnoses are also likely linked to restricted opportunities for crimes by individuals being institutionalized or having consistent supervision for long periods (Heeramun et al., 2017; King & Murphy, 2014; Latvala et al., 2022). On the other hand, individuals diagnosed with these disorders tend to have impaired empathy or comprehension of others' emotions. Thus, mild or moderate forms of these disorders, that do not require heavy supervision or treatment, may increase the risk for criminal offending (Heeramun et al., 2017; King & Murphy, 2014; Latvala et al., 2022). Research has put forth another potential explanation that violent offenders tend to have multiple diagnoses. Therefore, considering that individuals with ID or ASD commonly have multiple diagnoses (Collins, Gale Ives, Murphy, & Barnoux, 2023), the higher risk for violent convictions among individuals with ID or ASD may therefore be driven by comorbid diagnoses (Heeramun et al., 2017; Latvala et al., 2022). Nevertheless, more research is necessary to fully understand the different associations between non-violent and violent crimes in these populations.

##### 4.2. Psychiatric comorbidities

Our results highlight the importance of considering comorbidity of diagnoses when examining the risk for criminal convictions. Almost all psychiatric diagnoses with comorbid internalizing, externalizing, or neurodevelopmental diagnoses were associated with an increased risk for both non-violent and violent criminal convictions for both males and females. This is in line with research showing that having multiple diagnoses increases the risk for crime compared to only having one disorder (Van Dorn et al., 2012). However, the magnitude of the estimates differed between the three comorbidity categories and some combinations were associated with a decreased risk for criminal convictions.

Among the three comorbidity categories, comorbidities of externalizing diagnoses increased the risk the most for criminal convictions. SUD or ADHD with comorbid externalizing diagnoses resulted in the highest estimates for risk of criminal convictions, especially for violent criminal convictions and among females. This suggests that prevention and intervention efforts to prevent criminal offending should primarily be directed towards individuals diagnosed with multiple externalizing disorders. Nonetheless, all individual psychiatric diagnoses with comorbid externalizing diagnoses resulted in an increased risk for both non-violent and violent crimes for both sexes as compared to estimates for individual diagnoses without comorbidities. This is in line with previous studies showing that individuals with a psychiatric diagnosis and SUD (which is included in externalizing diagnoses in this study) had a higher risk for criminal convictions than individuals with a psychiatric diagnosis but without SUD (e.g., Chang, Larsson, Lichtenstein, & Fazel,

2015; Mohr-Jensen et al., 2019). It also indicates that CD (included in externalizing diagnoses), which is often seen as a proxy for criminal behavior (Hodgins, Cree, Alderton, & Mak, 2008), most likely had a strong association with criminal convictions and thereby drove the observed increased risk among externalizing diagnoses. This is also supported by our results showing that although ID and ASD were associated with a decreased risk without comorbidities, they were associated with an increased risk for both crime outcomes when comorbid with externalizing diagnoses. This is in line with the notion (e.g., Heeramun et al., 2017; Latvala et al., 2022) that the observed increased risk for criminal convictions among individuals with ID or ASD is probably driven by comorbid externalizing diagnoses. Taken together, our results align with previous research that comorbid externalizing diagnoses is a robust risk factor for criminal convictions among youth.

We observed somewhat similar results with comorbidities of internalizing diagnoses. Here, we found a consistent yet subtle pattern of higher risk magnitudes for each psychiatric diagnosis when comorbid with internalizing diagnoses, as opposed to estimates without such comorbidities. We also observed a change in direction from a reduced to an increased risk of non-violent crimes among females with the associations for ID and ASD. There is a lack of research examining the contributed risk of comorbid internalizing diagnoses to individual diagnoses, but our results are in line with research showing that depression, anxiety, and PTSD all have a strong link to criminal convictions (e.g., Fazel et al., 2015; Paulino et al., 2023; Peltonen et al., 2020). In addition, research has shown that depression and anxiety are highly prevalent among individuals with ASD (Rai et al., 2018). Taken together, this indicates that neurodevelopmental diagnoses such as ID and ASD do not increase the risk for non-violent crimes alone, but the increased risk is observed when comorbid with internalizing or, as previously mentioned, externalizing diagnoses.

Psychiatric disorders with comorbid NDD yielded the most distinguished results compared to the other two comorbidity categories. Although almost all individual psychiatric diagnoses with comorbid NDD had an increased risk for criminal convictions (except for ID and ASD in relation to non-violent crime), only SUD, depression, and PTSD with comorbid NDD had heightened magnitudes compared to estimates for these diagnoses alone. However, most associations for individual diagnoses with comorbid NDD were non-significant for non-violent crimes among males, indicating that the associations for psychiatric diagnoses with comorbid NDD differ depending on type of crime and sex. Contrary to the patterns observed with comorbid internalizing or externalizing disorders, ADHD, ID, and ASD with comorbid NDD had reduced magnitudes of risk compared to estimates of these diagnoses alone. While this suggests that comorbidity of NDD with other NDD diagnosis leads to a reduced risk compared to having a single NDD diagnosis, it is more probable that these findings reflect the influence of NDD severity on the association with criminal convictions instead. As previously mentioned, individuals diagnosed with more severe forms of NDD are more likely to be heavily supervised or be involved in ongoing treatments, which reduces the risk for criminal offending. Taken together, our results indicate that comorbidities in general increased the risk for criminal convictions, but that comorbidities with NDD could reflect more severe symptoms of NDD that in turn reduces the risk of criminal convictions.

#### 4.3. Differences by crime type and sex

In general, risk estimates were higher for violent crimes than for non-violent crimes, where comorbidities in particular have a strong association with violent criminal convictions. However, we observed several changes in direction for non-violent crimes where associations of single disorders went from a decreased risk to an increased risk when comorbidities were considered. This suggests that mild forms of some diagnoses (e.g., ID or ASD) may not be related to a risk for non-violent crimes, but more severe forms or having multiple diagnoses are related

to non-violent crimes. Given that most research in this field has studied violent crimes, we add to the existing literature by demonstrating that certain psychiatric diagnoses are related to non-violent criminal convictions, especially when comorbid with other diagnoses.

Although we could observe somewhat similar patterns of risk among males and females, we found several sex differences. The most consistent pattern we could identify was that females diagnosed with SUD, ADHD, depression, ID, or ASD (i.e., all diagnoses but PTSD) had higher risk for violent criminal convictions than males diagnosed with these disorders. This pattern was consistent in analyses of individual diagnoses, as well in analyses with comorbidities of internalizing, externalizing, and neurodevelopmental disorders. We found fewer sex differences when non-violent crimes were the outcome. Females diagnosed with depression, PTSD, or ASD exhibited a higher risk compared to males with the same diagnoses. Accounting for comorbidities, females with ADHD, depression, ID, or ASD coupled with internalizing disorders, faced elevated risk compared to males. Similarly, females with depression, ID, or ASD with externalizing disorders, showed higher risk than males. Lastly, females with ADHD or depression and comorbid NDD faced a greater risk than males.

Taken together, across all these sex differences, females with psychiatric diagnoses had a higher risk than males with psychiatric disorders. Furthermore, our findings revealed a higher number of sex differences pertaining to violent crimes as compared to non-violent crimes. This is in line with previous research showing that female offenders that committed more serious crimes had higher rates of psychiatric diagnoses than male offenders (Beaudry et al., 2021). One potential explanation for these results is that violent convictions are less prevalent among females than males in general, and violent convictions are therefore explained by psychiatric diagnoses to a higher extent among females than among males (Hodgins, 2022). It could also be that for some psychiatric diagnoses, females need to have more severe symptoms to receive a diagnosis, which could result in different levels of severity of diagnoses among males and females which could affect the associations with criminal convictions (Mohr-Jensen et al., 2019).

#### 4.4. Limitations

Our results should be interpreted with consideration of some limitations. First, although we were able to examine clinical diagnoses in the population, we were only able to use data from inpatient or outpatient specialist care to identify individuals with psychiatric diagnoses. Since only the most severe cases are given a diagnosis in these settings, less severe cases diagnosed from primary care were not captured in the present study. Thus, the prevalence of psychiatric diagnoses was most likely underestimated. It remains unknown whether this underestimation of prevalence resulted in an under- or overestimation of our estimates for associations with criminal convictions. In addition, we did not consider all potential diseases and conditions, such as somatic diseases or traumatic brain injury, something future studies could consider to further increase our understanding of associations between different diagnoses and crime.

Second, although we were able to adjust for several important confounders, including family history of criminal convictions and psychiatric diagnoses, there could be other potentially important confounders or mediators that were not included in the present study. For example, we did not consider the role of medication of psychiatric diagnoses. Studies have shown that medication for psychiatric diagnoses may affect associations with criminal behavior (e.g., Hemminki et al., 2017; Lagerberg et al., 2020; Lichtenstein et al., 2012; Sharma, Guski, Freund, & Göttsche, 2016). Thus, our results could be affected by medication patterns, something future studies should consider.

Third and last, this study was based on data from Swedish population-based registers. There could be potential differences in health care policies, diagnostic tools, and criminal justice systems across countries. For example, health care in Sweden is free which could



increase the likelihood of individuals seeking medical help. The age for criminal responsibility is also higher in Sweden than in some other countries. Thus, our results may not be generalizable to countries with other healthcare systems or to countries where younger youth can be convicted of crimes.

#### 4.5. Conclusions

In this large longitudinal population-based study, we found that there are different risk patterns for criminal convictions in youth among individuals with specific psychiatric diagnoses and comorbidities of externalizing, internalizing, and neurodevelopmental psychiatric diagnoses. Our results together with previous research support that comorbidities of externalizing diagnoses tend to drive the associations between psychiatric diagnoses and criminal convictions. A similar conclusion can be made for comorbidities of internalizing diagnoses, although with smaller effect sizes than comorbid externalizing diagnoses. Comorbidities of neurodevelopmental diagnoses had varying associations depending on the type of criminal conviction (non-violent or violent crime) and sex, but most likely reflects severity of NDD which may influence the association to criminal convictions. Apart from comorbidities, our results also demonstrate different associations between males and females, and between non-violent and violent crimes. Therefore, it is important for future research to consider the specific patterns of risk for criminal convictions among youth diagnosed with psychiatric disorders. Our results highlight the need for future research to examine and identify modifiable risk factors related to these diagnoses and patterns that could be targeted for clinical treatment and intervention efforts.

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#### Declaration of Competing Interest

Henrik Larsson reports receiving grants from Shire Pharmaceuticals; personal fees from and serving as a speaker for Medice, Shire/Takeda Pharmaceuticals and Evolan Pharma AB; and sponsorship for a conference on attention-deficit/hyperactivity disorder from Shire/Takeda Pharmaceuticals and Evolan Pharma AB, all outside the submitted work. Henrik Larsson is editor-in-chief of JCPP Advances.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcrimjus.2023.102114>.

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