

# **Substance use confounds associations between peer victimization and aggression in adolescence with mental disorders in adulthood: A prospective birth cohort study**

Marian Sarala, MD, PhD<sup>1</sup>; Jouko Miettunen, PhD<sup>2,3</sup>; Anni-Emilia Alakokkare, MSc<sup>2,4</sup>; Antti Mustonen, MD, PhD<sup>5</sup>; James G. Scott, MD, PhD<sup>6,7</sup>; Hannah J. Thomas, PhD<sup>6,8,9</sup>; Tuula Hurtig, PhD<sup>1,10,11</sup> and Solja Niemelä, MD, PhD<sup>4,12</sup>

<sup>1</sup> Research Unit of Clinical Neuroscience, University of Oulu, Oulu, Finland,

<sup>2</sup> Center for Life Course Health Research, University of Oulu, Oulu, Finland,

<sup>3</sup> Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland,

<sup>4</sup> Department of Psychiatry, University of Turku, Turku, Finland

<sup>5</sup> Faculty of Medicine and Health Technology, University Consortium of Seinäjoki, Tampere, Tampere University, Tampere, Finland

<sup>6</sup> QIMR Berghofer Medical Institute, Queensland, Australia

<sup>7</sup> Metro North Mental Health, Royal Brisbane and Women's Hospital, Queensland, Australia

<sup>8</sup> Queensland Centre for Mental Health Research, Queensland, Australia

<sup>9</sup> School of Public Health, Faculty of Medicine, University of Queensland, Queensland, Australia

<sup>10</sup> PEDEGO Research Unit, Child Psychiatry, University of Oulu, Oulu, Finland,

<sup>11</sup> Clinic of Child Psychiatry, Oulu University Hospital, Oulu, Finland,

<sup>12</sup> Addiction Psychiatry Unit, Department of Psychiatry, Hospital District of South-West Finland

**Corresponding author:** Marian Sarala. Address: Research Unit of Clinical Neuroscience, University of Oulu, P.O.Box 5000, 90014 University of Oulu, Finland. Email: [marian.sarala@student.oulu.fi](mailto:marian.sarala@student.oulu.fi), Telephone: +358405386838

**Declarations of interest:** none.

## **Ethics Committee Statement**

Northern Ostrobothnia Hospital District Ethical Committee 108/2017.

## **Data Availability Statement**

NFBC data is available from the University of Oulu, Infrastructure for Population Studies. Permission to use the data can be applied for research purposes via electronic material request portal. In the use of data, we follow the EU general data protection regulation (679/2016) and Finnish Data Protection Act. The use of personal data is based on cohort participant's written informed consent at his/her latest follow-up study,

which may cause limitations to its use. Please, contact NFBC project center ([NFBCprojectcenter\(at\)oulu.fi](mailto:NFBCprojectcenter(at)oulu.fi)) and visit the cohort website for more information.

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### **Abbreviations**

95% CI 95% confidence interval

AUD Alcohol use disorder

HR Hazard ratio

ICD-10 The International Classification of Disease, 10th revision

NFBC1986 The Northern Finland Birth Cohort Study 1986

SUD Substance use disorder

## ABSTRACT

**Introduction:** Peer victimization and aggression in adolescence are associated with later mental health morbidity. However, studies examining this association have not controlled for adolescent substance use. We aimed to study the associations between peer victimization, peer aggression, and mental disorders in adulthood, adjusting for substance use in adolescence.

**Methods:** Participants were from the prospective Northern Finland Birth Cohort 1986. Data were available for 6,682 individuals (70.8% of the original sample). Peer victimization and peer aggression were assessed with items from the Achenbach Youth Self Report at ages 15-16 years. Outcomes were non-organic psychosis, anxiety disorder, mood disorder, substance use disorder and any mental disorder (a none-vs-any indicator) at age 33 years collected from nationwide health care, insurance and pension registers. Family structure, alcohol intoxication frequency, daily smoking, illicit drug use and baseline psychopathology using Youth Self-Report total score, and parental mental disorders were considered as confounding factors.

**Results:** In multivariable analyses, the association between peer victimization and psychosis (HR 2.9, 95% CI 1.2-6.9,  $p=0.020$ ) and mood disorder (HR 1.7, 95% CI 1.2-2.4,  $p=0.012$ ) in females remained significant after adjusting for confounders. Other associations between female and male peer victimization or aggression and the studied outcomes attenuated after adjustments.

**Conclusions:** Some associations between peer victimization and aggression and later mental health morbidity are explained by adolescent substance use. For females, substance use does not account for the increased risk of psychosis and mood disorder in

those who experience peer victimization.

**Keywords:** peer victimization, peer aggression, bullying, substance use, adolescent, mental disorders

## INTRODUCTION

Problematic peer interactions are common experiences during childhood and adolescence, sometimes having long lasting consequences in later. Peer victimization refers to the experience of being a target of intentionally harmful/hurtful behavior by peers, whereas peer aggression describes the behavior of the perpetrator aggressing in an intentionally harmful/hurtful way towards a peer victim (Moore et al., 2014; Thomas J. et al., 2015). The high prevalence is demonstrated by a study of school students aged 12-17 years from 83 low and middle income and high-income countries in the six World Health Organization regions. Almost one in three (30.5%) adolescents were subjected to this behavior on one or more days in the previous month (Biswas et al., 2020). In prospective longitudinal studies, victimization by peers in childhood is associated with psychotic symptoms, anxiety and mood disorders in adulthood (Bowes et al., 2015; Copeland et al., 2013; Sourander et al., 2016; Stapinski et al., 2014; Takizawa et al., 2014; van Dam et al., 2012; Wolke et al., 2013). Furthermore, peer victimization and aggression and concurrent victimization and aggression towards peers ('victim-perpetration') at age 14-15 years has been associated with increased risk of substance use at age 26-27 years (Copeland et al., 2013; Sigurdson et al., 2014; Sourander et al., 2007; Wolke et al., 2013; Wolke & Lereya, 2015).

When examining females and males separately, frequent peer victimization and victim-perpetration in childhood predicted use of prescription medicine, panic disorder and agoraphobia especially in young women (Copeland et al., 2013; Sourander et al., 2009). In males, childhood peer victimization and victim-perpetration were associated with later depression, anxiety disorder, panic disorder and heavy daily smoking, but not illicit

substance misuse (Boden et al., 2016; Copeland et al., 2013; Haavisto et al., 2004; Klomek et al., 2008; Niemelä et al., 2011; Sourander et al., 2007).

The reported associations between peer aggression at the age of 8-16 years and later mental health and behavioral outcomes are mixed. In one study, female and male perpetrators of peer aggression were not more likely to experience later anxiety, depressive, alcohol or cannabis use disorders (Copeland et al., 2013). Similarly, no association was reported in adolescent males who perpetrated peer aggression and later adverse outcomes including depression (Haavisto et al., 2004; Sourander et al., 2009). In contrast, prospective longitudinal studies have shown males who perpetrated frequent peer aggression were at increased risk of depression and illicit substance use (Klomek et al., 2008; Niemelä et al., 2011). Experiences of peer victimization and involvement in peer aggression and their longitudinal consequences have been extensively studied in elementary school male children. Studies of adult mental health outcomes of adolescents who have had problematic peer interactions especially among females are less common, although females are associated with higher vulnerability to poor mental health (Copeland et al., 2013).

Confounding factors are a plausible explanation for the reported associations between peer victimization and perpetration and subsequent mental disorder. However, these associations are evident even after consideration of relevant confounding factors, such as family background and childhood and parental mental health problems (Boden et al., 2016; Bowes et al., 2015; Copeland et al., 2013; Haavisto et al., 2004; Kerr et al., 2017;

Klomek et al., 2008; Niemelä et al., 2011; Sourander et al., 2007, 2009, 2016; Takizawa et al., 2014). Adolescent substance use may be a mediator leading to later negative outcomes of adolescent peer violence. However, substance use in adolescence is also well known to be associated with both adolescent peer victimization/aggression and also adult mental disorders. In previous studies examining the mental health outcomes associated with peer aggression, there has been limited attention to the potential confounding role of adolescent substance use. To the best of our knowledge, there are only two previous studies that adequately adjusted for adolescent onset substance use (Copeland et al., 2013; Moore et al., 2014), despite it being identified as being a potential risk factor for mental disorders in young adults (Moylan et al., 2013; Mustonen et al., 2018; Sarala et al., 2020). Moore et al. (2014) observed an association between being a perpetrator of peer aggression at 14 years and harmful alcohol use at 17 years after adjusting for baseline substance use problems (Moore et al., 2014). However, no associations were found between victims or perpetrators of peer aggression at 14 years and harmful cigarette smoking and cannabis use at 17 years after the same adjustments. Copeland et al. (2013) reported an attenuated association between peer victimization and later depression after adjusting for substance abuse and dependence. A better understanding of the role of adolescent substance use in these associations may inform future interventions to support victims and prevent peer aggression.

We used data from the Northern Finland Birth Cohort 1986 to study the prospective associations between peer victimization, aggression and victimization-perpetration in adolescence and a wide range of register-based mental disorders diagnosed by the age of 33 years. We hypothesize that the associations between peer victimization or

aggression and subsequent mental disorders attenuate in both sexes after adjusting for substance use and mental health symptoms in adolescence as well as parental mental disorders.

## **METHODS**

### **Participants**

Participants were drawn from the Northern Finland Birth Cohort (NFBC) 1986, a sample consisting of 99% of all births from the two northern-most provinces in Finland, including all live born children (n=9,432) with an expected birthday between July the 1<sup>st</sup> 1985 and June the 30<sup>th</sup> 1986. Data were collected in two parts in 2001-2002 from the participants at age 15-16 years using questionnaires: First, a postal questionnaire including Youth Self-Report (YSR) questions was sent to the study members which was completed by consenting participants (n=7182, 77.9%). These individuals were invited to a field study, where they completed another questionnaire including questions on peer aggression and victimization (n=6974, 74%). Those who moved abroad (n=268, 2.8% of the original participants) or were deceased (n=60, 0.6% of the original sample) after participating in the study at age 15-16 years were included in the study. These participants were censored according to the day of death or moving to abroad.

Individuals who did not answer peer aggression and victimization questions and those who had mental disorders before age 16 years or intellectual disability (ICD-10; F70-F79) were excluded. The final cohort consisted of 6,682 individuals (70.8% of the original sample, 45.2% boys; Figure S1, available online). For more information about the study design, see NFBC data collection page (*University of Oulu: Northern Finland Birth Cohort 1986. University of Oulu., n.d.*). Information on mental health diagnoses was



cumulatively collected from the four national registries from the participant's age 16 years through to 33 years, i.e., until the end of 2018. Only the time of the first diagnosis was included if the same disorder was diagnosed twice or more in the same patient during the data collection period. The study was approved by the Ethical committee of the Northern Ostrobothnia Hospital District 108/2017.

Attrition from the 15-16-year follow-up study is presented elsewhere (Miettunen et al., 2014). In summary, fewer adolescents with mental disorder (65.1% v. 74.2%,  $p < 0.001$ ), parental mental disorder (58% v. 69%,  $p < 0.001$ ), males (64% v. 71%;  $p < 0.001$ ) and individuals living in urban areas (66% v. 71%,  $p < 0.001$ ) were retained in the follow-up study. Participants with missing data were excluded from the study, but this did not have major impact on the distribution of covariates within outcomes apart from anxiety disorders (Tables S2 and S3, available online). Data were not missing completely at random as male victims with an anxiety disorder dropped out from the adjusted model more often than non-victims.

### **Peer Aggression**

Information on peer aggression was assessed with two questions. Victimization was assessed using the item 'I get bullied a lot', and perpetration was assessed by the item 'I bully others a lot'. Response options included i) 'not true', ii) 'somewhat true' and iii) 'very true'. Based on responses to these questions, participants' experiences were classified into two groups if they responded 'somewhat true' or 'very true' on one or both items: i) victimization only, or ii) perpetration only. Participants were otherwise classified as not a victim or not a perpetrator. We also separately studied victim-perpetration and a four-class variable was formed: i) victimization only, ii) perpetration

only, iii) victim-perpetration, or iv) ‘uninvolved’. The questionnaire applied in this study used the term ‘bullying’, but it did not include information on the two key components of bullying: power differential or repetition of bullying. Therefore, we preferred to use the terms ‘peer aggression’ and ‘peer victimization’.

## **Mental Disorder**

Information on diagnosed mental disorders was cumulatively collected until age 33 years from nationwide registers: The Register of Primary Health Care Visits 2011-2018 and the Care Register for Health Care 2001-2018 of the National Institute for Health and Welfare, disability pensions of the Finnish Centre for Pensions 2001-2016, and the medication reimbursement register of the Social Insurance Institution of Finland 2001-2005. The Care Register contains data on patients discharged from inpatient care, and since 1998 also data on specialized outpatient care. The Register of Primary Health Care Visits comprises all outpatient primary health care delivered in Finland. For more information about the registers see (Filatova et al., 2017) Supplement 1. There were five mental disorder diagnostic outcomes. The first was “Any mental disorder” which was derived from four classes of disorders collected in the registers. These four classes were constructed by grouping the ICD-10 mental health diagnoses into: 1) Any non-organic psychosis, 2) anxiety disorder, 3) mood disorder, and 4) any substance use disorder (SUD) (Table S1, available online). SUD contained diagnoses of harmful use and dependence of alcohol and/or other drugs, including nicotine. Where a cohort member had multiple diagnoses, they were included in each of the relevant diagnostic groups.

## **Confounders**

Data on family structure were collected when the cohort member was aged 15-16 years. Family structure was categorized into families with either (1) both parents living with the participant all the time or (2) other type of family, including single parent and blended families.

Information on parental education level was gathered from a parent questionnaire when participants were aged 15-16 years. Education level of both parents separately was divided into two groups: (1) schooling for less than 12 years and (2) schooling for 12 years or more.

Information on frequency of alcohol intoxication, daily smoking and illicit drug use at age 15-16 years was collected with self-reported questions. Regarding intoxication frequency the study members were asked: 'How many times have you been drunk during the past 30 days?' with options: Never, 1-2, 3-5, 6-9, 10-19, 20-39 or 40 times or more. A two-class variable of being intoxicated (1) 0-2 times and (2)  $\geq 3$  times during the past 30 days was formed. For smoking the questions were: 'Do you smoke now?' with options: (1) not at all, (2) occasionally, (3) once a week, (4) on 2-4 days, (5) 5-6 days, or (6) 7 days a week. This item was categorized as a two-class variable of (1) no daily smoking, (options 1 -5) and (2) daily smoking. Regarding illicit drug use the study members were asked: 'Have you used marihuana or hashis?', 'Have you used ecstasy, heroin, cocaine, amphetamine, LSD or other similar drugs?', 'Have you sniffed thinner, glue, etc. for intoxication?' and 'Have you used medicines (sedatives, sleeping pills, or pain killers without alcohol) for intoxication?' The answers were combined as a two-class variable: Illicit drug use (no/yes). A person was classified to the yes-group, if

she/he had reported using any of these substances at least once by the age of 15-16 years.

Information on parental mental health diagnoses was based on parental diagnoses in the nationwide registers. These registers include: (1) Register of Health Care during the years 1969-2016 (Hospital Discharge Register until 1994). This register comprises inpatient care and visits to specialized outpatient health care since 1998. (2) The Register of Primary Health Care Visits (2011-2016); and (3) disability pensions of the Finnish Centre for Pensions (1965-2016).

During the field study at age 15-16 years, data were gathered on the adolescent's emotional and behavioral problems using the total score of the Youth Self-Report (YSR) questionnaire (Achenbach & Rescorla, 2001). This is a 118 item self-report questionnaire which consists of 8 DSM orientated subscales. For the purpose these analyses, we used the total YSR score but excluded the two questions relating to peer aggression and victimization.

### **Statistical methods**

Cross-tabulation and Chi-square-tests were used for exploring the associations of potential confounders and peer victimization and perpetration. For exploring the association of exposures and YSR total score, Mann-Whitney's U-test was used. The first study design involved a cox regression analysis with hazard ratios (HR) and their 95% confidence intervals (95% CI) to examine the association between peer victimization or aggression and mental disorders separately for females and males. The

reference groups were the non-victims or non-perpetrators (study design 1, Tables 1-4). A second study design again using cox regression analysis explored the association between peer victimization, peer aggression, and victim-perpetration and mental disorders for females and males combined. The reference groups were the uninvolved female or male adolescents (study design 2, Supplementary tables 4-6). Two study designs were used because there were small numbers in some groups of participants involved in peer aggression who later experienced mental health diagnoses. The separate study designs enabled exploration of associations stratified by gender and by involvement in peer aggression (victim, perpetrator or victim/perpetrator). The hazard of receiving a mental health diagnosis in the victim or perpetrator or victim-perpetrator groups (yes/no) was determined with unadjusted and adjusted cox regression survival analyses from age 16 to 33 years. We adjusted cox regression survival analyses for victims or perpetrators or victim-perpetrators and mental disorders with family structure, alcohol intoxication frequency, daily smoking, illicit drug use and psychopathology at age 15-16 and parental mental health diagnoses. Interactions between peer victimization or aggression and background variables in relation to mental disorders were studied with logistic regression analysis. The results were considered statistically significant at level  $p < 0.05$ . All statistical tests were two-tailed and performed with SPSS software (version 25).

## **RESULTS**

At age 16 years, 5.0% of females and 5.4% of males were exposed to peer victimization and 9.2% of females and 12.0% of males reported peer aggression towards others (Table 1). At age 33 years, 40.8% (n=71) of female and 26.6% (n=46) of male victims

and 31.3% (n=100) of female and 19.8% (n=76) of male perpetrators were diagnosed with any mental disorder. In addition, we examined those participants who were both victims and perpetrators (data shown in Table S4, available online).

\*\*\*Please, insert Table 1 here\*\*\*

Peer victimization experiences were statistically significantly associated with all mental disorder outcomes among female adolescents (Table 2). Also, peer aggression was associated with all outcomes except psychosis among females. Being a male victim was associated with any mental disorder, mood disorder and psychosis, but not with anxiety disorder or SUD. Peer aggression among males was associated with all the studied outcomes except psychosis. Furthermore, there was an association between female victim-perpetration and any psychosis, anxiety disorder, mood disorder and SUD (Table S5, available online). No associations were found between male victim-perpetration and the studied outcomes.

\*\*\*Please, insert Table 2 here\*\*\*

In adjusted Cox regression analyses, the associations between female and male victims or perpetrators and all the mental disorder outcomes attenuated after adjusting for adolescent psychopathology, intoxication frequency, daily smoking, illicit drug use and parental psychiatric disorders at age 16 years (Tables 3 and 4). This attenuation of

associations was also seen with female victim-perpetrators (Table S6, available online). However, the association between female victimization and subsequent non-organic psychosis and mood disorder remained statistically significant after adjusting for the covariates (HR 2.9, 95% CI 1.2-6.9,  $p=0.020$  for psychosis and HR 1.6, 95% CI 1.2-2.4,  $p=0.012$  for mood disorder).

\*\*\*Please, insert Table 3 here\*\*\*

\*\*\*Please, insert Table 4 here\*\*\*

## **DISCUSSION**

In this large birth cohort study using register-based follow-up into adulthood, the associations between adolescent peer victimization and perpetration, and young adult mental disorders attenuated in both females and males after adjusting for alcohol intoxication frequency, daily smoking, illicit drug use and psychopathology at age 16 years as well as parental mental disorders. Substance use in adolescence is associated with peer aggression and victimization. In males, it may be the associated substance use in adolescence rather than the peer victimization and aggression that is responsible for the increased risk of later mental disorders in adulthood. However, for females, peer victimization was associated with increased risk of later psychosis and mood disorder independent of substance use in adolescence. To our knowledge, this is the first study in which adolescent substance use was considered as a confounding factor when studying peer aggression and victimization in adolescence and mental disorders in adulthood.

Previous studies report that whilst female victimization in childhood is associated with an increased risk of adult mental health problems (Copeland et al., 2013; Sourander et al., 2009), females who are involved in peer aggression are not at increased risk (Copeland et al., 2013). In our work, peer victimization and peer aggression in adolescent females were associated with future mental disorder diagnoses. However, almost all associations attenuated to non-significance after adjusting for adolescent substance use, psychopathology at age 16 years or parental mental health diagnoses. Of the specific substance covariates, adolescent illicit drug use and daily smoking significantly attenuated the association between female victimization and perpetration and SUD. However, female victimization in adolescence was associated with an elevated risk for later psychosis and mood disorder even after adjustments. Recent meta-analyses have shown victims of peer aggression in childhood and adolescence are more likely to experience later mental illness, including psychosis and mood disorder (McKay et al., 2020; Moore et al., 2017). Our results are in accordance with these previous works. The multiple pathways leading from adolescence peer victimization to development of depression or psychotic symptoms in adulthood may include altered physiological and cognitive responses to stress and threat signals, interaction with pre-existing genetic vulnerability to mental disorders, and also direct causal environmental effect of bullying victimization to later psychopathology (Connolly & Beaver, 2016; Guimond et al., 2015; Lecei et al., 2019; Wolke et al., 2014).



Previous studies of male adolescents have shown that peer victimization is associated with anxiety disorder and depression (Haavisto et al., 2004; Klomek et al., 2008; Sourander et al., 2007) and peer aggression with depression and illicit drug use (Klomek et al., 2008; Niemelä et al., 2011). In our work, the associations between male victimization and psychosis and mood disorder and male aggression and anxiety and mood disorders and SUD attenuated after adjustments especially with baseline psychopathology and paternal mental disorder. Concerning mood disorder, adolescent illicit drug use modified the outcome in early adulthood. In addition, adjusting for co-occurring substance use in adolescence attenuated the SUD outcome later in life.

Adolescent illicit substance use has been reported to elevate the risk of anxiety and mood disorder (Fergusson et al., 2002; Sareen et al., 2006; Wang et al., 2018). Moreover, adolescent smoking and frequent intoxication has been associated with SUD in young adulthood (Riala et al., 2004; Sarala et al., 2020). Adolescents with substance use may be predisposed to later psychiatric disorders through the disruption of critical processes of brain development (Lubman et al., 2015). In our work, YSR scores increased the risk for all studied mental disorder outcomes for both females and males. This is consistent with previous studies, which show adolescents with mental health problems having an elevated risk of anxiety and mood disorders and SUD in adulthood (Benjet et al., 2016; Copeland et al., 2009). The psychosocial factors and hormonal, neuroendocrine and other neurophysiological changes that are associated with adolescent mental health problems may be responsible for symptoms persisting or re-occurring throughout adulthood (Faravelli et al., 2013; Leach et al., 2008). In addition, parental mental disorders have been found to increase the risk of anxiety and mood

disorders and SUD in young adult offspring via environmental and genetic factors (Dean et al., 2010). In this work, adolescent psychopathology, daily smoking, illicit drug use and parental mental health diagnoses were significant predictors of mental disorders in young adulthood. Thus, interventions that prevent substance use and peer aggression in adolescence and address the mental health problems of both adolescents and their parents are needed.

### **Strengths and limitations**

This study has major strengths: We used a longitudinal design and prospective data from a large population-based birth cohort with relatively small attrition. Also, a high quality, comprehensive register data enabled detection those with mental disorders until the age of 33 years. Information on participant's substance use and psychopathology at baseline and parental mental disorders were included in the analyses. This study has also limitations: Attrition at the 15-16 years questionnaires may have impacted the work by leading to over or under estimation of the results. Moreover, the questionnaire applied in this study did not include information on power differential between perpetrator and victim or repetition, recency or type of aggression. Furthermore, register data included only those individuals with a psychiatric illness diagnosed in national health care. Those persons who have not sought help for their mental health problems will not be identified by the registers. However, with universal access to health care, the vast majority of participants with significant impairment are likely to have been diagnosed and included.

## CONCLUSIONS

Illicit drug use, daily smoking, and psychopathology at age 16 years as well as parental mental disorders attenuate the associations between adolescent peer victimization and aggression and mental disorders in early adulthood. Accounting for adolescent substance use is essential in studies of adolescent victimization or aggression and later mental health outcomes. In addition, the risk for psychosis and mood disorder of females who experience peer victimization were elevated independent of adolescent substance use or other studied risk factors. The factors leading to these adverse outcomes in female victims need further exploration. Prevention of peer aggression, particularly in females may provide an opportunity to reduce the prevalence of mental disorders in adulthood.

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**Table 1. Background variables and mental health diagnoses at age 33 years and peer victimization and peer aggression (Study design 1)**

	Total n	Victim			Perpetrator		
		n	%	p-value*	n	%	p-value*
<b>Gender<sup>1</sup></b>	6682						
Female		174	5.0	0.421	320	9.2	<b>&lt;0.001</b>
Male		173	5.4		384	12.0	
<b>Family type</b>	5856						
Both parents		231	77.0	0.521	455	75.2	<b>0.038</b>
One parent or other		69	23.0		150	24.8	
<b>Maternal education level</b>	5828						
<12 years		224	73.9	<b>0.010</b>	406	67.1	0.293
≥12 years		79	26.1		199	32.9	
<b>Paternal education level</b>	5595						
<12 years		241	81.7	0.650	472	81.5	0.588
≥12 years		54	18.3		107	18.5	
<b>Intoxication frequency<sup>2,3</sup></b>	5764						
0		182	63.9	0.062	280	47.1	<b>&lt;0.001</b>
1-2		71	24.9		222	37.4	
3 or more		32	11.2		92	15.5	
<b>Daily smoking<sup>3</sup></b>	6605						
No		296	86.8	0.867	526	75.3	<b>&lt;0.001</b>
Yes		45	13.2		173	24.7	
<b>Illicit drug use<sup>3</sup></b>	5899						
No		237	80.9	<b>0.002</b>	453	75.4	<b>&lt;0.001</b>
Yes		56	19.1		148	24.6	
<b>Maternal mental disorder</b>	6682						
No		261	75.2	0.245	536	76.1	0.278
Yes		86	24.8		168	23.9	
<b>Paternal mental disorder</b>	6682						
No		276	79.5	0.959	546	77.6	0.145
Yes		71	20.5		158	22.4	
<b>Any Mental Disorder, female</b>	3491						
No		103	59.2	<b>&lt;0.001</b>	220	68.8	<b>0.025</b>
Yes		71	40.8		100	31.3	
<b>Any Mental Disorder, male</b>	3191						
No		127	73.4	<b>0.001</b>	308	80.2	0.132
Yes		46	26.6		76	19.8	
<b>Any Psychosis, female</b>	3491						
No		164	94.3	<b>&lt;0.001</b>	313	97.8	0.383
Yes		10	5.7		7	2.2	
<b>Any Psychosis, male</b>	3191						
No		164	5.2	<b>0.004</b>	371	96.6	0.070
Yes		9	5.2		13	3.4	
<b>Anxiety Disorder, female</b>	3491						
No		134	77.0	<b>0.001</b>	255	79.7	<b>0.002</b>
Yes		40	23.0		65	20.3	
<b>Anxiety Disorder, male</b>	3191						
No		155	89.6	0.295	342	89.1	<b>0.043</b>
Yes		18	10.4		42	10.9	
<b>Mood disorder, female</b>	3491						
No		129	74.1	<b>&lt;0.001</b>	267	83.4	<b>0.049</b>
Yes		45	25.9		53	16.6	
<b>Mood Disorder, male</b>	3191						
No		151	87.3	<b>0.002</b>	346	90.1	<b>0.011</b>
Yes		22	12.7		38	9.9	
<b>Substance Use Disorder, female</b>	3491						
No		163	93.7	<b>0.002</b>	304	95.0	<b>0.005</b>



Yes		11	6.3		16	5.0	
<b>Substance Use Disorder, male</b>	3191						
No		162	93.6	0.145	356	92.7	<b>0.001</b>
Yes		11	6.4		28	7.3	

  

		<b>Victim</b>			<b>Perpetrator</b>		
	<b>Total</b>			<b><i>p</i>-value*</b>			<b><i>p</i>-value*</b>
	<b>n</b>	<b>n</b>	<b>Mean ± SD</b>		<b>n</b>	<b>Mean ± SD</b>	
<b>YSR total score<sup>4</sup></b>	6629	342	42.3 ± 18.1	<b>&lt;0.001</b>	696	41.4 ± 18.2	<b>&lt;0.001</b>

\*Chi square test

<sup>1</sup> Information on gender presented as row percentages.

<sup>2</sup> past 30 days.

<sup>3</sup> at the age of 15-16 years.

<sup>4</sup> Information for Youth Self-Report (YSR) are reported as continuous variables.

**Table 2. Results of unadjusted cox regression analyses for female and male mental disorder diagnoses at age 33 years (Study design 1)**

Female			Any Mental Disorder			Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Crude Model	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value		
Victim	1.9	1.5-2.4	<0.001	4.5	2.3-8.9	<0.001	1.8	1.3-2.4	0.001	2.3	1.7-3.2	<0.001	2.7	1.4-5.1	0.002		
Perpetrator	1.3	1.1-1.6	0.015	1.5	0.7-3.3	0.320	1.6	1.2-2.0	0.001	1.3	1.01-1.8	0.043	2.2	1.3-3.7	0.005		

  

Male			Any Mental Disorder			Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Crude Model	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value		
Victim	1.7	1.3-2.3	<0.001	2.7	1.4-5.5	0.005	1.3	0.8-2.1	0.258	2.1	1.3-3.2	0.001	1.5	0.8-2.8	0.249		
Perpetrator	1.3	1.004-1.6	0.046	1.8	0.97-3.2	0.064	1.5	1.05-2.0	0.026	1.6	1.2-2.3	0.005	2.0	1.3-3.1	0.001		

Abbreviations: HR = hazard ratio, 95% CI = 95% confidence interval.

**Table 3. Results of adjusted cox regression analyses for female mental disorder diagnoses (Study design 1)**

	Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Characteristics	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value
<b>Victim</b>	<b>2.9</b>	<b>1.2-6.9</b>	<b>0.020</b>	1.5	1.0-2.2	0.079	<b>1.6</b>	<b>1.1-2.4</b>	<b>0.011</b>	1.5	0.6-3.6	0.378
<b>Family type</b>												
One parent or other	1.3	0.6-2.6	0.495	1.2	0.9-1.5	0.174	<b>1.3</b>	<b>1.01-1.7</b>	<b>0.039</b>	1.4	0.8-2.4	0.243
<b>Intoxication frequency</b>												
1-2	0.9	0.4-2.0	0.858	0.8	0.6-1.0	0.090	0.8	0.6-1.1	0.181	1.2	0.6-2.2	0.641
3 or more	1.9	0.7-4.8	0.196	1.1	0.8-1.7	0.482	1.1	0.7-1.6	0.731	1.2	0.6-2.2	0.702
<b>Daily smoking (yes)</b>	1.7	0.7-4.0	0.206	1.2	0.9-1.7	0.306	1.1	0.8-1.5	0.590	<b>2.7</b>	<b>1.5-5.1</b>	<b>0.002</b>
<b>Illicit drug use (yes)</b>	0.7	0.3-1.7	0.472	0.9	0.7-1.3	0.618	1.3	0.9-1.7	0.110	<b>2.1</b>	<b>1.1-3.8</b>	<b>0.020</b>
<b>Maternal mental disorder (yes)</b>	1.4	0.7-2.8	0.348	<b>1.4</b>	<b>1.1-1.7</b>	<b>0.013</b>	<b>1.8</b>	<b>1.4-2.3</b>	<b>&lt;0.001</b>	1.7	1.0-2.9	0.068
<b>Paternal mental disorder (yes)</b>	1.8	0.9-3.5	0.100	1.3	1.0-1.6	0.050	<b>1.3</b>	<b>1.01-1.7</b>	<b>0.043</b>	<b>2.1</b>	<b>1.2-3.6</b>	<b>0.007</b>
<b>YSR total score</b>	<b>1.02</b>	<b>1.01-1.04</b>	<b>0.014</b>	<b>1.015</b>	<b>1.01-1.02</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.015-1.03</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.004-1.03</b>	<b>0.014</b>

  

	Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Characteristics	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value	HR	95% CI	<i>p</i> -value
<b>Perpetrator</b>	0.9	0.3-2.4	0.828	1.2	0.9-1.5	0.244	0.8	0.5-1.2	0.228	0.8	0.4-1.9	0.676
<b>Family type</b>												
One parent or other	1.3	0.7-2.6	0.449	1.2	0.9-1.5	0.171	<b>1.3</b>	<b>1.02-1.7</b>	<b>0.036</b>	1.4	0.8-2.4	0.226
<b>Intoxication frequency</b>												
1-2	0.9	0.4-1.9	0.737	0.8	0.6-1.0	0.077	0.8	0.6-1.1	0.130	1.1	0.6-2.2	0.684
3 or more	1.8	0.7-4.6	0.226	1.1	0.8-1.6	0.517	1.1	0.7-1.5	0.784	1.2	0.5-2.7	0.685
<b>Daily smoking (yes)</b>	1.6	0.7-3.8	0.256	1.2	0.8-1.6	0.331	1.1	0.8-1.5	0.615	<b>2.7</b>	<b>1.4-5.0</b>	<b>0.002</b>
<b>Illicit drug use (yes)</b>	0.7	0.3-1.8	0.495	0.9	0.7-1.3	0.582	1.3	1.0-1.7	0.104	<b>2.1</b>	<b>1.1-3.8</b>	<b>0.020</b>
<b>Maternal mental disorder (yes)</b>	1.4	0.7-2.8	0.345	<b>1.4</b>	<b>1.1-1.7</b>	<b>0.013</b>	<b>1.8</b>	<b>1.4-2.3</b>	<b>&lt;0.001</b>	1.7	1.0-2.9	0.066
<b>Paternal mental disorder (yes)</b>	1.8	0.9-3.5	0.093	<b>1.3</b>	<b>1.002-1.7</b>	<b>0.048</b>	<b>1.3</b>	<b>1.01-1.7</b>	<b>0.044</b>	<b>2.1</b>	<b>1.2-3.6</b>	<b>0.007</b>
<b>YSR total score</b>	<b>1.03</b>	<b>1.01-1.05</b>	<b>0.002</b>	<b>1.015</b>	<b>1.01-1.02</b>	<b>&lt;0.001</b>	<b>1.025</b>	<b>1.02-1.03</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.01-1.04</b>	<b>0.007</b>

Abbreviations: HR = hazard ratio, 95% CI = 95% confidence interval, YSR = Youth Self-Report (peer aggression questions excluded).

**Table 4. Results of adjusted cox regression analyses for male mental disorder diagnoses (Study design 1)**

	Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Characteristics	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value
<b>Victim</b>	1.3	0.5-3.2	0.551	0.7	0.3-1.4	0.253	1.3	0.7-2.2	0.403	1.0	0.4-2.2	0.975
<b>Family type</b>												
One parent or other	0.9	0.5-1.8	0.759	1.2	0.9-1.7	0.281	1.2	0.8-1.7	0.371	<b>1.8</b>	<b>1.2-2.8</b>	<b>0.009</b>
<b>Intoxication frequency</b>												
1-2	0.9	0.5-1.6	0.652	0.8	0.6-1.2	0.250	1.0	0.7-1.5	0.891	1.2	0.7-2.0	0.424
3 or more	0.7	0.3-2.1	0.558	1.3	0.8-2.1	0.355	1.3	0.7-2.1	0.388	<b>1.9</b>	<b>1.01-3.6</b>	<b>0.046</b>
<b>Daily smoking (yes)</b>	1.1	0.5-2.6	0.787	0.9	0.6-1.5	0.678	1.1	0.7-1.7	0.772	1.5	0.9-2.6	0.142
<b>Illicit drug use (yes)</b>	1.2	0.5-2.7	0.685	1.3	0.8-2.0	0.303	<b>1.8</b>	<b>1.1-2.7</b>	<b>0.010</b>	<b>1.8</b>	<b>1.01-3.1</b>	<b>0.045</b>
<b>Maternal mental disorder (yes)</b>	1.1	0.6-2.0	0.797	<b>1.8</b>	<b>1.3-2.5</b>	<b>&lt;0.001</b>	1.4	1.0-2.0	0.055	1.5	1.0-2.4	0.072
<b>Paternal mental disorder (yes)</b>	<b>2.6</b>	<b>1.5-4.5</b>	<b>0.001</b>	<b>2.1</b>	<b>1.5-2.8</b>	<b>&lt;0.001</b>	<b>1.8</b>	<b>1.2-2.5</b>	<b>0.001</b>	<b>2.0</b>	<b>1.3-3.1</b>	<b>0.002</b>
<b>YSR total score</b>	<b>1.04</b>	<b>1.02-1.06</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.01-1.03</b>	<b>0.006</b>	<b>1.02</b>	<b>1.01-1.04</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.01-1.04</b>	<b>0.010</b>

  

	Any Non-organic Psychosis			Anxiety Disorder			Mood Disorder			Substance Use Disorder		
Characteristics	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value	HR	95% CI	p-value
<b>Perpetrator</b>	1.1	0.5-2.2	0.847	1.2	0.7-1.8	0.499	1.0	0.6-1.5	0.925	1.2	0.6-2.1	0.633
<b>Family type</b>												
One parent or other	0.9	0.5-1.8	0.770	1.2	0.9-1.7	0.269	1.2	0.8-1.7	0.375	<b>1.8</b>	<b>1.2-2.8</b>	<b>0.009</b>
<b>Intoxication frequency</b>												
1-2	0.9	0.5-1.6	0.615	0.8	0.6-1.2	0.261	1.0	0.7-1.5	0.929	1.2	0.7-2.0	0.447
3 or more	0.7	0.3-2.1	0.563	1.3	0.8-2.1	0.358	1.3	0.7-2.1	0.381	<b>1.9</b>	<b>1.02-3.6</b>	<b>0.045</b>
<b>Daily smoking (yes)</b>	1.1	0.5-2.6	0.793	0.9	0.5-1.4	0.632	1.1	0.7-1.7	0.758	1.5	0.9-2.6	0.153
<b>Illicit drug use (yes)</b>	1.2	0.5-2.7	0.683	1.3	0.8-2.0	0.305	<b>1.8</b>	<b>1.1-2.7</b>	<b>0.010</b>	<b>1.8</b>	<b>1.01-3.1</b>	<b>0.046</b>
<b>Maternal mental disorder (yes)</b>	1.1	0.6-2.1	0.781	<b>1.8</b>	<b>1.3-2.5</b>	<b>&lt;0.001</b>	1.4	1.0-2.0	0.050	1.5	1.0-2.4	0.070
<b>Paternal mental disorder (yes)</b>	<b>2.6</b>	<b>1.5-4.5</b>	<b>0.001</b>	<b>2.1</b>	<b>1.5-2.8</b>	<b>&lt;0.001</b>	<b>1.8</b>	<b>1.2-2.5</b>	<b>0.001</b>	<b>2.0</b>	<b>1.3-3.1</b>	<b>0.002</b>
<b>YSR total score</b>	<b>1.04</b>	<b>1.03-1.06</b>	<b>&lt;0.001</b>	<b>1.01</b>	<b>1.001-1.03</b>	<b>0.031</b>	<b>1.03</b>	<b>1.01-1.04</b>	<b>&lt;0.001</b>	<b>1.02</b>	<b>1.003-1.04</b>	<b>0.018</b>

Abbreviations: HR = hazard ratio, 95% CI = 95% confidence interval, YSR = Youth Self-Report (peer aggression questions excluded).