

RESEARCH ARTICLE

Higher Levels of Nicotine Dependence in Adolescence are Associated with Younger Onset Age of Violent Criminality: A Follow-Up Study of Former Adolescent Psychiatric Inpatients

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Abstract

Objective: Earlier studies have reported that smoking is associated with violent behaviour. This study investigated nicotine dependence (ND), defined as already present in adolescence, and its relation to subsequent violent criminal offending. **Method:** The baseline dataset is composed of 508 former adolescent inpatients, admitted to a psychiatric hospital between the ages of 13-17. Adolescent ND was assessed using the modified Fagerström Tolerance Questionnaire. Follow-up data on crimes up to young adulthood was acquired from the Legal Register Centre of Finland. The study analyzes the participants with violent offences (n = 78) and those without any criminal history (n = 368). **Results:** Over 80% of the violent offenders had ND already in adolescences. One third (32.2%) of those with high ND had committed their first violent crime before 18 years of age, the proportions being 15.2% in moderate and 7.1% in no-ND groups. The likelihood for committing first violent crimes at a younger age was increased in the participants with high (adjusted Hazard Ratio (aHR) = 2.66, p = .008) or moderate ND (aHR = 2.40, p = .011). **Conclusions:** Adolescent psychiatric patients, showing moderate to high levels of addiction to nicotine, should be a target population for adolescent focused smoking cessation interventions and programs. Adolescents addicted to nicotine may benefit from intensive clinical attention in order to avoid more adverse and unfavorable outcomes in life, beyond merely physical health related problems.

Key Words: *adolescent; psychiatric inpatients; nicotine dependence; age of violent offending*

Résumé

Objectif: Les études précédentes ont rapporté que le tabagisme est associé au comportement violent. La présente étude a investigué la dépendance à la nicotine (DN), définie comme étant déjà présente à l'adolescence, et sa relation aux infractions criminelles violentes subséquentes. **Méthode:** L'ensemble des données de base se compose de 508 anciens patients adolescents hospitalisés dans un hôpital psychiatrique entre 13 et 17 ans. La DN des adolescents a été évaluée à l'aide du questionnaire de tolérance Fagerström modifié. Les données de suivi sur les crimes jusqu'au jeune âge adulte ont été obtenues du centre de registre légal de Finlande. L'étude analyse les participants qui ont des infractions avec violence (n = 78) et ceux qui n'ont pas d'antécédents criminels (n = 368). **Résultats:** Plus de 80 % des délinquants violents avaient la DN déjà à l'adolescence. Un tiers (32,2 %) de ceux ayant une DN élevée avaient commis leur premier crime violent avant l'âge de 18 ans, dans des proportions de 15,2 % chez les modérés et de 7,1 % chez les groupes sans DN. La probabilité de commettre les premiers crimes violents plus jeune était accrue chez les participants ayant (un rapport

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de risque ajusté (RRa) = 2,66, $p = ,008$) élevé ou une DN modérée (RRa = 2,40, $p = ,011$). **Conclusions:** Les patients psychiatriques révélant des niveaux modérés à élevés de dépendance à la nicotine devraient constituer une population cible pour les interventions et les programmes de cessation du tabagisme axés sur les adolescents. Les adolescents dépendants à la nicotine peuvent bénéficier d'une attention clinique intensive afin d'éviter des résultats indésirables et défavorables dans la vie, au-delà des simples problèmes de santé physique.

Mots clés: adolescent; patients psychiatriques hospitalisés, dépendance à la nicotine; âge des infractions violentes

Introduction

Cigarette smoking is a serious health concern accounting for more than seven million deaths each year worldwide, as noted in the WHO report on the global tobacco epidemic (WHO 2017). The report summarizes that, thanks to national level prevention policies, global smoking prevalence has decreased, although much of this decline has occurred in high-income countries. In Finland, the National Institute for Health and Welfare reported that, among 14-18 year old students, smoking has declined significantly between the years 1977 -2019. In 2019, only 6% of the general population of adolescents were daily smokers (THL 2020). In contrast to the general population, people with mental illnesses show high smoking prevalence and this has led to calls for action in the prevention of adverse tobacco related outcomes (Prochaska et al. 2017).

Tobacco smoking has been shown to be a predictor of violent behavior among 6th-10th grade school students (Molcho et al. 2004). Smoking is also associated with violence among adults, even after controlling for potential covariates such as lower education, mood disorder and substance dependence. In their large epidemiologic study of community-dwelling individuals aged 18 years and above, Lewis et al found that daily smoking increased the likelihood of other-directed violence by up to 2.5-fold compared to non-smokers (Lewis et al. 2016). In a Finnish population-based study of adolescent males, daily smoking at the age of 18 was independently related to drug-, violent-, property- and traffic crime offending at the ages of 17-20 years and it increased the risk for violent offences up to 3.5-fold (Elonheimo et al. 2011).

Although the association between daily smoking and violent behavior in adolescences seems to be evident, the causality and the dose-response between nicotine dependence (ND) and the onset age of severe violent offending is, in great part, an unstudied topic (Molcho et al. 2004, Lewis et al. 2016, Elonheimo et al. 2011). Pahl et al. found that ND in youth aged between 12-17 was associated with violent behavior, deviance and other problematic behavior (Pahl et al. 2010). Therefore, further studies are warranted to

strengthen research-based evidence on the relationship between ND in adolescence and the onset of violent offending.

In our register-based follow-up study of former adolescent psychiatric inpatients, we had access to the nationwide crime register. The current study focused on analyzing the temporal relationship of adolescent ND to registered violent criminality up to early adulthood.

Method

Study design

This study is a part of the clinical follow-up project which examines psychosocial risk factors, psychiatric disorders and long-term outcomes of hospitalized adolescents. The original study population covers adolescents who were in psychiatric inpatient care between 13-17 years of age at the Department of Psychiatry in Oulu University Hospital, in Northern Finland, during April 2001 and May 2006. During this five-year data collection period, all adolescents aged 13-17 years of age, who were in need of acute psychiatric inpatient care, were treated in a 10-bed adolescent psychiatric inpatient ward. The catchment area of the Oulu University Hospital covers the whole Northern Finland, accounting for 43% of the total geographic area of the country.

After admission to adolescent psychiatric care, the patients and their parents/ legal guardians were asked to participate in the study project. Signed informed consent was required from both the patient and their parent/guardian. Of all adolescents admitting to inpatient care ($n = 637$) during the data collection period, those excluded from the study were adolescents aged over 18 ($n = 1$), with intellectual disability ($n = 26$) or an organic brain disorder ($n = 3$). Of the eligible patients ($n = 607$), the adolescents who did not provide informed consent ($n = 77$) or whose stay at the ward was too short (1-3 days) for them to complete their interviews ($n = 22$), were omitted from the study sample, resulting in the final study population of 508 adolescents (208 males, 300 females; mean age 15.5 [SD 1.3] years), representing a high participation rate (83.7%). The study protocol was approved by the Ethics Committee of Oulu University Hospital.

Factors assessed during adolescent psychiatric inpatient care

Diagnostic instrument

All participants were interviewed using the Schedule for Affective Disorder and Schizophrenia for School-Age Children Present and Lifetime (K-SADS-PL). This instrument is a semi-structured, diagnostic interview, designed to assess background information as well as current and past episodes of psychopathology in children and adolescents, according to DSM-IV criteria (Kaufman et al. 1997). Interviews were conducted by the treating physician or by trained medical students under the supervision of a senior physician.

The adolescent psychiatric disorders identified during inpatient care were based on the K-SADS-PL interview. The following major groups were formed: psychotic, substance use, affective, anxiety and conduct disorders. Multiple diagnoses in a single subject were possible. The K-SADS-PL also provided information on family structure at admission to adolescent inpatient care, and this was categorized into (1) two-parent family (two biological parents or blended family), (2) single parent family, and (3) out-of-home placement (foster family, child welfare placement, residential care home or living alone).

In Finland, personality disorder (PD) diagnoses are rarely set for patients under 18 year of age. For our follow-up project, PD diagnoses were obtained from the Finnish Nationwide Care Register for Health Care (CRHC), up to the end of the 2016. The CRHC is administered by the Finnish National Institute for Health and Welfare and it includes information on all inpatient episodes in primary and specialized level care (from 1969 onwards) and all specialized level outpatient visits (from 1998 onwards) in Finland. PD diagnoses were further reviewed by professional psychiatrists using DSM-IV-TR criteria (Kantojärvi et al. 2016).

Measure of nicotine dependence

The modified Fagerström Tolerance Questionnaire (mFTQ) for adolescents was used to assess the level of nicotine dependence (ND) (Prokhorov et al. 1996), which has shown acceptable internal consistency and validity at international level (Prokhorov et al. 2017). The mFTQ appraises smoking rate, frequency of inhalation, time between waking up and the first cigarette in the morning, level of unwillingness to give up the first cigarette in the morning, difficulty of refraining from smoking in places where it is forbidden, smoking despite medical illness, and smoking more in the first two hours of the day than during the remainder of a day. The score sum on the mFTQ can vary from 0-9. A score sum of 0-2 indicates no ND, a score of 3-5 is indicative of moderate ND, and a score of 6 or higher is defined as a high level of ND.

Follow-up data on registered crimes

Information on registered crimes was obtained from the Finnish Legal Register Centre. This register includes nationwide data on convicted crimes from the age of 15 years onwards. Our data on crimes was available up until November of 2016.

In the current study, the focus was purely on violent criminal offences. Thus, the individuals with convicted offences other than violent offences ($n=62$) were excluded from the current study. Violent crimes include offences marked in chapters 20 (sex offences) and 21 (homicide and bodily injury) of the crime nomenclatures maintained at Statistics Finland (Statistics Finland, 2016). The crime register identified six individuals who had committed a total of 10 sex offences (rapes, $n=1$; child sexual abuse, $n=9$) and 74 individuals committing a total of 247 violent criminal acts relating to homicide ($n=7$) and bodily injury ($n=218$). Two individuals had committed crimes in both main categories of crimes.

Thus, the final study sample included 78 subjects with a total of 257 convicted violent offences. A comparison group was comprised of participants who had no criminal records at all ($n = 368$).

Statistical methods

The group differences in categorical variables were analyzed with the Pearson's chi-square test or Fisher's Exact test. The Cox regression model with adjusted Hazard Ratios (HRs) was used to examine the association of the level of ND (no ND, moderate ND, high ND) to age at committing the first violent crime after controlling for covariates (gender, age at admission, family structure and psychiatric disorders). All statistical tests were two-tailed and the limit of statistical significance was set at $p \leq 0.05$. The statistical software used in analyses was IBM SPSS, Statistics 24.

Results

As presented in Table 1, the study participants with violent crimes were characterized by male gender ($p < 0.001$) and having an out-of-home placement background ($p < 0.001$). Further, they showed a higher prevalence of conduct ($p < 0.001$) and substance use disorders ($p < 0.001$) during adolescence and a follow-up diagnosis for personality disorders ($p = 0.050$). The prevalence of moderate to high ND was significantly higher among violent offenders compared to those without any crimes ($p < 0.001$).

The mean age at first violent crime among violent offenders ($n=78$) was 20.6 (SD 0.3) years. Nearly a third (32.3%) of the violent offenders with high ND had committed their first crime before 18 years of age. In contrast, violent offenders with moderate ND (15.2%) and no ND (7.1%) had lower rates of first violent crime before the age of 18.

Table 1. Characteristics of the study groups by follow-up offender status

	Study groups		Group difference p-value
	Violent offenders (n = 78)	No history of crimes (n = 368)	
	n (%)	n (%)	
The level of nicotine dependence (ND)			< .001
No ND	14 (17.9)	188 (51.1)	
Moderate ND	33 (42.3)	104 (28.3)	
High ND	31 (39.7)	76 (20.7)	
Covariates:			
Gender, male	59 (75.6)	117 (31.8)	< .001
Family type in adolescence			< .001
Two parent family	22 (28.2)	199 (54.1)	
Single parent family	13 (16.7)	75 (20.4)	
Out-of-home placement	43 (55.1)	94 (25.5)	
Adolescent psychiatric disorders			
Psychotic disorder	6 (7.7)	57 (15.5)	0.073
Anxiety disorder	11 (14.1)	85 (23.1)	0.079
Affective disorder	26 (33.3)	200 (54.3)	0.001
Conduct disorder	61 (78.2)	131 (35.6)	< .001
Substance use disorder	46 (59.0)	121 (32.9)	< .001
Follow-up diagnosis for personality disorder	15 (19.2)	41 (11.1)	0.05

Note: Psychiatric disorders were assessed during adolescent inpatient care between the 13-17 years of age, except register-based follow-up diagnosis for personality disorders, which could be set after 16 years of age.

In further analysis, the Cox regression model was utilized to examine the association of the level of ND to age at first violent crime after controlling the covariates (gender, age at admission, family structure and psychiatric disorders). A significant association was found between onset age of violent offending and high ND (*adj. HR* = 2.66, *95%CI* = 1.29-5.47, *p* = 0.008) and moderate ND (*adj. HR* = 2.40, *95%CI* = 1.23-4.69, *p* = 0.011), compared to those without ND. Of the covariates, violent criminal offending showed a statistically significant association with male gender (*adjusted Hazard Ratio (aHR)* = 4.20, *95%CI* = 2.39-7.38, *p* = < 0.001), conduct disorder (*aHR* = 2.27, *95%CI* = 1.23-4.21, *p* = 0.009) and out-of-home placement (*aHR* = 2.05, *95%CI* = 1.18-3.58, *p* = 0.011). The adjusted estimates for age at first violent crime by the level of ND are visualized in Figure 1.

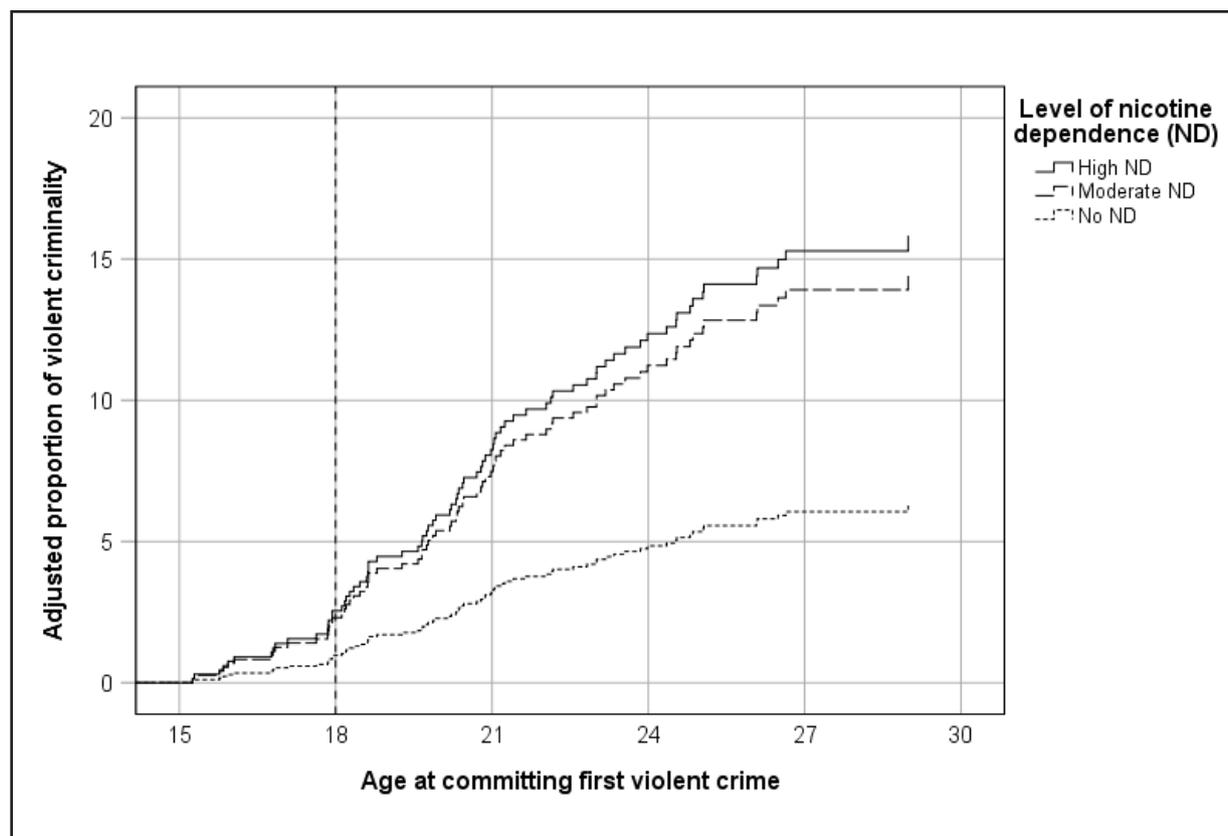
Discussion

In this study we demonstrated that not only is adolescent nicotine dependence (ND) associated with committing violent crimes, it is also related to younger onset age of violent offending. Adolescents with moderate to high levels of ND had over two-times higher risk of being involved in violent criminal acts compared to those without ND.

Earlier literature has also associated ND and substance use disorders to violence in adolescent samples (Harford et al. 2018, Harford et al. 2016, Nestor et al. 2018). ND is one example of an addictive behavior that has been explored in relation to criminality. In a review of teenage smoking, about 80% of teenage smokers were shown to present with ND, suggesting that the teenage brain may be more sensitive to addiction compared to adults and, thus, the formation of dependence could be more rapid (Lenney & Enderby 2008). In the same review, the authors give a short summary of the possible neurobiology behind ND and the role of monoamine oxidase (MAO) activity in the formation of the addiction (Lenney & Enderby 2008). The role of MAO abnormalities and aggression might contribute to the hypotheses of the link between addiction and aggression (Pivac & Ramsay 2016). Besides ND, our study showed that violent youths were diagnosed significantly more often with substance use disorders in adolescence, which supports the link between addictive behavior and violence.

In our study, adolescent conduct disorder was associated with early-onset violent offending. In previous studies, conduct disorder, as well as other mental and substance use disorders, have been linked to an increased risk of criminality

Figure 1. Adjusted estimates of age at first violent crime by level of nicotine dependence



and violence (Erskine et al. 2016). Further, adolescents who experience a greater number of conduct disorder symptoms are reported to more commonly have ND (Riala et al. 2011).

Our study also found that family structure during adolescence is significantly associated with early-onset violent offending, since those admitted to adolescent inpatient care from out-of-home placement had an over two-fold higher likelihood of violent offending compared to adolescents from two-parent families. This is consistent with earlier study findings that children from non-intact or broken families are at higher risk for delinquency than those from intact families (Ikäheimo et al. 2013). A study by DeGue et al., however, reported that out-of-home placements had no or only a slight effect on adult criminality (Degue & Widom 2009).

Strengths of our study include the use of nationwide register-based follow-up information on registered crimes, obtained from the Finnish Legal Register Center, as well as valid assessment of psychiatric disorders, using the K-SADS-PL interview for adolescents and the reliable assessment of the level of adolescent ND using the standardized mFTQ instrument. A limitation is that the crime register only includes convicted crimes committed after the 15th

birthday of an individual. The data on possible violent arrests before age of 15 years was not available and, thus, there is a possibility of occurrence of violent acts before developing ND in adolescence. Although the mFTQ questionnaire has demonstrated consistency and validity with adolescents, laboratory test data for levels of nicotine in blood would have produced a more accurate measure for assessment of ND among study participants. Finally, since our data was comprised of former adolescent psychiatric inpatients, the findings are not generalizable to the Finnish population of the same age

In summary, we found that high and moderate ND, already before 18 years of age, is associated with later violent offending and could be associated with younger age of committing the first violent crime. Therefore, adolescent psychiatric patients, showing moderate to high levels of addiction to nicotine, should be a target population for adolescent focused smoking cessation interventions and programs (Schepis & Rao 2008). Adolescents addicted to nicotine may benefit from intensive clinical attention since ND may be linked to more adverse and unfavorable outcomes in life, beyond merely physical health related problems. The Communities That Care (CTC) prevention system on

health-risking behaviors, such as smoking and delinquency of young people, is one potential option identified in the literature (Oesterle et al. 2015). Future studies in general population samples are called for, to verify and investigate in more detail the temporal relationship between adolescent ND and violent criminal offending, as well as background factors between addictive behaviors and violent behavior.

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Conflict of Interest

The authors have no financial relationships to disclose.

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