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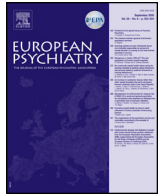
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## Original article

# Serious delinquency and later schizophrenia: A nationwide register-based follow-up study of Finnish pretrial 15- to 19-year-old offenders sent for a forensic psychiatric examination



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## ABSTRACT

**Background:** Aggressive and disruptive behaviors often precede the onset of schizophrenia. In this register-based follow-up study with a case-control design, we wanted to investigate if serious delinquency was associated with future diagnoses of schizophrenia or schizoaffective disorder (here, broadly defined schizophrenia) among a nationwide consecutive sample of 15- to 19-year-old Finnish delinquents sent for a forensic psychiatric examination in 1989–2010.

**Methods:** The sample comprised 313 delinquents with no past or current psychotic disorder. For each delinquent, four age-, gender- and place of birth -matched controls were randomly selected from the Central Population Register. Five controls (0.4%) had been treated for schizophrenia before their respective index-dates and were thus excluded from further analysis, leaving us with a control population of 1247 individuals. The subjects were followed till death, emigration or the end of 2015, whichever occurred first. Diagnoses were obtained from the Care Register for Health Care.

**Results:** Forty (12.8%) of the delinquents and 11 (0.9%) of the controls were diagnosed with schizophrenia later in life (HR 16.6, 95% CI 8.53–32.39,  $P < 0.001$ ). Almost half of the pretrial adolescents with later schizophrenia were diagnosed within 5 years of the forensic psychiatric examination, but latency was longer among the other half of the sample, reaching up to 20.5 years.

**Conclusions:** The study supports the previous research indicating a potential link between serious delinquency and later schizophrenia. Accurate psychiatric assessments should be made in correctional services but also later in life so that any possible psychotic symptoms can be detected in individuals with a history of serious delinquency even if there were no signs of psychosis before or at the time of the crime. Future research should explore which factors influence the delinquent's risk of developing later schizophrenia.

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## 1. Introduction

Schizophrenia is a severe mental disorder, characterized by positive symptoms such as hallucinations and delusions, and negative symptoms such as marked apathy, a paucity of speech, and blunt or incongruent emotional responses. The prevalence of schizophrenia is 0.4–0.7%, depending on the type of prevalence estimate used [1]. In Finland, a lifetime prevalence of 0.9% was

presented some years ago [2]. The onset of schizophrenia before the age of 13 is rare [3], as the prevalence of childhood-onset schizophrenia is estimated to be 1 in 10,000 children [4]. There is a substantial increase in schizophrenia frequency in adolescence [4], reaching a peak in early adulthood, and gradually declining until the age of 60, after which the incidence rates level off [5]. Schizoaffective disorder is a psychiatric disorder characterized by both abnormal thought processes and dysregulated emotions [6]. The onset of schizoaffective disorder typically occurs in young adulthood, but the disorder is only about one-third as common as schizophrenia [2]. In research, schizophrenia and schizoaffective

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disorder are often outlined as broadly defined schizophrenia since they resemble each other in many ways (e.g., see Kotov et al. [7] and Amann et al. [8]). Thus, many authors have pooled patients with these two disorders together to form a sample of persons with schizophrenia (see, e.g., Thomson et al. [9]; Barr et al. [10], Seow et al. [11]; Quidé et al. [12]; Yanagida et al. [13]). Before these disorders become clinically manifest and the diagnoses are established, individuals often undergo a prodromal phase, characterized by behavioral abnormalities and cognitive and affective changes [14]. The duration of the prodromal phase varies substantially between individuals, but has been estimated to last for an average of four to five years [14]. It is, however, important to notice that these behavioral, cognitive and affective symptoms may also resolve spontaneously without leading to psychosis [15,16].

It has long been recognized that non-psychotic disorders often occur before the onset of schizophrenia. For example, in a study Lewis et al. [17], 38% of men who developed schizophrenia before the age of 31 had a non-psychotic disorder diagnosed at the age of 18 when screened for entry into the Swedish army. Among these men, personality disorders (OR 8.2), neurosis (OR 4.6) and alcohol abuse (OR 5.5) turned out to be risk factors for future schizophrenia. The authors concluded that personality disorders might represent an underlying vulnerability to schizophrenia, and that other psychiatric disorders that occur before schizophrenia might reflect a prodromal phase of the illness. In a study by Weiser et al. [18] among 16- to 17-year-old men screened by the Israeli draft board, schizophrenia-spectrum personality disorders posed the highest risk (OR 21.5) of later hospitalization for schizophrenia, followed by adjustment disorders (OR 11.8), antisocial personality disorder and impulsive control disorder (OR 8.9), alcohol and drug abuse (OR 6.8), other personality disorders (OR 3.9), and neurosis (OR 3.6). Svirskis et al. [19] concluded that vulnerability to psychosis seems to be associated with a high number of lifetime Axis-I diagnoses including anxiety and mood disorders.

Most individuals with schizophrenia are never violent, but a meta-analysis by Fazel et al. [20] indicated that the rate of violence is 4–5 times greater in persons with schizophrenia than it is among the general population: the estimated proportion of violent people in the general population was 1.6%, whereas among schizophrenia patients, it was 9.9%. The onset of schizophrenia can be preceded by disruptive behaviors [21,22]. In Purcell et al.'s study [23] of treatment-seeking youngsters, the at-risk of psychosis group was significantly more likely to report having been charged by the police and convicted of criminal offences than the not-at-risk group. Accordingly, in a study by Hutton et al. [24], almost every third individual assessed as being at risk of psychosis reported convictions for violence-related crimes, and one in five reported current violent thoughts or plans. A Danish nationwide nine-year follow-up study by Gosden et al. [25] found that among young sentenced criminals, conviction of violence in late adolescence was significantly associated with a future diagnosis of schizophrenia (odds ratio [OR] 4.6, 95% confidence interval [CI] 1.54–13.74). In a study among 15- to 25-year-old pretrial arsonists, who were evaluated in one Finnish forensic psychiatric ward, fire-setting crimes during adolescence or young adulthood were significantly related to schizophrenia or schizoaffective disorder in later life (HR 12.5, 95%CI 4.49–34.65) [9]. Both research groups thus concluded that violent behavior could be seen as part of the pre-schizophrenia phase of young criminals. However, the above-mentioned studies have their limitations including the small sample size [9,24], the highly selected sample [9], the cross-sectional design [23,24], the lack of formal structured assessments of violence risk [24], the self-reported offending [23,24], and the lack of information about alcohol and other substance abuse [25].

The minimum age of criminal liability in Finland is 15. According to Finnish law, when a person is charged of a crime, the court

decides whether a forensic psychiatric examination is needed or not. After deciding on an examination, the court requests that arrangements be made by the National Institute for Health and Welfare. The examination is performed either in a state or municipal psychiatric hospital or in a psychiatric hospital for prisoners. These inpatient assessments last approximately two months, and gather data from various sources (family members, relatives, medical records, criminal records, school, child-welfare, and military records). They include psychiatric evaluations, standardized psychological tests, interviews conducted by a multi-professional team, an evaluation of the offender's physical condition, and continuous observation by the hospital staff. The final forensic psychiatric report includes an opinion on the level of criminal responsibility, a possible psychiatric diagnosis, and an assessment as to whether or not the offender fulfils the criteria for involuntary psychiatric care. In Finland, severe offences are often performed under alcohol intoxication, also among adolescents [26]. According to the Finnish criminal law, intentional alcohol intoxication does not diminish an individual's criminal responsibility. Psychotic offenders, on the other hand, are typically regarded as lacking criminal responsibility, and they are referred to involuntary psychiatric treatment instead of correctional services. The above-mentioned procedure concerns both adult and under-aged offenders. In the 1980s and 1990s, 300–400 examinations were performed annually. Nowadays, approximately 100 examinations are performed early. This decrease links to economic factors and factors related to changes in national criminal policy. The overall high quality and reliability of Finnish forensic psychiatric examinations are acknowledged in the courts and among scientists [27].

This register-based nationwide prospective follow-up study, with a case-control design, aimed to shed more light on the potential relationship between serious delinquency and a future diagnosis of schizophrenia, using a sample of Finnish adolescents referred for a forensic psychiatric examination. First, we wanted to find out if severe delinquency was related to risk of later schizophrenia. Secondly, we wanted to compare the delinquents with and without later schizophrenia with respect to gender, primary psychiatric diagnoses received in the forensic psychiatric examination, and comorbid alcohol and other substance-use disorders.

## 2. Methods

### 2.1. Sample and procedure

In this study, forensic psychiatric examination reports on all 15- to 19-year-old offenders who were born in Finland and had undergone the examination between 1.1.1989 and 31.12.2010 were collected from the archives of the National Institute of Health and Welfare. The reports were reviewed retrospectively. The study plan was evaluated by the Ethics Committee of the Helsinki and Uusimaa Hospital District, Finland. Permission to conduct the study was granted by the administration of the Helsinki and Uusimaa Hospital District, Finland, and the National Institute of Health and Welfare, Finland. The study was performed in accordance with the Declaration of Helsinki.

### 2.2. Participants

The study population comprised a nationwide consecutive sample of 348 delinquents. The criminal histories of the delinquents were reviewed, and, according to Fazel and Grann [28], murder, attempted murder, manslaughter, attempted manslaughter, arson, aggravated assault, assault, robbery, kidnapping, rape, attempted rape and child molestation were all regarded as violent offences, and theft, burglary, driving while intoxicated,

dangerous driving, driving without a driving license as well as drug smuggling and selling drugs were regarded as non-violent offences. Majority of the delinquents had performed more than one index offence. When the most severe offence was accounted, 325 (93.4%) delinquents had offended violently and 23 (6.6%) non-violently. In cases of non-violent offending, the criminal behavior was so intensive (e.g. 40–50 burglaries), that it was regarded as severe and the adolescent was sent for a forensic psychiatric examination. Based on the review of medical history included in the forensic psychiatric examination report, 35 (10.1%) delinquents had been diagnosed with some psychotic disorder before or during the forensic psychiatric examination, and were excluded from further analysis. Thus, the study population consisted of 313 delinquents with no history of a psychotic disorder. Of these, 29 (9.3%) were girls. The oldest participants were born in 1970, and the youngest in 1993. According to the principal psychiatric diagnosis given in the forensic psychiatric examination, 265 (84.7%) delinquents were diagnosed with a conduct disorder or a personality disorder (mainly antisocial, borderline or mixed personality disorders) (these disorders were pooled together for future analyses), 34 (10.9%) suffered from some other non-psychotic psychiatric disorders (e.g. depressive and anxiety disorders) and 14 (4.5%) had no psychiatric disorder. Of the 313 delinquents, 177 (56.5%) were diagnosed with comorbid alcohol abuse or dependence, 13 (4.2%) with cannabinoid abuse/dependence, 7 (2.2%) with stimulant abuse/dependence, and 3 (1.0%) with opioid abuse/dependence.

For each of the 313 delinquents, we randomly selected four age-, gender- and place of birth- matched controls ( $n = 1252$ ) from the Central Population Register. Based on the Care Register for Health Care of the National Institute for Health and Welfare, five controls (0.4%) had been treated for schizophrenia before their respective index-dates and were excluded from further analysis. Hence, the control population consisted of 1247 individuals.

### 2.3. Diagnoses of schizophrenia and schizoaffective disorder (broadly defined schizophrenia)

We conjoined the diagnoses of schizophrenia and schizoaffective disorder; together defined as broadly defined schizophrenia. The discharge diagnoses were obtained from the Care Register for Health Care of the National Institute for Health and Welfare, which was established in 1967 [29]. In Finland, psychiatric classification according to ICD-8 [30] served in clinical practice between 1969 and 1986 (schizophrenia: 295.0–6, 295.8–9; schizoaffective psychosis: 295.7). This classification was later replaced by DSM-III-R [31], used in clinical practice between 1987 and 1995. However, the diagnoses were converted to ICD-9 [32] diagnoses, when, for example, reporting them to the Care Register for Health Care (schizophrenia: 295.0–6, 295.8–9; schizoaffective psychosis: 295.7). Since 1996, ICD-10 [33] has been used in Finland (schizophrenia: F20; schizoaffective psychosis: F25).

### 2.4. Follow-up

The follow-up began the day the forensic psychiatric examination report was dated. The delinquents and their controls were followed till death, emigration or 31.12.2015, whichever occurred first. We obtained mortality data from the Causes of Death statistics (Statistics Finland), and information on emigration from the Central Population Register. The onset of schizophrenia was defined as the day on which the disorder was diagnosed and coded in specialized health care. During the follow-up, 50 (16.0%) delinquents died and 5 (1.6%) moved abroad. Among the controls, the respective numbers were 25 (2.0%) and 21 (1.7%). Thus, the median follow-up time was 15.9 years for the delinquents and 17.2 years for the controls ( $P = 0.003$ ).

### 2.5. Statistical analyses

The Kruskal-Wallis test and the Cox regression analysis with the log-rank test were used to compare delinquents and their controls. With regard to comparisons between delinquents with and without later schizophrenia, the likelihood ratio chi-square test and Fisher's exact test were performed. Hazard ratios (HRs) and odd ratios (ORs) with 95% CIs were calculated as a measure of the effect size. The findings were considered significant when the two-tailed  $P < 0.05$ . We used R version 3.3.1 (<http://www.R-project.org>) for the statistical analyses.

## 3. Results

Of the 313 delinquents, 40 (12.8%) were diagnosed with broadly defined schizophrenia (schizophrenia:  $n = 38$ ; schizoaffective disorder:  $n = 2$ ) during the follow-up period. Respectively, of their 1247 controls, 11 (0.9%) received this diagnosis (schizophrenia:  $n = 9$ ; schizoaffective disorder:  $n = 2$ ) (HR 16.6, 95%CI 8.53–32.39,  $P < 0.001$ ) (the Kaplan-Meier- survival curves are presented in Fig. 1). With regard to a narrow schizophrenia diagnosis, the delinquents' risk of this disorder was more than 19-fold compared to that of their controls (HR 19.3, 95%CI 9.33–39.93,  $P < 0.001$ ).

Among the 40 delinquents with future broadly defined schizophrenia, the median delay between the forensic psychiatric examination and being diagnosed with either schizophrenia or schizoaffective disorder was 7.4 years, ranging from 1.1 to 20.5 years. Seventeen (42.5%) of these individuals were diagnosed within five years of the examination.

The delinquents with later broadly defined schizophrenia were compared to those with no later disorder with respect to gender, primary psychiatric diagnoses received in the forensic psychiatric examination, and a comorbid alcohol/cannabinoid/stimulant/opioid abuse/dependence. No statistically significant differences were observed between the groups (Table 1). With regard to a narrow schizophrenia diagnosis, the finding was the same.

## 4. Discussion

The study revealed that serious delinquency is associated with later schizophrenia. More precisely, as many as 12.8% of the delinquents without any psychotic disorder before or during the forensic psychiatric examination, were diagnosed with broadly

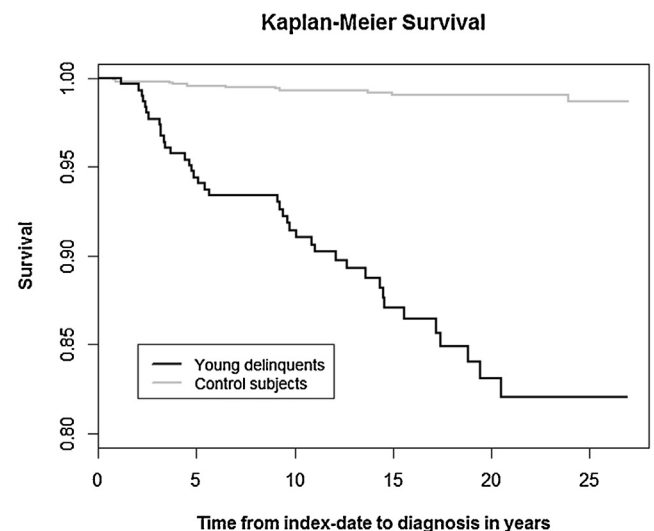


Fig. 1. The Kaplan-Meier survival curves for being diagnosed with schizophrenia among delinquents ( $n = 313$ ) and their controls ( $n = 1247$ ) ( $P < 0.001$ ).

**Table 1**

Comparisons between delinquents with (+) and without (-) later schizophrenia or schizoaffective disorder.

	Delinquents + (n = 40)	Delinquents - (n = 273)	OR	95% CI	P
Female n (%)	4 (10.0)	25 (9.2)	1.1	0.36–3.35	0.86
Primary diagnoses assessed on the forensic psychiatric examination					
Conduct or personality disorder	33 (82.5)	232 (85.0)	0.83	0.35–2.01	0.68
Another psychiatric disorder	5 (12.5)	29 (10.6)	1.2	0.44–3.31	0.72
No psychiatric disorder	2 (5.0)	12 (4.4)	1.14	0.25–5.31	0.86
A comorbid alcohol abuse/dependence	22 (55.0)	155 (56.8)	0.93	0.48–1.81	0.83
A comorbid cannabinoid abuse/dependence	1 (2.5)	12 (4.4)	0.56	0.07–4.41	1
A comorbid stimulant abuse/dependence	2 (5.0)	5 (1.8)	2.82	0.53–15.06	0.22
A comorbid opioid abuse/dependence	0 (0.0)	3 (1.1)	–	–	1

OR: odds ratio; CI: confidence interval. The likelihood ratio chi-square test and Fisher's exact test were used for comparisons.

defined schizophrenia later in life, which corresponds to an OR of almost 17. Our result resembles that of the Danish nationwide nine-year follow-up study of young convicted criminals by Gosden et al. [25], which reported that convictions of violence in late adolescence were significantly related to a future diagnosis of schizophrenia. Our finding is also in accordance with that of Thomson et al. [9] among Finnish pretrial arsonists. Looking more closely, our sample comprised altogether 50 (16.0%) delinquents with a history of some kind of fire-setting behavior. Most arsonists of Thomson et al. [9] were criminally versatile and suffered from various non-psychotic disorders. Thus, these two pretrial samples resembled each other in terms of offending behavior and psychopathology.

Almost half of the pretrial adolescents with later broadly defined schizophrenia were diagnosed within 5 years of the forensic psychiatric examination, but latency was longer among the other half of the sample, reaching up to 20.5 years. The finding indicates the importance of repeated accurate psychiatric assessments in detecting possible psychotic symptoms in individuals with a history of serious delinquency. These assessments should be carried out not only during correctional services, but also later in life, so that these individuals receive adequate treatment and rehabilitation. Violence among released prisoners with psychosis has been regarded as a significant public health problem. In a recent study by Igoumenou et al. [34] among 1717 adult prisoners, prisoners with current symptoms of schizophrenia re-offended more quickly following release than those without these symptoms. Treatment with antipsychotic medication, however, significantly delayed time to violence (18% reduction). Thus, close follow-up with appropriate psychiatric assessments of adolescents sentenced for severe crime could result in early detection and effective treatment of psychoses, and reduce incidents of future violence. Unfortunately, males, who form the majority of offenders, are known to have a low rate of help-seeking for mental health problems [35]. Thus, a major challenge is to make mental health services more accessible to males, especially to those who are socially marginalized, as offenders often are.

Juvenile delinquency is strongly linked to psychiatric morbidity [36,37]. Regarding non-psychotic disorders, research has revealed that between about half and two thirds of young offenders meet the diagnostic criteria for a conduct disorder, and between about a third and a half for a substance-use disorder [36,37]. Moreover, both antisocial [38] and borderline [39,40] personality disorders associate with criminality. Our delinquent sample considerably resembled these above-mentioned descriptions. In the present sample, no statistically significant differences were observed between delinquents with and without later schizophrenia in the prevalence of conduct/personality disorders, other non-psychotic disorders, or alcohol/cannabinoid/stimulant/opioid abuse/dependence. Contrary to previous community studies [17,18], our delinquents showed an extremely high prevalence of various non-psychotic disorders as only 4.5% of them were diagnosis-free,

which might explain our finding. Future research is obviously needed to explore which factors influence the delinquent's risk of developing later schizophrenia.

## 5. Strengths and limitations of the study

The main strength of this study lies in its nationwide and comprehensive nature. The Finnish Care Register for Health Care has been widely used in Finnish schizophrenia research [41]. The most important concern in register-based research is the validity of register-based diagnoses. Pihlajamaa et al. [41] investigated the diagnostic validity of schizophrenia in the Finnish Care Register for Health Care with a large, epidemiologically representative sample using a multi-diagnostic approach (DSM-III-R, DSM-IV, ICD-10). The study population consisted of all individuals ( $n = 806$ ) who were born in Helsinki, Finland, between 1 January 1951 and 31 December 1960, who had had at least one diagnosis of schizophrenia, schizophreniform disorder or schizoaffective disorder in the register, and whose hospital case notes were available. The proportion of subjects who received a core schizophrenia-spectrum diagnosis (= schizophrenia, schizoaffective disorder or schizophreniform disorder) in both the register and re-assessment varied between 75% (DSM-III-R criteria) and 78% (ICD-10 criteria). Of the subjects with a narrow schizophrenia diagnosis in the register, between 74% (DSM-IV) and 78% (ICD-10) received a diagnosis of schizophrenia in the reassessment depending on the diagnostic criteria applied. The authors concluded that the validity of the Finnish Care Register for Health Care schizophrenia diagnosis is acceptable for large-scale register studies and comparable with that of other Nordic registers. According to the Northern Finland 1966 Birth Cohort study [42], clinicians do not make the diagnosis of schizophrenia as often as the application of operational criteria would suggest they should. Discordant cases were more likely to be older at onset, experience shorter treatment duration and fewer treatment episodes, and to have a comorbid diagnosis of intellectual disability. As all citizens in Finland have a unique social security number, complete linkage between different national registers was possible and valid. The clearance rate for violent crimes is high in Finland [43]. The proportion of females was low, but corresponds quite well to the proportion of Finnish females who commit violent crimes as reported in national statistics on police-investigated crime and self-reported juvenile delinquency. The median follow-up time of the data was reasonable long, almost 17 years. It should be borne in mind that the courts decide who is sent for a pretrial forensic psychiatric examination, typically without consulting medical experts, and hence, these decisions have been described as somewhat arbitrary [44]. Most homicidal adolescents undergo this examination [26], but an estimated 10% of Finnish firesetters suspected by the police are sent to it [45]. Most likely, only the most severe cases that would result in harsh punishments are chosen for a forensic



psychiatric examination [44]. In this perspective, the delinquents of the present study constituted a selected group of delinquents, and one can argue that the sample is not representative of delinquents in general. Further, in Finland, developmental disorders have not been diagnosed in forensic psychiatric examinations until during the recent years. This is somewhat embarrassing, but most probably relates to the fact that most Finnish forensic psychiatrists have been working among adult patients, not with children and adolescents. Thus, their knowledge about developmental disorders has been limited. Also, it is likely that many delinquents had misused alcohol and drugs, but in a manner that the diagnostic criteria for abuse was not fulfilled. With regard to controls, the prevalence of schizophrenia was in line with that reported in previous prevalence studies [1]. Unfortunately, we had no data about their psychiatric morbidity other than schizophrenia and schizoaffective disorder. As in many register-based follow-up studies, the controls were matched according to age, gender and place of birth, but it was not possible to take other variables, like socio-economic status, into account, and this might have affected the outcome. Further, we do not know what environmental risks our delinquents were prone after the initial assessments. This, of course, applies to our controls too. All the pretrial offenders were Finnish in origin, thus the results cannot be generalized to immigrants. Because of these limitations, the study must be regarded as preliminary, and future case-control follow-up studies that take these limitations into account are needed.

## 6. Conclusion

The study supports the previous research indicating a potential link between severe delinquency and later schizophrenia. Accurate psychiatric assessments should be made in correctional services but also later in life so that any possible psychotic symptoms can be detected in individuals with a history of serious delinquency even if there were no signs of psychosis before or at the time of the crime. Future research should explore which factors influence the delinquent's risk of developing later schizophrenia.

## Funding sources and their roles

This study was funded by the Helsinki and Uusimaa Hospital District. The funder had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## Contributions

NL collected the data and worked as the first author, AH and JM performed all statistical analyses and participated in the writing process, RK-H planned the study protocol with NL and participated in the writing process. All authors read and approved the final manuscript.

## Disclosure of interest

The authors declare that they have no competing interest.

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