Violence of Young Criminals Predicts Schizophrenia: A 9-Year Register-Based Followup of 15- to 19-Year-Old Criminals

Niels Patrick Gosden, Peter Kramp, Gorm Gabrielsen, Tavs Folmer Andersen, and Dorte Sestoft

Violent and aggressive behavior in preschizophrenia adolescents has been described in several studies. Our aim was to investigate the extent to which violent conviction in late adolescence predicted later schizophrenia in a cohort of young criminals. We performed a 9-year register-based followup of a complete national cohort of young convicted criminals. A total of 780, 15- to 19-year-old subjects identified in 1992 were followed up in 2001 with register linkage of the Danish Psychiatric Central Register, the Danish National Criminal Register, and the Danish National Cause of Death Register. Analyses with Cox regression were performed to identify predictors of later schizophrenia. We found at followup that 3.3 percent of the cohort had been diagnosed with schizophrenia and 4.5 percent with any psychosis. Conviction of violence in late adolescence was significantly associated (odds ratio = 4.59 [95% confidence interval (1.54; 13.74)]) with future diagnosis of schizophrenia. Violent behavior can thus be seen as part of the preschizophrenia phase of young criminals.

Key words: Predictor/prevalence/register study/schizophrenia/violence

In recent years there has been an increasing focus on the risk that schizophrenia patients will commit violent crimes (Swanson et al. 1990; Hodgins et al. 1996; Arsenault et al. 2000; Brennan et al. 2000). In this study, we focused on violence as part of the preschizophrenia phase in adolescents.

Before schizophrenia becomes clinically manifest and the diagnosis is established, the individual often goes through a prodromal phase lasting about 4 to 5 years and a psychotic prephase of 1 year (Häfner 2000). The prodromal signs are usually affective symptoms (depressive), negative symptoms (Häfner 2000), and basic symptoms (Huber and Gross 1989; Gross et al. 1995); and early signs of schizophrenia are found in childhood and adolescence in the range of neurological, cognitive, and behavioral characteristics (for review, see Jones 1997).

Several studies have suggested that schizophrenia children and adolescents display aggressive or violent behavior before diagnosis. Bender (1958) coined the concept of “pseudopsychopathic schizophrenia” in a subtype with childhood schizophrenia who in adolescence developed antisocial acting-out behavior and were labeled “psychopathic,” although the psychotic phase of childhood occurred later (Bender 1958).

In one study, a history of violence before diagnosis among hospital-admitted psychotic adolescents was described “a common behavioral manifestation” and was present in 83 percent of boys and 43 percent of girls (Inamdar et al. 1982). A study of a British birth cohort born in 1958 found that at ages 7 and 11 schizophrenia boys had increased scores for overreaction (externalizing behavior), of which “being hostile to other children and adults” was one behavioral subtype (Done et al. 1994, p. 935). Similarly, the Edinburgh High-Risk Study found that schizophrenia was predicted by delinquent or aggressive behavior in adolescents at high risk of schizophrenia (Hodges et al. 1999; Miller et al. 2002), as well as violent assault in a group of former child and adolescent psychiatric patients (Cannon et al. 2001) and childhood physical aggression in a birth cohort (Arseneault et al. 2003). A birth cohort of 21-year-olds found that schizophrenia patients were likely to have been more violent than nonschizophrenia patients and that a history of childhood conduct disorder contributed to the link between schizophrenia spectrum disorders and violence (Arseneault et al. 2000). In contrast to the above-mentioned studies, no association between antisocial behavior at age 15 and later schizophrenia was found in the British 1946 birth cohort (Jones et al. 1994).

In an attempt to describe possible preschizophrenia symptoms, Arseneault et al. point out that “it is possible that conduct problems motivated by bizarre beliefs constitute a heretofore undertreated prodromal adolescent phase of some adult psychotic disorders” (Arseneault et al. 2000, p. 985).

This leads to the present study of young criminals, which had the primary goal of determining the extent to which a conviction of violent crime among young criminals predicted later psychiatric admission, admission for schizophrenia, or admission for any psychosis. The suggested relationship would be important for early detection and treatment of young criminals with prodromal symptoms or apparent psychosis.

Of special interest was also to investigate young criminals’ rates of lifetime psychiatric admission and
mortality and the association between mental disorder and violence.

Methods

Subjects. This study is based on data from a national study of all registered young criminals in Denmark. Complete, nationwide information on lifetime psychiatric hospitalizations and diagnoses, criminal verdicts, and mortality was used.

The present study population was identified in 1992 by a register linkage study of a complete national cohort of all persons in Denmark in contact with the Danish Prisons and Probation Service (DPPS) (Esdorf et al. 1992; Kramp 1993). The role of the DPPS is to enforce all punishments imposed by the courts. This applies to custodial sentences, probation orders, suspended sentences, community service orders, and the supervision of convicted mentally ill offenders.

In the original study, all persons under the jurisdiction of the DPPS were divided into two cohorts: (1) a prevalence cohort consisting of all persons registered on the index day, November 3, 1992, and (2) an incidence cohort consisting of all newly registered persons in the period from November 4 to December 3, 1992, the day of registration being their individual index day.

The present study is a prospective cohort study based on a register linkage followup of all the persons who were identified on the index days in 1992 and were 15 to 19 years old.

As all citizens in Denmark have a unique civil registration number, complete linkage between different national registers was possible and valid.

The Danish Psychiatric Central Register includes computerized data from 1969 of all inpatient admissions to psychiatric hospitals and psychiatric wards in general hospitals in Denmark (including dates of admission and diagnoses) (Munk-Jorgensen and Mortensen 1997).

The National Criminal Register contains data on all persons in Denmark with recorded criminal activity after the age of 15 (age of criminal responsibility in Denmark) and is considered “the most thorough, comprehensive and accurate in the Western World” (Wolfgang 1977; Hodgins et al. 1996). The Danish National Cause of Death Register contains computerized mortality data on all deaths in Denmark since 1943 (Juel and Helweg-Larsen 1999).

In June 2001 we performed an 8.7-year followup and linked the study cohort of 1992 to the Danish Psychiatric Central Register, the National Criminal Register, and the Danish National Cause of Death Register (for this register, it was a 6.1-year followup, because it was updated to only December 31, 1998).

The study cohort consisted of 848, 15- to 19-year-old persons identified in 1992 (794 males [93.6%], median age 18.8, standard deviation [SD] 0.83] and 54 females [6.4%, median age 19.1, SD 1.23]).

Of the original 848, 15 to 19 year olds in 1992, 811 (95.6%) were reidentified at followup in 2001; 37 were missing because of errors of data registration in 1992.

The followup analyses of mortality data were performed on the 811 persons (763 males, 48 females). During the followup period, 31 males died (3.8%) (no females died).

As all dead are deleted from the National Criminal Register, subsequent analysis of criminal predictors among the 31 dead was not possible. The final followup analyses on the relation between criminal behavior and mental disorders were thus performed on 780 (732 males, 48 females [no gender difference compared to original 848 cohort members, likelihood ratio χ², p = 0.703]), with 558 from the original prevalence cohort and 222 from the original incidence cohort.

Predictor and Outcome Variables. Predictors were sex, age, previous admission (to psychiatric hospital before index day), and verdicts of the following types of crime before index day: any violent crime, serious violent crime, other violent crime, arson, and sexual offense as well as cohort type (prevalence or incidence cohort) and judicial status (seven categories).

Outcome variables were time to admission after index day to psychiatric hospital for any mental disorder, time to admission after index day for schizophrenia, and time to admission after index day for any psychosis. This implies time to the first registered admission after the index day for any mental disorder, schizophrenia, and any psychosis.

All persons in the study cohort had a conviction of violence, nonviolence, or both.

Convictions were divided into convictions of any violent crime and nonviolent crime (see later level I analyses). Any violent crime was then subdivided into serious violent crime, other violent crime, arson, and sexual offense (see later level II analyses).

The crude criminal predictor any violent crime was defined as at least one conviction of a serious violent crime, other violent crime, arson, or sexual offense (used in level I analyses). The detailed criminal predictors were serious violent crime (homicide, attempted homicide, and particularly brutal assault), other violent crime (common and brutal assault [attempts and threats included] and other violence against the person and robbery), arson, and sexual offense (attempts included).

Nonviolent crime was defined as malicious damage to property, aggravated drug offenses under the penal code or the Euforantia Act, burglary and theft, other misappropriations and offenses against property, homicide and bodily harm by negligence, and violations of special laws (e.g., the Firearms Act, the Road Traffic Act).

The original prevalence and incidence cohorts were merged into one cohort (henceforth, the study cohort) to simplify design and achieve greater statistical strength.
As the two cohorts were selected differently, the predictor cohort type controlled for independent heterogeneity of effect related to the cohort type.

The predictor judicial status controlled for independent effect of the judicial status on outcome measures. Judicial status at time of contact (index day) with the DPPS was described through the predictor judicial status, which had seven categories: prisoners \( (n = 87) \), prisoners with special rights \( (n = 25) \), prisoners arrested or remanded in custody \( (n = 156) \), adolescents remanded in custody \( (n = 19) \), adolescents with suspended sentences under the supervision of the DPPS \( (n = 429) \), adolescents on parole \( (n = 55) \), and convicted mentally disordered offenders under supervision \( (n = 9) \). (The convicted mentally disordered offenders were under treatment when identified. All others were probably untreated.)

Schizophrenia was defined as ICD–10 F20 (World Health Organization 1993). Any psychosis was defined as ICD–10 F20.0–20.99 (schizophrenia), F22.0–F29.99 (delusional disorders), F30.2 (mania with psychotic symptoms), F31.2 and F31.5 (bipolar affective disorder with psychotic symptoms), F32.3 (severe depressive episode with psychotic symptoms), and F33.3 (recurrent depressive disorder with psychotic symptoms).

In Denmark, ICD–8 (Sundhedsstyrelsen 1971) was used as the World Health Organization (WHO) diagnostic classification system from 1969 to 1993, and beginning January 1, 1994, ICD–10 was implemented. All data from the Danish Psychiatric Central Register were registered accordingly. All ICD–8 diagnoses in this study were recoded to ICD–10 diagnoses following the WHO guidelines (1998) to establish diagnostic uniformity.

Statistics. Statistical analyses were performed in three parts. Analyses of associations were done with likelihood ratio \( \chi^2 \) tests. The study employed survival statistics to establish unadjusted (Kaplan-Meier analyses) and adjusted (Cox regression) predictors of outcomes of interest:

1. Analyses of association between the predictor previous admission and criminal predictors were done to examine the association between violence and mental disorder at index time.
2. Kaplan-Meier analyses of survival data were used to study the unadjusted association between predictors and outcome. Kaplan-Meier plots and log-rank tests were applied (Collet 1994). In the Kaplan-Meier analysis, all variables were dichotomous except judicial status, which was categorical.
3. To establish adjusted predictors of the outcomes of interest, the proportional hazards model (Cox regression) was used (Collet 1994). The Cox regression analyses were done in two levels.

   –Level I: The crude criminal predictor any violent crime and the predictors sex, age, previous admission, cohort type, and judicial status were used.

   –Level II: The crude criminal predictor was replaced by the more detailed criminal predictors serious violent crime, other violent crime, arson, and sexual offense together with the predictors sex, age, previous admission, cohort type, and judicial status. The detailed criminal predictors were used to allow for more specific tests of types of violent convictions as predictors of schizophrenia. Types of violence were compared to nonviolent crime.

Variables of violence were dichotomized in both analyses to reduce the effect of outliers. The predictor previous admission was a continuous variable.

Survival analyses were performed with the computer software SPSS 10.0 (2002).

Ethics. Register studies in Denmark need approval from only the Danish Data Protection Agency, not the Danish Scientific Ethical Committee. The approval was granted.

The Danish Psychiatric Central Register kept the complete data collected in 1992, including civil registration numbers. To ensure complete anonymity, all study persons had a serial number connected to their civil registration number. The Danish Psychiatric Central Register linked the registers by providing serial numbers and civil registration numbers to the registers, thus ensuring anonymity. All data received by the authors from the registers were attached to the serial number alone and not the civil registration number, thus ensuring anonymity.

Results

Predictors of Mental Disorders. Table 1 shows unadjusted predictors of Kaplan-Meier survival analyses. Previous admission, any violent crime, and other violent crime predicted admission after index day to psychiatric hospital, admission after index day for schizophrenia, and admission after index day for any psychosis. Serious violent crime predicted admission after index day for any psychosis and showed a tendency for prediction of admission after index day to psychiatric hospital.

Cohort type predicted admission after index day to psychiatric hospital, with the incidence cohort being quickest to admission. This is expected, as the incidence cohort represents the “newcomers” to the criminal system and selection of the obviously mentally ill has not yet been performed.

Judicial status predicted admission after index day to psychiatric hospital and admission after index day for schizophrenia and showed a tendency for prediction of admission after index day for any psychosis, which was equally expected, as the mentally disordered offenders were compared to the six other categories...
who were not specifically known at index time to be mentally disordered.

Sex, age, arson, and sexual offense did not predict the outcome variables.

In figure 1, the Kaplan-Meier survival curve illustrates that young criminals with the predictor any violent crime unadjusted have an increased rate of admission after index day for schizophrenia.

In level I Cox regression (table 2), the adjusted predictors previous admission and any violent crime predicted significantly admission after index day to psychiatric hospital, admission after index day for schizophrenia, and admission after index day for any psychosis.

In level II Cox regression (table 3), the adjusted predictor previous admission predicted significantly admission after index day to psychiatric hospital, admission after index day for schizophrenia, and admission after index day for any psychosis.

Knowledge of previous psychiatric admission as a test of later schizophrenia resulted in a positive predictive value (the chance of developing schizophrenia if the test was positive) of 0.17 (sensitivity = 0.42, specificity = 0.93). Knowledge of a verdict of any violent crime as a test of later schizophrenia resulted in a positive predictive value of 0.06 (sensitivity = 0.85, specificity = 0.50). Combining both predictors (previous admission + other violent crime) resulted in a positive predictive value of 0.24 (10 of 42 cases with previous admission + other violent crime were correctly classified) (sensitivity = 0.38, specificity = 0.96).

The appendix shows all 2 x 2 cells of numerical distributions between selected predictors and all three outcome variables.

Descriptive Results. From birth to index day, 66 (8.5%) of the study cohort had been admitted as psychiatric inpatients (59 males [8.1%] and 7 [14.6%] females; no significant gender difference, likelihood ratio \( \chi^2, p = 0.147 \)). From birth to followup in June 2001, 162 (20.8%) had been admitted as psychiatric inpatients (148 males
and 14 (29.2%) females; no significant gender difference, likelihood ratio $\chi^2$, $p = 0.155$).

Between index day and followup, 26 (3.3%) (25 males, 1 female) were admitted for the first time with schizophrenia.

Compared to the mortality in 1998 of men in the Danish population aged 19 in 1992 (Statistics Denmark 1999) (median age for the cohort was 18.8) the standardized mortality rate at followup was 2.63. The reason of death for the 31 males was 1 natural death, 1 homicide/violence, 2 suicides, 18 accidents, and 9 with unknown manner of death.

The manner of death for the 18 accidents was 6 by motor vehicle accidents, 8 by poisoning accidents with narcotics ($n = 6$) or prescribed drugs ($n = 2$), 3 by bodily injury (misclassification), and 1 by accidental shooting. Some of the accidents may have been suicides, but this is unknown.

### Table 2. Cox regression analysis level I

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>1.51</td>
<td>[0.75; 3.04]</td>
<td>0.246</td>
<td>0.51</td>
<td>[0.06; 4.20]</td>
<td>0.526</td>
<td>0.89</td>
<td>[0.20; 1.39]</td>
<td>0.878</td>
</tr>
<tr>
<td>Age</td>
<td>1.41</td>
<td>[1.70; 2.40]</td>
<td>0.211</td>
<td>2.41</td>
<td>[0.56; 10.34]</td>
<td>0.239</td>
<td>3.30</td>
<td>[0.78; 13.95]</td>
<td>0.105</td>
</tr>
<tr>
<td>Previous admission</td>
<td><strong>1.79</strong></td>
<td>[1.51; 2.13]</td>
<td><strong>0.000</strong></td>
<td><strong>1.86</strong></td>
<td>[1.34; 2.58]</td>
<td><strong>0.000</strong></td>
<td><strong>1.65</strong></td>
<td>[1.23; 2.21]</td>
<td><strong>0.001</strong></td>
</tr>
<tr>
<td>Any violent crime</td>
<td><strong>2.04</strong></td>
<td>[1.35; 3.09]</td>
<td><strong>0.001</strong></td>
<td><strong>4.59</strong></td>
<td>[1.54; 13.74]</td>
<td><strong>0.006</strong></td>
<td><strong>2.35</strong></td>
<td>[1.06; 5.21]</td>
<td><strong>0.035</strong></td>
</tr>
<tr>
<td>Cohort type</td>
<td>0.70</td>
<td>[0.45; 1.10]</td>
<td>0.118</td>
<td>0.80</td>
<td>[0.31; 2.08]</td>
<td>0.648</td>
<td>1.20</td>
<td>[0.66; 1.30]</td>
<td>0.680</td>
</tr>
<tr>
<td>Judicial status</td>
<td>NA</td>
<td>NA</td>
<td>0.509</td>
<td>NA</td>
<td>NA</td>
<td>1.00</td>
<td>NA</td>
<td>NA</td>
<td>0.993</td>
</tr>
</tbody>
</table>

*Note.*—CI = confidence interval; NA = not applicable, as judicial status is a categorical variable with seven levels; OR = odds ratio. 1OR for time to admission after index day to psychiatric hospital, time to admission after index day for schizophrenia, time to admission after index day for psychosis adjusted predictors at followup. Statistical significance is indicated by bold type. Predictors included in model: sex, age, previous admission, any violent crime, cohort type, and judicial status.

### Table 3. Cox regression analysis level II

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>1.51</td>
<td>[0.75; 3.03]</td>
<td>0.249</td>
<td>0.51</td>
<td>[0.06; 4.25]</td>
<td>0.532</td>
<td>0.96</td>
<td>[0.21; 4.32]</td>
<td>0.960</td>
</tr>
<tr>
<td>Age</td>
<td>1.40</td>
<td>[0.82; 2.39]</td>
<td>0.218</td>
<td>2.52</td>
<td>[0.58; 10.83]</td>
<td>0.216</td>
<td>3.27</td>
<td>[0.22; 13.52]</td>
<td>0.108</td>
</tr>
<tr>
<td>Previous admission</td>
<td><strong>1.78</strong></td>
<td>[1.49; 2.12]</td>
<td><strong>0.000</strong></td>
<td><strong>1.83</strong></td>
<td>[1.32; 2.54]</td>
<td><strong>0.000</strong></td>
<td><strong>1.63</strong></td>
<td>[1.20; 2.20]</td>
<td><strong>0.002</strong></td>
</tr>
<tr>
<td>Serious violent crime</td>
<td>1.72</td>
<td>[0.63; 4.70]</td>
<td>0.293</td>
<td>1.62</td>
<td>[0.21; 12.26]</td>
<td>0.643</td>
<td>6.24</td>
<td>[2.13; 18.36]</td>
<td>0.001</td>
</tr>
<tr>
<td>Other violent crime</td>
<td><strong>2.07</strong></td>
<td>[1.38; 3.12]</td>
<td><strong>0.000</strong></td>
<td><strong>5.18</strong></td>
<td>[1.72; 15.59]</td>
<td><strong>0.003</strong></td>
<td>2.13</td>
<td>[0.97; 4.68]</td>
<td>0.058</td>
</tr>
<tr>
<td>Arson</td>
<td>0.76</td>
<td>[0.28; 2.08]</td>
<td>0.590</td>
<td>1.00</td>
<td>[0; $\infty$]</td>
<td>0.979</td>
<td>1.00</td>
<td>[0; $\infty$]</td>
<td>0.983</td>
</tr>
<tr>
<td>Sexual offense</td>
<td>1.04</td>
<td>[0.38; 2.85]</td>
<td>0.937</td>
<td>2.17</td>
<td>[0.50; 9.34]</td>
<td>0.301</td>
<td>0.58</td>
<td>[0.35; 6.63]</td>
<td>0.576</td>
</tr>
<tr>
<td>Cohort type</td>
<td>0.70</td>
<td>[0.45; 1.10]</td>
<td>0.119</td>
<td>0.81</td>
<td>[0.31; 2.10]</td>
<td>0.662</td>
<td>1.15</td>
<td>[0.49; 2.74]</td>
<td>0.748</td>
</tr>
<tr>
<td>Judicial status</td>
<td>NA</td>
<td>NA</td>
<td>0.557</td>
<td>NA</td>
<td>NA</td>
<td>0.999</td>
<td>NA</td>
<td>NA</td>
<td>0.995</td>
</tr>
</tbody>
</table>

*Note.*—CI = confidence interval; NA = not applicable, as judicial status is a categorical variable with seven levels; OR = odds ratio. 1OR for time to admission after index day to psychiatric hospital, time to admission after index day for schizophrenia, time to admission after index day for psychosis adjusted predictors at followup. Statistical significance is indicated by bold type. Predictors included in model: sex, age, previous admission, serious violent crime, other violent crime, arson, sexual offense, cohort type, and judicial status.
Table 4. Convictions of study cohort from age 15 to index day in 1992

<table>
<thead>
<tr>
<th></th>
<th>Male (n = 732)</th>
<th></th>
<th>Female (n = 48)</th>
<th></th>
<th>All (n = 780)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Any violent crime</td>
<td>410</td>
<td>56.0</td>
<td>16</td>
<td>33.3</td>
<td>426</td>
<td>54.4</td>
</tr>
<tr>
<td>Serious violent crime</td>
<td>12</td>
<td>1.6</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>Other violent crime</td>
<td>382</td>
<td>52.2</td>
<td>15</td>
<td>31.1</td>
<td>397</td>
<td>50.9</td>
</tr>
<tr>
<td>Arson</td>
<td>30</td>
<td>4.1</td>
<td>1</td>
<td>2.1</td>
<td>31</td>
<td>4.0</td>
</tr>
<tr>
<td>Sexual offense</td>
<td>25</td>
<td>3.4</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>3.2</td>
</tr>
<tr>
<td>Nonviolent crime</td>
<td>691</td>
<td>94.4</td>
<td>44</td>
<td>91.7</td>
<td>735</td>
<td>94.2</td>
</tr>
</tbody>
</table>

1As some individuals were convicted of more than one subtype of violent crime, simple summing up is not possible.

Table 4 shows the distribution of convictions from age 15 to the index day, forming the base of the criminal predictors. Before index day, more than half had a conviction of violence (males > females, likelihood ratio $\chi^2, p = 0.002$), and at followup 72.1 percent (data not shown in table 4) had a conviction of any violent offense. Females had no convictions of serious violent crime or sexual offense and only one case of arson.

**Associations Between Mental Disorder and Violence.** Table 5 shows the association between violence and mental disorder by analyzing the predictors of violence and the predictor previous admission. Any violent crime, serious violent crime, other violent crime, sexual offense, and judicial status were significantly associated with previous admission.

**Discussion**

The main result of this study of young criminals was that psychiatric admission before age 19 or a verdict of other violent crime (violence excluding murder, attempted murder, and particularly brutal assault) between ages 15 and 19 predicted later hospitalization for schizophrenia. Psychiatric admission was a stronger predictor than other violent crime, but the latter was nevertheless found to have an independent predictive effect on future schizophrenia.

Knowledge of prior admission and of other violent crime of young criminals will identify them as high-risk individuals, as 24 percent will later develop schizophrenia. We consider it relevant to identify these predictors in young criminals, as their risk of later schizophrenia is high. This could be done, by simple screening of the entire young criminal population, for the predictors previous admission and other violent crime. Furthermore, in regard to early intervention, psychiatric screening for mental disorders should be done when a person enters the judicial system, which in general terms has been suggested for adolescents (Wasserman et al. 2003) and done on a trial basis in the Netherlands (Doreleijers et al. 2000). Early intervention for high-risk individuals could be recommending forensic assessment for the court, to identify psychiatric symptoms as a whole as well as prodromal signs of schizophrenia (Huber and

Table 5. Associations between predictors of violence and the predictor previous admission to psychiatric hospital before index day

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Previous Admission to Psychiatric Hospital Before Index Day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Any violent crime</td>
<td>1.87</td>
</tr>
<tr>
<td>Serious violent crime</td>
<td>5.69</td>
</tr>
<tr>
<td>Other violent crime</td>
<td>1.77</td>
</tr>
<tr>
<td>Arson</td>
<td>1.67</td>
</tr>
<tr>
<td>Sexual offense</td>
<td>5.18</td>
</tr>
<tr>
<td>Cohort type$^2$</td>
<td>1.02</td>
</tr>
<tr>
<td>Judicial status$^3$</td>
<td>$42.23$</td>
</tr>
</tbody>
</table>

*Note:* OR = odds ratio.

$^1$Statistical significance is indicated by bold type.

$^2$Prevalence versus incidence cohort. $^3$Convicted mentally disordered offenders versus all other.
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Gross 1989; Häfner 2000) and to follow the developing morbidity of the young criminal.

We found a high lifetime prevalence of schizophrenia (3.3%) and any psychotic disorder (4.5%) in a criminal population at ages 23 to 29. This is comparable to a review of prison studies that found a past-year prevalence of psychotic disorders of 4 percent (Fazel and Danesh 2002), taking into consideration that the present study used lifetime data and younger subjects.

We found strong associations (table 2) between mental disorder and violence (previous admission and any violent crime); for instance, adolescent criminals with a verdict of any violent crime had previously been admitted more often than adolescents who had verdicts of only nonviolent crime. This shows an association between mental disorder and violence in a group of 15- to 19-year-old criminals.

The Dunedin birth cohort found at age 21 an odds ratio (OR) of 5.1 for schizophrenia patients having a court conviction for violence (Arseneault et al. 2000), which coincides with this study’s adjusted OR of 4.59 of other violent crime (table 2) for later schizophrenia.

The same birth cohort also found that children with high physical aggression were at higher risk of later schizophreniform disorder, although children with childhood psychotic symptoms had even a higher risk (Arseneault et al. 2003).

Among adolescents aged 13 to 14, Cannon et al. (2001) found that violent assault within the last 12 months was positively associated with schizophrenia but stealing (a nonviolent crime) was significantly less likely to occur (Cannon et al. 2001). These studies support our result of other violent crime predicting schizophrenia (table 3), as all comparisons were done between violent and nonviolent crime.

The fact that serious violent crime predicted only any psychosis may be due to the low numbers of subjects (n = 12).

It was surprising that arson was neither associated with previous admission (table 5) nor a predictor of schizophrenia, given that 10 percent of adult violent arsonists in one study (Repo et al. 1997) were reported to have DSM-III schizophrenia or delusional disorder. A study comparing juvenile arsonists to violent juveniles found that arsonists received significantly more treatment for mental disorders (mostly psychotic disorders) (Rasanen et al. 1995). The failure of this study to find arson to be a predictor of schizophrenia may lie in low numbers or the fact that early-onset arsonists, as opposed to arsonists with late onset, do not later develop mental disorders to the same degree, or that the arsonists were not out of the risk period for developing schizophrenia. Only 4 received inpatient treatment, and none of the 31 arsonists ever developed schizophrenia in the followup period.

As seen in table 5, adolescent sexual offenders had a greater risk of previous hospital admission, which is in line with a study of adults convicted of sexual offenses that found they had a higher risk of schizophrenia (Wallace et al. 1998). But sexual offense in adolescence did not, unadjusted or adjusted, predict any of the outcome measures.

Age and sex, either unadjusted or adjusted, did not predict any of the outcomes. The reason age was not a predictor is probably the narrow age range. It could be expected that female gender would predict all outcomes, as female criminals usually are more mentally disordered. As this was not the case, the reason might be too short a followup period, as the schizophrenia spectrum disorders have later onset in females.

The register study was fully representative of young criminals (age 15–19) in contact with the DPPS, so the conclusions of the study can be extended to all young Danish criminals who have committed crimes serious enough to put them under the care of the DPPS.

Females represented 6.1 percent (n = 48) of the study cohort and had the same load of psychiatric admission before index but were less often convicted of violence before index. Although gender did not predict outcome measures, the conclusions of violence predicting schizophrenia should for females be treated with some reservation; the number of females was low, and the fact that only one developed schizophrenia may reflect the later onset of schizophrenia seen among women. A longer followup might or might not find female gender to predict outcome, because of the lower prevalence of violence in the female gender in this cohort.

Bias denotes deviation from the “truth,” and information bias (also know as observation, classification, or measurement bias) results from incorrect determination of exposure, outcome, or both (Grimes and Schulz 2002). In regard to determination of violence in the register study, all data came from the National Criminal Register, which contains complete data on all known criminal activities of all Danes, so the presence or absence of violence was fully registered. Violence not registered by police demanded self-report, which was beyond the scope of this study.

The age of criminal responsibility is 15 in Denmark; therefore, criminal acts committed when subjects were younger than 15 were not registered. This lack of information reduced the precise knowledge of the number of young criminals and might have changed the proportion of violent crime in the cohort; the register study could not examine possible high-risk individuals with early-onset violence (before age 15).

In regard to determination of schizophrenia in the register study, all cases of schizophrenia were recorded in the Danish Psychiatric Central Register, the register diagnoses were based on clinical examination, and diagnoses of schizophrenia have been shown to be valid (Munk-Jørgensen 1995).
In the register study, selection bias was likely to have occurred, as 31 males died during followup. They were deleted from the National Criminal Register, so knowledge of verdicts was unknown. At followup until death, 7 of the 31 had been psychiatric inpatients, and none of these were ever diagnosed with schizophrenia or any psychosis. Bias was likely to be present, as the proportion of previously admitted among the dead was greater than in the live cohort (likelihood ratio, \( p = 0.02 \); the dead were more mentally ill), but the study did not assess whether they were more violent, as criminal data were deleted.

This study has controlled for effects of confounding by multivariate analyses. Nevertheless, the role of unmeasured confounding must be addressed. The factors of exposure (predictors) are several criminal variables, gender, age, and a measure of previous mental illness (previous admission), and the outcome is schizophrenia. The study lacks information on confounders such as family history of schizophrenia/mental disorder (genetic loading), and substance abuse. We consider substance abuse to be associated with crime/violence but not to have an independent causal effect on outcome; rather, we believe that adolescents with substance abuse have a higher risk of schizophrenia. A recent review (Arseneault et al. 2004) of the causal effect of cannabis use for schizophrenia found an association between cannabis use and later schizophrenia, but cannabis was neither a sufficient nor a necessary cause of psychosis.

Social factors such as socioeconomic status and ethnicity were not considered to be confounders, as they do not have an independent etiologic effect on outcome (schizophrenia). The study therefore takes most of the confounders into consideration.

**Conclusion**

The results of this study indicate that violent behavior among young criminals is predictive of later schizophrenia and may be an early symptom of maladjusted behavior and part of a preschizophrenia phase.

We found that previous psychiatric admission and a violent conviction in a young criminal predicted future schizophrenia in 24 percent of cases.

The judicial system should focus on obtaining information about prior psychiatric admittance of young criminals, as this is a risk factor for later mental disorder. Young criminals convicted of violence are at risk of future psychotic disorders; thus, examinations at this age are important, as they offer the possibility of early recognition and intervention.

The conclusions of this study are limited to adolescents with registered crime in a judicial system comparable to Denmark’s.

**Acknowledgments**

This work was supported by the Ministry of Justice, Denmark, “Fonden af 1982,” and the Danish Prison and Probation Service.

**Appendix.** Numerical distribution between selected predictors and all outcome variables

<table>
<thead>
<tr>
<th>Predictor (before index day)</th>
<th>Outcome</th>
<th>Psychiatric Admission After Index Day</th>
<th>Admission After Index Day for Schizophrenia</th>
<th>Admission After Index Day for Psychosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td>Male</td>
<td>116</td>
<td>616</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>10</td>
<td>38</td>
</tr>
<tr>
<td>Previous admission</td>
<td></td>
<td>Yes</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>96</td>
<td>618</td>
</tr>
<tr>
<td>Any violence</td>
<td></td>
<td>Yes</td>
<td>89</td>
<td>337</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>37</td>
<td>317</td>
</tr>
<tr>
<td>Serious violent crime</td>
<td></td>
<td>Yes</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>122</td>
<td>646</td>
</tr>
<tr>
<td>Other violent crime</td>
<td></td>
<td>Yes</td>
<td>86</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>40</td>
<td>343</td>
</tr>
<tr>
<td>Arson</td>
<td></td>
<td>Yes</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>122</td>
<td>627</td>
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<tr>
<td>Sexual offense</td>
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<td>4</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>122</td>
<td>635</td>
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</table>
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References


