

Specific Major Mental Disorders and Criminality: A 26-Year Prospective Study of the 1966 Northern Finland Birth Cohort

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Objective: The purpose of the study was to examine the quantitative risk of criminal behavior associated with specific mental disorders. **Method:** An unselected 1966 birth cohort (N=12,058) in Northern Finland was prospectively studied until the end of 1992. The investigation started during the mothers' pregnancy, and the data on the subjects' family characteristics, mental and physical development, living habits, psychiatric morbidity, and criminal records were gathered at various times. **Results:** The prevalence of offenses was the highest among males with alcohol-induced psychoses and male schizophrenic subjects with coexisting alcohol abuse, and more than half of the schizophrenic offenders also had problems with alcohol. Eleven (7%) of the 165 subjects who committed violent crimes were diagnosed as psychotic. Male schizophrenic subjects had a moderately high risk for violent offenses, but the risk for other types of crimes was not elevated significantly. Odds ratios for criminal behavior were adjusted according to the socioeconomic status of the childhood family and were the same as or slightly lower than the crude odds ratios for all disorders except schizophrenia and mood disorders with psychotic features. **Conclusions:** The results indicate that the risk of criminal behavior was significantly higher among subjects with psychotic disorders, even though the socioeconomic status of the childhood family was controlled. The higher risk for violent behavior was associated especially with alcohol-induced psychoses and with schizophrenia with coexisting substance abuse. The results suggest that schizophrenia without substance abuse may also be associated with a higher risk of offenses, but this finding is tentative and requires further investigation.

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When the criminality of psychiatric patients is studied, it is difficult to obtain unbiased samples. The samples usually represent a relatively small proportion of offenders. For example, in the United States, about 8,000 homicides (30%) remain unsolved every year (1), and because of the lack of comprehensive registers, it is difficult to study those offenders who have been caught. The results from several studies of prison inmates and homicide offenders (2-8) suggest that the prevalence of psychiatric disorders is higher among offenders than in the general population. However, the subjects examined in these studies represent

only a portion of all offenders, and therefore the results are biased. It has been observed that crime rates, especially for violent offenses, are higher among ex-mental patients (9-14). Since serious crimes are quite an infrequent phenomena, the follow-up periods should be long enough to detect sufficient offenses for statistical analysis. In addition, most of these studies had methodological weaknesses: the samples did not remain intact until the end of the follow-up period, and the diagnoses were not validated.

Access to comprehensive central registers permits studies of the prevalence of criminality among unselected birth cohorts. The results of a Danish study, which had 23-year (criminal records) and 26-year (medical records) follow-up periods, showed that patients with psychotic disorders and histories of substance abuse were more likely to be registered for a criminal offense than were subjects without a mental disorder, but no relative risks were calculated (15). Hodgins (16) studied the quantitative association of mental disorders and criminality in a Swedish birth cohort. In that 30-year follow-up study, the association

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was investigated for the first time by using a large, comprehensive sample and state-of-the-art epidemiological and statistical methods to obtain odds ratios and confidence intervals for each diagnostic group. The results indicated that males with a major mental disorder had a 2.5-fold risk for all criminal offenses and a 4-fold risk for violent offenses when compared with males without a mental disorder. However, within the group with major mental disorders, there was no differentiation among schizophrenia, major affective disorders, paranoid states, and other psychoses, and it was not possible to obtain odds ratios for specific mental disorders. The same kind of finding was observed in a recent study with a larger cohort, but because of diagnostic categorization no data on specific mental disorders were available (17).

To our knowledge, there have been no published reports on the putative association between specific mental disorders and criminal behavior, with the exception of the results from a relatively selected sample of Finnish homicidal offenders (7, 8). The aim of the present study was to calculate, for the first time in an unselected birth cohort, odds ratios for the risk of criminal, and especially violent, behavior among subjects with DSM-III-R diagnoses for specific major mental disorders. This was done to test the hypothesis that subjects with specific major mental disorders have a higher risk of criminal behavior than subjects without a mental disorder.

METHOD

The study design and data used have already been described in detail (18–23). The original series consisted of 12,068 pregnant women who gave birth to 12,058 live infants in the two northernmost provinces of Finland during 1966; these births represented 96% of all births in that area during that year. Many social and biological characteristics of the mother and family were recorded during pregnancy, along with perinatal factors. The social status of the family and health of the child were recorded with another questionnaire when the child was 14 years old (24). A family questionnaire was completed by 96.1% of the families. In addition, data on the children's health and development (taken from various morbidity and mortality registers) were continuously recorded from birth onward, up to the age of 26 (25).

Final case ascertainment was completed up to the end of 1993 from the Finnish Hospital Discharge Register, which includes all patients discharged from all hospitals in Finland. These data have demonstrated good accuracy in research (26–28), and Keskimäki and Aro (27) have found that the accuracy of the principal diagnosis of 339 cases of mental disorder was good: in 98% the medical record and the Finnish Hospital Discharge Register had the same diagnosis. In the second stage, the validity of major mental disorders was ensured by hospital records and case notes. All hospital records were scrutinized. Clinical information was obtained from the case records and was processed in two ways. First, the Operational Criteria Checklist for Psychotic Illness (29) was completed, and the associated operational criteria program was used to provide diagnoses according to DSM-III-R criteria. In addition, the clinical data were transferred to a separate checklist to evaluate the DSM-III-R criteria for schizophrenia. Both the operational criteria and the DSM-III-R checklist diagnoses were then rechecked against clinical records by two senior researchers (M.I. and J.M.) in order to form a consensus and final operational diagnosis based on the available information.

The reliability of diagnoses was ensured in the following way: both

of the senior researchers (M.I. and J.M.) participated in a cross-national reliability investigation of the Finnish Adoptive Family Study of Schizophrenia (30), in which 40 case summaries of eight hierarchical categories were reviewed. The kappa for this approach (schizophrenia diagnosis) was highly satisfactory ($\kappa=0.77-0.87$). Interrater reliability at all stages was high ($\kappa=0.64-0.94$). If the patient had had many hospitalizations or outpatient episodes, we adopted a hierarchical approach and classified cases with the most severe disorder over the subject's lifetime (31). In this study, we used narrowly defined "nuclear" cases of schizophrenia or DSM-III-R code numbers 295.1–295.3, 295.6, and 295.9. We separated schizophreniform disorder (code 295.40), schizoaffective disorder (code 295.70), and delusional disorder (code 297) in the schizophrenia group.

The relevant data from criminal records were collected from files maintained by the Ministry of Justice for those between 15 and 25 years of age. In the study group a total of 6,007 boys and 5,757 girls were alive at the age of 15 years, and 5,636 boys and 5,217 girls were living in Finland (32). Five hundred three of the male subjects and 53 of the female subjects had committed at least one crime resulting in a criminal record by the end of 1992. Of the male subjects, 356 were sentenced for severe traffic violations, which were the most common crimes. A severe traffic violation was defined as an offense that resulted in a prison sentence (the most common offense was gross endangerment of other people's health while driving under heavy alcohol intoxication). Of the males, 194 committed crimes against property (theft, fraud, and treachery), which were the second most common crimes. Violent crimes were considered to be homicides, assault, robbery, arson, or violation of domestic peace. A total of 165 males committed such crimes. Other types of crime were disorderly conduct and illegal sale or possession of alcohol or narcotics.

The sociodemographic variables included place of residence at the time of birth, paternal socioeconomic status at the subject's birth and social mobility up to when the subject was age 14, and parental marital status (two-parent versus single-parent family). Socioeconomic status at birth was classified by the father's occupation (I and II=professional, III=skilled worker, IV=unskilled worker, and V=farmer).

To find the subjects with a major mental disorder who were never hospitalized, we also analyzed the outpatient registers of all of Finland. We found only two additional cases of outpatient schizophrenia through the end of 1993. These cases also passed the diagnostic validation process.

A logistic regression analysis was used to examine the association between psychiatric disorder and criminal behavior; the interaction effect of mental disorder and the father's socioeconomic class on criminal behavior was the response variable. At the first stage the unadjusted odds ratio was calculated by including one psychiatric disorder in the model at a time. At the second stage the adjusted odds ratio was calculated by including the father's socioeconomic class at the subject's birth, residence in a city, and one-parent family background in the model.

RESULTS

Of the 503 male offenders, 116 (23%) had a psychiatric diagnosis (27 had a major mental disorder), and 62% ($N=72$ of 116) of these subjects had committed their first crime before being diagnosed as having a psychiatric illness. Of the 5,636 male subjects, 351 had a psychiatric diagnosis, and 86 had a major mental disorder. Of the 165 violent offenders, 11 (7%) were diagnosed as psychotic.

The demographic data and the effect of the highest and the lowest classifications assessed by the father's occupation, along with the effect from place of residence (urban versus rural) and family structure (two-parent versus single-parent family), are shown in table 1. There was no marked relationship between criminal-

TABLE 1. Socioeconomic Characteristics, Mental Disorders, and Criminality Among Male Subjects in the 1966 Northern Finland Birth Cohort

Socioeconomic Status	Number of Subjects	Offenders		Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval	p ^a
		N	%					
Any mental disorder								
Father in highest socioeconomic class ^b	32	6	18.8	2.4	1.0-5.8	0.6	0.2-1.8	0.40
Father in lowest socioeconomic class ^b	88	40	45.5	9.1	5.9-14.1	1.5	0.8-2.7	0.16
No mental disorder								
Father in highest socioeconomic class ^b	636	23	3.6	0.4	0.2-0.5	0.4	0.3-0.7	0.0003
Father in lowest socioeconomic class ^b	913	93	10.2	1.2	0.9-1.5	1.3	1.0-1.7	0.05
Family living in a city ^c	2,428	249	10.3	1.3	1.1-1.6	1.2	1.0-1.4	0.10
One-parent family background ^c	1,047	173	16.5	2.5	2.1-3.1	2.2	1.8-2.7	<0.0001

^aCalculated by using a logistic regression analysis and interpreting the difference.

^bHighest=I, lowest=IV; reference group=fathers in socioeconomic classes II, III, and V (farmer).

^cVariables in dichotomized form with the other alternative as reference.

TABLE 2. Number of Male Subjects in the 1966 Northern Finland Birth Cohort With at Least One Registered Crime, by Diagnosis

DSM-III-R Diagnosis and Code	Number of Subjects	Offenders		Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval	p ^a
		N	%					
Schizophrenia (295.1, 295.2, 295.3, 295.6, 295.9)	51	10	19.6	3.1	1.5-6.2	3.0	1.4-6.3	<0.004
Schizophreniform and schizoaffective disorders (295.40, 295.70)	7	2	28.6	5.1	1.0-26.2	4.1	0.8-21.9	<0.09
Mood disorders with psychotic features (296.24, 296.34, 296.44, 296.54, 296.64, 296.70)	6	2	33.3	6.3	1.1-34.7	6.8	1.2-38.7	<0.03
Organic mental syndromes and disorders (291.00, 291.10, 291.20, 292, 293, 294)	13	10	76.9	42.2	11.6-154.0	30.3	7.8-117.0	<0.0001
Paranoid and other psychoses (297, 298)	9	3	33.3	6.3	1.6-25.4	5.5	1.3-23.8	<0.02
No mental disorder (reference group)	5,285	387	7.3	1.0				

^aCalculated as in table 1.

ity and socioeconomic status when the lowest and the highest socioeconomic classes were compared with the reference group (whose fathers were in socioeconomic classes II, III, and V). The odds ratios were 1.5 (subjects with mental disorders) and 1.3 (subjects without mental disorders) in the lowest socioeconomic class and 0.6 (subjects with mental disorders) and 0.4 (subjects without mental disorders) in the highest socioeconomic class.

Table 2 shows the number and prevalence of male subjects with registered crimes among each diagnostic group, as well as the odds ratios for crime and 95% confidence intervals. Data on subjects with mental disorders other than major mental disorders are not included. The corresponding data for violent crimes are shown in table 3, and for offenses against property in table 4. Each table also shows the odds ratios and 95% confidence intervals among subjects in each diagnostic group, adjusted according to the socioeconomic status of the individual's childhood family. When the socioeconomic status was adjusted, all odds ratios of mental disorders for criminality decreased or remained the same, except for those of patients with schizophrenia for violent offenses and mood disorders with psychotic features for any offenses and violent offenses, which increased slightly.

Forty-three female subjects had a diagnosis of major mental disorder (25 with schizophrenia; 10 with schizophreniform and schizoaffective disorders; none with paranoid, schizoid, or schizotypal personality disorder;

three with mood disorders with psychotic features; three with organic mental syndrome or disorder; and two with paranoid or other psychosis).

Only one criminal offender among the female subjects suffered from a major mental disorder (organic mental syndrome or disorder). Thus, the prevalence of offenders was 33.3% in this group (odds ratio=61.6, 95% confidence interval=5.5-693.0), whereas the prevalence of offenders among women with no mental disorders was 0.8% (N=42 of 5,217). Data on subjects with mental disorders other than major mental disorders were not included.

Four female schizophrenic subjects had problems with alcohol, and two of them were also abusers of benzodiazepine. Of the male schizophrenic subjects, 15 were characterized by either heavy drinking or other alcohol use problems in their daily life, and two were also known to be drug addicts. Forty percent (N=6 of 15) of male schizophrenic subjects with alcohol problems were criminal offenders, compared with 11% (N=4 of 36) of those without alcohol problems. The prevalence of criminality among mentally healthy males was 7% (N=387 of 5,285). Four (27%) of the 15 male schizophrenic subjects with coexisting alcohol abuse had committed violent offenses, compared with three (8%) of 36 without alcohol abuse. Both of these prevalences are notably higher (p<0.05, Fisher's exact test) than the prevalence among subjects without mental disorders (2%).

TABLE 3. Number of Male Subjects in the 1966 Northern Finland Birth Cohort With at Least One Registered Violent Crime, by Diagnosis

DSM-III-R Diagnosis ^a	Number of Subjects	Offenders		Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval	p ^b
		N	%					
Schizophrenia	51	7	13.7	7.0	3.1–15.9	7.2	3.1–16.6	<0.0001
Schizophreniform and schizoaffective disorders	7	0	0.0	0.0	0.0–0.0	0.0	0.0–0.0	1.00
Mood disorders with psychotic features	6	1	16.7	8.8	1.0–76.2	10.4	1.2–94.0	0.04
Organic mental syndromes and disorders	13	2	15.4	8.0	1.8–36.6	5.0	1.0–23.6	0.04
Paranoid and other psychoses	9	1	11.1	5.5	0.7–44.5	4.7	0.6–39.3	0.15
No mental disorder (reference group)	5,285	117	2.2	1.0				

^aFor diagnostic codes, see table 2.

^bCalculated as in table 1.

TABLE 4. Number of Male Individuals Committing Offenses Against Property, by Diagnosis

DSM-III-R Diagnosis ^a	Number of Subjects	Offenders		Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio	95% Confidence Interval
		N	%				
Schizophrenia	51	2	3.9	1.6	0.4–6.6	1.6	0.4–6.7
Schizophreniform and schizoaffective disorders	7	0	0.0	0.0	0.0–0.0	0.0	0.0–0.0
Mood disorders with psychotic features	6	0	0.0	0.0	0.0–0.0	0.0	0.0–0.0
Organic mental syndromes and disorders	13	5	38.5	24.2	7.8–75.0	15.1	4.5–50.2
Paranoid and other psychoses	9	1	11.1	4.8	0.6–39.0	4.0	0.5–34.1
No mental disorder (reference group)	5,285	133	2.5	1.0			

^aFor diagnostic codes, see table 2.

Two of three female subjects and four of six male subjects with mood disorders with psychotic features were at least heavy weekend users of alcohol, and two of the males were also criminal offenders.

DISCUSSION

To our knowledge, this is the first cohort study to demonstrate the quantitative risk of criminal and violent behavior for specific mental disorders. The results of this longitudinal, 26-year prospective study, on an unselected birth cohort of 12,058 individuals, suggest that several specific mental disorders are associated with an elevated risk for criminal and violent behavior. While the odds ratios for any criminal offense were 3.1 for schizophrenia and 6.3 for mood disorders with psychotic features, the corresponding odds ratios for a violent offense were 7.0 for schizophrenia and 8.8 for mood disorders with psychotic features. The comparison of the odds ratios for a violent offense and for any offense suggests that schizophrenia and mood disorders with psychotic features may be associated with a moderately elevated risk for violent offenses, whereas the risk for other kinds of offenses was quite low. About 7% (N=11 of 165) of all male violent offenders were diagnosed as psychotic. Organic mental syndromes and disorders were associated with the highest risk for traffic offenses and offenses against property. All subjects with both a diagnosis of organic mental syndrome or disorder and a criminal record had alcohol-induced psychosis and were actually alcoholics. The risk of criminal offenses was four times higher among male schizophrenic subjects with coexisting alcohol

abuse than among sober male schizophrenic subjects. Although the risk of violent offenses was highest among male schizophrenic subjects with coexisting substance abuse, the risk of violent offenses was also significantly higher among male schizophrenic subjects without substance abuse than among male subjects without any mental disorder. This finding was based on three cases of schizophrenic offenders without substance abuse, and it must be considered tentative. Therefore, further investigation is required to confirm that schizophrenia per se is associated with a higher risk of violent behavior. It must be emphasized that alcohol abuse accounts for most of the criminal behavior among schizophrenic subjects, and because of a relatively small number of offenders it is difficult to make firm conclusions about the role of coexisting substance abuse in criminal behavior.

None of the female schizophrenic subjects who used alcohol or drugs committed any crimes. Because of the small number of female offenders, it was difficult to make any firm conclusions. Of the 503 male criminal offenders, 356 were charged with drunk driving. The preponderance of crimes associated with alcohol and its morbid consequences highlights the important role of alcohol in mediating behavior that leads to a criminal record. The effects of comorbid alcohol use need to be taken into account before one can draw any conclusions regarding an association between other mental disorders and criminal behavior. Future research is necessary to continue the investigation of the association of concomitant alcoholism and mental disorders with criminality (33).

When the odds ratios of different disorders are evaluated, it must be emphasized that the data were based on

hospitalized subjects. However, only two additional schizophrenic patients (N=2 of 73, 3%) were found from the outpatient registers, which indicates that only a few subjects may have been omitted. It has been estimated that the lifetime risk of schizophrenia is as high as 1.3% in Finland (34, 35). Häfner et al. (36) have demonstrated that 62% of men with lifetime schizophrenia had developed the disorder by the age of 25 years. Thus, the expected cumulative prevalence of schizophrenia in our cohort would be $0.62 \times 1.3\% = 0.8\%$, corresponding to 45 male subjects with schizophrenia. The observed number of 51 male schizophrenic subjects (1.0%) suggests that only a few cases may have been excluded from the registers. For those categories with a small number of subjects (subjects with mood disorders with psychotic features and schizophrenic subjects with offenses against property), a few additional untreated subjects without a criminal history would change the odds ratios quite remarkably. However, even 20 additional untreated schizophrenic subjects without a history of violent crime would have decreased the odds ratio for a violent offense from 7.0 to 4.8, and the lower end of the 95% confidence limit from 3.1 to 2.2, and in that case the increase in risk would still be highly significant. Because our cohort was followed up to only 26 years of age, it is possible that schizophrenic disorders or mood disorders with psychotic features might have developed later in a few individuals.

Low socioeconomic status was slightly associated with a higher risk of criminal behavior: for subjects in the lowest socioeconomic class, the odds ratios were 1.5 for subjects with mental disorders and 1.3 for subjects without mental disorders. While the odds ratios adjusted according to socioeconomic status of the childhood family were the same as or slightly lower than the crude odds ratios for all other types of disorders and offenses, offenders with schizophrenia and mood disorders with psychotic features had slightly higher adjusted odds ratios than the crude odds ratios, especially for violent crimes.

In 1993, the crime rate in northern Finland (i.e., all crimes, including minor offenses) was determined to be 149.2 crimes/1,000 persons per year, compared to 157.5 crimes/1,000 persons per year in the entire country. The corresponding rates for violent offenses were 3.3 crimes/1,000 persons per year in northern Finland and 3.7 crimes/1,000 persons per year for all of Finland (37). Although the crime rate in northern Finland is slightly lower than that in the entire country, we suggest that our data may be generalizable to subjects under 30 years of age in other parts of Finland. These data may also be generalizable to other industrialized Western countries that have relatively low crime rates (e.g., Sweden, Denmark, Norway, United Kingdom, and Canada) but not to countries with high crime rates such as the United States.

REFERENCES

1. International Crimes Statistics 1981–1990. Lyons, France, International Criminal Police Organisation, 1991
2. Mohanan J: Mental disorder and violent behavior: perceptions and evidence. *Am Psychol* 1992; 47:511–521
3. Hodgins S, Côté G: The prevalence of mental disorders among penitentiary inmates. *Can Ment Health* 1990; 38:1–5
4. Lindqvist P: Criminal homicide in northern Sweden, 1970. *Int J Law Psychiatry* 1986; 8:19–37
5. Côté G, Hodgins S: The prevalence of major mental disorders among homicide offenders. *Int J Law Psychiatry* 1992; 15: 89–99
6. Gottlieb P, Gabrielsen G, Kramp P: Psychotic homicides in Copenhagen from 1959 to 1983. *Acta Psychiatr Scand* 1987; 76: 285–292
7. Tiihonen J, Eronen M, Hakola P: Criminality associated with mental disorders and intellectual deficiency. *Arch Gen Psychiatry* 1993; 50:917–918
8. Eronen M, Hakola P, Tiihonen J: Mental disorders and homicidal behavior in Finland. *Arch Gen Psychiatry* 1996; 53:497–501
9. Sosowsky L: Crime and violence among mental patients reconsidered in view of the new legal relationship between the state and the mentally ill. *Am J Psychiatry* 1978; 135:33–42
10. Steadman HJ, Cocozza JJ, Melick ME: Explaining the increased arrest rate among mental patients: the changing clientele of state hospitals. *Am J Psychiatry* 1978; 135:816–820
11. Sosowsky L: Explaining the increased arrest rate among mental patients: a cautionary note. *Am J Psychiatry* 1980; 137:1602–1605
12. Steadman HJ, Monahan J, Clark Robbins P, Appelbaum P, Grisso T, Klassen D, Mulvey EP, Roth L: From dangerousness to risk assessment: implications for appropriate research strategies, in *Mental Disorder and Crime*. Edited by Hodgins S. Newbury Park, Calif, Sage Publications, 1993, pp 39–62
13. Lindqvist P, Allebeck P: Schizophrenia and crime: a longitudinal follow-up of 644 schizophrenics in Stockholm. *Br J Psychiatry* 1990; 157:345–350
14. Tiihonen J, Hakola P, Eronen M, Vartiainen H, Ryyänen O-P: Risk of homicidal behavior among discharged forensic psychiatric patients. *Forensic Sci Int* 1996; 79:123–129
15. Ortmann J: Psykisk ofvigelse og kriminel adfærd en under søgelse af 11533 mænd født i 1953 i det metropolitane område København, Forskningsrapport 17. Copenhagen, Denmark, Rapport til Justitsministeriet, Direktoratet for kriminal forsorgen, 1981
16. Hodgins S: Mental disorder, intellectual deficiency and crime: evidence from a birth cohort. *Arch Gen Psychiatry* 1992; 49: 476–483
17. Hodgins S, Mednick SA, Brennan PA, Schulsinger F, Engberg M: Mental disorder and crime: evidence from a Danish birth cohort. *Arch Gen Psychiatry* 1996; 54:489–496
18. Rantakallio P: Groups at risk in low birth weight infants and perinatal mortality. *Acta Paediatr Scand Suppl* 1969; 193:1–71
19. Rantakallio P: A 14-year follow-up of children with normal and abnormal birth weight for their gestational age—a population study. *Acta Paediatr Scand* 1985; 74:62–69
20. Rantakallio P, von Wendt L: Mental retardation and sub-normality in a birth cohort of 12,000 children in Northern Finland. *Am J Ment Defic* 1986; 90:380–387
21. Rantakallio P, von Wendt L: A prospective comparative study of the aetiology of cerebral palsy and epilepsy in a one-year birth cohort of Northern Finland. *Acta Paediatr Scand* 1986; 75:586–592
22. Rantakallio P, von Wendt L, Koivu M: Prognosis of perinatal brain damage: a prospective study of a one year birth cohort of 12,000 children. *Early Hum Dev* 1987; 15:75–84
23. Rantakallio P: The longitudinal study of the Northern Finland birth cohort of 1966. *Paediatr Perinat Epidemiol* 1988; 2:59–88
24. Rantakallio P, Läärä E, Isohanni M, Moilanen I: Maternal smoking during pregnancy and delinquency of the offspring: an association without causation? *Int J Epidemiol* 1992; 21:1106–1113
25. Koskenvuo M, Kaprio J, Romo M, Langinvainio H: Incidence and prognosis of ischaemic heart disease with respect to marital status and social class. *J Epidemiol Community Health* 1981; 35:192–196
26. Poikolainen K: Accuracy of hospital discharge data: five alcohol-related diseases. *Drug Alcohol Depend* 1983; 12:315–322

27. Keskimäki J, Aro S: Accuracy of data on diagnoses, procedures and accidents in the Finnish Hospital Discharge Register. *Int J Health Sciences* 1991; 2:15-21
28. Mähönen M: Poistoilmoitusrekisteri sepelvaltimotaudin epidemiologisen tutkimuksen tietolähteenä [The Reliability of Hospital Discharge Data as a Tool for Epidemiologic Research on Ischemic Heart Disease]. Helsinki, Stakesin tutkimuksia 28, 1993
29. McGuffin P, Farmer A, Harvey I: A polydiagnostic application of operational criteria in studies of psychotic illness. *Arch Gen Psychiatry* 1991; 48:764-770
30. Tienari P, Wynne LC, Moring J, Wahlberg K-E, Sorri A, Naarala M, Lahti I: Genetic vulnerability or family environment? implications from the Finnish Adoptive Study of Schizophrenia. *Psychiatr Fenn* 1993; 24:23-41
31. Isohanni M, Mäkikyrö T, Moring J, Räsänen P, Hakko H, Partanen U, Koiranen M, Jones P: A comparison of clinical and research DSM-III-R diagnoses of schizophrenia in a Finnish national birth cohort: clinical and research diagnoses of schizophrenia. *Soc Psychiatry Psychiatr Epidemiol* (in press)
32. Rantakallio P, Myhrman A, Koiranen M: Juvenile offenders, with special reference to sex differences. *Social Psychiatry and Psychiatr Epidemiology* 1995; 30:113-120
33. Räsänen P, Tiihonen J, Isohanni M, Rantakallio P, Lehtonen J: Schizophrenia, alcohol abuse and violent behavior. *Schizophr Bull* (in press)
34. Lehtinen V, Väisänen E: Epidemiology of psychiatric disorders in Finland: a five-year follow-up. *Soc Psychiatry* 1981; 16:171-180
35. Lehtinen V, Joukamaa M: Mental disorders in a sample representative of the whole Finnish adult population, in *Psychiatric Epidemiology: Progress and Prospects*. Edited by Cooper B. London, Croom Helm, 1987, pp 43-54
36. Häfner H, Maurer K, Löffler W, Riechel-Rüssler A: Schizophrenia and Lebensalter. *Nervenartz* 1991; 62:536-548
37. *Statistical Yearbook of Finland 1994*. Helsinki, Statistics Centre of Finland, 1994