Obstetric Complications, Parenting, and Risk of Criminal Behavior

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Background: The results of studies that have examined the relationship between prenatal and perinatal complications and adult criminality and violence are contradictory. Supporting evidence for this relationship comes from studies of samples drawn from a single cohort. The present study was designed to examine the associations between prenatal and perinatal complications and criminality, defining more precisely than past investigations subject characteristics and the types of offenses.

Methods: The cohort includes the 15117 persons born in Stockholm, Sweden, in 1953 and followed up to age 30 years. Information was extracted from obstetric files, health, social, work, and criminal records. Obstetric complications were defined as deviations from normal development occurring at any point from conception through the neonatal period. Inadequate parenting was indexed by social intervention.

Results: Inadequate parenting was experienced by 19.1% of the men and 18.1% of the women, and was shown to increase the risk of offending (men, 1.39 times [95% confidence interval (CI), 1.28-1.50]; women, 2.09 [95% CI, 1.70-2.56]) and of violent offending (men, 2.02 times [95% CI, 1.67-2.44]; women, 2.09 [95% CI, 1.70-2.56]). Obstetric complications in the absence of family problems did not increase the risk of offending. A combination of pregnancy complications and inadequate parenting affected 3.1% of the men and 4.0% of the women, and increased the risk of offending (1.64 times [95% CI, 1.43-1.89]; 1.79 times [95% CI, 1.16-2.75], respectively) and violent offending (2.86 times [95% CI, 2.09-3.91]; 1.81 times [95% CI, 0.57-5.79]).

Conclusions: A combination of pregnancy complications and inadequate parenting increased the risk of violent and nonviolent offending only slightly more than inadequate parenting alone. However, inadequate parenting was experienced by 5 times more cohort members than was the combination of inadequate parenting and pregnancy complications.

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SUBJECTS AND METHODS

SUBJECTS

The cohort is composed of all 13,117 persons born in Stockholm in 1933 and residing there in 1963. Of them, 94% were still alive and living in Sweden at age 30 years. Excluded from the present analyses are those individuals who were institutionalized before beginning school, those who were mentally retarded, and those who were admitted to a psychiatric ward with disorders other than substance use disorders. This article is based on data from 7,101 men and 6,751 women.

Subjects with at least 1 conviction for a criminal offense by age 30 years were classified as offenders; those with at least 1 violent offense, as violent offenders; and those who were convicted for an offense both before and after the age of 18 years and who committed at least 1 crime during each of 3 or more age periods (before age 15 years, 15-17 years, 18-20 years, and 21-30 years) were defined as persistent early starters.

MEASURES

Criminal convictions were documented from the records of the Swedish National Police in 1983. Violent offenses were defined as crimes involving the use or threat of physical violence (i.e., assault, rape, robbery, unlawful threat, and molestation).

Information on any abnormality of the mother or the fetus was extracted from the files of midwives, obstetricians, and hospitals during the early 1970s. This information was coded using the McNeil-Sjöström Scale for Obstetric Complications by one of us (T.F.M.). The severity of each complication is rated on a 6-point scale reflecting the ordinal degrees of inferred potential harm to the baby: severity level 1 indicates not harmful or relevant (e.g., maternal heartburn, maternal fatigue); severity level 2, not likely harmful or relevant (e.g., maternal nose bleed, maternal headache, maternal ischias [pain due to compression of the spinal cord and specifically of the ischiadic nerve]); severity level 3, potentially but not clearly harmful or relevant (e.g., maternal lebrile cystitis, maternal sinus infection, induction of labor); severity level 4, potentially clearly harmful or relevant (e.g., mild preeclampsia, breech delivery); severity level 5, potentially clearly greatly harmful or relevant (e.g., severe preeclampsia, fetal asphyxia); and severity level 6, very great harm to or deviation in offspring (e.g., eclampsia, severe neonatal distress, offspring hypoxic-ischemic cerebral injury). The scale is a reliable and valid research instrument for measuring somatic complications and conditions occurring during pregnancy (PC), labor-delivery (LDC), and the neonatal period (NCC).

For each period and for each subject, 2 scores were calculated: (1) the number of different OCs above a severity level of 3; and (2) the sum of the severity scores for OCs with a severity score above 3. The McNeil-Sjöström Scale has been used with considerable empirical success in identifying the complications associated with schizophrenia, and it is more sensitive to OCs than other scales.

Socioeconomic status (SES) of a subject’s family of origin was indexed using Swedish norms. Parents’ occupations at the time of the subject’s birth were used to assign individuals a score ranging from 5 (unskilled workers) to 1 (upper or upper-middle socioeconomic status). Inadequate parenting was documented from the reports of the Child Welfare Committee, which at that time in Sweden had a broad mandate to ensure children’s well-being. Each subject’s file was initially divided into 3 sections: from birth to 6 years, from age 7 to 12 years, and from age 13 to 18 years. Scores were then assigned for each of the 3 age periods. Decisions made by the Child Welfare Committee to

RESULTS

MEN

The mean number and mean severity ratings of PCs, LDCs, and NNCs did not differ for offenders compared with nonoffenders, or for violent offenders compared with
intervene because of inadequate or inappropriate parent- ing were assigned a score of 1 if the subject was left with his or her parents and a score of 2 if the subject was re- moved from the family home. These scores were added to those assigned to placements. If the subject was placed in a foster home, a score between 1 and 6 was assigned de- pending on the length of the placement. If the subject was placed in an institution, a score between 2 and 12 was as- signed depending on the length of the placement.35

ANALYSES

All analyses were conducted separately for men and women. Differences in OCs, SES, and parenting were compared be- tween: (1) offenders and nonoffenders, (2) violent off-enders and nonoffenders, and (3) early starters and nonof- fenders. Descriptive statistics are presented in Table 1 and

**Table 2.**

In the first step of the analyses, t tests were used to compare the mean number of PCs, LDCs, and NNCs; the mean severity level of OCs at each reproductive period; and the mean scores for SES and parenting. These analyses measure group differences on each of the mentioned variables and presume that the groups of subjects are relatively homogeneous with respect to the variable being measured. In order to verify the extent to which group differences applied to all subjects within a group, $\chi^2$ tests were conducted to compare the prevalence of each measure within each group of subjects. An $\alpha$ value of $P<.01$ was used to adjust for the large number of tests that were conducted. Because the number of crimes committed by subjects varied widely, nonparametric statistics were used to compare mean numbers of nonviolent and violent crimes.

In the second step of the analyses, logistic regressions were conducted to examine interactions between OCs and psychosocial adversity. Separate logistic regressions were carried out for 3 different dependent variables: (1) criminal/ noncriminal, (2) violent criminal/noncriminal, and (3) early starter criminal/noncriminal. The predictor variables entered into the logistic regressions were the following: OCs (PCs, LDCs, or NNCs); SES; parenting; OCs (PCs, LDCs, or NNCs) $\times$ SES; and OCs (PCs, LDCs, or NNCs) $\times$ parenting. Thus, separate logistic regressions were conducted for OCs that occurred during 3 different periods of develop-ment.

One possible outcome of having entered 2 interactions simultaneously into models is that if the 2 interactions were strongly correlated, then the effect of one interaction may have cancelled the effect of the other in the model. Thus, we conducted a second set of logistic regressions in which a single interaction (eg, PCs $\times$ family problems), along with OCs, SES, and family problems, were en- tered into the model. This second set of analyses was conducted only with interactions that had a significant prob- ability of less than .05 in the first set of analyses. We adopted these liberal criteria in conducting this second set of analyses because there were so few significant interactions in the first set. It is important to note that the 2 significant inter- actions in the first set of the analyses were still significant in the second set, and that no additional interactions were significant in the second set.

Thus, in the logistic regressions, the dependent variable was dichotomized (noncriminal/criminal, noncriminal/violent criminal, noncriminal/early-start criminal), and for many of the analyses, the independent variables were dichotomized (PCs: 0 vs 1 or more; LDCs: 0 vs 1 or more; NNCs: 0 vs 1 or more; SES: high status 1-3 vs low status 4 and 5; inadequate parenting: no intervention vs intervention). It has recently been shown that dichotomi- zation of variables facilitated the study of risk factors for delinquency, encouraged a focus on individuals, and most importantly, showed no signs of producing misleading conclusions.36

nonoffenders. Severity ratings are presented as means $\pm$ Sds. Early starters, compared with nonoffenders, had fewer LDCs (early starters: 0.62 $\pm$ 0.73; nonoffenders: 0.73 $\pm$ 0.79; $t_{438.27} = -2.57$, $P<.01$) and also had a lower mean severity rating for LDCs (early starters: 2.27 $\pm$ 2.70; nonoffenders: 2.70 $\pm$ 3.03; $t_{462.67} = -2.83$, $P<.005$). There were no differ-ences between any of the groups in the proportions of subjects who had experienced PCs, LDCs, and NNCs.

Compared with nonoffenders (SES: 2.94 $\pm$ 1.39; parenting: $-0.32 \pm 0.47$), men who committed an offense had been raised in families of lower SES (offenders: 3.35 $\pm$ 1.34, 683.22, $P<.001$; violent offenders: 3.58 $\pm$ 1.30, t1093 = 9.85, $P<.001$; early starters: 3.67 $\pm$ 1.22, $t_{512.22} = 1.66$, $P<.001$) and had experienced more se- verely inadequate parenting (offenders: 0.06 $\pm$ 0.35, $t_{5387.55} = 6.69$, $P<.001$; violent offenders: 0.14 $\pm$ 0.70, $t_{496.96} = 7.35$, $P<.001$; early starters: 0.15 $\pm$ 0.68, $t_{465.89} = 5.27$, $P<.001$).

Compared with nonoffenders (43.2%), a larger pro- portion of offenders (56.5%; $\chi^2_{1,5281} = 81.86$, $P<.001$), and early starters (32.4%; $\chi^2_{1,5307} = 76.04$, $P<.001$) experienced inadequate parent- ing (Table 1).

Logistic regressions indicated that the interaction be- tween PCs and parenting was significant in predicting criminality (Wald $\chi^2 = 5.73$, $P<.02$) and violent crimi- nality (Wald $\chi^2 = 5.34$, $P<.02$). Table 3 presents the results of comparisons of men who had experienced only inadequate parenting (19.1%), men who had experienced only PCs (18.7%), men who had experienced both inadequate parenting and PCs (3.1%), and men who had experienced neither inadequate parenting nor PCs (59.1%). As can be observed, inadequate parenting in- creased the risk of both offending in general and violent offending, though slightly less than did the combination of inadequate parenting and PCs.

There were significant differences in the mean number of crimes (Kruskal-Wallis $df = 3.1,26.08$, $P<.001$) and mean number of violent crimes (Kruskal-Wallis $df = 3.65,34$, $P<.001$) of the 4 aforementioned groups. Because these 1-way nonparametric analyses of variance (comparing men who experienced both PCs and inadequate parenting, only PCs, only inadequate parenting, and neither for both total number of crimes and total number of violent crimes) were statistically significant,
Mann-Whitney U tests were used to compare group means. The number of PCs are reported as means ± SDs. The men who had experienced both PCs and inadequate parenting committed, on average, more crimes (8.22±27.27) and more violent crimes (0.47±1.70) than the men with no PCs and adequate parenting (crimes: 2.70±14.10, P < .001; violent crimes: 0.18±1.18, P < .001), and than those who had experienced only PCs (crimes: 2.26±8.97, P < .001; violent crimes: 0.14±0.80, P < .001).

Those who had experienced both PCs and inadequate parenting had committed, on average, more crimes (5.73±20.03, P = .01) and similar numbers of violent crimes (violent crimes: 0.33±1.43, P was not significant).

The types of complications experienced by the men with PCs and inadequate parenting were examined. The most frequent complications were preeclampsia-related conditions, affecting 82% of the men with PCs and inadequate parenting. The prevalence rates of the 6 most frequent complications (toxemia plus other complications, toxemia alone, anesthesia, Rhesus immunization, twin, other) were compared for the offenders and the non-offenders. No differences were found.

### Table 1. Percentages of Male Nonoffenders, Offenders, Violent Offenders, and Early-Start Offenders With Each Characteristic*

<table>
<thead>
<tr>
<th></th>
<th>Nonoffenders (n = 4756)</th>
<th>Offenders (n = 2345)</th>
<th>Violent Offenders (n = 525)</th>
<th>Early-Start Offenders (n = 441)</th>
<th>All Subjects, No.†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCs</td>
<td>889 (18.7)</td>
<td>438 (18.7)</td>
<td>98 (18.7)</td>
<td>84 (19.0)</td>
<td>1868</td>
</tr>
<tr>
<td>LDCs</td>
<td>2117 (55.4)</td>
<td>999 (53.0)</td>
<td>223 (54.0)</td>
<td>177 (48.7)</td>
<td>1868</td>
</tr>
<tr>
<td>NNCs</td>
<td>704 (18.4)</td>
<td>378 (20.1)</td>
<td>89 (21.5)</td>
<td>83 (23.3)</td>
<td>1885</td>
</tr>
<tr>
<td>Psychosocial adversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor parenting</td>
<td>760 (16.0)</td>
<td>593 (25.3)</td>
<td>167 (31.8)</td>
<td>143 (32.4)</td>
<td>1885</td>
</tr>
<tr>
<td>Low SES</td>
<td>1991 (43.2)</td>
<td>1268 (56.5)</td>
<td>316 (63.6)</td>
<td>285 (68.0)</td>
<td>1885</td>
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<td>Obstetrical complications and psychosocial adversity</td>
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<td></td>
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</tr>
<tr>
<td>PCs + poor parenting</td>
<td>108 (2.3)</td>
<td>110 (4.7)</td>
<td>34 (6.5)</td>
<td>25 (5.7)</td>
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<td>PCs + low SES</td>
<td>419 (8.8)</td>
<td>250 (10.7)</td>
<td>56 (10.7)</td>
<td>56 (12.7)</td>
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<tr>
<td>LDCs + poor parenting</td>
<td>245 (5.5)</td>
<td>208 (9.6)</td>
<td>60 (12.5)</td>
<td>44 (10.9)</td>
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<tr>
<td>LDCs + low SES</td>
<td>930 (21.6)</td>
<td>552 (27.0)</td>
<td>138 (31.2)</td>
<td>110 (29.6)</td>
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<tr>
<td>NNCs + poor parenting</td>
<td>93 (2.1)</td>
<td>102 (4.7)</td>
<td>32 (6.7)</td>
<td>26 (6.5)</td>
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<tr>
<td>NNCs + low SES</td>
<td>340 (7.9)</td>
<td>218 (10.6)</td>
<td>56 (12.6)</td>
<td>60 (16.1)</td>
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</tr>
</tbody>
</table>

*Violent and early-start offenders are subgroups among the offenders. Data are presented as numbers (percentages). Percentages are calculated using the number of subjects with complete data for that item. PCs indicates complications occurring during pregnancy; LDCs, labor-delivery complications; NNCs, neonatal complications; SES, socioeconomic status; and ellipses, not applicable.

†Reflects the total number of subjects, including those with missing data.

### Table 2. Percentages of Female Nonoffenders, Offenders, Violent Offenders, and Early-Start Offenders With Each Characteristic*

<table>
<thead>
<tr>
<th></th>
<th>Nonoffenders (n = 6297)</th>
<th>Offenders (n = 454)</th>
<th>Violent Offenders (n = 65)</th>
<th>Early-Start Offenders (n = 30)</th>
<th>All Subjects, No.†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetrical complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCs</td>
<td>1070 (17.0)</td>
<td>67 (14.8)</td>
<td>9 (13.8)</td>
<td>7 (23.3)</td>
<td>1868</td>
</tr>
<tr>
<td>LDCs</td>
<td>2650 (52.2)</td>
<td>169 (46.8)</td>
<td>29 (35.7)</td>
<td>12 (46.2)</td>
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<tr>
<td>NNCs</td>
<td>911 (18.0)</td>
<td>43 (11.9)</td>
<td>7 (13.0)</td>
<td>3 (11.5)</td>
<td></td>
</tr>
<tr>
<td>Psychosocial adversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor parenting</td>
<td>1066 (16.9)</td>
<td>142 (31.3)</td>
<td>18 (27.7)</td>
<td>15 (50.0)</td>
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</tr>
<tr>
<td>Low SES</td>
<td>2864 (46.9)</td>
<td>256 (59.0)</td>
<td>30 (61.3)</td>
<td>19 (67.9)</td>
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<tr>
<td>Obstetrical complications and psychosocial adversity</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCs + poor parenting</td>
<td>174 (2.8)</td>
<td>20 (4.4)</td>
<td>3 (4.6)</td>
<td>3 (10.0)</td>
<td></td>
</tr>
<tr>
<td>PCs + low SES</td>
<td>525 (8.3)</td>
<td>44 (9.7)</td>
<td>6 (9.2)</td>
<td>4 (13.3)</td>
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<tr>
<td>LDCs + poor parenting</td>
<td>366 (6.2)</td>
<td>47 (11.5)</td>
<td>6 (9.7)</td>
<td>6 (21.4)</td>
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</tr>
<tr>
<td>LDCs + low SES</td>
<td>1266 (22.4)</td>
<td>94 (24.3)</td>
<td>15 (27.8)</td>
<td>8 (29.6)</td>
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<tr>
<td>NNCs + poor parenting</td>
<td>140 (2.4)</td>
<td>14 (3.4)</td>
<td>2 (3.2)</td>
<td>2 (7.1)</td>
<td></td>
</tr>
<tr>
<td>NNCs + low SES</td>
<td>457 (8.1)</td>
<td>28 (7.2)</td>
<td>4 (7.3)</td>
<td>3 (11.1)</td>
<td></td>
</tr>
</tbody>
</table>

*Violent and early-start offenders are subgroups among the offenders. Data are presented as numbers (percentages). Percentages are calculated using the number of subjects with complete data for that item. PCs indicates complications occurring during pregnancy; LDCs, labor-delivery complications; NNCs, neonatal complications; SES, socioeconomic status; and ellipses, not applicable.

†Reflects the total number of subjects, including those with missing data.
Neither inadequate parenting, PCs, nor both factors predicted early-start criminality as tested in a logistic regression analysis.

**WOMEN**

The mean numbers and mean severity ratings of PCs, LDCs, and NNCs did not differ for offenders compared with nonoffenders, violent offenders compared with nonoffenders, and early-start offenders compared with nonoffenders. There was only 1 significant difference between any of the groups in comparisons of the proportions of the different subject groups with OCs. More of the nonoffenders (18.0%) than the offenders had neonatal complications ($\chi^2_{1,4335} = 8.50, P < .004$).

Compared with nonoffenders (SES: 3.04 ± 1.38), all groups of female offenders had been raised in families of lower SES (offenders: 3.41 ± 1.36, $t_{6398} = 5.39, P < .001$; violent offenders: 3.63 ± 1.33, $t_{6398} = 3.32, P < .001$; early-start offenders: 3.82 ± 1.28, $t_{6312} = 2.97, P < .003$). Additionally, offenders (0.17 ± 0.99), compared with nonoffenders (−0.03 ± 0.37), had experienced inadequate parenting ($t_{425.33} = 4.22, P < .001$).

Compared with nonoffenders (46.9%), a larger proportion of offenders (59.0%; $\chi^2_{1,6751} = 6.46, P < .01$) and early-start offenders (67.9%; $\chi^2_{1,6327} = 23.05, P < .001$) had been raised in families of low SES. Additionally, compared with the nonoffenders (16.9%), a larger proportion of offenders (31.3%; $\chi^2_{1,6751} = 59.34, P < .001$) and early-start offenders (50.0%; $\chi^2_{1,6327} = 23.05, P < .001$) had experienced inadequate parenting.

The logistic regressions indicated no significant interactions between PCs, LDCs, NNCs, and SES, or inadequate parenting in association with offending, violent offending, and early-start offending. This may be because of the small number of female offenders and the even smaller numbers in the various comparisons. Table 3 presents general comparisons of the risks of offending and of violent offending among the women who had experienced only inadequate parenting (18.1%), among those who had experienced only PCs (17.0%), and among those who had experienced both inadequate parenting and PCs (4.0%), compared with those who had experienced neither inadequate parenting nor PCs (60.9%). As is true for the men, inadequate parenting increased the risk of offending and of violent offending only slightly less than did the combination of inadequate parenting and PCs. Among the women in the early-start group, only 37% had not experienced either PCs or inadequate parenting, 10% of them also experienced PCs, and another 13% had experienced PCs but not inadequate parenting.

Among both men and women, no relationship was identified between PCs, LDCs, and NNCs occurring in the absence of inadequate parenting and violent and nonviolent offending. Early-start offenders were characterized by fewer and less severe LDCs than nonoffenders. The associations between both low SES and inadequate parenting and offending, violent offending, and early-start offending were found, as in many previous investigations, to be powerful.\textsuperscript{13,14}

Pregnancy complications combined with inadequate parenting in the early years of life slightly increased the risk of offending, and it more than doubled the risk of violent offending. The combination of PCs and inadequate parenting affected only 3% of the men and 4% of the women, and it increased the risk of crime and of violent crime only slightly more than did inadequate parenting alone. This is important because inadequate parenting was much more common, affecting another 16% of the men and 18% of the women (who did not experience PCs). To illustrate the significance of this finding for preventing crime, consider the following numbers: of all the men born in Stockholm in 1953, 1135 experienced inadequate parenting and did not experience PCs. Of these 1135 men, 483 (42.6%) were convicted of an offense. By contrast, 218 of the male cohort members experienced both inadequate parenting and PCs, and 110 (50.5%) of them were convicted of criminal offenses. In other words, 4 times ($n = 483$) more male offenders experienced inadequate parenting than inadequate parenting combined with PCs ($n = 110$). However, while few men had experienced both PCs and inadequate parenting, of those who did, half became offenders and 16% became violent offenders who committed many offenses.

The finding that inadequate parenting in combination with OCs increased the risk of offending concurs generally with studies of samples from the Danish Perinatal Project. However, results differ in 3 important ways. In the present study, (1) the complications associated with offending occurred during the pregnancy and not at birth or in the neonatal period; (2) complications were associated with offending in general and not only with violent offending; and (3) the association between OCs and inadequate parenting and offending was not observed for early-start offenders. One possible explanation for these differences in the findings is the exclusion of the men-

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**Table 3. Odds Ratios for Offending and for Violent Offending\textsuperscript{*}**

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Offending</td>
<td>Violent Offending</td>
</tr>
<tr>
<td>Inadequate parenting</td>
<td>1.39 (1.28-1.50) [4857]</td>
<td>2.02 (1.67-2.44) [4294]</td>
</tr>
<tr>
<td>Pregnancy complications</td>
<td>0.96 (0.87-1.06) [5748]</td>
<td>0.90 (0.70-1.17) [4354]</td>
</tr>
<tr>
<td>Inadequate parenting and pregnancy complications</td>
<td>1.64 (1.43-1.89) [5774]</td>
<td>2.96 (2.09-3.91) [3651]</td>
</tr>
</tbody>
</table>

\textsuperscript{*}Data are presented as odds ratios (95% confidence intervals) [No. of subjects].

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tally retarded and mentally ill from the sample examined in the present investigation. Such persons are at increased risk for offending, at an even higher risk for violent offending and homicide than the general population, and are susceptible for OCs, particularly at birth and during the neonatal period. If samples inadvertently included disproportionate numbers of mentally retarded and/or mentally ill subjects, an association between a combination of OCs and family adversity and offending that applies only to them may have been interpreted as characteristic of male offenders in general. This would be especially true in a country like Denmark, where the violent crime rate is relatively low, and the proportions of mentally retarded and mentally ill subjects among the offenders are relatively high. This speculation is supported by the finding that most of the offenders in the present cohort who developed major mental disorders had experienced complications during the neonatal period.

A disproportionately high number of men who became persistent offenders and who had begun to offend at a young age had experienced fewer LDCs than average. Three possible explanations for this finding warrant further study. First, based on twin and adoption studies, it would be expected that some elevated proportion of the mothers of early-start offenders would themselves present a history of antisocial behavior, which is associated with low anxiety, fear, and arousal. These maternal characteristics could be associated with a reduction of LDCs. A second possible explanation relates to recent findings on body size. In the present investigation and in the longitudinal investigation of a New Zealand cohort, it has been found that this type of early-start male offender is heavier than average at birth. Finally, body size at age 3 years has been found to be associated with aggressive behavior at age 11 years, body mass index at various ages has been found to be associated with aggressive behavior, and weight during the first 12 months of life has been associated with violent offending in adulthood.

The present investigation is characterized by a number of strengths that increase confidence in the validity and generalizability of the results. This was a large, unselected birth cohort born and raised in a society that provided good health care and social services to all of its citizens. Information from the obstetric records was extracted by persons blind to the objectives of the present study, and they were coded using a standardized and validated rating scale. Information on criminality was complete. Subjects were followed up from pregnancy to age 30 years with almost no attrition. Finally, the specificity of risk factors for criminal behavior of men and women without mental retardation or mental illness were examined.

Like all investigations, however, ours has weaknesses. Four are of importance for interpreting the results: (1) Even though an α level of .01 was used to limit type I error due to multiple comparisons, this procedure would not protect against all such errors. Consequently, the findings should be interpreted cautiously until they are replicated. (2) No information was available on the behaviors of the mothers during the pregnancy, such as smoking, which has been found to increase the risk of violent criminality in the offspring. (3) Official criminal records were used to index behavior. Again, this would lessen the strength of all associations except those related to serious violence, such as murder, that would almost always lead to criminal charges. (4) The follow-up period was not long enough to allow exclusion of all persons who would develop major mental disorders.

The results of the present investigation suggest that future studies on factors related to the development of offending will more surely advance knowledge if they focus on homogeneous groups of offenders and take account of both information recorded in obstetric files in addition to mothers' reports of behaviors during each reproductive period that may harm their children.

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