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 15,117 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 15,117 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 7101 men and 6751 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 (ie, 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 (eg, maternal heartburn, maternal fatigue); severity level 2, not likely harmful or relevant (eg, 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 (eg, maternal lebrite cystitis, maternal sinus infection, induction of labor); severity level 4, potentially clearly harmful or relevant (eg, mild preeclampsia, breech delivery); severity level 5, potentially clearly greatly harmful or relevant (eg, severe preeclampsia, fetal asphyxia); and severity level 6, very great harm to or deviation in offspring (eg, 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 (NNC). 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 exclude persons with mental retardation and with major mental disorders, who are at higher risk for both offending and for brain insults during the early stages of life. None of the studies have excluded persons with mental retardation and with major mental disorders, who are at higher risk for both offending and OCs than those in the general population. Finally, the available findings may be contradictory because persistent offenders, those who have had conduct problems since childhood and who commit most of the crimes, have not been distinguished from other types of offenders. Much evidence has accumulated from investigations conducted in several different countries, confirming similar prevalence rates and characteristics specific to this type of offender. Etiological factors, which act early in life, are suspected to play a role. Hereditary factors have been identified, and the results of 2 investigations support the hypothesis of an involvement of OCs. An adoption study indicates that prenatal exposure to alcohol interacts with a hereditary vulnerability, contributing to the development of conduct problems and aggressive behavior, and sons of mothers who were malnourished during the first and second trimesters of pregnancy have been found to have an increased risk of antisocial personality disorder.

Given the paucity and lack of precision of the available information on the role of OCs in the development of offending and its potential importance in developing prevention programs, the present study was undertaken. We examined a birth cohort followed up from early pregnancy to age 30 years. Our goal was to examine the associations between OCs and violent and nonviolent criminality, to examine the type and timing of the associated OCs rated using a standardized and validated scale, and to more narrowly define psychosocial adversity as low socioeconomic status and inadequate parenting. Further, to achieve our goal, we reduced the heterogeneity of the sample by excluding subgroups of persons known to be at high risk both for offending and for OCs and conducted analyses separately for groups at differential risks for offending behavior and for OCs (ie, men, women, and early-start persistent offenders).

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
nonoffenders. Severity ratings are presented as means ± SDs. Early starters, compared with nonoffenders, had fewer LDCs (early starters: 0.62±0.73; nonoffenders: 0.73±0.79; \( t_{38.27} = -2.57, P < .01 \)) and also had a lower mean severity rating for LDCs (early starters: 2.27±2.70; nonoffenders: 2.70±3.03; \( t_{42.42} = -2.83, P < .005 \)). There were no differences between any of the groups in the proportions of subjects who had experienced PCs, LDCs, and NNCs.

Compared with nonoffenders (SES: 2.94±1.39; parenting: -0.32±0.47), men who committed an offense had been raised in families of lower SES (offenders: 3.35±1.34, \( t_{68.51} = 11.66, P < .001 \); violent offenders: 3.58±1.34, \( t_{50.95} = 9.85, P < .001 \); early starters: 3.67±1.22, \( t_{52.22} = 11.62, P < .001 \)) and had experienced more severely inadequate parenting (offenders: 0.06±0.35, \( t_{38.27} = 6.69, P < .001 \); violent offenders: 0.14±0.70, \( t_{40.26} = 7.35, P < .001 \); early starters: 0.15±0.68, \( t_{46.59} = 5.27, P < .001 \)).

Compared with nonoffenders (43.2%), a larger proportion of offenders (56.5%; \( \chi^2_{1,685} = 106.27, P < .001 \)), violent offenders (63.6%; \( \chi^2_{1,503} = 75.18, P < .001 \)), and early starters (68.0%; \( \chi^2_{1,528} = 95.43, P < .001 \)) had been raised in families of low SES. Additionally, compared with the nonoffenders (16%), a larger proportion offenders (25.3%; \( \chi^2_{1,710} = 88.23, P < .001 \)), violent offenders (31.8%; \( \chi^2_{1,328} = 81.86, P < .001 \)), and early starters (32.4%; \( \chi^2_{1,509} = 76.04, P < .001 \)) experienced inadequate parenting (Table 1).

Logistic regressions indicated that the interaction between PCs and parenting was significant in predicting criminality (Wald \( \chi^2 = 5.73, P < .02 \)) and violent criminality (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 increased 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 = 3,126.08, 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 than those who had experienced only inadequate parenting (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 nonoffenders. 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 = 4766)</th>
<th>Offenders (n = 2245)</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></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>3824 (866)</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>3823 (868)</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>1408 (282)</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>4608 (926)</td>
</tr>
</tbody>
</table>

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></td>
</tr>
<tr>
<td>LDCs</td>
<td>2650 (52.2)</td>
<td>169 (46.8)</td>
<td>29 (53.7)</td>
<td>12 (46.2)</td>
<td>5076 (254)</td>
</tr>
<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>5074 (254)</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>
<td>6106 (305)</td>
</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>
<td>6106 (305)</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 ($\chi^2_{1,1835}=8.50, P<.004$).

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, $t_{538}=5.39, P<.001$; violent offenders: 3.63±1.33, $t_{606}=3.32, P<.001$; early-start offenders: 3.82±1.28, $t_{612}=2.97, P<.003$). Additionally, offenders (0.17±0.99), compared with nonoffenders (−0.03±0.37), had experienced inadequate parenting ($t_{425.3}=4.22, P<.001$).

Compared with nonoffenders (46.9%), a larger proportion of offenders (59.0%; $\chi^2_{1,6731}=6.46, P<.01$) 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%; $\chi^2_{1,6731}=59.34, P<.001$) 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, 50% had experienced inadequate parenting, 10% of them also experienced PCs, and another 13% had experienced PCs but not inadequate parenting.

**COMMENT**

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.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**

<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>2.86 (2.09-3.91) [3651]</td>
</tr>
</tbody>
</table>

*Data are presented as odds ratios (95% confidence intervals) [No. of subjects].
tally retarded and mentally ill from the sample examined in the present investigation. Such persons are at increased risk for offending.\textsuperscript{15} at an even higher risk for violent offending\textsuperscript{5,16} than the general population, and are susceptible to OCs, particularly at birth and during the neonatal period.\textsuperscript{35} 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.\textsuperscript{30}

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,\textsuperscript{27-30} 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.\textsuperscript{23} Finally, body size at age 3 years has been found to be associated with aggressive behavior at age 11 years.\textsuperscript{41} Body mass index at various ages has been found to be associated with aggressive behavior,\textsuperscript{42} and weight during the first 12 months of life has been associated with violent offending in adulthood.\textsuperscript{43} Boys who are larger than their peers during early childhood may learn to be aggressive as a result of persistent provocation,\textsuperscript{42} or alternately, the various measures of body size used in these different investigations may be tapping a metabolic syndrome which is related to brain functioning and to impulsivity or reduced behavioral disinhibition.

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.\textsuperscript{24} 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.\textsuperscript{45,46} (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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\section*{REFERENCES}


