

Prenatal and Perinatal Complications as Predispositions to Externalizing Behavior

Author: Liu, Jianghong

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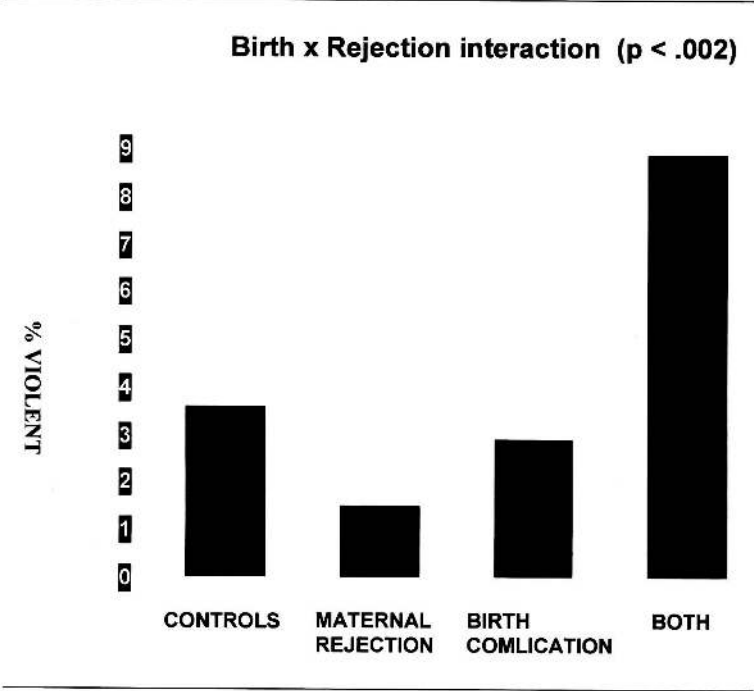
Abstract: None available.

Full Text: Headnote ABSTRACT: There is an increasing body of evidence indicating that prenatal and perinatal factors predispose to externalizing behavior in the offspring. This paper first reviews recent empirical research on prenatal and perinatal complications and externalizing behavior. Brain dysfunction mechanisms are then discussed. It is suggested that (a) birth complications can cause brain damage and (b) brain damage can predispose to antisocial and violent behavior. Finally, the paper argues that prevention strategies using a multidisciplinary approach may help reduce prenatal and perinatal complications. In consequence, such strategies may also help reduce the likelihood of later externalizing behavior problems. KEY WORDS: prenatal and perinatal complications, birth complications, brain damage, externalizing behavior, antisocial behavior, violence, prevention. INTRODUCTION Studies on biological risk factors for antisocial behavior have increasingly received attention (Brennan, Grekin, & Mednick, 1999; Caspi, McClay, Moffitt, Mill, Martin, et al., 2002; Raine, 2002a). In spite of this growing knowledge base, there have been relatively fewer studies of the impact of early health risk factors on the offspring's behavior problems. For example, there has been relatively little research (compared to psychosocial research) on prenatal risk factors for childhood externalizing behavior (Raine, 2002b). Early health risk factors which are assumed to increase the risk of childhood externalizing behavior, as well as adult antisocial and violent behavior, include exposure to alcohol, tobacco, toxicity, and drugs during pregnancy, head injury during early childhood, teenage pregnancy, birth complications, and malnutrition both of the pregnant mother and of the child during early life (Brennan, Grekin, Mortensen, & Mednick, 2002; Liu, Raine, Venables, Dalais, & Mednick, 2004; Moffitt, 2002; Rasanen, Hakko, Isohanni, Hodgins, et al., 1999; Rutter, Giller, & Hagell, 1998; Raine, 2002a). However, the following literature review will not cover all these factors, but will instead focus on prenatal and perinatal factors. WHAT IS THE PROBLEM? THE EMPIRICAL STUDIES One possible contribution to the offsprings' behavior problems is preand perinatal complications. Technically, prenatal complications refer to the mother or the fetus experiencing complications during the months of pregnancy, while perinatal complications are considered to be those that occur during birth itself. However, in some cases the term birth complications refers to both prenatal and perinatal complications. For the purpose of this paper, the term birth complications will include pre- and perinatal complications. In the research literature, externalizing disorders consist of disruptive, hyperactive, and aggressive behaviors . Liu (in press) also argues that externalizing behavior often includes three key behavior problems: (a) aggression, (b) delinquency, and (c) hyperactivity. Other terms used to describe externalizing behavior problems include "conduct problems," "antisocial," and "under-controlled" . Birth complications and the offspring's mental health outcome have been well studied, particularly with respect to schizophrenia (Cannon, van Erp, Rosso, Huttunen, et al., 2002; Dalman, Allebeck, Cullberg, Grunewald, & Koster, 1999; Kunugi, Nanko, & Murray, 2001; Mednick, Huttunen, & Machon, 1994). For example, several epidemiological studies have suggested that maternal exposure to influenza during the second trimester of pregnancy is a risk factor for schizophrenia (Mednick, Machon, Huttunen, & Bonett, 1988; Takei, & Murray, 1994; Wright, Takei, Rifkin, & Murray, 1995). It has been suggested that viral infections, more prevalent in the winter months, might increase pregnancy and birth complications, which might in turn be responsible for the excess of winter-born individuals with schizophrenia (Machon, Mednick, & Schulsinger, 1987). It is postulated that maternal influenza during the second trimester may impair fetal growth and predispose to obstetric complications and lower birth weight in those individuals destined to break down for schizophrenia (Wright, et al., 1995). In contrast to research on schizophrenia, the

link between birth complications and antisocial, aggressive behavior has been less well established. Several decades ago, Pasamanick, et al. (1956) were the first to recognize a link between birth complications and behavior disorders in children. Raine, Brennan, & Mednick (1994) found that those who experienced both birth complications and early rejection from the mother (mother not wanting pregnancy, attempt to abort fetus, early institutionalization), were more likely to develop violent behavior in adulthood. These findings were replicated by Piquero & Tibbetts (1999). Similarly, Gibson & Tibbetts (1998) in a study of 832 inner-city, African-American youths found that the combined effect of maternal cigarette smoking and low Apgar scores had a significant influence in predicting offending behavior, whereas the independent effects of the component variables did not. Furthermore, Botting et al. (1997) compared 137 12-year-olds who experience low birth weight to a control group. It was found that 25% of the children in the very low birth weight group had psychiatric disorders (including behavior disorders), compared to only 9% of the control children. A recent longitudinal study conducted by Arseneault et al. (2000) indicated that kindergarten children with minor physical anomalies, particularly anomalies of the mouth, were more at risk for violent delinquency in adolescence. This association was found to be independent of the effect of childhood physical aggression and family adversity. Similarly, birth complications were found to be linked to hyperactivity in children (Mick, Biederman, Prince, Fischer, & Faraone, 2002; Milberger, Biederman, Faraone, Guite, et al., 1997). Nevertheless, not all studies find a relationship between birth complications and childhood behavior problems. Some have failed to support this notion. McNeil & Wiegink (1971) examined the relationship between pregnancy and birth complications and the occurrence of later childhood behavioral disorders. In this study, no link was found between pregnancy and birth complications, including premature birth, and behavioral disorders. This study suggested that birth complications alone may not predispose to externalizing behavior in the offspring, but may instead require the addition of other factors that interact with birth complications in predisposing to externalizing behavior problem. More specifically, birth complications are more likely to interact with social variables in explaining antisocial behavior (Hodgins, Kratzer, & McNeil, 2001; Piquero & Tibbetts, 1999; Raine, Brennan, & Mednick, 1994).

Figure 1

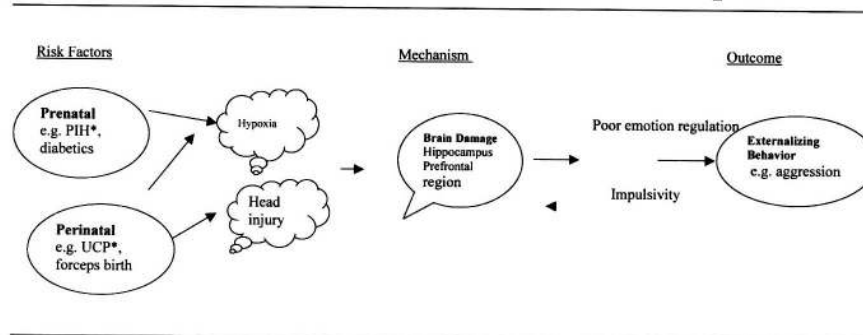
Adapted from: Raine, Brennan, & Mednick (1994). Birth Complications Combined with Early Maternal Rejection at Age 1 Year Predispose to Violent Crime at Age 18 years. Archives of General Psychiatry, 51, 984-988



This interaction theory has been empirically tested. As outlined above, Raine, Brennan, and Mednick (1994) measured birth complications in a sample of 4,269 males from Copenhagen, Denmark, and also maternal rejection of the child at age 1 year. While there were no main effects for these risk factors, individuals with both birth complications and maternal rejection were three times more likely to become violent criminal offenders by age 34 years (see Figure 1). This interaction effect was particularly linked to violent crime occurring before age 18 (Raine et al., 1997). Furthermore, Piquero and Tibbetts (1999) found that pre/perinatal disturbances when combined with a disadvantaged familial environment at age seven years significantly increased the chance of criminal offending during early adulthood among a high-risk, innercity sample. In addition, three other recent studies have shown that birth complications are more likely to interact with other variables in predispositions to externalizing behavior problems. In a Swedish sample, pregnancy complications interacted with poor parenting in predicting adult violence in a large sample of 7,101 men (Hodgins et al., 2001). In a Canadian sample of 849 boys, (Arsenault, Tremblay, Boulerice, & Saucier, 2002) found an interaction between obstetric complications and family adversity in increasing violent offending at age 17 years. In a Finnish sample, perinatal risk interacted with being an only child in raising the odds of adult violent offending by a factor of 4.4 in a sample of 5,587 males (Kempainen, Jokelainen, Jaervelin, Isohanni, & Raesaenen, 2001). On the other hand, no interaction between perinatal insult and family adversity was found for a smaller sample of German children (N = 362) where outcome was restricted to follow-up at age 8 years (Laucht, Essser, Baving, et al., 2000).

Figure 2

Prenatal and Perinatal Complications as Predispositions to Externalizing Behavior *PIH: Pregnancy-Induced Hypertension; UCP: Umbilical Cord Prolapse



WHY DOES IT HAPPEN? THE MECHANISM OF ACTION While the findings on birth complications and antisocial behavior are relatively robust, an important question concerns how prenatal factors can predispose the growing fetus to later antisocial behavior, and what the process is whereby birth complications lead to externalizing and violent behavior. There are reasons to expect this link. For example, prenatal factors may directly or indirectly affect brain structures in the developing fetal CNS, and brain dysfunction has been linked to later aggression and delinquency (Fishbein, 2001; Mednick, & Kandel, 1988; Moffitt, 1990)-see Figure 2. Birth complications are viewed as a type of biological risk factor during the prenatal period that can increase the risk for cognitive, behavioral, emotional, and physical problems later on in childhood (Brennan, Mednick, & Raine, 1997). More specifically, it is assumed that birth complications directly and indirectly cause brain damage which in turn leads to externalizing behavior problems. But how could birth complication cause brain damage? The fetus may experience hypoxia or anoxia, and it is known that hypoxia selectively damages the hippocampus, one component of the limbic system that brainimaging research on violence indicates is involved in aggression regulation (Carlson, 1998; Raine, Buchsbaum, & LaCasse, 1997; Raine et al., 2004). Such hypoxia or anoxia can result from maternal illness or stress, or from toxicity (Pillitteri, 2002). Furthermore, the brain could suffer

mechanical damage during the birth process (e.g. forceps delivery). Neuropsychological functional deficits can also be a consequence of anoxia or brain damage. Why should brain dysfunction predispose to externalizing behavior such as aggression? One explanation is that the prefrontal region of the brain normally acts to control and regulate emotional reactions like aggression that are generated by deeper, limbic brain mechanisms (Raine, 1993; Stoff, Breiling, & Maser, 1997). Therefore, damage to the prefrontal region of the brain may cause it to function poorly, and be less able to keep aggressive impulses in check. Consequently, it could result in increased impulsive behavior and associated aggression in the face of external provocation (Henry & Moffitt, 1997). Supporting this proposition, research has found that children with traumatic brain injury have significantly higher levels of disturbed emotional and behavior disorders, including aggressive and antisocial behavior than comparison children (Andrews, Rose, & Johnson, 1998). Furthermore, neuropsychological testing of juvenile delinquents has indicated relatively poor functioning of the frontal and temporal regions of the brain compared to controls (Henry et al., 1997; Moffitt, 1990). EEG studies have also shown that aggressive prisoners are more likely to show brain aberrations and particularly frontal and temporal lobe abnormalities (Fishbein, Herning, Pickworth, Haerten, et al., 1989; Mark & Ervin, 1970; Volavka, 1987). In addition, EEG abnormalities in 11-15 year-old children have been found to be linked to later criminality in adulthood (Raine et al., 1990; Volavka, 1987). Brain imaging studies have shown that violent offenders have relatively reduced glucose metabolism in the prefrontal region of the brain even after controlling for handedness, sex, ethnicity, and presence and absence of head injury (Henry et al., 1997; Raine et al., 1997). More recently, one study has shown that even slight, visually imperceptible reductions in prefrontal gray matter volume is associated with antisocial personality disorder (Raine, Lencz, Bihle, LaCasse, & Colletti, 2000). Consequently, there is empirical support for the notion that (a) birth complications can cause brain damage and (b) brain damage can predispose to antisocial and violent behavior.

WHAT CAN WE Do ABOUT IT? PREVENTION AND INTERVENTION FOCUSING ON PRENATAL CARE

Prenatal, perinatal, and postnatal health care interventions to reduce birth complications may also help reduce the likelihood of later behavior problems (Raine & Liu, 1998). More specifically, health promotion and disease prevention needs to be applied to all pregnant women. Importantly, interventions could provide better prenatal and perinatal health care services to under-served populations who are more likely to have birth complications. Liu and Raine (2000) have proposed three prevention strategies focusing on a multidisciplinary approach to reduce prenatal and perinatal complications. Nurses, midwives, obstetricians, childbirth educators, and social workers may utilize their own specialties working towards better prenatal care. These include primary prevention that is focused on good prenatal care for the whole population to reduce rates of fetal malnutrition and birth complications, and secondary prevention that targets vulnerable populations and tackles specific risk factors for later violence, such as cigarette smoking and other drug use during pregnancy, and maternal rejection of the child. This could consist of regular prenatal visits, early detection and management of pregnancy complications such as hypertension and diabetes, more education about nutrition and the negative effects of smoking/drugs and alcohol on the fetus, and earlier hospitalization, bedrest, and fetal assessment through ultrasound and fetal monitoring prior to delivery. For example, once placenta previa is detected early by ultrasound, bedrest could be encouraged to prevent third trimester bleeding and to prevent fetal hypoxia, a condition potentially related to fetal neurophysiologic deficits. In addition, post-natal home visits by a nurse or, alternatively, regular pediatric check-ups could provide early detection of motor and cognitive developmental lags in babies with birth complications, thus leading to early remediation of these deficits. Furthermore, nurses on such visits could encourage parents to provide an enriched environment to their child to boost cognitive ability, and also encourage close bonding between the mother and infant. Olds et al. (1998) found, in a large, 15-year prospective study, that nurse home visitations during prenatal and early childhood periods reduced adolescent delinquency. By identifying early risk factors, the avenue is opened for violence prevention programs to significantly reduce childhood externalizing behavior through relatively simple, and potentially inexpensive, biological interventions. In conclusion, it is argued here that prenatal and perinatal

complications may lead to externalizing and antisocial behavior through the mechanisms of damage to the brain regions of the prefrontal cortex and hippocampus. Nurses, midwives, obstetricians, childbirth educators and social workers are in an ideal position to develop early prevention and intervention program to help reduce prenatal and perinatal complications. Consequently, such a multidisciplinary approach may potentially help reduce the likelihood of later externalizing behavior problems.

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Author Affiliation: Jianghong Liu, Ph.D is a postdoctoral research fellow in Social Science Research Institute at University of Southern California. Dr. Liu's research interests involve early health risk factors in developing later childhood externalizing behavior. This work was supported by postdoctoral fellowship NRSA 1 F32 NR008661-01 from the National Institute for Nursing Research (NINR). The address for the author is Social Science Research Institute, University of Southern California, Los Angeles, CA 90089-0375. Her email address is jianghol@usc.edu.

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