

SELECTED RESEARCH ON MEDICAL MARIJUANA DURING CHILDBEARING YEARS

research on prenatal cannabis, 2008-9

who uses cannabis prenatally?

Demographic, emotional and social determinants of cannabis use in early pregnancy: the Generation R study.

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AIMS: To ascertain demographic, emotional and social determinants of cannabis use in early pregnancy.

DESIGN: This study was embedded in the Generation R study, a multiethnic population-based cohort of parents and their children, followed from pregnancy to childhood.

SETTING: Rotterdam, The Netherlands.

PARTICIPANTS: Mothers enrolled in pregnancy who answered questions about their own and their partners substance use before and during pregnancy (n=7610).

MEASUREMENTS: Using self-report questionnaires, information was collected on maternal demographics, psychopathology, delinquency, childhood trauma, social stress, family functioning, and parental alcohol, tobacco and substance use. Multinomial logistic regression analysis was used, with non-using women as reference.

FINDINGS: 246 (3.2%) women used cannabis before pregnancy and 220 (2.9%) women used cannabis both before and during pregnancy.

- The strongest determinant for maternal cannabis use during pregnancy was cannabis use by the biological father of the child (OR=38.56; 95%CI=26.14-58.88).
- Maternal cannabis use during pregnancy was also independently associated with being single (OR=4.25; 95%CI=2.33-7.75) or having a partner without being married (OR=2.75; 95%CI=1.56-4.85),
- childhood trauma (OR=1.39; 95%CI=1.22-1.57)
- and delinquency (OR=3.37; 95%CI=1.90-5.98),
- but not with maternal age, ethnicity, psychopathology, family functioning and perceived stress.
- Being religious was protective (Islam: OR=0.25; 95%CI=0.09-0.65) for maternal cannabis use during pregnancy. Additionally, lower educational level determined continued cannabis use in ever-users (OR=3.22; 95%CI=1.54-6.74).

CONCLUSIONS: Our results showed that multiple demographic, emotional and social characteristics were associated with maternal cannabis use. These characteristics should be considered when investigating offspring exposed to cannabis in utero, as they may play an important role in mother-child interaction and child development.

cannabis and prenatal nausea:

Complement Ther Clin Pract. 2009 Nov;15(4):242-6. Epub 2009 Aug 15.

Reprint of: survey of medicinal cannabis use among childbearing women: patterns of its use in pregnancy and retroactive self-assessment of its efficacy against 'morning sickness'.

Westfall RE, Janssen PA, Lucas P, Capler R.

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A majority of women experience some nausea and/or vomiting during pregnancy. This condition can range from mild nausea to extreme nausea and vomiting, with 1-2% of women suffering from the life-threatening condition hyperemesis gravidarum. Cannabis (*Cannabis sativa*) may be used therapeutically to mitigate pregnancy-induced nausea and vomiting.

This paper presents the results of a survey of 84 female users of medicinal cannabis, recruited through two compassion societies in British Columbia, Canada. Of the seventy-nine respondents who had experienced pregnancy, 51 (65%) reported using cannabis during their pregnancies. While 59 (77%) of the respondents who had been pregnant had experienced nausea and/or vomiting of pregnancy, 40 (68%) had used cannabis to treat the condition, and of these respondents, 37 (over 92%) rated cannabis as 'extremely effective' or 'effective.'

Our findings support the need for further investigations into cannabis therapy for severe nausea and vomiting during pregnancy.

marijuana vs low birth weight - no connection

Illicit drug use and adverse birth outcomes: is it drugs or context?

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Prenatal drug use is commonly associated with adverse birth outcomes, yet no studies have controlled for a comprehensive set of associated social, psychosocial, behavioral, and biomedical risk factors. We examined the degree to which adverse birth outcomes associated with drug use are due to the drugs versus surrounding factors.

Data are from a clinical sample of low-income women who delivered at Johns Hopkins Hospital between 1995 and 1996 (n = 808). Use of marijuana, cocaine, and opiates was determined by self-report, medical record, and urine toxicology screens at delivery. Information on various social, psychosocial, behavioral, and biomedical risk factors was gathered from a postpartum interview or the medical record.

Multivariable regression models of birth outcomes (continuous birth weight and low birth weight ([LBW] < 2,500 g)) were used to assess the effect of drug use independent of associated factors.

- In unadjusted results, all types of drug use were related to birth weight decrements and increased odds of LBW.
- However, only the effect of cocaine on continuous birth weight remained significant after adjusting for all associated factors (-142 g, p = 0.05).
- No drug was significantly related to LBW in fully adjusted models.
- About 70% of the unadjusted effect of cocaine use on continuous birth weight was explained by surrounding psychosocial and behavioral factors, particularly smoking and stress.
- Most of the unadjusted effects of opiate use were explained by smoking and lack of early prenatal care.

Thus, prevention efforts that aim to improve newborn health must also address the surrounding context in which drug use frequently occurs.

cannabis and fetal stress coping ability

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The endocannabinoid system during development: emphasis on perinatal events and delayed effects.

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The endocannabinoid system (ECS) including its receptors, endogenous ligands ("endocannabinoids"), synthesizing and degrading enzymes, and transporter molecules has been detected from the earliest embryonal stages and throughout pre- and postnatal development; endocannabinoids, notably 2-arachidonoylglycerol, are also present in maternal milk.

During three developmental stages, (1) early embryonal, (2) prenatal brain development, and (3) postnatal suckling, the ECS plays an essential role for development and survival.

- During early gestation, successful embryonal passage through the oviduct and implantation into the uterus require critical enzymatic control of the endocannabinoids.
- During fetal life, endocannabinoids and the cannabinoid CB(1) receptor are important for brain development, regulating neural progenitor differentiation and guiding axonal migration and synaptogenesis.
- Postnatally, CB(1) receptor activation by 2-arachidonoylglycerol appears to play a critical role in the initiation of milk suckling in mouse pups, possibly by enabling innervation and/or activation of the tongue muscles.

Perinatal manipulation of the ECS, by administering cannabinoids or by maternal marijuana consumption, alters neurotransmitter and behavioral functions in the offspring. Interestingly, the sequelae of prenatal cannabinoids are similar to many effects of prenatal stress, which may suggest that prenatal stress impacts on the ECS and that vice versa prenatal cannabinoid exposure may interfere with the ability of the fetus to cope with the stress.

Future studies should further clarify the mechanisms involved in the developmental roles of the ECS and understand better the adverse effects of prenatal exposure, to design strategies for the treatment of conditions including infertility, addiction, and failure-to-thrive.

Use of Marijuana During Pregnancy

Lynn Zimmer and John P. Morgan (1997)

Warnings that marijuana causes birth defects date back to the late 1960s.¹ Some researchers claimed to have found chromosomal abnormalities in blood cells taken from marijuana users. They predicted that young men and women who used marijuana would produce deformed babies.² Although later studies disproved this theory,³ some current drug education materials still claim that genetic damage is passed on by marijuana users to their children.⁴

Today, researchers look for a direct effect of THC [for tetrahydrocannabinol, either of two physiologically active isomers, C₂₁H₃₀O₂, from hemp plant resin] on the fetus. In animal studies, THC has been shown to produce spontaneous abortion, low birth weight, and physical deformities—but only with extremely large doses, only in some species of rodents, and only when THC is given at specific times during pregnancy.⁵ Because the effects of drugs on fetal development differ substantially across species,⁶ these studies have little or no relevance to humans. Studies with primates show little evidence of fetal harm from THC.⁷ In one study, researchers exposed chimpanzees to high doses of THC for up to 152 days and found no change in the sexual behavior, fertility, or health of their offspring.⁸

Dozens of studies have compared the newborn babies of women who used marijuana during pregnancy with the babies of women who did not. Mainly, they have looked for differences in birth weight, birth length, head circumference, chest circumference, gestational age, neurological development, and physical abnormalities. Most of these studies, including the largest study to date with a sample of over twelve thousand women,⁹ have found no differences between babies exposed to marijuana prenatally and babies not exposed.¹⁰ Given the large number of studies and the large number of measures, some differences are likely to occur by chance. Indeed, researchers have found differences in both directions. In some studies, the babies of marijuana users appear healthier and hardier.¹¹ In others, researchers have found more adverse outcomes in the babies of marijuana users.¹²

When adverse outcomes are found, they are inconsistent from one study to another, always relatively minor, and appear to have no impact on infant health or mortality.¹³ For example, in one recent study, researchers reported a statistically significant effect of marijuana on birth length. The marijuana-exposed babies, on average, were less than two-tenths of one inch shorter than babies not exposed to marijuana.¹⁴ Another study found a negative effect of marijuana on birth weight, but only for White women in the sample.¹⁵ In a third study, marijuana exposure had no effect on birth weight, but a small negative effect on gestational age.¹⁶ Overall, this research indicates no adverse effect of prenatal marijuana exposure on the physical health of newborns.

Researchers have also examined older children for the effects of prenatal exposure to marijuana. A study of one-year-olds found no differences between marijuana-exposed and nonexposed babies on measures of health, temperament, personality, sleeping patterns, eating habits, psychomotor ability, physical development, or mental functioning.¹⁷ In two studies, one of three-year-olds,¹⁸ the other of four-year-olds,¹⁹ there was no effect of prenatal marijuana exposure on children's overall IQ test scores. However, in the first study, when researchers looked at Black and White children separately, they found, among Black children only, slightly lower scores on two subscales of the IQ test. On one subscale, it was children exposed to marijuana only during the first trimester who scored lower. On the other subscale, it was children exposed during the second trimester who scored lower.²⁰ In neither case did the frequency or quantity of mothers' marijuana use affect the outcomes. This makes it highly unlikely they were actually caused by marijuana. Nonetheless, this study is now cited as evidence that using marijuana during pregnancy impairs the intellectual capacity of children.²¹

Also widely cited are two recent case-control studies describing a relationship between marijuana use by pregnant women and two rare forms of cancer in their children. A case-control study compares people with a specific disease (the case sample) to people without the disease (the control sample). Using this method, researchers identify group differences in background, environment, lifestyle, drug use, diet, and the like that are possible causes of the disease.

A study of children with non-lymphoblastic leukemia reported a tenfold greater risk related to their mothers' use of marijuana during pregnancy.²² A second study reported a threefold greater risk of rhabdomyosarcoma.²³ These calculations were based on women's reports that they used marijuana at some point during pregnancy. In the first study, ten out of the 204 case-group mothers (5 percent) reported marijuana use, compared to one out of the 204 control-group mothers (0.5 percent). In the second study, 8 percent of case-group mothers reported using marijuana, compared to 4.3 percent of controls.

These studies do not prove that marijuana use by pregnant women causes cancer in their children. They report a statistical association based solely on women's self-reports of marijuana use. It is likely that both groups of mothers underreported marijuana use; in other studies, researchers have found that marijuana use by pregnant women typically

ranges from 10 to 30 percent.²⁴ There is reason to suspect greater underreporting by control-group mothers, who were randomly selected and questioned about their marijuana use on the telephone. Because the mothers of the sick children were trying to help researchers identify the cause of their children's disease, they had more reason to be honest about their illegal drug use.

Like all case-control studies, these two studies identified many differences between case-group mothers and control-group mothers, all of which could possibly lead scientists to discover the cause of these rare forms of cancer. Other factors associated with childhood rhabdomyosarcoma include low socioeconomic status, fathers' cigarette smoking, a family history of allergies, children's exposure to environmental chemicals, childhood diets that include organ meats, mothers' use of antibiotics during pregnancy, mothers being over age thirty at the time of the child's birth, overdue delivery, and the child having had fewer immunizations.²⁵ Without additional research, none of the factors that are statistically associated with childhood cancer can be identified as causes of childhood cancer. At this time, there is no corroborative evidence to link marijuana with cancer. In fact, in a recent study, researchers found significantly lower rates of cancer in rats and mice following two years of exposure to extremely large doses of THC.²⁶

Since 1978, psychologist Peter Fried and his colleagues have collected longitudinal data on prenatal marijuana exposure as part of the Ottawa Prenatal Prospective Study (OPPS). Over the years, these researchers have administered hundreds of tests to the same group of children, assessing their physical development, psychomotor ability, emotional and psychological adjustment, cognitive functioning, intellectual capacity, and behavior.

Out of all the OPPS studies and all the tests given, researchers have found very few differences between marijuana-exposed and nonexposed children. At age one, researchers found that marijuana-exposed infants scored higher on one set of cognitive tests.²⁷ At age three, the children of moderate marijuana users (one to five joints per week during pregnancy) had higher scores on one test of psychomotor ability.²⁸ At age four, the children of women who smoked marijuana heavily during pregnancy (an average of nineteen joints per week) scored lower on one subscale of one cognitive test.²⁹ However, at ages five and six, this difference was no longer present.³⁰ When the children were six, the researchers added several new measures of "attentional behavior." The children of heavy marijuana users scored lower on one computer-based test of "vigilance."³¹ Eleven new psychological and cognitive tests, administered to six- to nine-year-olds, showed no statistically significant differences between the children of marijuana users and nonusers. Parents rated marijuana-exposed children as having more "conduct problems," but this difference disappeared after the researchers controlled for confounding variables.³²

Despite the overwhelming similarities in the children of marijuana users and nonusers, in their published reports OPPS researchers consistently highlight the occasional negative finding. Fried believes that these findings underestimate the harms of prenatal marijuana exposure. He suggests that "more sensitive measures" are needed because:

instruments that provide a general description of cognitive abilities may not be capable of identifying nuances in neuro-behaviour that may discriminate between the marijuana-exposed and non-marijuana exposed children. . . . Tests that examine specific characteristics that may underline cognitive performance may be more appropriate and successful.³³

Recently, Fried predicted that a new test of "executive function" would reveal marijuana-related deficits in preteen youngsters.³⁴ A short time later, Fried announced that preliminary analysis of his data showed this effect was present.³⁵ Almost immediately, his announcement appeared in U.S. government reports as evidence of marijuana's harm to the fetus.³⁶ Additional reports of harm based on the OPPS sample, which now includes fewer than thirty marijuana-exposed children, may be forthcoming—despite the fact that, according to Fried, the consequences of prenatal drug exposure typically diminish as children get older.³⁷

After controlling for known confounding variables, Fried estimates that prenatal drug exposure accounts for 8 percent or less of the variance in children's scores on developmental and cognitive tests—and this estimate is for alcohol, tobacco, and marijuana combined.³⁸ In essentially all studies, marijuana contributes less than alcohol or tobacco.³⁹ In addition, the findings differ from one study to another, and show no consistent relationship of fetal harm to either the timing or degree of marijuana exposure. While it is sensible to advise women to abstain from all drugs during pregnancy, the weight of current scientific evidence suggests that marijuana does not directly harm the human fetus.

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Prenatal Marijuana Exposure and Neonatal Outcomes in Jamaica: An Ethnographic Study

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ABSTRACT.

Objective. To identify neurobehavioral effects of prenatal marijuana exposure on neonates in rural Jamaica.

Design. Ethnographic field studies and standardized neurobehavior assessments during the neonatal period.

Setting. Rural Jamaica in heavy-marijuana-using population.

Participants. Twenty-four Jamaican neonates exposed to marijuana prenatally and 20 nonexposed neonates.

Measurements and main results. Exposed and nonexposed neonates were compared at 3 days and 1 month old, using the Brazelton Neonatal Assessment Scale, including supplementary items to capture possible subtle effects. There were no significant differences between exposed and nonexposed neonates on day 3. At 1 month, the exposed neonates showed better physiological stability and required less examiner facilitation to reach organized states. The neonates of heavy-marijuana-using mothers had better scores on autonomic stability, quality of alertness, irritability, and self-regulation and were judged to be more rewarding for caregivers.

Conclusions. The absence of any differences between the exposed on nonexposed groups in the early neonatal period suggest that the better scores of exposed neonates at 1 month are traceable to the cultural positioning and social and economic characteristics of mothers using marijuana that select for the use of marijuana but also promote neonatal development. *Pediatrics* 1994;93:254-260; prenatal marijuana exposure, neonatal outcomes, Jamaica, Brazelton scale supplementary items.

ABBREVIATIONS. NBAS, Neonatal Behavioral Assessment Scale; SES, Socioeconomic status.

The purpose of this study was to identify the effects of marijuana (or "ganja" as it is called in Jamaica) consumption during pregnancy and lactation on offspring during the neonatal period. Despite the prevalence of marijuana use among women of childbearing age, 1-3 reports on the behavioral teratogenic effects of prenatal marijuana exposure have been conflicting and inconclusive. Fried and Makin, 4 for example, found that moderate levels of marijuana use in their middle-class Ottawa sample (7.0 joints per week) were associated with poorer habituation to light, higher levels of irritability, and increased tremors and startles as assessed by the Brazelton Neonatal Behavioral Assessment Scale (NBAS) between the third and sixth days of life. Tennes et al, 5 on the other hand, found no relationship between exposure to marijuana and the neonates' behavior as rated by the NBAS. Similarly, a recent study of 373 lower socioeconomic status (SES) mothers and their neonates by Richardson and colleagues 6 found no relationship between moderate levels of marijuana use during pregnancy and neonate behavior on the NBAS on the second day of life. Yet Chasnoff, 7 lending support to Fried's findings, observed that marijuana use during pregnancy made a significant contribution to variance in the Brazelton State Regulation cluster scores, including habituation, in neonates a few days of age.

More recently, Coles et al, 8 studied the effects of maternal drug use on the neurobehavioral status of 107 neonates and found maternal marijuana use had depressed effects on the Orientation cluster of the NBAS at 14 days and on the Range of State cluster at the end of the first month. The interaction of marijuana use and cocaine and alcohol, however, was responsible for significant amounts of the variance in neonate behaviors over the first month of life. Nevertheless, they concluded that although the influence of drug and alcohol exposure could be noted statistically, the effects on neonate behavior were small and behavior was not clinically aberrant.

It is likely that many of conflicting results among published studies on the effects of prenatal drug exposure are due to methodological problems in (1) the measurement of neonatal outcomes and (2) the context in which the research is conducted. With the exception of the analysis of cries of neonates in Jamaica 9 and the work of Scher et al 10 and Dahl et al 11 that demonstrated altered sleep cycling and motility among North American neonates, most research has used the Brazelton Neonatal Behavioral Assessment Scale as an outcome measure in examining the effects of prenatal drug exposure. Inconsistencies in the use of the scale, however, have included the timing of the administration, the degree to which examiners were trained to reliability, 12, 13 and the approach to data reduction and analysis. Perhaps most important, only the 28 neurobehavioral items on the NBAS have been used in any analysis to date. Although supplementary items were added to the second edition of the Brazelton Neonatal Behavioral Assessment Scale 12 to be used with high-risk or fragile neonates, the items have not yet been employed in any published study of the effects of in

utero drug exposure. This may mean that the more subtle differences that could distinguish marijuana-exposed neonates simply may not have emerged in the traditional scoring schemes and neurobehavioral cluster analysis.

With regard to the research context, it should be noted that virtually all the studies of prenatal exposure have been conducted in the United States and Canada where marijuana use is primarily recreational. This is in marked contrast to other societies, such as Jamaica, where scientific reports have documented the cultural integration of marijuana and its ritual and medicinal as well as recreational functions. [14](#), [15](#) Previous studies have had difficulty controlling possible confounding effects of factors such as polydrug use, antenatal care, mothers' nutritional status, maternal age, SES and social support, as well as the effects of different caretaking environments, which could lead to differences in neonate behavior. [8](#), [16](#) The legal and social sanctions associated with illicit drug use often compromise self-report data and render it almost impossible to obtain accurate prenatal exposure levels. [17](#)

The Jamaican perinatal marijuana study provides a unique opportunity to address several of these methodological issues. First, although the study employed the NBAS to assure comparability with other studies, it was assumed that the full-term scale might not be sensitive to less obvious effects of risk status. Because the effects of marijuana were expected to be subtle, [4](#) and because the results of studies using the NBAS to examine the effects of substance abuse on neonatal behavior have been inconclusive, [6](#), [8](#), [16](#) the new supplementary items were administered to better capture the more latent effects of maternal marijuana use on neonatal behavior.

In Jamaica the use of marijuana is culturally integrated and governed by social rules that guide consumption and distribution and inhibit abuse. [14](#), [15](#) Because the cultural meanings that attend marijuana use and users have been documented to influence the outcomes of consumption, [14](#), [18](#) the Jamaican study permits cross-cultural scrutiny of the concepts and assumptions formulated in Eurocentric cultures. Also unlike the United States and Canada where polydrug use prevails, marijuana use by women in Jamaica has been relatively uncontaminated by other drugs; even alcohol and tobacco are used only minimally by women. [14](#), [15](#), [18](#), [19](#) Furthermore, conducting the study in one rural parish (county) provided an opportunity to compare users and nonusers who are drawn from the same population in which there is little variation in such factors as nutrition and prenatal care. Finally, field workers resided in the communities and developed long-term, trusting relationships with participants. This enhanced the credibility of self-reports of consumption and permitted confirmation by direct observations of marijuana-linked behavior.

Previously reported findings from this study suggested a biological vulnerability associated with prenatal exposure to marijuana in the immediate postnatal period. [9](#) This paper explores the influence of the cultural context of caregiving by evaluating the infants both at the beginning and the end of the neonatal period with assessment measures specifically designed to capture the subtle effects of maternal marijuana use on neonatal behavior.

CULTURAL CONTEXT

This project was based in the southeastern part of Jamaica in which there is a well-known and documented widespread use of marijuana. [19](#) Consistent with the working class throughout Jamaica, residents in the rural communities from which the sample for this study is drawn view marijuana not only as a recreational drug but one that also has ritual and medicinal value. Rastafarians, members of a political-religious movement that endorses marijuana as a sacred substance, may smoke ritually on a daily basis. Marijuana also is known for its therapeutic and health-promoting functions. It is consumed as a tea by family members of all ages for a variety of illnesses and to maintain and promote health. [14](#), [15](#) Although the consumption of marijuana tea transcends class, age, and gender divisions, marijuana smoking traditionally has been an adult male, working class activity. [14](#), [15](#) The female marijuana smoker was a rarity and the few women who engaged in smoking were considered base and undignified and often held in contempt by both men and women. Instead, women prepared marijuana for themselves and their families in the form of teas and tonics.

More recently, however, increasing numbers of women have begun to smoke marijuana regularly. [20](#) To some extent, this was attributed to the increasing participation of women in Rastafarianism, but the practice has spread to nonRastafarian women as well. Not only are such women now grudgingly tolerated by their communities, many of the heavy-marijuana-users, particularly if they were Rastafarians, have been given the commendatory title of "Roots Daughter." Roots Daughters are described as women "with a purpose," who can "think, reason and smoke like a man" and who are self-reliant and dignified. They smoke marijuana on a daily basis, in a manner not unlike that of their male counterparts, and continue to smoke during pregnancy and the breast-feeding period.

Although marijuana use during pregnancy is discouraged in prenatal clinics and through government-sponsored prevention programs, the consumption of marijuana during pregnancy by Jamaican women is not necessarily indicative of a mother's lack of concern about the health and development of her infant. Supported by the folk belief that marijuana has health-rendering properties and by the experience of relatives and neighbors, women use it as a vehicle for dealing with the difficult circumstances surrounding pregnancy and childbirth. For instance, 19 of the marijuana smokers in the sample reported that it increased their appetites throughout the prenatal period and / or relieved the nausea of pregnancy. Fifteen reported using it to relieve fatigue and provide rest during pregnancy. All the mothers considered the effects of marijuana on nausea and fatigue to be good for both themselves and their infants.

The responsibilities that accompany pregnancy and infant care in an unyielding economic environment are not trivial. The

multigravidas, in particular, reported that the feelings of depression and desperation attending motherhood in their impoverished communities were alleviated by both social and private smoking. Despite these reports of the benefits of marijuana to both mother and baby, the women who smoke marijuana with any regularity continue to be in the minority. Most women in Jamaica refrain from smoking the substance and those who do smoke marijuana represent a departure from the norms regarding standard female behavior. [20](#)

METHOD

An ethnographic design, combining community and household naturalistic observations and interviews of 60 women with standardized testing of their neonates using the NBAS, was employed. With the assistance of local midwives, the field workers identified and recruited pregnant women who used marijuana until a sample of 30 was obtained. After each participant agreed to participate and informed consent was obtained, she was then matched (again, with the assistance of local midwives) with a gravid woman who did not use marijuana, according to age, parity, and SES. The study was fully explained to both the marijuana users and the companion group and none refused to participate. During the course of the study, three of the mothers designated as nonusers were discovered to be tea drinkers and were transferred to the users category, resulting in a sample of 33 users and 27 nonusers. Further losses to the sample include two spontaneous abortions in the users category and one stillbirth and a preterm in the nonuser category, yielding a maternal sample of 31 users and 25 nonusers. Social, medical, and obstetrical histories were determined via maternal interviews. Naturalistic observations of the women in their homes and communities were conducted by the field workers who maintained routine contact with the participants throughout the prenatal period. Data concerning labor and delivery and the status of the neonate, details of labor, any anomalies or complications, birth weight, and length of gestation were abstracted from hospital records for each birth event.

The sample was drawn from the vast category of "rural poor," which constitute the majority of the population of this region of Jamaica. The two groups were matched for SES, based on income and employment, parity (0 to 8 for both smokers and nonsmokers) and age. The 60 women ranged in age from 15 to 42 and all were of Afro-Jamaican descent. None were gainfully employed in permanent jobs although many worked occasionally outside their homes as agricultural or domestic laborers or as "higglers" (vendors). Only one of the women was legally married, although more than half of the women were living in a more or less permanent common-law arrangement with their infant's father. Three of the women were members of a Rastafarian sect and lived in a communal "Rasta Camp." All had regular prenatal care from at least the second trimester to birth. The use of alcohol and tobacco was minimal in both groups and did not exceed 3 beers or 15 tobacco cigarettes per week for any of the women in the study. Based on self reports, reports of community residents and direct observations by field workers, the group of marijuana-using mothers was further designated as "light," "moderate," or "heavy" users, depending on the frequency the amount of use. Light users were defined as those women who consumed marijuana tea only or smoked infrequently, averaging less than 10 cigarettes per week. Moderate users were those women who smoked 3 or more days a week, averaging between 11 and 20 marijuana cigarettes. Heavy users smoked daily, usually more than 21 marijuana cigarettes per week. Many moderate and heavy users also were regular marijuana tea drinkers. Although it was not by design, the user group was divided into almost equal categories of heavy ($n = 10$), moderate ($n = 9$), and light ($n = 12$).

Although the sample was matched on three major variables, the social histories revealed subtle and unanticipated differences both within the using group and between the two groups. First, as a group, the heavy users had the highest level of education. All the heavy users had had some schooling beyond the primary school level and three had had some post secondary training. Although SES was a matching variable in the selection of the sample, the roots daughters (heavy-marijuana-users) were distinguishable by the source of support. None relied exclusively on the father of the study child for support whereas most of the sample was either solely or heavily dependent on their infant's father. Although none of the women in the sample was routinely employed, the alternative sources of income for the roots included their own cash-generating activities such as running an illegal gambling operation or selling marijuana, remittances from relatives living abroad, support from parents or from former mates in the form of cash, food, housing, clothing and/or child care, and for the three Rastafarian women, housing and food in a communal living arrangement. The heavy-marijuana-users did not have more income and status than the other women, but they did have more control over how they acquired and spent their resources. Closely linked to this greater economic independence is the lower level of conjugal stability among users compared with nonusers. Because they did not rely on male support, they were relatively free to separate and form new relationships if their current relationship was not to their liking. [21](#) Among the women using marijuana heavily, only 48% were in common-law unions compared with 71% of the nonusing women. Among the 10 heavy-marijuana-users, only 3 lived in more or less permanent, co-residential relationships with the fathers of their infants. The remaining seven maintained their own households, although 3 were visited regularly by their infant's father.

Newborn Assessments

The newborn assessments were administered in the hospital on the first and third days and at 1 month of the newborn's life in the hospital maternity ward. To keep the conditions of birth as comparable as possible, only those newborns who were born in the hospital and remained there for 3 days were included in the analysis. Therefore, although the maternal sample was 31 users and 25 nonusers the newborn sample was reduced to 24 exposed and 20 nonexposed newborns.

The Jamaican examiner, who was blind to the neonates group assignment, was a registered nurse who had worked for several years on the maternity unit and was trained by the Child Development Unit Harvard Medical School both to the .90 reliability criterion and to administer the NBAS supplementary items. [12](#) Three examination data collection points were used to embrace the entire neonatal period: 1 day, 3 days, and 1 month. Given the great disparity within the sample regarding the timing and place of birth, the day assessments were omitted from the analysis because of possible differences in recovery time, in keeping with the recommendations of the NBAS manual. [12](#) Based on the developmental assumptions underlying the NBAS, [13](#) the assessment of neonate behavior at the end of the first month also can provide a functional assessment of the effects of the caregiving environment on neonate behavior. The Brazelton scores at the end of the first month, therefore, can be interpreted not only in terms of direct marijuana effects but also as a result of the effects of the environment on behavior. [12](#)

The supplementary items assess behavior such as the quality of the neonate's attention or the cost of this level of responsivity to the neonate's physiological or motor system. The supplementary items also assess the extent of examiner effort that may be necessary to facilitate the neonate's performance. This, in turn, may be a critical area that differentiates the fragile neonate, who has difficulty in coping with the demands of the examination, from the less stressed, healthy neonate. These additional supplementary items also identify the threshold of responsivity in neonates and the degree to which they are vulnerable to external environmental stimulation.

Quality of Alert Responsiveness is an assessment of the overall capacity of the neonate to respond to both human and nonhuman stimuli. Cost of Attention describes the degree to which the neonate's motor, state, and physiological systems are stressed or compromised as the neonate interacts with the environment. Examiner Persistence is a measure of the amount of examiner facilitation that is necessary to enable the neonate to maintain homeostasis or to be able to respond optimally to the challenges of the examination. General irritability is an extension of the irritability item in the Scale proper and describes the overall amount of fussing or crying during the course of the examination. The Robustness and Endurance item assesses the degree to which neonates become exhausted or stressed during the course of the assessment or the extent to which their "energy" resources enable them to organize or recover in the face of stress. The Regulatory Capacity score is an index of the strength of the regulatory system and of the neonate's ability to self-regulate. State Regulation provides a measure of the range of the neonate's six states and the degree to which the states are robust and stable and contribute to the overall organization of the neonate. Balance of Motor Tone Examines the consistency of motor tone throughout the body and is demonstrated by the balance between the flexor and extensor motor groups. The final item, Reinforcement Value of the Infant's Behavior, is a measure of the examiner's reaction to the neonate and a clinical rating of the degree to which the neonate was easy or difficult to manage through the course of the examination. Of these nine items, only Regulation of State and the Cost of Attention items were not scored. On the basis of the individual item scores, each subject was assigned a score for each of the seven clusters, and a score for each of the seven summary supplementary items.

For the analysis of the NBAS data, the 3-day and 1-month individual scores were reduced to the seven clusters described by Lester et al. [22](#) These clusters and the supplementary items were used as dependent measures in the subsequent analyses. The clusters are Habituation, Orientation, Motor Organization. Range of State, Regulation of State, Autonomic Regulation, and the number of Abnormal Reflexes.

The groups were first dichotomized into marijuana-exposed versus nonexposed and, using SPSS-X statistical software, The tests were performed to compare the performance of these neonates on the NBAS clusters and on the supplementary items. Because the neonates of the heavy users received the most frequent and consistent exposure both prenatally and during the first month of life they served as the "extreme" cases in which to search for specific developmental and behavioral effects. To examine these effects, the scores of the neonates of heavy-marijuana-using and neonates of nonusing mothers were also compared using t tests.

RESULTS

The course of the pregnancies were similar in each group and the two groups of neonates were not significantly different according to physical examination data, including birth weight and length and gestational age. [23](#) Because Apgar scores were not recorded by hospital nurses at standard time intervals, they were less reliable. Nevertheless, there were no significant differences in the Apgar scores between the two groups.

t tests were used to compare the performance of neonates of users (n = 24) and nonusers (n = 20) on the NBAS cluster scores and on the supplementary items on the third day of life. [Table 1](#) shows that there were no significant differences on the seven clusters. There also were no differences on the seven supplementary items. To examine the degree to which heavy marijuana use may have an effect on neurobehavioral outcome, we then compared the performance of the heavily exposed and nonexposed neonates on the NBAS on day 3, by examining group differences on the seven Brazelton cluster scores and on the supplementary items scores. As [Table 2](#) reveals, there were no significant differences in performance on the Brazelton cluster scores on day 3. Similarly, no differences were found on the supplementary item summary scores.

At 1 month, however, comparisons between exposed and nonexposed neonates revealed that the neonates of using mothers had significantly higher scores on the Autonomic and Reflex clusters of the NBAS (see [Table 3](#)). On the

supplementary items, these neonates scored higher (were less irritable) on the General Irritability item.

Comparing the heavily exposed and the nonexposed infants, the Brazelton clusters on day 30, showed that the offspring of heavy-marijuana using mothers had significantly higher scores on the Orientation cluster, on the Autonomic Stability cluster, and on Reflexes (see [Table 4](#)). Due to the intercorrelation among the variables comprising each cluster, no *t* scores or *P* values are reported for individual items. Nevertheless, a comparison of individual item scores showed that neonates of heavy users had higher scores on habituation to auditory and tactile stimuli, and to animate auditory stimuli, the degree of alertness, capacity for consolability, irritability (ie, less irritable), and had fewer startles and tremors. The comparisons on the supplementary items revealed significant differences on all seven variables, with the neonates of mothers who were heavy-marijuana users performing more optimally on these items.

DISCUSSION

Although no positive or negative neurobehavioral effects of prenatal exposure were found at 3 days of life using the Brazelton examination, there were significant differences between the exposed and nonexposed neonates at the end of the first month. Comparing the two groups, the neonates of mothers who used marijuana showed better physiological stability at 1 month and required less examiner facilitation to reach an organized state and become available for social stimulation. The results of the comparison of neonates of the heavy-marijuana-using mothers and those of the nonusing mothers were even more striking. The heavily exposed neonates were more socially responsive and were more autonomically stable at 30 days than their matched counterparts. The quality of their alertness was higher; their motor and autonomic systems were more robust; they were less irritable; they were less likely to demonstrate any imbalance of tone; they needed less examiner facilitation to become organized; they had better self-regulation; and were judged to be more rewarding for caregivers than the neonates of nonusing mothers at 1 month of age.

TABLE 1. Neonatal Behavioral Assessment Scale Cluster and Supplementary Scores, Day 3

Users	Nonusers		<i>t</i> Score		
	(n = 24)		(n = 20)		
	Mean	SD	Mean	SD	
Habituation	6.83	0.804	6.82	0.835	-.06
Orientation	5.87	0.953	5.45	1.324	-1.10
Motor organization	5.39	0.576	5.42	0.405	0.22
Range of state	4.15	0.415	4.07	0.474	-.57
Regulation of state	5.43	1.163	5.73	0.664	1.06
Autonomic stability	7.59	1.350	7.41	2.020	-.35
Reflexes	15.15	2.240	13.82	3.264	-1.47
Quality of alertness	5.69	1.692	6.05	1.298	0.80
Robustness	7.46	0.811	7.64	1.115	0.59
Regulatory capacity	5.80	1.767	6.00	1.458	0.39
Motor tone	6.76	0.992	6.94	1.249	0.48
General irritability	7.70	0.806	7.75	0.447	0.21
Examiner's persistence	5.42	1.653	5.58	2.002	0.28
Reinforcement value	5.88	1.451	5.94	1.435	0.13

TABLE 2. Neonatal Behavioral Assessment Scale Cluster and Supplementary Scores, Day 3

Heavy users	Nonusers		t Score		
	(n = 10)		(n = 20)		
	Mean	SD	Mean	SD	
Habituation	6.45	0.683	6.82	.835	1.10
Orientation	5.87	0.655	5.45	1.324	-1.05
Motor organization	5.42	0.484	5.42	0.405	0.01
Range of state	4.13	0.427	4.07	0.474	-.31
Regulation of state	5.43	0.836	5.73	0.664	0.93
Autonomic stability	8.13	1.200	7.41	2.020	-1.18
Reflexes	15.66	2.180	13.82	3.264	-1.72
Quality of alertness	5.77	1.856	6.05	1.298	0.40
Robustness	7.22	0.441	7.64	1.115	1.38
Regulatory capacity	5.33	1.871	6.00	1.458	0.93
Motor tone	6.77	1.093	6.94	1.249	0.34
General irritability	7.85	0.378	7.75	0.447	-.59
Examiner's persistence	6.00	1.581	5.58	2.002	-.57
Reinforcement value	5.77	1.716	5.94	1.435	0.24

TABLE 3. Neonatal Behavioral Assessment Scale Cluster and Supplementary Scores, One Month

Users	Nonusers		t Score		
	(n = 24)		(n = 20)		
	Mean	SD	Mean	SD	
Habituation	7.20	0.877	6.53	1.503	-1.50
Orientation	6.63	1.439	6.45	1.310	-.45
Motor organization	6.45	0.669	6.36	.715	-.41
Range of state	3.88	0.748	4.03	.614	0.80
Regulation of state	5.62	1.074	5.47	1.415	-.39
Autonomic stability	8.69	0.549	7.33	2.260	-2.63*
Reflexes	15.55	1.88	13.40	2.990	-2.85*
Quality of alertness	7.28	1.357	6.65	1.496	-1.51
Robustness	8.78	0.499	8.47	.841	-1.45
Regulatory capacity	7.00	1.633	6.15	1.725	-1.72
Motor tone	7.46	1.105	7.50	0.513	0.15
General irritability	8.37	0.565	7.75	0.716	-3.20*
Examiner's persistence	7.25	1.666	6.55	1.877	-1.33
Reinforcement value	7.28	1.512	6.70	1.418	-1.37

* $P < (\text{on top of}) (\text{symbol}) .01.$

Cry changes reported for this population [9](#) had suggested a biological vulnerability [24](#) in the immediate postnatal period that was not evident in the supplementary item results of this study. A possible explanation for this discrepancy is that the Brazelton supplementary items, conducted under more controlled conditions, simply provided a more comprehensive and reliable assessment of the neonates' neurobehavioral status. It also is possible that the social effects [25](#) of the neonate's cry characteristics may even have elicited a quality of caregiver responses that could contribute to better outcomes at 1 month. It should be pointed out that Coles et al [8](#) also reported more significant differences at 1 month on the Brazelton Scale clusters than at earlier assessments, suggesting environmental effects. In this case, the direction of the differences in performance on the Brazelton examination between 3 days and 1 month suggest not only that the environment may be more influential than prenatal exposure in predicting outcomes but that the environment of the exposed group may be superior to that of the nonexposed group.

Conventional wisdom would suggest that mothers who are long-term marijuana users are less likely to create optimal caregiving environments for their neonates. In this area of rural Jamaica, however, where marijuana is culturally integrated, and where heavy use of the substance by women is associated with a higher level of education and greater financial independence, it seems that roots daughters have the capacity to create a postnatal environment that is supportive of neonatal development. Indeed, Pearson's correlations, performed determine whether there was an association between the mother's education and neonatal outcomes at 1 month, revealed that maternal education was significantly correlated with the Autonomic cluster at 1 month ($r = .27$, $P = .031$) and approached significance with all the supplementary items.

Although it is tempting to explain the 1-month outcomes by simply appealing to the correlation evidence linking performance to maternal characteristics, the question remains as to how these characteristics are translated to the formation of a better environment for neonatal development, particularly given the higher level of conjugal instability among users. Ethnographic observations of the postnatal environments identified that, despite the higher level of single mother households among the users, they had fewer children at home and thus fewer child care responsibilities compared with their nonusing counterparts. They also had more adults living in their households. Pearson's correlations revealed that the household child / adult ratio was significantly correlated with the Habituation clusters at 1 month ($P = .046$, $r = .30$) and with later child development outcomes. [21](#) Although the exact mechanism linking child / adult ratio to 1 month outcomes requires further delineation, it is possible that with more adults present to assist the mother and respond to the neonate and / or with fewer children to compete for attention, the mother is better equipped to facilitate the neonate's interaction with his / her environment. The lower child / adult household ratios and the mother's characteristics are not unrelated. The dispersal or outplacement of older children to their respective father's households as a new child is brought in is a common practice, facilitated by the pattern of serial mating in which the using mothers are more likely to engage. Thus, in this Jamaican rural working class context, conjugal instability is associated with greater rather than diminished access to the resources that influence child development.

TABLE 4. Neonatal Behavioral Assessment Scale Cluster and Supplementary Scores, One Month

Heavy users	Nonusers		<i>t</i> Score		
	(n = 10)		(n = 20)		
	Mean	SD	Mean	SD	
Habituation	6.75	1.521	6.53	1.503	-.22
Orientation	7.40	0.457	6.45	1.310	-2.87 _±
Motor organization	6.33	0.374	6.36	0.715	0.16
Range of state	3.41	0.984	4.03	0.614	1.75
Regulation of state	6.20	1.007	5.47	1.415	-1.57
Autonomic stability	9.00	0	7.33	2.260	-3.30 _±
Reflexes	15.78	2.220	13.40	2.990	-2.38 _±
Quality of alertness	8.00	0.500	6.65	1.496	-3.61 _±
Robustness	9.00	0.000	8.47	.841	-2.73 _±
Regulatory capacity	7.77	1.093	6.15	1.725	-3.07 _±
Motor tone	7.88	0.333	7.50	.513	-2.44 _±
General irritability	8.75	0.463	7.75	.716	-4.37 _±
Examiner's persistence	8.33	0.707	6.55	1.877	-3.70 _±
Reinforcement value	8.00	0.707	6.70	1.418	-3.29 _±

* $P < (\text{on top of}) (\text{symbol}) .03$. + $P < (\text{on top of}) (\text{symbol}) .01$.

Cross-societal research [14](#), [15](#), [26](#) has identified the importance of understanding the cultural context of drug use to explain outcomes. Whether or not the effects of marijuana during the prenatal period are real or only perceived, it is clear that for them, it has at least symbolic value in assisting them through the physical, social, and psychological difficulties of pregnancy and the postnatal experience. Furthermore, unlike the United States, in which heavy marijuana use often is associated with maternal incompetence and a suboptimal caregiving environment, the data from this study indicate that in Jamaica, the heavy-marijuana-using mother's education, independence, and greater access to resources converge in a constellation of maternal competence and a supportive context for neonatal development.

Strengths and Limitations

It should be noted that there are several limitations posed by this study and caution must be used in interpreting the results. First, the means by which the study participants were recruited may have introduced a bias in the sample. Second, the sample size is small, obviating the use statistical procedures that might be able to account for the many environmental variables that seem to influence some of the outcomes. Third, in a prospective study of this nature it is impossible to foresee and control for all the potential environmental and maternal confounders. Finally, this study has not eliminated alternative explanations. It is possible for example, that the outcomes at 1 month are related to neonatal exposure to marijuana constituents via breast milk or to prenatal influences that simply were not manifested at the 3-day examination.

On the other hand, the prospective design, using ethnographic techniques and inductive analyses, offers several advantages to the exploration of prenatal exposure to illicit drugs. First, given the difficulties encountered in recruiting participants who are engaging in an illegal activity and then retrieving credible data from them, identification by fieldworkers, with assistance from local midwives, represented a contributive alternative to a random sampling strategy. Second, although the sample size is small, it provided an opportunity to follow up drug-using women through pregnancy with the level of detail that often is lacking in retrospective studies of large numbers of women. Finally, the effects of prenatal exposure to drugs such as marijuana depend on several factors for which it is difficult and sometimes impossible to control in most clinical investigations. [8](#) Although this study was successful in controlling for polydrug use and SES, other variables (financial independence, mothers education, and household child / adult ratio) emerged as meaningful during the course of this study. Indeed a strength of the inductive design is its capacity to identify such unanticipated variables and to understand how they are linked in Jamaican culture with heavy marijuana use and a roots daughter syndrome. Although some might interpret this failure to identify the relevant variables at the outset of the study and control for them in a more experimental design as a weakness of the study, one could argue, conversely, that the project's greatest value is its capacity for discovery and the generation of hypotheses and research questions that can be explored in subsequent studies.

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[End]

[Additional research on marijuana and reproductive health is discussed in *Exposing Marijuana Myths: A Review of the Scientific Evidence* (particularly "Claim #7: Marijuana Use During Pregnancy Harms The Fetus"), by Lynn Zimmer, Ph.D., Associate Professor of Sociology, Queens College; and Dr. John P. Morgan, Professor of Pharmacology, City University of New York Medical School. See also the Portland NORML news release of March 7, 1996.]