THE EFFECT OF PREGNANCY INTENTION ON CHILD DEVELOPMENT*

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In this paper, we use data from the National Longitudinal Survey of Youth to investigate the empirical link between unintended pregnancy and child health and development. An important contribution of our study is the use of information on siblings to control for unmeasured factors that may confound estimates of the effect of pregnancy intentions on infant and child outcomes. Results from our study indicate that unwanted pregnancy is associated with prenatal and postpartum maternal behaviors that adversely affect infant and child health, but that unwanted pregnancy has little association with birth weight and child cognitive outcomes. Estimates of the association between unwanted pregnancy and maternal behaviors were greatly reduced after controls for unmeasured family background were included in the model. Our results also indicate that there are no significant differences in maternal behaviors or child outcomes between mistimed and wanted pregnancies.

In 1988, 56% of pregnancies were unintended, either mistimed or unwanted at conception (Forrest 1994). The consequences of unintended pregnancy are thought to be substantial: Unintended pregnancy has been shown to be associated with late prenatal care, maternal smoking during pregnancy, low birth weight, infant mortality, child abuse, and developmental delay. In a report from the Institute of Medicine (IOM; Brown and Eisenberg 1995), the authors conclude that "the consequences of unintended pregnancy are serious, imposing appreciable burdens on children, women, men and families" (p. 1). Policies directed at reducing unintended pregnancy would reduce the risk of adverse outcomes for infants and children. Therefore the committee on unintended pregnancy "urges, first and foremost, that the nation adopt a new social norm: All pregnancies should be intended" (p. 3). To this end, it recommends "a multifaceted, long-term campaign to (1) educate the public about the major social and public health burdens of unintended pregnancy and (2) stimulate a comprehensive set of activities at national, state, and local levels to reduce such pregnancies" (p. 4).

The association between unintended pregnancy and adverse infant and child health outcomes provides an important justification for the IOM recommendation. Although the primary recommendation of the IOM report is to reduce unwanted pregnancy, it is also clear that the committee foresaw additional benefits related to improvements in infant and child development. In this paper we are primarily interested in whether the reported association between unintended pregnancy and infant and child development is causal. We argue that existing evidence for a causal relationship is weak. In particular, past studies did not control adequately for potential confounding effects of family and social background. Unintended pregnancy is correlated with income, race, marital status, education, cognitive ability, and other parental characteristics, all of which are also related to prenatal behavior, child health, and child development. Policies intended to enhance infants' and children's well-being may be advanced more effectively if they are based on a causal as opposed to an associative relationship.

Our objective therefore is to investigate empirically the causal link between unintended pregnancy and child health and development, as well as parental behaviors related to child health and development. In contrast to previous studies, we include an extensive set of controls in our empirical analysis to minimize potential confounding. In addition, we exploit information on siblings to control for unobserved factors both in child outcomes and in pregnancy intention.

A second motivation for our study is the paucity of research on the effect of pregnancy intention on child development. Most prior research based on data for the United States has focused on birth outcomes and on prenatal and perinatal behaviors. Only one previous study has examined the consequences of unintended childbearing for the development of children beyond infancy (Baydar 1995). European researchers, by contrast, have analyzed the long-term consequences of mistimed or unwanted pregnancies on employment, schooling, and social adjustment, and often have found significant adverse effects (Kubicka et al. 1995; Myhrman et al. 1995). We examine whether pregnancy intention affects the health and development of children up to 11 years of age.

PREVIOUS STUDIES

Research on the consequences of unintended pregnancy in the United States has focused primarily on infant health, especially birth weight, and on maternal behaviors that affect infant health, such as smoking during pregnancy and the use of prenatal care (Bustan and Coker 1994; Kost, Forrest, and Singh undated; Marsiglio and Mott 1988; Sable et al. 1997; Weller, Eberstein, and Bailey 1987). These studies typically find evidence that unintended pregnancy has an adverse effect on maternal behaviors and use of prenatal care, but they

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find only weak or mixed evidence of adverse effects on infant health.

Few studies, however, control adequately for potentially confounding effects of personal and family background characteristics. Several studies present only simple cross-tabulations of pregnancy intention and the outcomes of interest. Others include only a limited set of covariates and make no effort to control for unmeasured characteristics.

A second limitation is the use of outcomes such as parental behaviors that depend on recognition of pregnancy. Women who intended to become pregnant are likely to recognize the pregnancy earlier than women who did not intend to become pregnant.[1] Differences in pregnancy recognition alone could explain differences in delay of prenatal care by pregnancy intention. Therefore late initiation of prenatal care and other risk-increasing maternal behaviors (e.g., smoking) that depend on pregnancy recognition do not necessarily reflect mistreatment of the fetus or the child. Women who become pregnant unintentionally may engage in risky behaviors before recognizing conception; once aware of the pregnancy, however, they may cease or even compensate for past behaviors.

Three recent U.S. studies examined effects of pregnancy intention on outcomes beyond birth: Two focused on maternal behaviors, and the other on child development. Marsiglio and Mott (1988) examined the effect of unintended pregnancy on well-baby care and breast feeding. They used a sample from the National Longitudinal Survey of Youth (NLSY) (1979–1986) of women aged 19 to 27 who had only one child. These authors found no effects of unintended pregnancy on well-baby care or breast feeding in models that included a limited set of controls for socioeconomic background. They did not differentiate between mistimed and unwanted pregnancies, although other studies find this distinction to be important.

Rosenzweig and Wolpin (1993) examined use of well-baby care and maternal employment after birth for women aged 21 to 29 in the NLSY (1979–1986). They developed a dynamic model of child quality production, with special attention to the effect of child endowments on postpartum maternal behaviors. In cross-sectional analyses they found that unintended infants (unwanted or mistimed) were more likely than wanted infants to receive well-baby care, holding constant the child's endowment. Yet when the authors estimated a mother fixed-effects model (i.e., differences between siblings), the results were reversed: Infants from unintended pregnancies were no more likely to receive well-baby care, and mothers of unintended births were more likely to work. The within-mother estimates must be interpreted cautiously, however, because the sample size was only 62 in the case of well-baby care, and 186 in the case of maternal employment. Furthermore, if an unwanted birth affects siblings, estimates obtained by using sibling differences may be biased downward.

The only study of unintended pregnancy and child outcomes in the United States was conducted by Baydar (1995); she examined several developmental outcomes and developmental resources, including aspects of the home environment and parenting behaviors thought to stimulate development in young children. Baydar studied children less than two years old in 1986, taken from the NLSY. In simple tabulations, three of 10 developmental outcomes were associated with mistimed or unwanted pregnancy. In multivariate analyses, however, pregnancy intention was unrelated to measures of child development. Baydar did find that the availability of developmental resources was associated with cognitive development, and concluded that developmental resources mediated effects of pregnancy intention on cognitive development. This conclusion may be unwarranted, however, because all but one of the statistically significant bivariate correlations between pregnancy intention and development resources is eliminated by controls for family background.

A Finnish study analyzed the educational attainment of children born in 1966, whose pregnancies had been characterized as accepted, mistimed, or unwanted (Myhrman et al. 1995). Those who were born as a result of an unwanted pregnancy were more likely never to attend school beyond (the compulsory) grade 9. This difference remained after adjustment for mother's education, mother's age, single-parent family structure, social class, family size, and maternal employment. Mistimed births were not associated with reduced education after adjustment for family background characteristics.

Several other European studies examined effects of denied abortion on child development (Cameron and Titchenor 1976; David et al. 1977; Forssman and Thuwe 1988; Hook 1975). A widely cited study assessed children resulting from births to women in Prague, Czechoslovakia who were twice denied abortion. Evidence of adverse outcomes associated with these pregnancies has been mixed: When children from unwanted pregnancies (UP) were compared with matched controls from accepted or wanted pregnancies (AP), there was no evidence of adverse health outcomes in infancy or early childhood. Cognitive development also was unaffected (e.g., there were no differences in IQ scores). The researchers, however, found evidence of a lower rate of language acquisition, as well as impaired socioemotional development. By age 9, stronger evidence of socioemotional problems and maladjustment emerged, especially among UP boys (see summaries in David 1981). Later studies of this cohort suggested that differences between UP and AP children persisted and increased with age.

In a follow-up analysis of the Prague cohort, UP and AP subjects were compared at age 30 (Kubicka et al. 1995). The authors found that UP subjects continued to experience less successful psychosocial adaptation than their AP counterparts. UP females also were more likely to be unemployed. Overall, effects associated with an unwanted pregnancy per-

1. Indeed, Kost, Forrest, and Singh (undated) show that 43% of women whose pregnancies were unwanted did not recognize conception until at least seven weeks, as compared with 26.5% of women with intended pregnancies.

sisted, but appeared to diminish with age, in contrast to earlier findings. Yet when UP and AP subjects were matched to their AP siblings, deficits for UP males were reduced and were no longer statistically significant; differences in emotional stability persisted among UP females, however. The authors conclude:

> [A] causal interpretation of these differences, if siblings of UPs are not considered, may not be justifiable because the familial background of UPs and controls differs most likely in more respects than is [sic] the unwantedness of pregnancy in one group. Matching on demographic and related variables cannot exclude possible differences in familial background (genetic and environmental) additional to unwanted pregnancy. (Kubicka et al. 1995:368)

Two conclusions emerge from our review of the literature. First, relatively few U.S. studies have examined the association between pregnancy intention and adverse health and developmental consequences for children beyond infancy. Most of the previous studies focused on the relationship between pregnancy intention and prenatal behaviors and birth outcomes. We analyze the association between pregnancy intention, parental behaviors, and child outcomes from the prenatal period through early adolescence. This more comprehensive approach allows us to test whether the adverse effects of pregnancy intention found for prenatal behaviors—the most consistently reported association among studies based on U.S. survey data—persist into childhood.

Second, many past analyses did not control adequately for factors that may confound estimates of the effect of pregnancy intention on child development. A review of the literature, however, suggests that the association between unintended pregnancy and child development is sensitive to controls for maternal characteristics and family background. We address this shortcoming in two ways: (1) We include in our regressions an extensive set of control variables that measure maternal attributes and family characteristics, and (2) we exploit differences between siblings to adjust for unmeasured influences.

ANALYTICAL FRAMEWORK

In our empirical analysis, we rely on a simple behavioral model of fertility to establish a definition of an unintended pregnancy and to link pregnancy intention to maternal behavior and child development. Our definition of unintended birth is similar to that presented by Michael and Willis (1975). We begin by noting that fertility choices are constrained by costly and imperfect methods of fertility control. Thus a woman will choose an efficient fertility control strategy to yield an optimal expected number of children. Yet because of the uncertainty of fertility control, the actual number of births may be greater or smaller than the optimal expected number. Moreover, the greater the degree of uncertainty (or the cost of reducing uncertainty), the larger will be the variation in births. We define an unwanted birth as a birth above the expected number of births.

One of the key features of this simple model of fertility is that the number of unintended births may depend on the number of expected births. Michael and Willis (1975), for example, constructed a model in which the variance of births increases with the mean. Thus uncertainty and the number of unintended births increase with the mean. As a result, factors such as income that affect the mean number of births also affect the variance of births and the number of births from unintended pregnancies. It is necessary to control for these factors in empirical analyses because they also affect child outcomes (in ways other than through the pregnancy intention). In regard to schooling, for example, more highly educated parents may desire smaller families because they face a higher opportunity cost of children; they also may practice contraception more efficiently and thus may experience fewer unintended births. Therefore parents' schooling also affects child well-being and thus is confounded with pregnancy intention. Bias may be present in estimates of the effect of pregnancy intention obtained from analyses that ignore the influence of unmeasured factors such as family background. Controlling for these factors is a central focus of our research.

The simple behavioral model also suggests that an unintended birth will affect maternal investments and child development. An unwanted birth increases family size, and an increase in family size raises the price of "child quality" because more resources are needed to produce a given level of child quality (Becker and Lewis 1973). Thus an unwanted birth raises the price of child quality and lowers average child quality. In this case, the resources allocated to each child are diminished. Therefore the model also suggests that children who were intended may also be affected adversely by an unintended birth; we return to this point below. In addition, the resources allocated specifically to the unwanted child could decrease disproportionately. This would be the case if the cost of adjustment to the unwanted birth falls most heavily on the unwanted child.

A second way in which pregnancy intention may affect child quality is through changes in parents' concern for children. Parents may resent an unwanted or mistimed child for the burden it imposes on the family, and may treat him adversely. Consequently an unwanted child will receive less nurturing and resources than a wanted child, and will experience less favorable outcomes than his siblings. Studies of European women denied abortion have emphasized this mechanism to explain adverse social development associated with unwanted pregnancy (David et al. 1988). Unintended pregnancies may be associated with use of fewer healthy inputs such as prenatal care because of delay in recognizing the conception, or because of denial that it occurred (Weller et al. 1987). Finally, wantedness may reflect differences in the prices of fertility control; therefore it may serve as a proxy for these prices, which economic theory suggests affect child quality and investments in child quality (Rosenzweig and Wolpin 1993).

To this point we have defined an unintended birth with reference to the optimal number of children, or in terms of a "numbers failure," but an unintended birth also may refer to the timing of births. Births may be mistimed in that they come sooner or later than preferred because of the uncertainty of fertility control. We follow the literature, and regard as mistimed only those births that occur sooner than desired. The timing of parental investments in child quality is important because parents may want to invest in child quality when the cost of doing so is relatively small. For example, a woman may want to spend time raising children when she is young if the opportunity cost of her time is relatively low. Alternatively, a woman may want to delay childbearing until she has invested in her own human capital.

EMPIRICAL SPECIFICATION

We are interested in obtaining estimates of the effects of pregnancy intention on child outcomes, *q*, and maternal behaviors, *b*. Accordingly we specify the following empirical models:

$$q_{it} = \alpha_0 + \sum_j^J \beta_j \sum_{t-k}^T X_{ijt} + \sum_j^J \lambda_j \sum_{t-k}^T Z_{ijt} + \alpha_1 UNWANT_i + \phi_i + \varepsilon_{it} \quad (1)$$

$$b_{it} = \eta_0 + \sum_j^J \xi_j X_{ijt} \sum_j^J \delta_j Z_{ijt} + \eta_1 UNWANT_i + \phi_i + \varepsilon_{it}, \quad (2)$$

where k is child's age, i an index of children, t an index of time, and j an index of characteristics. Let X_{ijt} be exogenous measures of family background and parental characteristics, let Z_{ijt} be possibly endogenous measures of parental characteristics, let $UNWANT_i$ represent pregnancy intention, and let ϕ_i capture unobserved, time-invariant characteristics associated with child well-being. The summation of X_{ijt} and Z_{ijt} over time in Eq. (1) indicates that we allow the cumulative effect of factors such as income and AFDC participation to affect child outcomes at time t. Finally, let α, β, λ, η, ξ, and δ be parameters, and ε_{it} the error term.

As we describe below, the NLSY collected extensive information that can be used to control for family background and parental characteristics. Some controls for parental background and capabilities, however, are endogenous (Z_{ijt} in Eqs. (1) and (2)). Parental choices with respect to education, marital status, family income, and labor force participation, for instance, may be influenced by child outcomes. Therefore our empirical strategy is to present estimates from two specifications. The first includes variables that we consider to be exogenous (X_{ijt} in Eqs. (1) and (2)). The second specification adds controls that are possibly endogenous. We present both sets of results because there may be a tradeoff between endogeneity bias and omitted variable bias.

A related statistical problem with the estimation of the parameters in Eqs. (1) and (2) is the presence of unmeasured factors (ϕ in Eqs. (1) and (2)) that affect child development and maternal behaviors. We have noted the demographic and socioeconomic background differences between women who have unintended (especially unwanted) births and those who do not. Recent research in adolescent fertility suggests that measured characteristics may be insufficient to control for differences in family socioeconomic background between women who have teen births and those who have births at later ages (Geronimus and Korenman 1993; Geronimus, Korenman, and Hillemeier 1994; Hoffman, Foster, and Furstenberg 1993; Hotz, McElroy, and Sanders 1995). Furthermore, Kubicka et al. (1995) demonstrate that estimated effects of unintended births resulting from denied abortions are sensitive to the use of sibling controls. To address this problem, we estimate mother (between-sibling) fixed-effects models using a sample of women with at least two children. Fixed-effects models allow us to compare outcomes among intended and unintended births across children in the same family (i.e., "within mother"). This procedure controls for unmeasured time-invariant maternal characteristics that affect outcomes.

Two points related to the fixed-effects model merit further discussion. First, fixed-effects models rely on a subsample of families with multiple births. Therefore we check that cross-section estimates for this subsample are similar to those for the overall sample to ensure that any differences in results between cross-section and fixed-effects analyses are due to different statistical procedures rather than different samples. Second, if unintended births affect the entire family (as they would if they reduced resources available to all children), then within-mother differences may understate the effect of unintended births.

Therefore, as an alternative to sibling comparisons, we also estimate models that use only between-family variation to identify effects of unintended pregnancy on maternal and child outcomes. Specifically, we regress average outcomes for all siblings in a family on the proportion of children from unintended pregnancies. These estimates measure the total effect of an unintended child on all children in the family, but do not control for unmeasured maternal characteristics. By contrast, estimates obtained from sibling differences measure the impact on the unwanted sibling above and beyond the impact on all children in the family.

We estimate all models with dichotomous outcomes by logistic regression; we estimate models with continuous outcomes by ordinary least squares (OLS). In all cases we adjust standard errors for clustering within families on the basis of Huber (1967), using algorithms contained in the software Stata (StataCorp 1997). For within-mother estimates of dichotomous outcomes, we use Chamberlin's (1980) conditional logit model.

DATA: THE NATIONAL LONGITUDINAL SURVEY OF YOUTH

Data for this study come from the youth cohort of the National Longitudinal Survey of Labor Market Experiences (NLSY). The NLSY is a national probability sample of young adults who were between ages 14 and 21 in 1979, the first year of the survey (Center for Human Resources 1994). The respondents have been interviewed yearly since that time. The sample originally comprised 12,686 youths, approximately half of whom are women. The retention rate for

the survey has been extremely high; as of 1993, it was 91% of the eligible population.[2]

In addition to the large female sample, the NLSY has obtained information for 9,360 children born to 4,415 sample mothers by 1992. The use of more recent years of the NLSY survey produces a sample of births that is more representative of all births to this cohort of women in the U.S. population than were the samples used in past research. Specifically, we can include six more years of data than did Marsiglio and Mott (1988), Rosenzweig and Wolpin (1993), and Baydar (1995). We limit the sample to children born after 1978 because family characteristics are not available before 1979, the first year of the NLSY survey.[3]

Two features of the NLSY make it particularly suited to our research objectives: the longitudinal design and the assessment of multiple children born to mothers in the sample. The longitudinal nature of the data allows us to relate information about pregnancy intention collected during pregnancy or shortly after birth to child outcomes measured at various ages beginning at birth and continuing through age 11.[4] The availability of health and developmental outcomes for siblings allows us to control for unmeasured characteristics common to siblings who may differ in their "intendedness" status. Of the 4,415 mothers in the NLSY, 3,038 have had at least two births; 61% of these families contained at least one unintended and one intended child.

Questions on Pregnancy Intention

The questions on pregnancy intention in the NLSY closely parallel those in the National Survey of Family Growth. Women are asked a series of four questions about pregnancy intention for each pregnancy. In 29% of the cases, intention questions were asked during pregnancy (ex ante; that is, before the birth). For the remaining pregnancies, the responses were obtained ex post: in most cases within one year of the child's birth. Pregnancy intention could be determined for 89% of births.[5] Among births classified, the breakdown of pregnancy intention is as follows: 60% wanted, 30% mistimed, and 10% unwanted. In contrast to much previous research, we differentiate between unwanted and mistimed births in our empirical analysis.

Researchers have questioned the validity of information about pregnancy intention (Klerman and Jekel 1984; Miller 1974; Rosenzweig and Wolpin 1993; Westoff and Ryder 1977). Westoff and Ryder, for example, suggested that mothers (or parents) may engage in "*ex post* rationalization": After a child is born, they may disproportionately report the pregnancy as intended. Klerman and Jekel (1984) argued that responses to questions about pregnancy intention depend on the circumstances in which the information is obtained, including, for example, the interviewer's race and sex. In contrast, Schoen et al. (1999) showed that fertility intention (i.e., wantedeness) predicts fertility accurately and is the most important predictor of fertility beside marital status. The upshot is that pregnancy intention may be measured with some error; thus estimates of its effect on infant and child development may be biased.

Outcomes

The NLSY contains measures of infant health, child cognitive development, child social development, and maternal behaviors related to infant health. In 1986, 1988, 1990, and 1992 a battery of child assessments was administered to all children born to female respondents by those dates. From these assessments we have chosen three measures of cognitive development and one measure of social development.

The cognitive assessments are (raw) scores on the Peabody Individual Achievement Tests (PIATs) of reading and math, and the Peabody Picture Vocabulary Test (PPVT-R). The PIAT reading recognition test measures primarily word recognition. The PIAT math test measures the child's attainment in mathematics as taught in mainstream education. The PIAT test instruments are the same for all children; thus the raw score on the test increases as the child grows older and can answer more of the questions correctly. For example, the math test consists of 84 multiple-choice questions beginning with recognizing numerals and progressing to trigonometry (Baker et al. 1993). The PIAT is a widely used assessment of cognitive ability and academic achievement, and is a reliable and valid measure of various aspects of child cognitive development.[6] The PPVT-R is a measure of receptive vocabulary for Standard American English. Children may have taken these tests on more than one occasion, so we selected the first test score for each child. We also reestimated all models using the last test score; the results were qualitatively similar to those reported below for the first test.[7]

To measure social development we use the raw score on the Behavior Problems Index (BPI), which measures mater-

2. The eligible population includes those respondents who were not intentionally dropped from the sample. In 1985 the NLSY dropped a subsample of military participants; in 1991 it dropped a subsample of disadvantaged white youths. See the *NLS Handbook* (Center for Human Resources 1994).

3. As of 1992 only 10% of all children of NLSY mothers were born before 1979.

4. Questions on pregnancy intention were first asked in 1982. Thus, for children born between 1979 and 1981, assessment of pregnancy intention may have been obtained as long as three years after the birth. As an adjustment, we control for year of birth in model B in Table 2, and control for child's age and year of assessment in all models in Table 3.

5. We independently developed an algorithm for linking questions on pregnancy intentions in the NLSY to child outcomes. We then cross-checked our assignment of pregnancy intentions with two other independent assignments: one by Baydar (1995) and the other by Rosenzweig and Wolpin (1993). Agreement between the three assignments was over 90%. For cases that we could not assign, we used the assignment of Baydar (1995) if available. We were unable to link specific child outcomes to pregnancy intention questions for approximately 11% of the children in the sample. For these cases, we created a dummy variable indicating that their status could not be determined.

6. See Baker et al. (1993) for a complete description of the cognitive tests administered to the children in the NLSY.

7. Our results were hardly affected by whether we used outcomes from the first or the last time the child was assessed, because the age ranges for each test are very narrow. For example, approximately 95% of the children in our sample took the math and reading tests between ages 5 and 7. In addition, we include individual-year dummy variables for each child age.

nal reports of problem behaviors. The BPI has been collected in several national surveys and has proved a reliable predictor of socioemotional development (Baker et al. 1993). As in the cognitive tests, we chose the first BPI assessment for each child. Note that the BPI is scaled so that higher scores indicate more behavior problems (see Table 1).

We use a dichotomous indicator of low birth weight (less than 5.5 pounds) as a measure of infant health. Although the NLSY information on birth weight is based on maternal reports, comparisons of birth weight reports from the NLSY and from vital records showed high rates of agreement (Baker et al. 1993).

The NLSY contains several measures of maternal behaviors and resource utilization that not only may affect child development but also may be correlated with pregnancy intention. Several measures are related to birth outcomes, including prenatal care, cigarette smoking, and alcohol consumption during pregnancy. For the neonatal period, the NLSY contains information on infant-feeding practices.

The NLSY also contains an extremely rich set of controls. It offers extensive longitudinal information about the mother, including her family background, education and labor market experiences, income, marital history, cognitive ability and achievement (i.e., Armed Services Vocational Aptitude Battery), and psychological indices (e.g., Rotter Scale of Self-Efficacy). The longitudinal data allow us to construct several summary measures of maternal and family characteristics during the child's lifetime, such as average family income.

RESULTS

Descriptive Analysis

Table 1 presents sample means for outcomes by pregnancy intention. We calculate these figures using NLSY sampling weights.

We find substantial differences in outcomes by pregnancy intention. Outcomes were worst for children whose mother reported their pregnancy to be unwanted: Unwanted children received less prenatal care, were more likely to have mothers who were heavy smokers during pregnancy, were less likely to be breast-fed, and had higher rates of low birth weight than did children who were intended. Infants whose mothers reported that the pregnancy was mistimed, or infants

TABLE 1. MEAN OUTCOMES FOR INFANTS AND CHILDREN, BY PREGNANCY INTENTIONS

	Intended	Mistimed	Unwanted	Not Determined
Infant Outcomes				
Late prenatal care initiation (> 6 months)	0.046	0.063	0.083	0.065
Prenatal smoking (> 1 pack per day)	0.081	0.103	0.122	0.143
Birth weight in ounces	119.1	117.6	114.7	117.4
Low birth weight (< 88 ounces)	0.064	0.063	0.116	0.086
Ever breast-fed	0.567	0.452	0.329	0.464
Number of observations (N = 7,751)	4,325	2,011	627	788
(row percentage)	(55.8)	(26.0)	(8.1)	(10.2)
Child Outcomes Ages 5–13				
PIAT math score	17.54	17.06	14.97	16.22
(standard deviation)	(8.25)	(8.25)	(6.70)	(7.65)
PIAT reading score	19.00	19.20	17.23	18.33
(standard deviation)	(9.04)	(8.98)	(7.31)	(8.91)
Number of observations (N = 4,250)	2,199	1,240	353	458
(row percentage)	(51.7)	(29.2)	(8.3)	(10.8)
Child Outcomes Ages 4–13				
Behavior Problems Index score	8.84	10.15	10.06	9.26
(standard deviation)	(5.66)	(5.75)	(6.00)	(5.67)
Number of observations (N = 4,814)	2,532	1,389	395	498
(row percentage)	(52.6)	(28.9)	(8.2)	(10.3)
Child Outcomes Ages 3–13				
Peabody Picture Vocabulary Test score	47.40	47.04	39.95	38.96
(standard deviation)	(21.45)	(23.73)	(21.56)	(21.86)
Number of observations (N = 5,329)	2,852	1,498	424	555
(row percentage)	(53.5)	(28.1)	(8.0)	(10.4)

Notes: The number of observations refers to the outcome with the most nonmissing observations. All figures are calculated with NLSY sampling weights.

for whom pregnancy intention could not be determined, showed better outcomes than unwanted infants but worse than those who were intended. We observe a similar pattern for child outcomes, although the differences are less pronounced than for infant outcomes except for the Peabody Picture Vocabulary Test.

Table 1 provides preliminary evidence that unintended pregnancy harms infant and child development. As noted previously, however, unintended pregnancy is also associated with other factors that may affect infant and child development. Indeed, this point is confirmed by a comparison of means (not shown) for other sociodemographic characteristics of the mother by pregnancy intention: Mothers who characterize the pregnancy as unwanted are more likely to have never married, to be black, to have lower family income, to have completed less schooling, and to have scored lower on the Armed Forces Qualifications Test (a test of academic ability and achievement). The observed association between social and economic disadvantage and unwanted pregnancy provides an alternative explanation for the adverse infant and child outcomes associated with unwanted pregnancy in Table 1. To investigate these competing explanations, we turn to the multivariate analysis.

Regression Estimates

Tables 2 and 3 summarize results of regression analyses for eight different outcomes related to infant and child development. Table 2 presents results related to maternal behaviors associated with infant health and birth weight; Table 3 presents the results related to child development. As noted, a child may be assessed in more than one year for a particular outcome (e.g., PIAT tests); therefore we select the outcome corresponding to the first time the child was assessed (see note 6).

We present estimates from three sets of regressions. Estimates in columns 1 and 2 are based on the complete cross-section of pregnancies and/or children; estimates in columns 3 and 4 are based on sibling differences (mother fixed effects); estimates in columns 5 and 6 are based on between-family differences, where the unit of observation is the family and where observations are averages taken across all children present in the family.

For each sample, we estimate two models. Model A contains a limited set of exogenous variables such as region of residence, child's sex, mother's race and ethnicity, and measures of the mother's family background (e.g., family structure at age 14). Model B includes, in addition to the controls contained in model A, a variety of sociodemographic variables that are less plausibly exogenous, such as the child's birth order, the mother's age at birth, family AFDC status, mother's education, mother's labor force status, and family income. (The complete list of variables appears in the footnotes to Tables 2 and 3.) Characteristics such as the mother's race and ethnicity and the mother's family structure at age 14 do not vary by sibling; therefore these variables are omitted from the model when regressions include mother fixed effects.

One additional point pertains to the timing of measurement. In the analyses related to infants, most mother and family characteristics are measured at the first survey after the birth of the child. In the analyses of child outcomes, mother and family characteristics are measured either at the time of the child assessment (e.g., mother's education) or as an average over the child's life (e.g., family income; see Eq. (1)). Lifetime averages are intended to capture cumulative processes in development. For example, contemporaneous measures of family characteristics such as income may be noisy measures of the conditions that prevailed during most of a child's life (Duncan and Brooks-Gunn 1997).

Maternal behaviors and infant health. Cross-sectional estimates from model A provide the most consistent evidence of a direct relationship between unwanted and (to a lesser extent) mistimed pregnancy and adverse maternal behaviors and infant health. For each maternal behavior, the coefficient associated with an unwanted pregnancy is generally twice as large as the coefficient on mistimed pregnancy. In the case of very late prenatal care, for instance, women whose pregnancies are unwanted are 2.8 percentage points more likely to initiate care after the sixth month of pregnancy than are women whose pregnancies are intended. This effect is relatively large, given that approximately 6% of women in our sample begin prenatal care after the sixth month. We find substantially smaller differences in timing of prenatal care between women whose pregnancies are intended and women with mistimed pregnancies: only 1.5 percentage points. In the case low birth weight, the coefficients on mistimed and on unwanted pregnancy differ in sign and statistical significance.

Estimates obtained from model B provide less evidence that unintended pregnancy is associated with adverse behaviors and health outcomes. For example, the coefficients of unwanted pregnancy are smaller (by about 50% on average) than in model A and are statistically significant for prenatal care timing, heavy smoking, and breast feeding (column 1). In the case of mistimed pregnancy, adding covariates to model A eliminates all but one statistically significant association between mistimed pregnancy and maternal behaviors and infant health (column 2). The most important of the additional variables, in terms of their influence on the effect of pregnancy intentions, are mother's age at birth, mother's marital status, mother's education (particularly in the smoking model), and year of birth.

Estimates obtained from sibling differences (mother fixed effects) are presented in columns 3 and 4; the between-family estimates are shown in columns 5 and 6. Coefficients of both unwanted and mistimed pregnancy in model A with mothers' fixed effects are smaller, in most cases, than the corresponding cross-sectional estimates. In regard to heavy smoking, for example, the cross-sectional estimates indicate that the proportion of heavy smokers among mothers with unwanted pregnancies is 5.9 percentage points greater than among mothers with intended pregnancies ($p < .01$). The difference for mistimed pregnancies is 2.7 percentage points ($p < .05$). When we compare this result with estimates that

TABLE 2. ESTIMATES OF THE EFFECT OF PREGNANCY INTENTION ON PRENATAL AND POSTPARTUM OUTCOMES

	Cross-Section[a] Logit Coefficients		Within-Mother[b] Logit Coefficients		Between-Families[c] OLS Coefficients	
	Unwanted (1)	Mistimed (2)	Unwanted (3)	Mistimed (4)	Unwanted (5)	Mistimed (6)
Late Prenatal Care						
Model A[d]	0.522**	0.276*	0.545†	0.039	0.026	0.019*
	(0.183)	(0.121)	(0.292)	(0.201)	(0.017)	(0.009)
	[.028]	[.015]	[.029]	[.002]		
Model B[e]	0.341†	0.180	0.592†	–0.005	0.018	0.012
	(0.191)	(0.125)	(0.322)	(0.227)	(0.018)	(0.009)
	[.018]	[.010]	[.032]	[.000]		
Heavy Smoking						
Model A[d]	0.704**	0.326**	0.307	0.233	0.068**	0.029*
	(0.152)	(0.104)	(0.322)	(0.227)	(0.022)	(0.012)
	[.059]	[.027]	[.026]	[.019]		
Model B[e]	0.274†	0.152	0.196	0.254	0.016	0.010
	(0.164)	(0.112)	(0.384)	(0.255)	(0.021)	(0.012)
	[.023]	[.013]	[.016]	[.021]		
Low Birth Weight						
Model A[d]	0.274†	–0.135	0.014	–0.137	0.032	–0.017†
	(0.153)	(0.111)	(0.263)	(0.189)	(0.022)	(0.010)
	[.020]	[–.010]	[.001]	[–.010]		
Model B[e]	0.019	–0.280	0.062	–0.168	0.006	–0.029**
	(0.159)	(0.113)	(0.279)	(0.196)	(0.023)	(0.010)
	[.001]	[–.020]	[.004]	[–.012]		
Breast Feeding						
Model A[d]	–0.481**	–0.248**	–0.410*	–0.211	–0.103**	–0.082**
	(0.112)	(0.065)	(0.215)	(0.143)	(0.034)	(0.020)
	[–.119]	[–.061]	[–.101]	[–.052]		
Model B[e]	–0.199†	–0.105†	–0.424†	–0.117	–0.016	–0.034†
	(0.119)	(0.069)	(0.237)	(0.153)	(0.034)	(0.020)
	[–.049]	[–.026]	[–.105]	[–.029]		

Notes: Except for the estimates in columns (5) and (6), estimates of the effect of pregnancy intention on late prenatal care, heavy smoking, low birth weight, and breast feeding were obtained by logistic regression. Standard errors are in parentheses. For logistic regression models, marginal effects, evaluated at the mean probability for the full sample, are in brackets. Standard errors for cross-sectional estimates have been adjusted for correlation among siblings.

[a]All children with valid outcome; sample sizes vary from 7,429 to 7,751.

[b]All families with at least two children; sample sizes vary from 560 to 1,461.

[c]Family averages for all families with children; sample sizes vary from 4,098 to 4,145.

[d]Model A (exogenous controls): a dummy variable for child's sex; dummy variables for region (3) and urban residence (2) in the year following the child's birth; dummy variables for mother's race/ethnicity (2); characteristics of the mother's household when she was 14 years old: whether it was a two-parent household, whether the household received newspapers or magazines, whether someone in the household had a library card, and the educational attainment of the mother's mother.

[e]Model B (exogenous and potentially endogenous controls): In addition to the variables in Model A, a dummy variable for whether child was first born; the number of siblings at the time of birth; dummy variables for mother's religious attendance (2) in 1979; dummy variables for year of child's birth (13); mother's marital status (2) and AFDC participation in the year following the birth; mother's education, age at birth, and family income in the year following the birth; and her 1980 AFQT score, 1979 self-efficacy (Rotter) score, and 1980 self-esteem score.

†$p < .10$; *$p < .05$; **$p < .01$

include for mother fixed effects, we find that estimates of the effect of unwanted and mistimed pregnancy on smoking are smaller and statistically insignificant. This pattern is also evident in the results for low birth weight.

In contrast, fixed-effects estimates from model A associated with prenatal care timing and breast feeding are approximately of the same magnitude as the corresponding cross-section estimates. When additional covariates are added to

TABLE 3. ESTIMATES OF THE EFFECT OF PREGNANCY INTENTION ON CHILD DEVELOPMENT

	Cross-Section[a] OLS Coefficients		Within-Mother[b] OLS Coefficients		Between-Families[c] OLS Coefficients	
	Unwanted (1)	Mistimed (2)	Unwanted (3)	Mistimed (4)	Unwanted (5)	Mistimed (6)
Math Scores						
Model A[d]	–0.416	–0.182	0.264	–0.071	–0.448	–0.162
	(0.312)	(0.216)	(0.719)	(0.459)	(0.408)	(0.268)
Model B[e]	–0.047	–0.068	0.323	0.013	–0.079	–0.072
	(0.307)	(0.210)	(0.719)	(0.464)	(0.400)	(0.264)
Reading Scores						
Model A[d]	–0.576†	–0.025	–0.154	0.031	–0.663	–0.083
	(0.309)	(0.235)	(0.628)	(0.464)	(0.428)	(0.299)
Model B[e]	–0.059	0.108	–0.042	0.023	–0.065	0.117
	(0.298)	(0.221)	(0.617)	(0.461)	(0.412)	(0.297)
PVT						
Model A[d]	–1.623*	–0.883†	0.250	1.216	–1.961	–1.498
	(0.696)	(0.461)	(1.246)	(0.755)	(1.020)	(0.630)
Model B[e]	0.118	–0.181	0.194	1.110	0.005	–0.699
	(0.680)	(0.436)	(1.267)	(0.758)	(1.003)	(0.617)
BPI						
Model A[d]	–0.836*	–0.666**	–0.178	–0.112	–0.951*	–0.927**
	(0.359)	(0.200)	(0.596)	(0.364)	(0.442)	(0.257)
Model B[e]	–0.365	–0.374†	–0.333	–0.090	–0.389	–0.598*
	(0.355)	(0.200)	(0.609)	(0.359)	(0.451)	(0.260)

Notes: All estimates obtained with ordinary least squares. Standard errors are in parentheses and have been corrected for clustering; STATA's algorithm used for robust estimation (Stata Corporation 1997).

[a]Earliest observed valid outcome for all children; sample sizes vary from 5,329 to 4,193.

[b]All families with at least two children; sample sizes vary from 3,769 to 2,669.

[c]Family averages for all families with children; sample sizes vary from 3,143 to 2,669.

[d]Model A (exogenous controls): a dummy variable for child's sex; dummy variables for region (3) and urban residence (2) in the year following the child's birth; child's age in months; dummy variables for year of assessment (2); dummy variables for mother's race/ethnicity (2); characteristics of the mother's household when she was 14 years old: whether it was a two-parent household, whether the household received newspapers or magazines, whether someone in the household had a library card, and the educational attainment of the mother's mother.

[e]Model B (exogenous and potentially endogenous controls): In addition to the variables included in Model A, a dummy variable for whether child was first born; the number of siblings at the time of assessment; dummy variables for mother's religious attendance (2) in 1979; proportion of years of child's life that mother was never married, separated/divorced, and received AFDC; averages over the child's life of family income; mother's weeks worked per year and hours worked per week, an interaction of weeks and hours worked; mother's education at assessment; mother's age at birth; and mother's 1980 AFQT percentile score, 1979 self-efficacy (Rotter) score, and 1980 self-esteem score.

†$p < .10$; *$p < .05$; **$p < .01$

the fixed-effects models (i.e., model B), the estimates associated with smoking and low birth weight become even smaller, but those associated with prenatal care timing and breast feeding are hardly affected.

One interpretation of the mother fixed-effects procedure is that it is an effective control for unobserved heterogeneity. In particular, the results associated with heavy smoking and low birth weight suggest that unmeasured family background characteristics rather than pregnancy intention account for the adverse behaviors associated with unintended pregnancies. An alternative interpretation is that the within-mother estimates (sibling differences) are biased downward because of effects that "spill over" from a mother's unintended pregnancies to her intended pregnancies. The "spillover" argument is also supported by the model A estimates from the between-family analysis, which also tend to be larger than model A fixed-effects estimates.

Other estimates in Table 2, however, support the interpretation that pregnancy intention is confounded by family background. First, the coefficients in models A and B for the

within-mother sample are similar (columns 2 and 3); this finding suggests that the addition of mother fixed effects in the more parsimonious specification (model A) is an effective control for the characteristics introduced as controls in model B. Second, the coefficients for model B obtained from the cross-sectional and between-family approaches are similar to estimates obtained with mother fixed effects, although the between-family estimates are significantly smaller in the case of prenatal care timing and breast feeding. In other words, we apparently eliminate the confounding effect of family background either by including mother fixed effects or by including a detailed set of observed characteristics. An advantage of the mother fixed-effects specification, however, is that these specifications do not include potentially endogenous covariates.

In sum, we find relatively weak support for the hypothesis that unintended pregnancy is associated with adverse maternal behaviors and poor infant health, adjusted for family background. Some evidence suggests that unwanted pregnancy is associated with very late prenatal care, heavy smoking, and reduced breast feeding (column 1), but these findings are not robust. We next examine the relationship between child cognitive and behavioral development and pregnancy intention.

Child cognitive development. Table 3 summarizes results of regression models in which the dependent variable is one of four measures of cognitive or socioemotional development: the Peabody Picture Vocabulary Test (PPVT-R), the PIAT math test, the PIAT reading recognition test, and the Behavior Problems Index (BPI). We multiply the BPI by –1 so that higher indices reflect better development, as in the other cognitive outcomes.

Nearly all the estimates in Tables 3 suggest that pregnancy intention has little effect on children's cognitive development. In the case of mistimed pregnancies, few estimates in Table 3 are statistically significant. This result is similar to our previous findings for maternal behaviors and infant health. Thus the results shown in Tables 2 and 3 suggest that mistimed pregnancies are not significantly associated with adverse consequences for infants and children. This finding has been obscured in past studies that treated all unintended pregnancies equally.

Cross-sectional estimates in model A indicate that children resulting from unwanted pregnancies register lower reading scores, have less highly developed vocabularies, and suffer greater behavioral problems than do children from intended pregnancies. Yet once we control for family and environmental factors (observed or unobserved), estimates of the effect of unwanted pregnancy on children's cognitive development are small and not statistically significant. Except for the BPI, estimates based on sibling differences (mother fixed effects) in model A are similar to those based on between-family variation from model B (columns 3 and 5). As before, inclusion of mother fixed effects appears to be an effective method to eliminate confounding from family background. The advantage of sibling differences (mother fixed effects) is that we can control for family background without the need to include potentially endogenous covariates, although estimates obtained through sibling differences may be biased because of "spillover" effects.

Additional Analyses (Not Shown)

To investigate whether differences between the cross-section and the mother fixed-effects estimates in Tables 2 and 3 could be due to differences in the samples rather than in the method, we reestimated the cross-sectional models but limited the sample to families with at least two children. The estimates differed inconsequentially from the full cross-section.

We argued that the between-family estimates (columns 5 and 6) were less subject to "spillover" bias than were within-family estimates. A limitation of these estimates, however, is the potential confounding from unobserved family background. We interpret the agreement among estimates in Table 2 and 3, especially in model B, as evidence that such confounding is not likely. Nevertheless, we estimated effects based on differences among first cousins: that is, differences among children whose mothers are sisters (family fixed effects). These estimates also would be less likely to be affected by "spillover" bias, but would control more effectively for unmeasured background characteristics than would the between-family estimates. Estimates from these models were uninformative: measured imprecisely, unstable across specifications, and often counterintuitive (results are available on request). Moreover, cross-sectional estimates obtained from this sample of sisters and their children were dissimilar to estimates from the full cross-section.

DISCUSSION

As noted in our introduction, the report by the Institute of Medicine concluded that an unintended child "is at greater risk of being born at low birth weight, of dying in its first year of life, of being abused, and of not receiving sufficient resources for healthy development" (Brown and Eisenberg 1995:1). We analyzed the association between unintended childbearing and child health and cognitive development, controlling for family background and parental characteristics. We found some evidence that unwanted pregnancy is associated with less healthy prenatal and postpartum behaviors, but that it has little association with birth weight or child cognitive outcomes. In some models, women whose pregnancies were unwanted were more likely to delay prenatal care and to smoke during pregnancy than women whose pregnancies were wanted, and were less likely to breast-feed. We found no relationship, however, between pregnancy intention and birth weight. One explanation is that the differences in smoking and use of prenatal care by pregnancy intention may be too small to permit detection of their effect on low birth weight, given our sample sizes.

Although we found little association between pregnancy intention and our measures of child social and cognitive development, the effects of other variables in these models, such as family income, mother's education and cognitive ability, and family structure, were usually significant. Thus the absence of a significant effect of pregnancy

intentions is not a consequence of poorly measured outcomes. The disadvantage of including this extensive set of family background measures is that many of these variables—family size, marital status, AFDC participation, and labor supply, for instance—are potentially endogenous or could be mechanisms through which unintended pregnancy affects child outcomes. If this is so, it may be inappropriate to control for these variables in assessing the effect of unintended pregnancy. Yet in models that include few controls but adjust for family background by including mother fixed effects, we also found little evidence for an effect of unintended pregnancy on child development.

In sum, our findings challenge the notion that unwanted pregnancy harms infant health and child development as measured in our data. Our results suggest that the robust associations between pregnancy intention and infant health reported in the literature are confounded by unmeasured family background variables. Policies that reduce births resulting from unintended pregnancies may have only a limited effect on the health and development of a particular woman's children. In contrast, policies that reduce the social and environmental deficits into which unwanted children are born, or directly target adverse infant health and child development, hold greater promise for improving these outcomes. Such a policy prescription, however, should rest on a thorough examination of the costs and effectiveness of various intervention strategies.

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