



Original Contribution

Children Born After Unplanned Pregnancies and Cognitive Development at 3 Years: Social Differentials in the United Kingdom Millennium Cohort

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Initially submitted August 3, 2012; accepted for publication March 13, 2013.

Children born after an unplanned pregnancy have poorer developmental scores. This could arise from less favorable parenting but also could reflect confounding from the socioeconomic circumstances. In a large representative sample in the United Kingdom, the Millennium Cohort Study (2001–2005), cognitive delay at 3 years was explored with the Bracken Assessment. Its association with unplanned pregnancy was studied in logistic models controlling for demographic and socioeconomic characteristics of the family, the child's characteristics, and parenting behavior. Stratification by the mother's educational level (grouped into 3 categories) was explored. Of 12,182 children included in the analysis, 41% were born after a pregnancy reported by the mother to have been a "surprise." Such unplanned pregnancies were associated in univariate analysis with more cognitive delay. Among mothers with a low or middle level of education, this association vanished when socioeconomic circumstances were controlled. Among mothers with a high level of education, the risk of cognitive delay remained significantly and unexplainedly raised after unplanned pregnancies, despite controlling for socioeconomic characteristics and parental behavior. In conclusion, for socially disadvantaged children, having resulted from an unplanned pregnancy does not seem to increase their already disproportionate risk of cognitive delay. Births after unplanned conceptions are mainly a symptom rather than a source of disadvantage.

child development; follow-up studies; parenting; socioeconomic factors; United Kingdom; unwanted child

Factors operating as early as the prenatal period can have long-term consequences for child development (1, 2). Whether the pregnancy was planned or not is one of the factors that could have long-term consequences for the child. Despite widespread use of contraception and abortion in developed countries (3, 4), the proportion of live births resulting from an unplanned pregnancy (i.e., either a pregnancy that never would have been wanted or a pregnancy that was not wanted at that particular time) remains high, with rates as elevated as 43% in the United States (5), 34% in the United Kingdom (6), and "only" 18% in France (7). Unplanned pregnancies leading to the birth of a child are strongly associated with socially and economically disadvantaged parents (8, 9). The scale of births after an unplanned pregnancy (20%–40% of children in developed countries) warrants an investigation of the consequences for the child.

Some studies have already claimed that births after an unplanned pregnancy could be associated with an increased risk of impaired child development, low verbal ability, and low educational attainment (10–12). In more than 6,971 families followed in a representative cohort of children in the United

States, mistimed and unwanted pregnancies were associated with lower development at 3 years on the Denver Developmental Score, which measures personal-social, fine-motor, language, and gross-motor skills (13). To explain such an association, it had been suggested that unplanned pregnancies could be accompanied by parenting behaviors less favorable to child development (14). Research has found associations of births after unplanned pregnancies with poorer prenatal and postnatal behaviors, such as later and fewer antenatal care visits and less frequent breastfeeding (15, 16), an impaired mother-child relationship (10, 17), a more authoritarian parenting style (10, 18, 19), and fewer opportunities for skill development during childhood—that is to say, a less effective home learning environment (10). Thus, parenting behavior seems to be a possible mediator in the pathway between unplanned pregnancies and child development. Unplanned pregnancy could have an impact not only during childhood but also later in life, as suggested by increased mental health problems and lower self-esteem among teenagers and young adults whose births were not planned (20–22).

To understand whether the association of an unplanned pregnancy with child development represents a causal pathway, it is necessary to allow for the possible spurious confounding impact of the family's social and economic characteristics (12, 13, 23). Family socioeconomic disadvantage is a well-known risk factor both for impaired child development (24–26) and for unplanned births (8, 9). Moreover, the consequences of having a birth after an unplanned pregnancy appear to vary with socioeconomic differences in the importance of planning in other aspects of a woman's life, such as qualifications, career, and housing (27, 28). This suggests the hypothesis of a differential impact of unplanned pregnancies on child development in different social contexts. For example, an unplanned birth could be particularly disruptive for women with a high educational level who wish to develop a career and could consequently have a stronger impact on the development of children of socially advantaged women.

Our aim is to explore the association between birth after an unplanned pregnancy and child cognitive delay at 3 years in a large cohort from the United Kingdom, the Millennium Cohort Study, by taking into account family socioeconomic circumstances and parental behavior and practices considered as potential mediators (including quality of the mother-child relationship, the home learning environment, and disciplinary practices). Moreover, in an extension to the literature, we stratified analyses by the mother's level of education to explore, for the first time, the differential impacts of unplanned pregnancy in different social contexts.

MATERIALS AND METHODS

The Millennium Cohort Study

The Millennium Cohort Study is an ongoing nationally representative longitudinal study of children born in the United Kingdom in 2000–2002 (29). The sample is stratified by United Kingdom countries and is clustered, with overrepresentation of electoral wards that have high child poverty rates and concentrations of ethnic minorities. At the first survey, when the child was 9 months of age, 18,552 families were interviewed, with a response rate of 72% (30). Of those, 14,898 (80%) were interviewed when the child was 3 years of age. Each survey involved home visits by trained interviewers. The Millennium Cohort Study gained approval from National Health Service Multi-Centre Research Ethics Committees (South Multi-Centre Research Ethics Committee, MREC/01/6/19, and London Multi-Centre Research Ethics Committee, MREC/03/03/22, for the first and second surveys respectively). All questionnaires and detailed information on the survey are available online (www.cls.ioe.ac.uk/mcs).

Unplanned pregnancies

During the survey performed when the child was 9 months old, the mother was asked about the pregnancy of the cohort child: "Were you planning to get pregnant at that time or was it a surprise?" Henceforth, "surprise" is deemed "unplanned" in this article. The intendedness of a pregnancy is measured here simply by the planned/unplanned dichotomy, with no attempt to recognize any degrees of ambivalence.

Child's cognitive assessment

During the survey performed when the child was 3 years old, cognitive development was measured by the Revised Bracken Basic Concept Scale (31). Six subtests were administered to Millennium Cohort Study children (colors, letters, numbers and counting, sizes, comparisons, and shapes). The raw Bracken score was adjusted by age at assessment. According to the Bracken norms for the United States, children with an adjusted score <85 were classified as "delayed" (representing scores that are >1 standard deviation below the mean) (31).

Socioeconomic circumstances, child's characteristics, and parenting behavior

Three groups of other variables were considered, as described in Tables 1 and 2. The first group was socioeconomic circumstances. It included 9 variables (mother's age at the child's birth, number of older siblings, mother's level of education, mother's occupation, child's ethnic group, language spoken at home, family income, perceived financial situation, natural parents' separation by age 3 years), of which all but the last were based on the survey performed at 9 months. Information on the father was not included because the information was missing if the father did not live with the mother or did not respond. Where known, the father's education was correlated with the mother's. This raised the issue of co-linearity in multivariate models. The second group of variables contained child characteristics. It included 2 variables collected at 9 months (sex and health at birth according to prematurity and low birth weight). The third group was a set of possible mediators on parenting behavior. It included 4 variables collected at 9 months (maternal alcohol consumption during pregnancy, maternal smoking during pregnancy, breastfeeding, maternal depressive symptoms on a short version of the Malaise Inventory). Alcohol and smoking consumption during pregnancy were thus collected retrospectively, and underreporting cannot be ruled out. Nine parenting behavior variables were collected when the child was 3 years old (frequency of mother reading to the child, Home Learning Environment Index (32), regular bedtime, child's television watching, frequency of punishment, strictly enforced rules, child-mother closeness, child-mother conflict, mother's perception of herself as a mother). The impact of parental intelligence quotient could not be explored because this information was not collected in the Millennium Cohort Study.

Methods

We selected all families participating at both the 9 months and 3 years surveys, where the natural mother lived in the household and was the main respondent, and for which information on all aforementioned variables were complete. In cases of multiple births, only 1 randomly chosen child was included. All percentages and odds ratios were weighted to reflect the original sampling probabilities. Variances were estimated with the correction for a finite population.

Association between pregnancy planning and cognition was explored through logistic regressions. Nested models were considered: "Model 1" includes only pregnancy planning;

Table 1. Distribution in the Study Population, Percentage of Unplanned Pregnancies,^a and Risk of Delayed Cognitive Development by Socioeconomic Circumstances and Child's Characteristics (*n* = 12,182), United Kingdom Millennium Cohort, 2001–2005

	Distribution in the Study Population ^b		Unplanned Pregnancy, ^{b,c} %	Cognitive Delay, ^{b,d} %
	No.	%		
Mother's age at the child's birth, years				
≤19	900	7	84	22
20–24	2,048	16	59	17
25–29	3,372	28	36	12
30–34	3,815	32	30	9
35–39	1,779	15	32	9
≥40	268	2	50	8
Number of older siblings				
≥2	2,740	21	57	20
1	4,353	37	31	11
0	5,089	42	42	9
Mother's level of education ^e				
Low	2,689	21	60	25
Middle	5,469	45	43	11
High	4,024	34	27	5
Mother's occupation				
Does not work	785	5	69	35
Semiroutine or routine	4,323	35	53	19
Lower supervisory, technical	689	5	50	15
Small business employer	453	4	32	8
Intermediate	2,227	19	37	7
Managerial and professional	3,705	32	26	4
Natural parents' separation				
Never lived together	9,985	82	83	23
Together only at 9 months	769	7	57	18
Lived together at 3 years	1,428	11	34	10

Table continues

“Model 2” introduces the 9 socioeconomic variables; “Model 3” adds the 2 child characteristics; and “Model 4” also includes the 13 parenting behavior variables. The possibility of collinearity was explored by testing the stability of results with different subgroups of variables (results not shown).

Differential impacts of unplanned pregnancy were explored with consideration of the social context. Social context was proxied by mother's level of education, which represents a major axis of socioeconomic advantage. Roughly, the “high” educational level group was “college educated”—that is, those with degrees, bachelors or higher, or equivalent vocational qualifications (National Vocational Qualification Level 4 or 5). “Middle” educational level covers those who did not proceed to college but gained academic qualifications at secondary school, or equivalent vocational qualifications, at National Vocational Qualification Levels 2 and 3. The “low” educational level group had minimal (Level 1 or other overseas)

or no qualifications. A first approach was to simply test an interaction between pregnancy intendedness and mother's level of education (results not shown). The second was to perform a stratified analysis by mother's level of education to allow for more complex and pervasive social interactions. Empirically, stratification proved the more appropriate strategy. Data analyses were carried out in Stata/SE version 11.1 (StataCorp LP, College Station, Texas).

RESULTS

Of the 14,898 families who participated in the first 2 surveys, 12,182 (82%) were entered in this analysis. Reasons for exclusion included the following: Main respondent was not the natural mother (*n* = 411); values on pregnancy planning were missing (*n* = 19); Bracken Assessment was not fully completed (*n* = 1,518); or values on at least 1 other variable

Table 1. Continued

	Distribution in the Study Population ^b		Unplanned Pregnancy, ^{b,c} %	Cognitive Delay, ^{b,d} %
	No.	%		
Child's ethnic group				
Other than white	1,433	10	52	24
White	10,749	90	40	11
Language spoken at home				
Other than English (and English eventually)	1,244	7	43	24
English only	10,938	93	41	11
Family income				
Missing data	845	6	39	16
<£10,400	2,601	20	72	24
£10,400–£20,800	3,698	30	43	13
>£20,800	5,038	44	26	5
Perceived financial situation				
Difficult	1,143	10	59	18
Just	3,240	26	51	16
Good	7,799	64	34	9
Sex of the child				
Male	6,109	50	41	15
Female	6,073	50	41	9
Health at birth, according to prematurity (<37 weeks) and low birth weight (≤2,500 g)				
Good	11,037	91	41	12
Premature or low birth weight	1,145	9	47	16

^a The mother was asked whether the pregnancy had been planned or “was a surprise” (deemed “unplanned”).

^b Percentages are weighted, whereas numbers are not weighted.

^c *P* values for χ^2 test comparing proportion of unplanned pregnancy for each variable were always <0.001, except for 2 variables: language spoken at home (*P* = 0.26) and sex of the child (*P* = 0.86).

^d *P* values for χ^2 test comparing proportion of cognitive delay for each variable were always <0.001.

^e The “high” educational level group was “college educated”: those with degrees, bachelor’s or higher, or equivalent vocational qualifications (National Vocational Qualification Level 4 or 5). “Middle” educational level covers those who did not proceed to college but gained academic qualifications at secondary school, or equivalent vocational qualifications, at National Vocational Qualification Levels 2 and 3. The “low” educational level group had minimal (Level 1 or other overseas) or no qualifications.

included in the analysis were missing (*n* = 768). In the study population of 12,182 families, 81% were from England. Sixty percent of the mothers were between 25 and 34 years of age at the child’s birth. Mother’s level of education was high for 34%, middle for 45%, and low for 21%. Most (82%) of the natural parents of the cohort child lived together at both surveys; 58% of the children had older siblings.

In the study sample, 41% of the births followed an unplanned pregnancy (Table 3). There was a strong social gradient on the proportion of unplanned pregnancies, from <30% among mothers with a high educational level to 60% among mothers with a low educational level. Of unplanned pregnancies, 60% occurred among mothers who were teenagers, already had at least 2 children, or did not live with the father. These circumstances varied widely by mother’s educational level (Table 3). Births after an unplanned pregnancy were associated with

socioeconomic hardship, less favorable parenting behavior, and poorer health characteristics at birth (Tables 1 and 2).

The risk of delayed cognitive development was 12% in the whole analysis sample. This risk was twice as high when the birth followed an unplanned pregnancy (17%) as when the pregnancy was planned (8%) (Table 4). The risk of the child’s cognitive delay varied even more by mother’s level of education: from 5% to 25% (Table 1). As in the proportion of unplanned pregnancies, the risk of cognitive delay was associated with socioeconomic hardship, less favorable parenting behavior, and poorer health characteristics at birth (Tables 1 and 2). In each of the 3 subsamples of mother’s level of education, the risk of cognitive delay was much higher when the pregnancy was unplanned than when it was planned (Table 4). Among mothers with a high educational level, the risk of cognitive delay was twice as high when the pregnancy

Table 2. Distribution in the Study Population, Percentage of Unplanned Pregnancies,^a and Risk of Delayed Cognitive Development by Parenting Behavior ($n = 12,182$), United Kingdom Millennium Cohort, 2001–2005

	Distribution in the Study Population ^b		Unplanned Pregnancy, ^{b,c} %	Cognitive Delay, ^{b,d} %
	No.	%		
Maternal alcohol consumption during pregnancy ^e				
Never	8,323	66	43	14
Light	2,956	27	35	8
Moderate	647	5	48	11
Heavy/binge	256	2	52	15
Maternal smoking during pregnancy				
Smoked during pregnancy	2,813	22	62	19
Stopped smoking during first trimester	1,349	12	50	11
No smoking during pregnancy	8,020	66	33	10
Breastfeeding				
Never tried	3,935	30	53	18
Tried briefly or for ≤ 2 weeks	2,109	16	41	12
Breastfed for 2 weeks to 3 months	2,267	20	38	10
Breastfed for >3 months or 13 weeks	3,871	34	32	7
Maternal depressive symptoms at 9 months				
Depressive symptoms	1,701	13	55	17
No depressive symptoms	10,481	87	39	11
Frequency of mother reading to the child				
Not at all	238	2	67	47
Less often	222	2	65	35
Once or twice a month	310	2	49	24
Once or twice a week	1,831	14	52	20
Several time a week	2,358	19	43	12
Every day	7,223	61	36	8
HLE index				
1st HLE quintile (lowest HLE)	2,438	19	46	19
2nd HLE quintile	2,441	20	41	15
3rd HLE quintile	2,463	20	41	11
4th HLE quintile	2,474	21	40	8
5th HLE quintile (highest HLE)	2,366	20	38	6
Regular bedtime				
Never	910	7	55	21
Sometimes	1,594	12	55	18
Usually	4,615	38	40	11
Always	5,063	43	36	9

Table continues

was unplanned than when it was planned, but this corresponded to an increase in the risk of only 4%. Among mothers with a low educational level, the risk of cognitive delay was only 1.4 times higher when the pregnancy was unplanned than when it was planned. However, the increase in the risk was 8%. In the univariate logistic analysis (Table 5, Model 1), an unplanned pregnancy was significantly associated with cognitive delay in the whole sample and in each subsample

by mother's level of education. When the Bracken cognitive score was used as a continuous instead of a binary variable (Web Figure 1, available at <http://aje.oxfordjournals.org/>), a negative and linear relation was observed with the proportion of unplanned pregnancy for mothers with middle and low educational levels. Among mothers with a high educational level, the negative slope did not extend downward over the whole range of scores (Web Figure 1B). Complementary

Table 2. Continued

	Distribution in the Study Population ^b		Unplanned Pregnancy, ^{b,c} %	Cognitive Delay, ^{b,d} %
	No.	%		
Child's television watching, hours				
>3	2,109	17	54	18
1–3	7,243	60	40	10
0–1	2,830	23	35	12
Frequency of punishment				
Missing data	2,026	15	49	19
Daily on ≥2 items	2,364	20	45	14
Daily on 1 item	2,156	18	35	10
Less than daily	5,636	47	39	9
Strictly enforced rules				
Not strictly enforced	3,060	24	48	17
Varies	3,432	27	40	12
Strictly enforced	5,690	49	38	10
Child-mother closeness				
Missing data	1,455	11	54	28
Low	3,379	28	46	16
Normal or high	7,348	61	37	8
Child-mother conflict				
Missing data	1,266	9	53	25
High	2,904	25	44	14
Normal or low	8,012	66	38	9
Mother's perception of herself as a mother				
Missing data	1,028	7	47	24
Not very good or in trouble	340	3	61	15
An average parent	4,208	36	43	13
Better than average	2,909	25	34	7
A very good parent	3,697	29	41	11

Abbreviation: HLE, Home Learning Environment.

^a The mother was asked whether the pregnancy had been planned or “was a surprise” (deemed “unplanned”).

^b Percentages are weighted, whereas numbers are not weighted.

^c *P* values for χ^2 test comparing proportion of unplanned pregnancy for each parenting behavior variable were always <0.001.

^d *P* values for χ^2 test comparing proportion of cognitive delay for each parenting behavior variable were always <0.001.

^e Maternal alcohol consumption during pregnancy was defined on the basis of the criteria outlined by the United Kingdom National Alcohol Strategy, presented in detail in Kelly et al. (41). The apparently unexpected patterns of unplanned pregnancies and cognitive delay by level of maternal alcohol consumption during pregnancy are explained by the social differentials in alcohol consumption.

analyses explored the continuous Bracken score in linear regression models (see Web Figure 1, footnote b) and advanced cognitive development (Bracken score >115) in logistic regressions (Web Tables 1 and 2). These showed that factors affecting delayed and advanced child development are different.

In the sample as a whole, the association between an unplanned pregnancy and cognitive delay declined to insignificance as soon as the socioeconomic variables were included (Table 5). Different patterns emerged in the 3 subsamples of mother's level of education. Among mothers with low and

middle educational levels, the association between an unplanned pregnancy and the risk of cognitive delay vanished as soon as the socioeconomic variables were included (Models 2, 3, and 4). Among mothers with a high educational level, the association decreased but remained significant (*P* = 0.01) when the socioeconomic variables were included (Model 2). When the parenting behavior variables were included (Model 4), the association between an unplanned pregnancy and the risk of cognitive delay decreased (compared with Models 2 and 3) but still remained significant (odds ratio = 1.48, *P* = 0.03).

Table 3. Distributions of Pregnancy Intendedness,^a Happiness, and Birth Circumstances by Mother's Level of Education, United Kingdom Millennium Cohort, 2001–2005^b

	Whole Sample (n = 12,182)	Mother's Level of Education ^c		
		High (n = 4,024)	Middle (n = 5,469)	Low (n = 2,689)
Pregnancy intendedness, %				
Planned	59	73	57	40
Unplanned	41	27	43	60
Happiness about the prospect of having the baby when the mother first knew about the pregnancy				
Among planned pregnancies, %				
(Very) happy	98	99	98	98
Not bothered either way	1	0	1	1
(Very) unhappy	1	1	1	1
Among unplanned pregnancies, %				
(Very) happy	64	73	62	59
Not bothered either way	13	9	13	17
(Very) unhappy	23	18	25	24
Birth circumstances ^d				
Among planned pregnancies, %				
Teenage mother (≤ 19 years)	2	0	2	8
≥ 2 older siblings	15	11	16	25
No father in the household	6	4	7	10
None of the above	77	85	75	57
Among unplanned pregnancies, %				
Teenage mother (≤ 19 years)	15	1	16	23
≥ 2 older siblings	29	26	25	37
No father in the household	16	12	19	16
None of the above	40	61	40	24

^a The mother was asked whether the pregnancy had been planned or "was a surprise" (deemed "unplanned").

^b Percentages are weighted, whereas numbers are not weighted.

^c The "high" educational level group was "college educated": those with degrees, bachelor's or higher, or equivalent vocational qualifications (National Vocational Qualification Level 4 or 5). "Middle" educational level covers those who did not proceed to college but gained academic qualifications at secondary school, or equivalent vocational qualifications, at National Vocational Qualification Levels 2 and 3. The "low" educational level group had minimal (Level 1 or other overseas) or no qualifications.

^d Only 1 circumstance was considered, in the following priority order: teenage mother, ≥ 2 older siblings, or the natural father not living in the household when the child was 9 months of age.

DISCUSSION

Among a large United Kingdom sample, the proportion of unplanned pregnancies was as high as 41%. Information on the planned/unplanned status of the pregnancy was collected in the Millennium Cohort Study when the child was 9 months old. Even if reassuring results have been exhibited on the validity of retrospective assessments of pregnancy intention (33), it cannot be ruled out that mothers might rationalize an unplanned pregnancy as planned after the birth of the child (34, 35), which could lead to an undercounting of unplanned pregnancies. However, the already very high level of unplanned pregnancies observed here, 41%, suggest that mothers did not "rationalize" very much, perhaps because of

the neutral wording of the question ("Were you planning to get pregnant at that time or was it a surprise?"). Moreover, a sensitivity analysis showed that the estimated impact of unplanned pregnancy on child development did not seem very sensitive to misclassification bias under the hypothesis that children from misclassified pregnancies (declared as planned instead of unplanned) have the same risk of cognitive delay as children from declared unplanned pregnancies (Web Figure 2). The proportion of unplanned pregnancies was strongly associated in this study with family socioeconomic disadvantages, in accordance with the literature (8, 9).

The impressive proportion of unplanned pregnancies should be tempered by the fact that 64% of mothers with an unplanned pregnancy recalled that, when they first knew

Table 4. Unplanned Pregnancy^a and Risk of Delayed Cognitive Development at 3 Years (Percentages), United Kingdom Millennium Cohort, 2001–2005^b

	Subjects With Cognitive Delay, %	
	Among Planned Pregnancies	Among Unplanned Pregnancies
Among the whole sample (<i>n</i> = 12,182)	8	17
Among mothers with high educational level ^c (<i>n</i> = 4,024)	4	8
Among mothers with middle educational level ^c (<i>n</i> = 5,469)	9	14
Among mothers with low educational level ^c (<i>n</i> = 2,689)	20	28

^a The mother was asked whether the pregnancy had been planned or “was a surprise” (deemed “unplanned”).

^b Percentages are weighted, whereas numbers are not weighted.

^c The “high” educational level group was “college educated”: those with degrees, bachelor’s or higher, or equivalent vocational qualifications (National Vocational Qualification Level 4 or 5). “Middle” educational level covers those who did not proceed to college but gained academic qualifications at secondary school, or equivalent vocational qualifications, at National Vocational Qualification Levels 2 and 3. The “low” educational level group had minimal (Level 1 or other overseas) or no qualifications.

about the pregnancy, they were in fact happy about the prospect of having that baby (Table 3). This high rate of reported happiness could reflect the fact that in developed countries, women with unplanned pregnancies about which they are unhappy often terminate them and thus are not included in birth samples. Such selection could be socially differentiated, with a higher probability of abortion among advantaged women (27). Less happy mothers also might be more likely to refuse to participate in a cohort study on their children, which would lead to an underrepresentation of less-intended pregnancies in such cohorts. The high level of happiness about an unplanned pregnancy has been discussed in the literature as reflecting women’s ambivalence about pregnancy and the unconscious wish to become pregnant (36).

On the basis of the Bracken test, a validated intellectual screening instrument (37, 38), 12% of the sample was classified as having delayed cognitive development. This risk was quite close to the rate in the normative sample from the United States, 16% (31). However, it is possible that some more-delayed children had been excluded from this analysis, among those 1,518 children who had not attempted or finished the Bracken. These children were significantly different from the children of the analysis sample, having less favorable characteristics in terms of their socioeconomic environment and parental behavior (Web Tables 3 and 4) and having generally lower cognitive scores at age 5 years (Web Table 5). This confirms the suspicion that children with no Bracken score at age 3 years were disproportionately cognitively delayed as well as socially disadvantaged. However, the proportion of unplanned pregnancy was not signifi-

cantly different for children who did not complete the Bracken compared with the study population, once mother’s level of education was controlled (Web Table 6). Therefore, the measured relation between delayed development at age 3 years and pregnancy intendedness could be exaggerated in the analysis sample by the omission of noncompleting children (Web Tables 7 and 8).

The risk of cognitive delay varied strongly with planning status: from 8% among planned pregnancies to 17% among unplanned pregnancies. A few studies have concluded that unwanted pregnancies could have stronger impact than mistimed pregnancies on maternal health behavior during the pregnancy (23, 39, 40). In the present study, we were not able to distinguish between mistimed and unwanted pregnancies. However, possible differences among unplanned pregnancies were explored between those where the mother declared she was happy about the prospect of having that baby and those where she was not (Web Table 9). In multivariate analyses (Model 4), the 2 unplanned groups presented very similar results.

The well-established risk of impaired child development among less-advantaged families (24–26) was evident in this analysis (5%–25%, by maternal educational level). Within the 3 social groups, the risk of cognitive delay increased when the pregnancy was unplanned. When the mother had a low or middle level of education, the association between unplanned pregnancy and child cognitive delay seemed to be explained entirely by its correlation with family socioeconomic circumstances.

Of the 34% of mothers with a high educational level (whose children had a low risk, 5%, of cognitive delay), the association between unplanned pregnancies and cognitive delay was more complex. For these children, the association was due only partly to confounding with socioeconomic circumstances. When parenting behavior variables were introduced, the odds ratio diminished only moderately (from 1.57 in Model 3 to 1.48 in Model 4). Thus, parenting behavior mediated only very partially the relation between unplanned pregnancy and child cognitive development among mothers with a high educational level. Indeed, the mediation of parenting behavior seemed much more limited in these results than had been hypothesized in the introduction. To our knowledge, this is the first investigation of differentials by mother’s level of education in the link between unplanned pregnancies and child cognitive development. This association remained unexplained, in as much as the introduction of 13 parenting behavior variables did not explain fully the relation between unplanned pregnancy and child cognitive delay in the most advantaged group. This significant relation was observed only for delayed and not for advanced cognitive development (data not shown), which suggests a nonlinear relation over the whole spectrum of child development. As mentioned previously, it cannot be ruled out that the association was overestimated because of the exclusion of children who did not complete the Bracken Assessment. Under the hypothesis that children who did not complete the Bracken were actually all delayed, the odds ratio for mothers with a high educational level was significant in Models 1 to 3 but was not significant in Model 4 (with a borderline result: odds ratio = 1.24, 95% confidence interval: 0.99, 1.54; *P* = 0.06) (Web Table 7).

Table 5. Unplanned Pregnancy^a and Risk of Delayed Cognitive Development at 3 Years (Logistic Regressions), United Kingdom Millennium Cohort, 2001–2005^b

	Model 1 Unplanned Pregnancy			Model 2 Model 1 + Socioeconomic Circumstances ^c			Model 3 Model 2 + Child's Characteristics ^d			Model 4 ^e Model 3 + Parenting Behaviour ^f		
	OR ^g	95% CI	P Value	OR ^g	95% CI	P Value	OR ^g	95% CI	P Value	OR ^g	95% CI	P Value
Among the whole sample (<i>n</i> = 12,182)	2.23	1.96, 2.55	<0.001	1.15	0.99, 1.34	0.06	1.15	0.99, 1.33	0.07	1.11	0.95, 1.29	0.21
Among mothers with high educational level ^h (<i>n</i> = 4,024)	2.27	1.67, 3.08	<0.001	1.58	1.14, 2.20	0.01	1.57	1.13, 2.19	0.01	1.48	1.05, 2.08	0.03
Among mothers with middle educational level ^h (<i>n</i> = 5,469)	1.66	1.35, 2.03	<0.001	1.06	0.85, 1.34	0.59	1.05	0.84, 1.32	0.66	1.01	0.80, 1.28	0.94
Among mothers with low educational level ^h (<i>n</i> = 2,689)	1.56	1.28, 1.91	<0.001	1.08	0.87, 1.36	0.48	1.08	0.86, 1.36	0.48	1.05	0.82, 1.34	0.72

Abbreviations: CI, confidence interval; OR, odds ratio.

^a The mother was asked whether the pregnancy had been planned or “was a surprise” (deemed “unplanned”).

^b Odds ratios are weighted, whereas numbers are not weighted.

^c Including 9 socioeconomic circumstances variables: mother's age at the child's birth, number of older siblings, mother's level of education, mother's occupation, child's ethnic group, language spoken at home, family income, perceived financial situation, and natural parents' separation by age 3.

^d Including 2 child characteristic variables: sex and health at birth according to prematurity and low birth weight.

^e Full Model 4 is presented in Web Table 10.

^f Including 13 parenting behavior variables: maternal alcohol consumption during pregnancy, maternal smoking during pregnancy, breastfeeding, maternal depressive symptoms on a short version of the Malaise Inventory, frequency of mother reading to the child, Home Learning Environment Index (32), regular bedtime, child's television watching, frequency of punishment, strictly enforced rules, child-mother closeness, child-mother conflict, and mother's perception of herself as a mother.

^g Odds ratio for the risk of an unplanned birth versus a planned birth (reference category).

^h The “high” educational level group was “college educated”: those with degrees, bachelor's or higher, or equivalent vocational qualifications (National Vocational Qualification Level 4 or 5). “Middle” educational level covers those who did not proceed to college but gained academic qualifications at secondary school, or equivalent vocational qualifications, at National Vocational Qualification Levels 2 and 3. The “low” educational level group had minimal (Level 1 or other overseas) or no qualifications.

The significant association among mothers with a high educational level could reflect stronger adverse consequences of family building not going to plan in more educated milieu. Further research would be needed to explore the precise pathway for any such association. One hypothesis for the raised odds ratios among the highly educated could involve the well-being and mental health of the mother in the long term (and not only in the postnatal period). Another hypothesis could involve the conflicts between the child and the mother, which appeared to be an important factor for risk of child cognitive delay among mothers with a high educational level but not among mothers with low and middle educational levels (Web Table 10). Moreover, it would be important to confirm these results when the child grows beyond early childhood, into school age.

To conclude, birth after an unplanned pregnancy and child cognitive delay are both phenomena highly marked by socio-economic inequalities, with greater risks when the mother has a low level of education. Nevertheless, for children whose mother has a low or middle level of education, no observable impact of having been unplanned can be shown. It cannot be ruled out that the impact of unplanned pregnancy was in fact “masked” by the very strong negative impact of family

social and demographic circumstances. However, in the present social context of mothers with low and middle levels of education, births after unplanned conceptions are a facet or symptom rather than a source of disadvantage. On the other hand, among children of mothers with a high educational level, being unplanned was a disadvantage even though the risk of cognitive delay remained low (8%) compared with the risk for planned children of mothers with low educational level (20%). These results do not suggest that public health policies should focus specifically on children born after unplanned pregnancies. They do reinforce the need to focus on social inequalities as the most important factor in child cognitive differentials and as an important element in unplanned pregnancies.

ACKNOWLEDGMENTS

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This work is based on the United Kingdom Millennium Cohort Study, which is funded by the United Kingdom Economic and Social Research Council and a consortium of government departments.

We thank Dr. Henri Leridon, from Ined, Dr. Laurent Toulemon, from Ined, and Dr. Jean Bouyer, from Inserm, for useful comments on the manuscript.

Conflict of interest: none declared.

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