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Effect of Teenage Pregnancy on Educational Disabilities in Kindergarten

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Teenage pregnancies have become a public health issue because of their observed negative effects on perinatal outcomes and long-term morbidity. The association of young maternal age and long-term morbidity is usually confounded, however, by the high prevalence of poverty, low level of education, and single marital status among teenage mothers. The authors assess the independent effect of teenage pregnancy on educational disabilities and educational problems in a total population of children who entered kindergarten in Florida in 1992–1994 and investigate how controlling for potentially confounding factors affects the relation between teenage pregnancies and poor outcome. When no other factors are taken into account, children of teenage mothers have significantly higher odds of placement in certain special education classes and significantly higher occurrence of milder education problems, but when maternal education, marital status, poverty level, and race are controlled, the detrimental effects disappear and even some protective effects are observed. Hence, the increased risk for educational problems and disabilities among children of teenage mothers is attributed not to the effect of young age but to the confounding influences of associated sociodemographic factors. In contrast to teen age, older maternal age has an adverse effect on a child's educational outcome regardless of whether other factors are controlled for or not. *Am J Epidemiol* 2001;154:212–20.

child development; education, special; logistic models; morbidity; pregnancy in adolescence; socioeconomic factors

Teenage pregnancy has long been identified as a risk factor for adverse perinatal and long-term outcomes (1). The occurrence of low birth weight has been observed to be much higher among children of teenage mothers than among children of women beyond adolescence (1–11), and giving birth during the teen years has been found to be associated with a higher risk of prematurity (2, 9, 12). Negative effects on long-term cognitive and emotional development and on the educational performance of these children have also been consistently observed (13–19). Most of these effects have been attributed to other factors besides young maternal age. These findings are consistent when several industrialized countries are compared (20). Authors have long acknowledged the confounding influences of maternal education, poverty, marital status, and, more generally, family background. Often, even after controlling for such confounding factors, negative effects have still been observed (2, 5, 13, 14), but in some studies, the negative effects have been found to completely disappear, and some positive effects of younger age have even been found (4, 6, 7, 11, 16). Hence, there is still much controversy regarding the true effects of teenage pregnancies (11–28).

Many studies reported in the literature are inconclusive because of small sample sizes, potential biases in the study sample selection, and inadequate control for confounding factors. Some new designs, such as sibling studies and ingeniously chosen control groups, attempt to better control for confounding factors (3, 26), but even in those studies, the separation of maternal age effects and the effects of other confounding factors is not complete. The current study population consisted of all Florida-born children who entered kindergarten in Florida public schools between 1992 and 1994. The large sample size (more than 300,000 records) allowed us to control several important confounders by using multivariable models and to study the effect of maternal teenage on rare outcomes.

Most previous studies that focus on the long-term outcomes of children use as their outcome measure scores on tests of academic achievement, neurologic functioning, and teacher and parent reports. We examine placement in special education classes and in remedial services programs as a result of demonstrated academic problems. Our study is

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Abbreviations: EH, emotionally handicapped; EMH, educable mentally handicapped; IQ, intelligence quotient; LD, learning disabled; PI, physically impaired; PMH, profoundly mentally handicapped; TMH, trainable mentally handicapped.

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population based and allows us to assess the effects of maternal age on functionally determined, school-based disabilities while controlling for a variety of sociodemographic confounders. It was motivated by the results from a previous study by our group (28), in which we compared the effects and the impact of a variety of perinatal and sociodemographic variables on classroom placement by fitting generalized logistic regression models and computing excess/deficit numbers based on these models. The basic study population and the outcome measure in both studies were the same, but in this study, we focus specifically on the effects of maternal age. In the previous analyses of this data set, we unexpectedly observed no detrimental effect of giving birth during the teen years when we controlled for all other risk factors considered, but a negative effect of older age was present. In this study, we examine the influence of confounders on the true effect of maternal age. We fit a variety of models to assess the confounding influences of risk factors for educational problems and investigate the effect of maternal age among subpopulations of teenage mothers.

MATERIALS AND METHODS

Study participants

The study sample consisted of children born in Florida between 1985 and 1990 who entered kindergarten in Florida public schools in the academic years 1992–1993, 1993–1994, or 1994–1995. Kindergarten records were obtained from the Florida Department of Education and were merged with birth records available in the Florida Vital Statistics data set. A total of 339,171 records were available for analysis after records with missing values for any of the variables studied were deleted. This represents 65 percent of the available kindergarten records. The matched and the unmatched records were comparable with respect to the predictor and response variables (28). Nearly all (95 percent) of the children who receive special education services in Florida are in public schools (29), and therefore, nearly all severely and moderately disabled children were included in the analysis. Public schools also serve more than 90 percent of the total kindergarten population in Florida.

Variables

Outcome variables. The outcome variable was educational placement in kindergarten into seven mutually exclusive special education categories designed to serve children with an educational disability, an academic problems category for children with milder educational problems, and a reference category consisting of children who attended regular classroom or gifted classes only. Assignment to special education was determined by the child's primary exceptionality, which identified the disability requiring the greatest allocation of personnel resources (in cases in which more than one disability was diagnosed). Only actual placement was considered. Special education categories included: 1) physically impaired (PI): severe skeletal or neuromuscular condition adversely affecting educational performance; 2) sensory impaired: deaf, blind, hard of hearing, or partially sighted; 3) profoundly mentally handicapped (PMH): intelligence quotient (IQ) less than 25; 4) trainable mentally handicapped (TMH): IQ between 25 and 54; 5) educable mentally handicapped (EMH): IQ between 55 and 69; 6) learning disabled (LD): psychological processing disorders marked by difficulties in the acquisition and use of language, reading, writing, or mathematics; and 7) emotionally handicapped (EH): condition resulting in persistent and maladaptive behaviors.

Procedures for eligibility determination and classification criteria of primary exceptionality are standardized throughout the state's 67 school districts. Placement criteria are dictated by Florida Board of Education rules in accordance with federal guidelines and are monitored by the Florida Bureau of Student Services and Exceptional Education (30, 31) (upon request, the authors will provide the complete definitions of special education categories in Florida).

The academic problems category comprised milder educational intervention or remediation programs and practices used in Florida that could not be analyzed separately without bias because of local districts' variations in assigning students to these programs. Speech and language impairment was a type of assignment for remedial services for disorders of language, articulation, fluency, or voice. The Federal Chapter 1/Title 1 Basic Program provided educational services to low-achieving students, and nonpromotion to first grade was defined as a child who was assigned to kindergarten again the following year.

Children with both a special education primary exceptionality and an academic problem were placed in the special education category.

Predictor variables. Maternal age was a four-category variable with a young teenage group (ages 11–17 years), a late teenage group (ages 18–19 years), older mothers (age ≥36 years), and mid-age mothers (ages 20–35 years). Mother's age was determined from the child's birth certificate. Several sociodemographic risk factors were considered: mother's education, mother's marital status, race, sex, and poverty. All of these predictors except poverty were obtained from the birth records. The definition of poverty was based on whether the child was eligible for free or reduced lunch in kindergarten. Mother's education was defined as less than high school, high school, and greater than high school education. Race/ethnicity had three categories: Black, White, and other, with the category other being predominantly Hispanic (93 percent). Marital status was defined as single or married. All sociodemographic predictors except child's sex are potential confounders for the relation between giving birth during the teen years and the response because they are significantly related both to the main predictor of interest and to the response. A few perinatal variables were also considered: birth weight, a seven-category variable (450–749, 750–999, 1,000–1,499, 1,500–2,499, 2,500–2,999, 3,000–4,749, and 4,750–6,049 g), congenital anomaly, complications of labor, and prenatal care were yes or no variables, and previous pregnancy experience was defined as previous failed pregnancies, no previous pregnancy, or one or more previous, successful pregnancies with no failures.

Statistical methods

The CATMOD procedure in SAS (32) was used to fit generalized logistic regression models for multinomial responses to assess the unadjusted and the adjusted effects of maternal age on the outcome. The emphasis of the analyses was on the effects of giving birth during the teen years, but the effects of older maternal age were simultaneously assessed. Generalized odds ratios, with regular classroom placement as the reference category, were used to measure the effect on each educational disability of levels of maternal age in relation to the reference category 20–35 years. Ninety-five percent confidence intervals were constructed for all estimated odds ratios. Odds ratios significantly greater than one indicate detrimental effects of younger (or older) than normal age, while odds ratios significantly less than one indicate protective effects of younger (or older) age.

We first fitted two main effects models: 1) an univariable model in which maternal age was the only predictor and 2) a multivariable model with main effects for all predictors considered. Standardized percentages were computed based on the two fitted models, as outlined in the appendix. The standardized percentages from the univariable model are not adjusted for other factors and, hence, are exactly the same as the raw percentages. Large differences between the two sets of percentages suggest that confounding is present.

A stepwise model fitting was used to identify the strongest sociodemographic confounders of the relation between maternal age and the outcome. Perinatal variables did not appear to be confounders, since the maternal age effect estimated from the complete multivariable model was essentially the same as that from the model with only sociodemographic predictors. Therefore, we started with a generalized logistic regression model with main effects for maternal age, maternal education, marital status, poverty, race, and sex and then dropped potential confounders one at a time on the basis of the change in the estimated generalized odds ratios in the maternal age groups. At each step, the predictor that led to the greatest change in odds ratios was considered to be the strongest confounder and was dropped. The odds ratios for older age in the complete multivariable model were not significantly different from those in the univariable model, so the decisions were based only on the estimates for the maternal teenage categories. The patterns were consistent for all outcomes in both teenage groups (odds ratios changed in the same direction). Therefore, the "greatest confounder" was the one that changed the significance of the largest number of odds ratios or, in the case of a tie, the one that led to the larger differences in absolute values of the odds ratios. A limitation of the current strategy is that the relative importance of a predictor depends on the other predictors present in the model.

Because of a lack of sufficient variability in education within the maternal teenage categories, it was difficult to separate the effect of age from that of education in these groups. Thus, we further examined the effect of age within subgroups of teenage mothers. The rarity of special education placement also prevented us from considering two-way interactions in these analyses. To check whether there was an age effect in the youngest teenage group, we performed an additional analysis in which we considered only children of mothers aged 11–17 years with less than a high school education who were unmarried and poor. This group is typical of the sociodemographic conditions for young teenagers. We then fitted generalized logistic regression models with maternal age as a continuous predictor and computed estimated generalized odds ratios for the effect of a 1-year increase in maternal age. This analysis addresses the question of whether there is a detrimental effect of younger age for the most typical teenagers.

RESULTS

Table 1 contains the counts and the raw and the standardized percentages in the outcome categories for each maternal age category. The standardized percentages for placement in the various special education categories and in the academic problems category for both teenage groups tend to be lower than the corresponding raw percentages. This trend indicates that when other factors are controlled for, maternal teen age and adverse outcomes in kindergarten do not appear to be as highly associated as when no other factors are taken into account. Hence, there is some evidence that a large number of children of teenage mothers show disabilities or academic problems not because of the effect of having a teenage mother per se but because of the confounding influences of other factors. In contrast, the raw and the standardized percentages for older age in most outcome categories (except perhaps PI) are very similar, indicating that the effect of older maternal age on educational disabilities is not altered by the considered sociodemographic and perinatal factors.

Estimated generalized odds ratios and associated 95 percent confidence intervals for the maternal age effect from the univariable model and the complete multivariable main effects model are given in table 2. When no other factors were taken into account, children of mothers in both teenage groups were found to be at a significantly increased risk for EMH, PMH, EH, and academic problems. The odds were about twice as high for EMH, PMH, and EH for the younger teenagers (odds ratio = 2.03, 1.94,and 1.84, respectively). However, when all of the other factors were included in the model, the only significant odds ratios were smaller than one, and hence, maternal teenage appeared to have some protective effects. Children of mothers aged 11–17 years were found to be at a significantly lower risk for TMH and academic problems, and children of mothers aged 18–19 years were found to be at a significantly lower risk for TMH, LD, and academic problems. In both the multivariable and the univariable models, children of older mothers were found to be at a significantly increased risk for PI, TMH, and academic problems. The risk was also found to be increased for EMH when other factors were controlled but not when age was the only predictor in the model.

As indicated by the magnitudes, directions, and significances of the estimated odds ratios for the complete multivariable model (table 2, first two rows) and for a multivariable model with only sociodemographic predictors (table 3, model I, first two rows), similar results were obtained when all variables were controlled and when only sociodemographic

TABLE 1. Sample counts and raw and standardized percentages* for the effect of maternal age on educational outcome, Florida, 1992–1994

Maternal age (years)	Educational placement									
	PI†	SI†	PMH†	TMH†	EMH†	LD†	EH†	AP†	RC†	Total
11–17										
No.	64	29	34	44	193	106	176	7,612	13,528	21,786
%	0.29	0.13	0.16	0.20	0.89	0.49	0.81	34.94	62.09	100.00
Std %†	0.23	0.12	0.09	0.13	0.52	0.43	0.57	29.02	68.89	100.00
18–19										
No.	87	59	40	58	224	110	244	9,634	19,642	30,098
%	0.29	0.20	0.13	0.19	0.74	0.37	0.81	32.01	65.26	100.00
Std %	0.23	0.17	0.09	0.13	0.46	0.31	0.58	26.56	71.47	100.00
20–35										
No.	753	379	246	517	1,335	1,231	1,343	74,681	190,145	270,630
%	0.28	0.14	0.09	0.19	0.49	0.45	0.50	27.60	70.26	100.00
Std %	0.28	0.14	0.09	0.19	0.49	0.45	0.50	27.60	70.26	100.00
≥36										
No.	68	19	18	69	94	83	82	4,933	11,291	16,657
%	0.41	0.11	0.11	0.41	0.56	0.50	0.49	29.62	67.79	100.00
Std %	0.32	0.11	0.08	0.38	0.58	0.50	0.52	29.58	67.95	100.00

* Standardized percentages are computed by using the estimated model-based probabilities from the complete multivariable model and by using mothers aged 20–35 years as the standard population (see Appendix).

† PI, physically impaired; SI, sensory impaired; PMH, profoundly mentally handicapped; TMH, trainable mentally handicapped; EMH, educable mentally handicapped; LD, learning disabled; EH, emotionally handicapped; AP, academic problems; RC, regular classroom; Std %, standardized percentage.

variables were controlled. Hence, perinatal variables as a whole do not appear to act as confounders for the relation between maternal age and the outcome and were excluded from further analysis.

To investigate which of the sociodemographic predictors were the strongest confounders of the relation between birth to a teenager and educational placement, we deleted factors from the main effects model with all sociodemographic predictors and compared the estimated generalized odds ratios. At each step, we deleted each of the remaining variables one at a time and selected the one that led to the greatest change in the estimated generalized odds ratios. The results of this stepwise deletion procedure are summarized in table 3. Model I in each age group contain the odds ratios and the corresponding 95 percent confidence intervals when all sociodemographic predictors in the model were controlled for. Then maternal education, maternal marital status, poverty, race, and sex are consecutively dropped from the model, and the estimated odds ratios for each educational placement are provided in the remaining rows in the table. Maternal education appeared to be the strongest confounder and hence was dropped first from the model (table 3, model II). As a result, all but one of the protective effects disappeared, and some detrimental effects were observed. Although dropping maternal education led to the most significant change in odds ratios, it was only after also dropping maternal marital status, poverty, and race from the model that the odds ratios reached those from the univariable model (table 3, model V). The patterns of changes in odds ratios were consistent in all cases, and the choice of the greatest confounder was relatively straightforward according to the strategy outlined in Materials and Methods. Not surprisingly, dropping the child's sex from the model did not lead to changes in odds ratios (table 3, model VI). Sex cannot be a confounder because it is not significantly related to maternal age.

In a supplemental analysis, we also checked for confounders among the perinatal predictors by adding perinatal predictors to the first model in table 3 one at a time, but no significant changes in the odds ratios were observed. The estimated odds for the effect of older age also did not change significantly when sociodemographic and perinatal variables were dropped and were added to the model, respectively. On the other hand, when parity was also controlled for, almost all protective effects of giving birth during the teen years disappeared. This may explain why children of younger mothers appear to be less likely to demonstrate academic problems, learning disabilities, and trainable mental handicaps than do children of older mothers. Children of teenage mothers are less likely to have older siblings and may get more attention at home than do children of older mothers (19).

Because of the complete confounding present in the youngest teenage group between maternal education and maternal teen age (no mothers with more than a high school education were available in this age group), it is impossible to separate the effects of maternal age and maternal education for children of mothers aged 11–17 years. To check whether there is an effect (possibly biological) of age among younger mothers, we considered the population of children

TABLE 2. Generalized odds ratios and associated 95% confidence intervals for maternal age effect from the univariable and the complete multivariable main effects models, Florida, 1992–1994

Controlled variables and maternal age (years)	Educational placement							
	PI†	SI†	PMH†	TMH†	EMH†	LD†	EH†	AP†
All								
11–17								
OR†	0.96	0.88	1.05	0.59*	0.84	0.85	0.91	0.90*
95% CI†	0.71, 1.30	0.57, 1.37	0.68, 1.62	0.42, 0.84	0.70, 1.00	0.67, 1.07	0.75, 1.10	0.87, 0.94
18–19								
OR	1.00	1.31	1.19	0.73*	0.96	0.69*	1.14	0.96*
95% CI	0.79, 1.27	0.97, 1.77	0.83, 1.70	0.55, 0.98	0.82, 1.11	0.56, 0.85	0.98, 1.32	0.93, 0.98
≥36								
OR	1.50*	0.88	1.21	2.39*	1.38*	1.20	1.16	1.15*
95% CI	1.16, 1.93	0.56, 1.40	0.75, 1.96	1.85, 3.09	1.12, 1.71	0.96, 1.50	0.92, 1.45	1.11, 1.19
None								
11–17								
OR	1.20	1.08	1.94*	1.20	2.03*	1.21	1.84*	1.43*
95% CI	0.93, 1.54	0.74, 1.57	1.36, 2.78	0.88, 1.63	1.75, 2.37	0.99, 1.48	1.57, 2.16	1.39, 1.48
18–19								
OR	1.12	1.51*	1.57*	1.09	1.62*	0.87	1.76*	1.25*
95% CI	0.90, 1.40	1.15, 1.98	1.13, 2.20	0.83, 1.43	1.41, 1.87	0.71, 1.05	1.53, 2.02	1.22, 1.28
≥36								
OR	1.52*	0.84	1.23	2.25*	1.19	1.14	1.03	1.11*
95% CI	1.19, 1.95	0.53, 1.34	0.76, 1.99	1.75, 2.89	0.96, 1.46	0.91, 1.42	0.82, 1.29	1.08, 1.15

* Significant at the 0.05 level. The reference group for all odds ratios consists of mothers aged 20–35 years.

† PI, physically impaired; SI, sensory impaired; PMH, profoundly mentally handicapped; TMH, trainable mentally handicapped; EMH, educable mentally handicapped; LD, learning disabled; EH, emotionally handicapped; AP, academic problems; OR, odds ratio; CI, confidence interval.

of mothers aged 11–17 years with less than a high school education who were unmarried and poor. This subsample contained the vast majority of mothers in the age group 11–17 years. Some significant detrimental effects of younger age were observed in this subpopulation (table 4). Among young teenagers aged 11–17 years, being younger by 1 year led to a significant increase of about 44 percent in the odds for placement in the EH group and of about 24 percent in the odds for placement in EMH group. For Blacks, in particular, being younger by 1 year was associated with a significant increase in the odds of placement in EH, LD, EMH, and TMH, while among Whites, the odds increased significantly only for academic problems. In all other cross-classifications of sociodemographic factors, the age effect was either not estimable or not significant.

DISCUSSION

We investigated the independent effect of maternal age on educational disabilities in kindergarten. We found that after controlling for maternal education, marital status, poverty, race, and sex, there was no residual negative effect of giving birth in the teen years, and some protective effects were even observed (for academic problems, LD, and TMH). These apparent protective effects disappeared, however, when parity was also controlled for. Our findings concerning educational disabilities are consistent with results from previous studies on children's educational achievement that adverse consequences of teenage childbearing appear to be due to social and economic origins rather than to the effects of young age per se (14, 16, 22, 23, 25). Although some previous studies have detected negative effects even after controlling for confounders (13, 15), in our study, no residual negative effects were present.

It should be pointed out that although teen age birth does not appear to have a detrimental effect per se on educational outcome, it may contribute to low maternal education, unmarried status, and/or poverty, factors with known, large, negative effects on educational disabilities. Hence, although maternal age does not directly influence the outcome, it may have an indirect effect through the intermediate sociodemographic factors. Fortunately, sociodemographic factors such as maternal education are remedial, and intervention programs targeted at teenage mothers have been shown to ameliorate some of the negative consequences of teenage parenting (33). These findings underscore the importance and value of high school graduation programs for teenage mothers.

Unlike teen age, older maternal age was found to be a risk factor for certain types of educational disabilities regardless of whether other risk factors were controlled. Hence, children of older mothers are more likely to have PI, TMH, or academic problems in kindergarten, possibly as a direct result of the older age of the mothers. While the effect on PI and TMH may be due to structural damage and hence

TABLE 3. Generalized odds ratios and associated 95% confidence intervals for maternal age effects on educational outcomes when controlling for subsets (I–V) of potentially confounding sociodemographic factors, Florida, 1992–1994†

Maternal age (years) and model	Educational placement							
	PI‡	SI‡	PMH‡	TMH‡	EMH‡	LD‡	EH‡	AP‡
11–17								
I	0.89	0.92	1.01	0.59*	0.79*	0.78*	0.84	0.83*
	0.67, 1.18	0.61, 1.40	0.68, 1.52	0.42, 0.82	0.67, 0.94	0.63, 0.97	0.70, 1.00	0.80, 0.85
II	1.04	0.96	1.42	0.77	1.12	0.94	1.07	1.00
	0.79, 1.35	0.65, 1.42	0.97, 2.08	0.56, 1.07	0.96, 1.31	0.76, 1.15	0.91, 1.26	0.97, 1.03
III	1.09	0.99	1.47*	0.83	1.28*	0.98	1.24*	1.06*
	0.84, 1.42	0.67, 1.45	1.02, 2.13	0.61, 1.13	1.09, 1.49	0.80, 1.20	1.05, 1.46	1.03, 1.09
IV	1.24	1.06	1.52*	0.93	1.49*	1.12	1.45*	1.15*
	0.96, 1.61	0.72, 1.56	1.05, 2.19	0.68, 1.27	1.28, 1.74	0.92, 1.37	1.24, 1.71	1.12, 1.19
V	1.20	1.08	1.95*	1.20	2.04*	1.22	1.86*	1.44*
	0.93, 1.55	0.74, 1.58	1.36, 2.79	0.88, 1.64	1.76, 2.38	1.00, 1.49	1.59, 2.18	1.40, 1.48
VI	1.20	1.08	1.94*	1.20	2.03*	1.21	1.84*	1.43*
	0.93, 1.54	0.74, 1.57	1.36, 2.79	0.88, 1.63	1.75, 2.37	0.99, 1.48	1.57, 2.16	1.39, 1.48
18–19								
I	0.91	1.33	1.12	0.71*	0.91	0.65*	1.08	0.91*
	0.72, 1.15	0.99, 1.77	0.79, 1.59	0.54, 0.95	0.79, 1.06	0.54, 0.80	0.94, 1.25	0.88, 0.93
II	0.98	1.38*	1.32	0.82	1.09	0.72*	1.21*	1.00
	0.78, 1.23	1.04, 1.84	0.93, 1.86	0.62, 1.08	0.94, 1.26	0.59, 0.87	1.05, 1.40	0.97, 1.03
III	1.01	1.41*	1.35	0.86	1.19*	0.74*	1.34*	1.04*
	0.81, 1.27	1.07, 1.67	0.96, 1.89	0.65, 1.13	1.03, 1.37	0.61, 0.90	1.17, 1.54	1.01, 1.07
IV	1.14	1.50*	1.39	0.96	1.38*	0.84	1.57*	1.12*
	0.91, 1.43	1.14, 1.98	0.99, 1.95	0.73, 1.26	1.20, 1.60	0.69, 1.02	1.37, 1.80	1.09, 1.15
V	1.12	1.52*	1.58*	1.09	1.64*	0.88	1.79*	1.25*
	0.90, 1.40	1.15, 1.99	1.13, 2.21	0.83, 1.43	1.42, 1.89	0.72, 1.06	1.56, 2.05	1.22, 1.29
VI	1.12	1.51*	1.57*	1.09	1.62*	0.87	1.76*	1.25*
	0.90, 1.40	1.15, 1.98	1.13, 2.20	0.83, 1.43	1.41, 1.87	0.71, 1.05	1.53, 2.02	1.22, 1.28
≥36								
I	1.63*	0.90	1.29	2.49*	1.41*	1.23	1.20	1.17*
	1.27, 2.10	0.56, 1.42	0.80, 2.08	1.93, 3.20	1.14, 1.74	0.99, 1.54	0.95, 1.50	1.13, 1.21
II	1.63*	0.87	1.27	2.44*	1.37*	1.21	1.18	1.16*
	1.27, 2.09	0.55, 1.38	0.78, 2.05	1.90, 3.15	1.11, 1.69	0.97, 1.52	0.94, 1.48	1.12, 1.20
III	1.62*	0.87	1.26	2.42*	1.34*	1.21	1.15	1.15*
	1.26, 2.08	0.55, 1.48	0.78, 2.03	1.88, 3.11	1.08, 1.65	0.97, 1.51	0.92, 1.44	1.11, 1.19
IV	1.52*	0.84	1.24	2.27*	1.21	1.13	1.05	1.10*
	1.19, 1.95	0.53, 1.34	0.77, 2.01	1.76, 2.92	0.98, 1.50	0.90, 1.41	0.84, 1.31	1.06, 1.14
V	1.52*	0.84	1.23	2.25*	1.19	1.14	1.03	1.11*
	1.19, 1.95	0.53, 1.34	0.76, 1.99	1.75, 2.89	0.96, 1.45	0.91, 1.42	0.82, 1.29	1.07, 1.15
VI	1.52*	0.84	1.23	2.25*	1.19	1.14	1.03	1.11*
	1.19, 1.95	0.53, 1.34	0.76, 1.99	1.75, 2.89	0.96, 1.46	0.91, 1.42	0.82, 1.29	1.08, 1.15

* Significant at the 0.05 level. The reference group for all odds ratios consists of mothers aged 20–35 years.

† Controlled variables: model I: maternal education, marital status, poverty, race and sex; model II: marital status, poverty, race, and sex; model III: poverty, race, and sex; model IV: race and sex; model V: sex; model VI: none.

‡ PI, physically impaired; SI, sensory impaired; PMH, profoundly mentally handicapped; TMH, trainable mentally handicapped; EMH, educable mentally handicapped; LD, learning disabled; EH, emotionally handicapped; AP, academic problems.

reflects biological disadvantage, the category academic problems encompasses milder educational problems, and hence, the effect of older age may be attributable to unmeasured environmental factors. With increasing numbers of women giving birth at older ages, if a causal relation between increased maternal age and adverse outcomes is confirmed, the impact of this factor is likely to increase.

This study considered a variety of educational disabilities in kindergarten and revealed a number of important associations. To understand those associations better, it is imperative to consider possible mechanisms through which maternal age affects specific outcomes. For example, a study by Williams and Decoufle (34) focuses on mental retardation (corresponding to PMH, TMH, and EMH combined) and attributes the increased incidence of codevelopmental retardation among children of older White mothers to Down's syndrome. A number of studies (13, 14, 16, 18, 22) attribute lower cognitive scores (corresponding to the categories LD and academic problems) among children of teenagers to decreased vocalization and poor parenting practices.

TABLE 4. Generalized odds ratios for the effects of a 1-year decrease in maternal age on educational outcomes among subpopulations of teenagers, Florida, 1992–1994†

Subpopulation	Educational placement							
	PI‡	SI‡	PMH‡	TMH‡	EMH‡	LD‡	EH‡	AP‡
Age 11–17 years, less than high school education, unmarried, poor (*n* = 12,430)								
OR‡	0.85	0.84	0.76	1.36	1.24*	1.26	1.44*	1.03
95% CI‡	0.59, 1.22	0.48, 1.47	0.46, 1.24	0.93, 2.03	1.05, 1.47	0.98, 1.62	1.21, 1.72	0.99, 1.07
Age 11–17 years, less than high school education, unmarried, poor, Black (*n* = 9,037)								
OR	0.59*	0.95	0.87	1.62*	1.22*	1.43*	1.46*	1.00
95% CI	0.34, 1.00	0.53, 1.73	0.51, 1.49	1.01, 2.59	1.01, 1.47	1.02, 1.99	1.19, 1.80	0.96, 1.05
Age 11–17 years, less than high school education, unmarried, poor, White (*n* = 2,304)								
OR	1.04	0.34	0.50	1.18	1.07	1.36	1.37	1.17*
95% CI	0.81, 1.79	0.04, 3.31	0.10, 2.82	0.45, 3.11	0.71, 1.62	0.86, 2.11	0.95, 1.98	1.07, 1.28

* $p < 0.05$.
† The odds ratios estimate the effect of a 1-year decrease in maternal age among young teenagers aged 11–17 years.
‡ PI, physically impaired; SI, sensory impaired; PMH, profoundly mentally handicapped; TMH, trainable mentally handicapped; EMH, educable mentally handicapped; LD, learning disabled; EH, emotionally handicapped; AP, academic problems; OR odds ratio; CI, confidence interval.

Because of the lack of information on the sociodemographic status of the mothers on the kindergarten records, almost all predictor variables considered were measured at birth. Therefore, the true effect of factors such as maternal education and marital status may be underestimated. The risk for educational problems for a child whose teenage mother completed high school after the child's birth is likely to be smaller than that for a child whose teenage mother did not advance her education after the birth; yet both cases are treated the same way in our sample. The effect of this type of mismeasurement on our findings will be to diminish the apparent significance of maternal education because the high-risk group of mothers with a low level of education at birth also includes those who increase their level of education after the birth of their children. It is advisable that in future studies sociodemographic statuses both at birth and later in life be taken into account when long-term outcome is of interest.

It was somewhat surprising that none of the perinatal variables acted as confounders for the relation between giving birth in the teen years and educational problems. This finding may at least be partially explained by the long-term outcome under consideration being less affected by adverse biological conditions at birth than some short-term outcomes such as low birth weight and infant mortality. As a result of the analysis, it appears that there is no indirect effect of maternal age on the outcome through the considered perinatal variables once the sociodemographic factors are controlled for.

Among the sociodemographic predictors studied, maternal education appeared to be the strongest confounder, but marital status, poverty, and race were also very important. In our choice of possible confounders, we were limited by the information available on the birth certificate and in the kindergarten records. There are additional risk factors such as injury after birth, near drownings, lead poisoning, and other toxic exposures that should be included in future studies. In addition, predictors such as poverty could be measured more precisely when information from several years is considered.

Because of the rarity of the outcome and of the complete confounding between youngest teen age and maternal education, we were unable to study interactions between the risk factors. The restriction of the study sample to only young teenagers with less than a high school education who were unmarried and poor and the treatment of maternal age as a continuous variable allowed us to assess the independent effect of age on the outcome within the subpopulation of most typical teenage mothers. It is not clear, however, whether the observed detrimental effect of a 1-year decrease in age for certain mild educational disabilities (EH and EMH) is attributed to purely biological causes, to sociodemographic causes, or to a combination of both. The fact that no age effect was observed for the most severe disabilities in younger mothers, if not explained by small sample sizes in the restricted population, does give some credence that there may not be a biological disadvantage of younger age with regard to disabilities in kindergarten. A more plausible explanation is that children of younger teenagers are at a disadvantage because of environmental factors.

In conclusion, children of teenage mothers are at a higher risk for disabilities in kindergarten, but this increased risk appears to be due not to a biological effect of the young age of the mother per se but to the confounding influences of associated sociodemographic and/or environmental factors. Prevention of teenage pregnancies should continue to be an important public policy goal, and programs should target teenage mothers to ameliorate the effects of more important predictors such as low maternal education, single marital status, poverty, and minority race that are likely to continue to place the children of teenage mothers at risk for adverse outcomes after birth.

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APPENDIX

The standardized percentages for placement in the outcome categories were calculated from the following formula:

$$p_{jl} = \frac{\sum_{c} n_{cr} P_{jcl}}{\sum_{c} n_{cr}},$$

where n_{cr} is the number of children born to mothers aged 20–35 years (the standard population) for a fixed combination c of levels of the other factors, and P_{jcl} are the model-based estimates of the probabilities that the jth outcome occurs given the lth level of the risk factor and the cth combination of levels of the other factors. When P_{jcl} is based on the univariable model (with maternal age as the only predictor), the standardized percentages are exactly equal to the raw percentages, whereas when P_{jcl} is based on the multivariable model, the standardized percentages are adjusted for all remaining factors in the model.