Articles

Number of Siblings and Educational Attainment

JUDITH BLAKE

Family background continues to be closely related to individuals' educational attainment in the United States. A notable change in one aspect of this background, number of siblings, is occurring as fertility is becoming extremely low. Examination of the negative relation between individuals' sibling number and years of schooling indicates that education among those with many siblings is disproportionately cut short before high school graduation. Because there is a strong negative relation between number of siblings and scores on tests measuring verbal ability, recent reductions in sibling number would be expected to contribute to enhanced verbal ability and increasing years of schooling for those born now in the United States.

IN THE UNITED STATES, PUBLIC SCHOOLING HAS BEEN SEEN as leveling out the diversity of family influences on educational attainment. However, social science research points to the persistence of family background as a major predictor of years of schooling (*1*). Among family background influences on education, the father's schooling has been found consistently to be the most influential (*2*), but more recent research has indicated that number of siblings is next in importance (*3*)—the fewer siblings, the more education.

Theoretically, a negative relation of number of siblings and schooling may be expected because intrafamilial resources are concentrated in small families and diluted in large ones. Reasons for suspecting a causal relation have been discussed in detail elsewhere (*4*). There is also empirical evidence of the effects of sibling number on the amount of education (*3*), which is the focus of this article.

Research attention to number of siblings as an influence on schooling has been stimulated, in part, by changes in the number of children women have been bearing and the number of siblings in each child's family. Both variables have been moving in a direction that bodes well, on average, for future educational attainment.

With regard to the number of children women have been bearing, our continuous statistical record on the completed family size of women in the United States goes back to the reproductive behavior of women who themselves were born from 1867 onward (*5*). The cohorts of women born between 1867 and 1870 had a mean of 4.0 children, whereas the cohorts of women born between 1946 and 1950 (women who are giving rise to the so-called baby bust at present) will have a mean of 2.1 children. Significantly, after those women born between 1867 and 1870, no cohorts of women had as many as a mean of 4.0 children again. Of the 17 five-year cohorts born between 1871 and 1955, 11 had fewer than a mean of 3 children, only one had a mean of 3.5 and one a mean of 3.8 children. The number of "baby bust babies" born to recent cohorts of women (those having 2.1 children on average) will be the smallest in our history. For example, Ryder estimates that women born between 1951 and 1955 will end up with a mean of only 1.9 children (*5*).

At face value, these data might suggest that if most cohorts of women have been having a mean of three or fewer children since early in the century, the principal educational advantage of growing up in such a family has been realized already and very little additional benefit can be expected. Actually, this reasoning is incorrect.

The Disparity Between the Family Size of Mothers and of Children

The terms "sibling number" and "number of siblings" are used to denote the number of children in each person's family including in the index person him or herself. Demographic research has shown that although the mean number of children born to mothers has been modest for some time, the mean number of siblings has been quite large on average (*6*). This counterintuitive disparity between the mean family size of mothers and the number of siblings among children is based on the fact that each generation emanates disproportionately from the most prolific mothers. Moreover, the more variance there is in mothers' fertility, the more disparity there is between the mean family size of mothers and sibling number among children (*6–7*). Thus, from the point of view of the mean sibling number in which most children have been reared (as distinct from the mean family size most mothers have borne), large families, not small ones, have been preponderant until very recently. Only with the advent of the so-called baby bust, are we seeing a revolution in the number of siblings lagging by many decades the fertility revolution in the family size of mothers. This is shown in Table 1, which documents U.S. reproductive experience over the periods of the Depression, the baby boom, and the baby bust.

During the Depression, the family size of mothers ranged from a mean of 2.93 to 3.13, but the number of siblings among children was consistently larger (Table 1). Among the cohort of mothers who had a mean of 3.13 offspring, the mean sibling number of the children was almost 5.0. Indeed, considering the distribution of the number of siblings (Table 2), the offspring of these same mothers were heavily concentrated in large sibling numbers. Forty-four percent were in sibling numbers of five or more, and 26 percent in sibling numbers of seven or more. Only 17.4 percent were in sibling numbers of two.

The author is Fred H. Bixby Professor of Population, School of Public Health and Department of Sociology, University of California, Los Angeles 90024–1772.

During the baby boom, the average family size of mothers of baby boom babies was somewhat larger than that of the mothers of Depression babies, but because the variance of mother's fertility had declined during the baby boom, the number of siblings was generally slightly smaller than it was during the Depression (Table 1). Nonetheless, the average number of siblings ranged between a mean of 4.39 and 4.49. For baby boom children whose mothers finished their childbearing (women of age 45 to 49) in 1980, 41.5 percent were in sibling numbers of five or more and 18.8 percent in sibling numbers of seven or more (Table 2). Only, 13.9 percent were in sibling numbers of two.

During the baby bust (a period we are still experiencing), a marked contraction in both the mean sibling number (Table 1) and in the proportions of children brought up in large families (Table 2) is evident. Because the period of the baby bust is a recent one, I use information, in Tables 1 and 2, from the 1986 Current Population Survey (CPS) of the Bureau of the Census (*8*), and for the youngest cohort of mothers of baby bust babies (those age 30 to 34), I use CPS data on the actual number of children ever born (as for other mothers) plus the additional children the mothers expect to have. Since very few of these young mothers have, or expect to have, more than four children, the Current Population Survey truncated the responses at four or more.

The sibling number of baby bust children born to mothers age 40 to 44 in 1986 (mothers of essentially completed childbearing) was concentrated on three or fewer (62.1 percent) and the five or more category was 20.1 percent, with the category seven or more having only 4.9 percent. Among mothers age 35 to 39 in 1986, the sibling number of the baby bust children was even more concentrated at three or fewer (74.5 percent), the five or more category was 11.2 percent, and seven or more was 2.8 percent. Finally, among mothers age 30 to 34, the sibling number of children was 78.4 percent for three or fewer, and 21.6 percent for four or more.

In sum, these tables tell us that, until recently, relatively few children were brought up in small families and more than 40 percent of children were brought up in families of substantial size—five or more offspring. More than half of all children were brought up in families of four or more. If decreasing numbers of siblings affect educational attainment positively, then we must expect that recent fertility changes will have educational benefits.

Sibling Number and Educational Attainment

What is the evidence for an inverse association of number of siblings and educational attainment? In attempting to answer this question, I have based my research on six large-scale national surveys in the United States undertaken from 1955 to 1986 (*9–11*). These surveys were performed both by the federal government and by major research organizations in this country. The surveys contain not only information on the respondents' number of siblings and years of schooling, but also on parents' educational attainment, the family's socioeconomic status, whether the respondent was brought up on a farm, whether he or she lived with both parents, and, finally, the respondent's age as an indicator of when he or she was brought up. Chosen because they contained the requisite information, in addition to being of unusually high quality, national coverage, large size, and historical range, these surveys have afforded a major opportunity for replicating investigation on different data sets.

My statistical analysis of these data is restricted to whites because, until recently, survey organizations did not oversample blacks. The total number of white adults age 20 and over who were respondents, or about whom information was available from respondents, is 113,821. I limit my discussion here to men in three of the data sets (a total of 63,344 respondents), but the results are similar for the women and men not described here (*3*). The data sets used here are Occupational Changes in a Generation (OCG) 1962 (*11*), previously analyzed with a different focus by Blau and Duncan (*1*), and OCG 1973 (*11*), analyzed as a follow-up by Featherman and Hauser (*1*). Additionally, 15 annual surveys of the General Social Survey (GSS) dating 1972 through 1986 are included here (*10*).

The total years of education achieved by those age 25 and over have been controlled statistically for the parental background variables previously mentioned, as well as the respondent's age. The mean adjusted total years of education for sibling numbers one through seven or more, respectively (*12*), is shown in Fig. 1. It can be seen that education declines monotonically as sibling number increases and, hence, the largest gap is between those from small families (one and two child families) and those from families of seven or more, a gap of almost 2 years, or slightly more than one half a standard deviation in total years of schooling. The importance of such a large differential in educational attainment becomes more

Table 1. Mean family size of ever-married mothers age 45 to 49 and the mean number of siblings of their children born during the Depression, the baby boom, and the baby bust (*8*).

Mother's birth cohort	Year when age 45 to 49	Mean		Variance of	
		Family size of mothers	Number of siblings	Family size of mothers	Number of siblings
		Depression children			
1901–1905	1950	3.13	4.80	5.23	7.77
1906–1910	1955	2.96	4.53	4.65	7.45
1911–1915	1960	2.93	4.33	4.08	6.50
		Baby boom children			
1921–1925	1970	3.18	4.39	3.85	5.64
1931–1935	1980	3.45	4.49	3.59	4.51
		Baby bust children			
1942–1946	1991	2.66	3.34	1.80	2.40
1947–1951	1996	2.37	2.95	1.36	2.09
1952–1956	2001	2.37	2.78	0.98	1.12

Table 2. Percentage distribution of the number of siblings of children born during the Depression, baby boom, and baby bust to ever-married mothers of completed and near completed fertility in the United States (*8*).

Census year (mother's age)	Number of siblings							
	1	2	3	4	5	6	7+	Total
				Depression children				
1950 (45–49)	8.0	17.4	16.6	13.9	10.1	8.0	26.0	100
1955 (45–49)	8.8	19.7	17.8	14.2	9.6	7.4	22.5	100
1960 (45–49)	8.1	20.5	19.7	15.0	10.2	7.2	19.3	100
				Baby boom children				
1970 (45–49)	5.0	18.2	21.3	17.5	12.1	8.0	17.9	100
1980 (45–49)	3.3	13.9	22.3	19.0	13.5	9.2	18.8	100
				Baby bust children				
1986 (40–44)	6.1	29.0	27.0	17.8	10.0	5.2	4.9	100
1986 (35–39)	8.5	36.7	29.3	14.3	5.9	2.5	2.8	100
1986 (30–34)	6.8	40.5	31.1	21.6				100

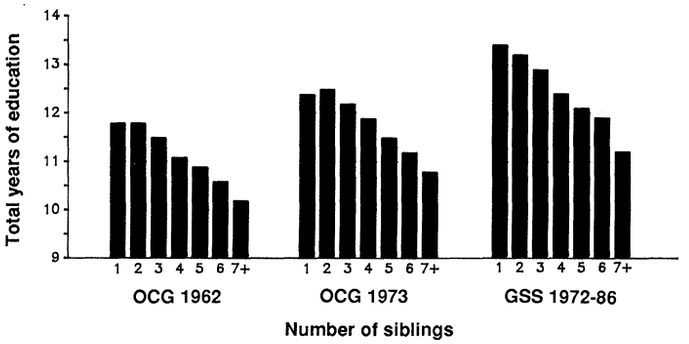

Fig. 1. Total years of education (adjusted means) by number of siblings. The subjects were all white men age 25 and over (*10, 11*).

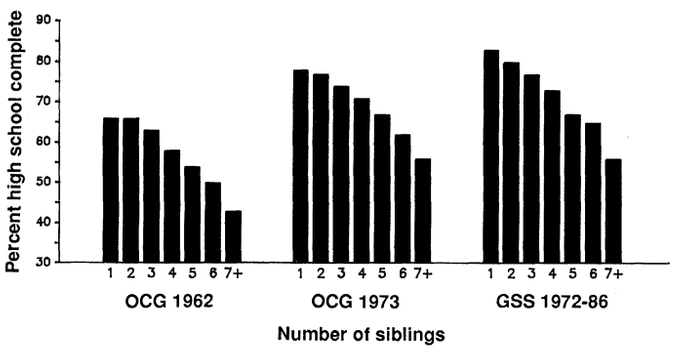

Fig. 2. Percentage of persons who graduated from high school (adjusted means) by number of siblings. The subjects were all white men age 20 and over (*10, 11*).

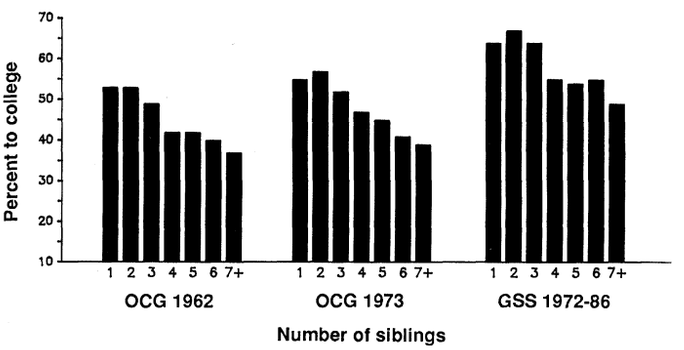

Fig. 3. Percentage of high school graduates who went to college (adjusted means) by number of siblings. The subjects were all white men age 25 and over (*10, 11*).

telling when the location, in the educational process, of these losses is considered.

One might expect that the largest effect of sibling number would be on whether these men were able to go to college, since it is with secondary education that free schooling ceases. Actually, a pronounced effect (as it turns out, the most pronounced effect) is on whether the respondents graduated from high school (Fig. 2). The smaller the family the more likely were they to graduate; for example, 48 percent more only children graduate than those from families of seven or more children (*10*). By contrast, the chances of going to college, given high school graduation, evince less of a relation with sibling number (Fig. 3). For example, 31 percent more only children attend college than children from families of seven or more. It would appear that those men from large families who managed to make it through high school were survivors out of many who dropped out along the way. By the time the survivors had completed high school, they were composed of individuals who had characteristics more predictive of college attendance than the characteristics of those from large families generally.

Only children in two of these surveys were somewhat less likely to go to college than those from two-child families, although in all of the surveys only children graduated from high school in equal or greater numbers than those who had a sibling. Detailed analysis of fathers' occupations suggests that a share of these male only children may have been called on to go into family businesses after high school graduation.

How important is number of siblings compared to other variables in our statistical model? When total years of education is the dependent variable, standardized regression coefficients show that sibling number is second to father's education in two out of three of the surveys. When graded schooling (grades 1 to 12) is the dependent variable, sibling number is second in importance to father's education in all of the surveys. Only with regard to college schooling is father's socioeconomic status the most important variable, his education is next, and sibling number is third.

Birth Order and Educational Attainment

Does birth order make a difference to education? For example, do some birth orders in large families do as well as those from small families? Here the answer is negative, nor does birth order make a statistically significant difference in small families. However, in very large families we find a parabola—those who are the last-born and next-to-last born attain the most education, and those who are born early in the middle part of the sibling number distribution get the least education (Fig. 4). These results would seem further to bolster the dilution hypothesis because the latest born have the advantage of older siblings who are earners rather than competitors for resources, the mother is no longer drained by continuous childbearing, nor are there additional offspring to whom family resources must be allocated. For early middle children, just the opposite is true in every instance. And, for oldest children, although they have the spotlight as no other child will have in a large family, this favored position must necessarily be brief, since mothers cannot tarry long if they are to produce seven or more children.

Number of Siblings and Intellectual Ability

Because this analysis has shown that the educational effects of sibling number impinge at an early age, a logical next question concerns the causes of this educational advantage among young people from small families. A number of influences have been worthy of examination (*3*), but here we will concentrate on just one, intellectual ability. Not only is such ability a logical antecedent to education, but numerous studies have indicated a strong inverse relation between number of siblings and various measures of intellectual ability (*13*). This prior work suggests that, in part, the educational differential may hinge on greater intellectual ability, on average, among children from small families, whereas those from large families are less advantaged intellectually.

Why, on average, should children from small families demonstrate high intellectual ability and those from large families do less well? One possible explanation is the prevalent association between family size and socioeconomic status of the parents—higher status among parents with few children and lower status among parents with many. If studies of intellectual ability do not control statistically for parental background (as most have not), then it is not clear how much, if any, of the ability difference is due to number of siblings

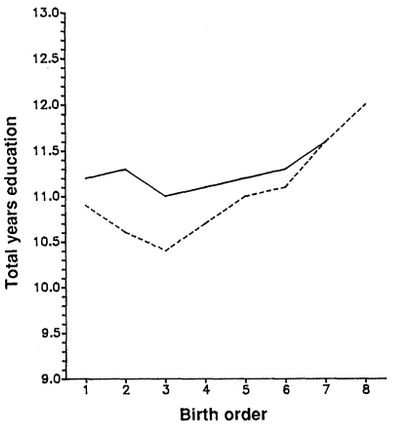

Fig. 4. Total years of education (adjusted means) by birth order, white men age 25 and over in sibling numbers 7 and 8, OCG 1973 (*11*).

and how much to differential socioeconomic status of parents (*13, 14*). Another possible explanation is that parents who have few children are themselves more endowed intellectually and that these traits have high heritability (*15*). Finally, there is the possibility that parents in small families can muster more concentration, attention, and interaction per child, which in turn affects the youthful intelligence quotient (IQ). This is the dilution hypothesis in relation to intellectual ability.

In attempting to evaluate these possible explanations, the first can be largely ruled out by controlling for a range of parental background characteristics as has been done for the analysis of the respondent's education. Such controls also address the heritability issue in part since adjusting for characteristics like parents' education provides a partial control over parents' IQ. Moreover, the evidence is scant for an association between genotypical parental IQ and family size (*15*). Indeed, even if such an association were to be found, recent genetic literature suggests that heritabilities for IQ are much lower than was previously believed (*16*). Although the heritability explanation cannot be ruled out entirely, controls for parental background will provide an important safeguard against charges of spuriousness.

Information on Verbal and Nonverbal Ability

I now consider the evidence from one major study, Cycle II of the Health Examination Survey (HES) of noninstitutionalized children age 6 to 11, a study conducted by the National Center for Health Statistics, which was completed in 1965 (*17*). In the present analysis, the sample has been confined to white non-Hispanics (a total of 4511 children) because of the small number of nonwhite, non-Anglo children in the study. There are controls for the parents' characteristics—their education, income, marital status (whether the family was intact), region of residence, community size, and whether the mother was employed. The study also used a standardized intelligence test, the Wechsler Intelligence Scale for Children (WISC), which includes verbal and nonverbal subtests. Two of these subtests (vocabulary and block design) were used in Cycle II, thereby enabling me to distinguish between these types of abilities among the children. This analysis thus follows on prior work that stresses the role of verbal ability among children from different sibling numbers (*14*). Nisbet has suggested that children in smaller families have more verbal ability because they spend more time interacting with their parents. Moreover, verbal ability is the best single predictor of future academic achievement (*18*).

Does the negative relation of educational attainment and sibling number reflect in part a similar relation of intellectual ability and sibling number even after controls for parental background? We see a strong negative relation of number of siblings and vocabulary and a relatively minimal relation with block design (Fig. 5). The correlation ratios are 0.319 and 0.129 for vocabulary and block design, respectively. The difference between the vocabulary scores of only children and those from families of seven or more is seven-tenths of a standard deviation. In other words, 65 percent of children taking the test had a score better than the average score for those from sibling numbers of seven or more, and 62 percent of those taking the test had a score worse than the average score for only children. The magnitude of a seven-tenths of a standard deviation difference can be appreciated by a comparison with the national drop in Stanford Achievement Test (SAT) scores between 1963 and 1980. This SAT decline was one-half a standard deviation and gave rise to widespread concern among educators and federal officials, as well as numerous conferences and volumes of analysis (*19*).

In additional analysis based on samples of older children who are high school sophomores and seniors, an association of number of siblings and verbal ability is also found, but it is not as strong as among young children because, I believe, of selective school leaving among children from large families (*3*). It is also possible, of course, that if youngsters stay in school, those from large families gain from the school experience marginally more than those from small families and, hence, show relative improvement with age. However, findings from a vocabulary test administered to adults in the GSS (*3*) suggest that selection out of school of less verbally able young people is a more probable reason for a reduction in strength of the number of siblings/aptitude relation among high school students. Among the GSS respondents, my analysis indicates that at each level of the respondent's educational attainment including college (and controlling for the mother's education), there is a decline of verbal ability as number of siblings increases.

It thus seems that as between verbal and nonverbal components of intelligence, the most important influence of sibling number, on average, is on the verbal component, even after controls for parental background. These findings help to validate earlier research (*14*) and assist in explaining the strong association of sibling number and educational attainment. Moreover, the results are important in suggesting that not all components of aptitude are adversely affected by number of siblings, something about which we have had little information. This finding casts some doubt on the hypothesis that the number of siblings–aptitude relation stems from parents of

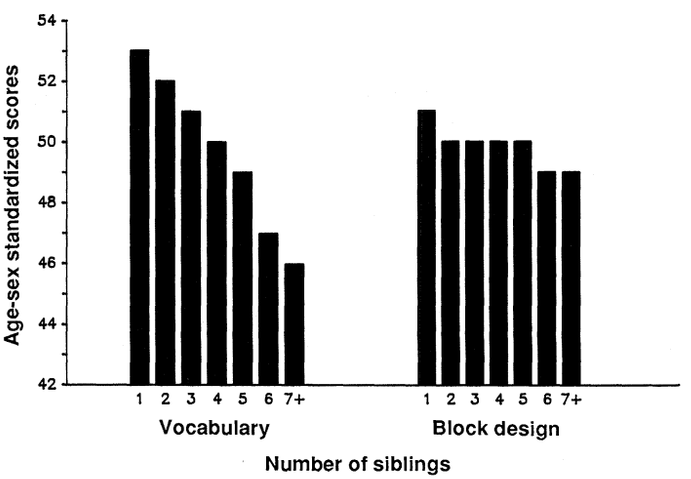

Fig. 5. Age-sex standardized scores [50 ± 10 (mean ± SD)] on vocabulary (verbal ability) and block design (nonverbal ability) components of the WISC by sibling number, adjusted for parental characteristics. All of the subjects were white boys and girls (*17*).

smaller families being genotypically more intelligent. On average, children from large families only suffer certain kinds of ability deficits—those that are associated with lesser levels of adult-child interaction. Unfortunately, since verbal ability is the principal cognitive predictor of educational success, this particular deficit has significantly negative educational consequences for youngsters from large families.

Conclusion

Because family background is a major influence on how much schooling individuals achieve, changes in the family impact educational attainment in the next generation. In the United States we are currently witnessing an important familial change—a revolution in the number of siblings—beginning with the reproduction of parents during the baby bust. For the first time in U.S. history, as many as three-fourths of children are being reared in families that include three or fewer siblings, and less than five percent of children are in families of seven or more. By contrast, as recently as the Depression, less than half of children were in families of three or fewer and one quarter were being reared in families of seven or more. Will this change affect years of schooling among baby bust babies?

The evidence presented here indicates that, other things equal, a positive overall effect of the revolution in number of siblings on educational attainment can be expected. Analysis of numerous studies, and a large number of cases, demonstrates that individuals from small families get substantially more education than those from large families even after statistical controls for other family background variables and the respondent's age. Moreover, the years of schooling lost by those from large families occur primarily before high school completion, not as a consequence of the expenses of college.

In an effort to understand this youthful truncation of education, the influence of sibling number on cognitive ability has been examined. I have found that verbal ability, itself a major predictor of educational success, is also negatively related (and strongly so) to number of siblings. Since verbal ability is associated with parental interaction and attention, it is more readily understandable why family size has such an early influence on schooling.

Obviously, the family is changing in other ways as well, and some of these changes, like a decrease in marital stability, are on balance quite probably negative for childrearing. Such extended issues cannot be addressed in a short article (*3*). However, we can say that in the event of adverse changes in other family variables, the decline in number of siblings probably will prove to be an offset for the youngsters involved. And, for those children whose parents are managing to furnish a reasonably adequate family life in other respects, the decline in sibling number will provide on average a distinct advantage over the large families children have experienced until very recently.

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$$\bar{X}_s = \frac{S_m^2}{\bar{X}_m} + \bar{X}_m$$

where $\bar{X}_s$ equals the mean number of siblings, S_m^2 equals the variance of the mean family size of mothers, and $\bar{X}_m$ equals the mean family size of mothers.
7. The substantive basis for the disparity between the mean family size of mothers and the mean number of siblings is explained in detail in (*3*), pp. 273–283. The formula for the mean number of siblings is given in (*6*).
8. Data for mothers age 45 to 49 in 1950 and 1955 are from U.S. Bureau of the Census, *Census of Population: 1950,* Special Reports, part 5, chapter C, *Fertility*, tables 1 and 2 (Government Printing Office, Washington, DC, 1955); data for mothers age 45 to 49 in 1960 are from U.S. Bureau of the Census, *Census of Population: 1960,* Subject Reports, Final Report PC(2)-3A, *Women by Number of Children Ever Born*, tables 1 and 2 (Government Printing Office, Washington, DC, 1964); data for mothers age 45 to 49 in 1970 are from U.S. Bureau of the Census, *Census of Population: 1970,* Subject Reports, Final Report PC(2)-3A, *Women by Number of Children Ever Born*, tables 1 and 2 (Government Printing Office, Washington, DC, 1973); data for mothers age 45 to 49 in 1980 are from U.S. Bureau of the Census, Current Population Reports, series P-20, no. 375, *Fertility of American Women: June 1980*, table 12B (Government Printing Office, Washington, DC, 1982); data for mothers age 45 to 49 in 1991, 1996, and 2001 are from U.S. Bureau of the Census, series P-20, no. 421, *Fertility of American Women: June 1986*, tables 1, 7, and 11 (Government Printing Office, Washington, DC, 1987).
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