Work in progress

The Role of Mother's Age at Birth for Children's Education in the Context of Below-Replacement Fertility in Brazil

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Abstract:
Over the last two decades, Brazil has witnessed dramatic changes in its fertility patterns. The decline to below-replacement level fertility has been accompanied by increases in the proportion of children born to adolescent mothers and the proportion of children born to older mothers. Yet, we know little about the well-being outcomes of these children. This study uses the 1992-2009 Pesquisa Nacional por Amostra de Domicílios to analyze the relationship between maternal age at child's birth and children's educational outcomes. We find that children born to the youngest and oldest mothers fare worse than those born to mothers in their early 20s to early 30s; they have lower levels of education, greater odds of having an age-grade disparity, and lower odds of completing primary education. We use propensity score matching to assess the extent to which selection into early or late motherhood accounts for the negative association with children's educational outcomes.

Introduction

Brazil, the largest country in Latin America, reached below replacement fertility at the end of the last decade. The most recent DHS (*PNDS* 2006) estimates the total fertility rate at 1.8 children per woman. However, differently from other countries that reached below-replacement fertility, Brazil shows a pattern of increasing rejuvenation of the fertility schedule, with recent increases in adolescent fertility (Berquó and Cavenaghi 2005; Cavenaghi 2009). The increase in young fertility and the mismatch between adolescent and total fertility has prompted concerns about the negative consequences of early motherhood. While adolescent childbearing is perceived as risky for mothers, there is little evidence on the impact of adolescent childbearing for the children of teen mothers in developing countries. With the exception of a few studies that use data from the U.S. or other Western countries (Barber 2001; Powell, Steelman and Carini 2006), there is even less evidence addressing the consequences of the whole spectrum of mother's age at birth for children's well-being.

Therefore, the goal of this paper is to examine the consequences of mother's age at child's birth for the education of children over a period marked by dramatic demographic change in Brazil. We focus on children at the two extremes of the maternal age distribution—children born to adolescent mothers and children born to older mothers—to address the importance of timing of birth for children's education. We use unusually rich nationally representative data from the *Pesquisa Nacional por Amostra de Domicílios*-National Household Survey (PNAD) from 1992-2009. We examine three educational outcomes—age-grade disparity, age standardized educational attainment and primary school completion.

We start our analysis with ordinary least square and logistic regressions. Because part of the associations we find between mother's age at first birth and children educational outcomes can be explained by selection into early or late motherhood, we next use a propensity score matching approach to address such issues. With the propensity score approach we compare how children of teen and older mothers compare to children born to mothers at the *normative* ages of 22-32 on age-grade disparity, completion of primary education and age-standardized educational attainment.

Data and Methods

Data

We use data from the Pesquisa Nacional por Amostra de Domicílios (PNAD) from 1992 to 2009. The PNAD is a nationally representative survey collected by the Brazilian Census Bureau (*Instituto Brasileiro de Geografia e Estatística*). The PNAD is a probability-based, stratified, multistage survey of Brazilian households. The sampling design follows a three-step probabilistic procedure based first on counties, then census tracts within counties, and finally households within sectors. The data is collected annually, with the exception of Census years.

The paper focuses on first-born children ages 10-18 and 16-18. This choice of analysis is both theoretical and practical. Theoretically, we limit our analysis to first-born children to avoid confounding effects of birth order. We consider children and adolescents ages 10-18 because these are the ages of transitioning into and out of secondary school in Brazil. While educational levels have recently improved in Brazil, secondary school enrollment levels are far from ideal. Adolescents are at the most vulnerable age of dropping out of school, which could lead to dramatic negative consequences. In practical terms, because the PNAD is a household survey, the data do not allow for the examination of mother's age at birth for those who do not live with their mothers. Since most adolescents live with their mother in Brazil (92.6% for 10-18 years-old in the 1992-2009 period), the use of this sample permits analyses of educational outcomes accounting for parental characteristics and for maternal age at birth. We found no significant differences between children in the samples of those living and not living with their mother. Our second analytical sample is composed of adolescents 16-18. We use this sample to examine primary school completion as those at those ages should have transitioned or finished secondary school.

Table 1 shows the means and proportions of our analytical samples of children ages 10-18 and 16-18 by selected characteristics. Our analytical samples are composed of 378,406 10-18 year-olds and 128,688 16-18 year-olds.

Methods

We first use ordinary least square regression to examine age for grade disparity and age-standardized educational attainment. We use logistic regressions for our models of primary school completion. Our main variable of interest is mother's age at first birth. We include control variables for region of residence, urbanicity, sex, race, mother's education, number of siblings, family structure and log of family income.

Because part of the associations we will find between mother's age at first birth and children educational outcomes can be explained by selection into early or late motherhood, we next use a propensity score matching approach to address such issues. With the propensity score approach we compare how children of teen and older mothers compare to children born to mothers at the *normative* ages of 22-32 on age-grade disparity, completion of primary education and age-standardized educational attainment.

Preliminary Results

We begin by documenting the proportion of children born according to mother's age at birth over the period we examine. Figure 1 shows that while the proportion of births to adolescent mothers increased in the 1990s, it leveled off by the late 2000s. Nonetheless, Figure 1 shows that about 30% of first-born children were born to adolescent mothers. It is also interesting to note that the proportion of first-born children born to mothers ages 33 and older has increased, suggesting a postponement behavior. Figure 2 shows the distribution of first-born children ages 10-18 by mother's age at birth for the entire 1992-2009 period. From Figure 2 it is clear that a non-trivial number (40%) of first-born children are born to mothers ages 21 and older.

We next show each of our three educational outcomes—mean age-standardized educational score, age-grade disparity and primary school completion—by mother's age at birth. Overall, all three figures show a consistent pattern of disadvantage associated with maternal age at birth resulting from adolescent mothers and those older than age 30. While the educational levels increased from the 1990s to the 2000s—and this is expected due to the large increase in education the country has seen throughout this period of time—the shape of the association remains remarkably unchanged. For this reason we decided to examine the combined samples corresponding to years 1992 to 2009.

Because of the age patterns in mother's age at first birth we observed in Figures 3 to 5, we coded mother's age as a set of dummy variables corresponding to 16 and younger, 17-18, 19, 20-21, 22-32 and 33-45. Children born to mothers ages 22-32 are the omitted category.

Table 2 shows the odds ratios from logistic regressions predicting age-grade disparity for first-born children ages 10-18. Results from Table 3 show a positive association between being born to an adolescent mother and age-grade disparity. The association persists even when all control variables—sex, race, age, mother's education, log of family income, number of siblings, family structure, urbanicity, region of residence and year—are added in the full model, Model 7. Results for Model 7 suggest a linear trend related to being born to a teen mother in that children born to teen mothers younger than 16 have higher chances of an age-grade disparity than children born to older teen mothers. Interestingly, Model 7 shows that while children born to a 19 year-old mother have 24% higher chances of being enrolled in a grade lower than the appropriate grade for their age, there is a similar disadvantage for children born to mothers ages 33 and older (18%).

The results in Tables 3 and 4 for the additional educational outcomes we examine show a remarkably similar pattern. That is, the magnitude of the negative association between being the first-born to an adolescent mother and education is similar to the negative association between being the first-born to mothers older than 33. Models 4 and 7 show that while such significant association does not go away when we include controls, family structure and mother's education seem to explain part of the association. Because selection into early or late motherhood may partially explain our results, we next address such potential biases by employing a propensity score matching approach. We use a propensity score approach to compare how children of teen and older mothers compare to children born to mothers at the *normative* ages of 22-32 on the educational outcomes we examined above.

Table 1. Weighted descriptive statistics of variables used in the analyses, First-born children age 10-18, Brazil, 1992-2009

	Children age 10-18		Children age 16-18	
Variable	Mean or proportion	S.D	Mean or proportion	S.D.
Maternal age at first birth				
16 or younger	0.050			
17-18	0.114		0.095	
19	0.076		0.068	
20-21	0.158		0.151	
22-32	0.501		0.528	
33-45	0.101		0.118	
Educational outcomes				
Educational attainment (age-standardized)	0.170	0.944		
Age-grade disparity	0.796			
Primary school completion			0.602	
Female	0.478		0.456	
Age	14.070	2.564	16.986	
Race				
White	0.532		0.536	
Black	0.046		0.049	
Mulatto	0.416		0.410	
Asian	0.004		0.004	
Other	0.001		0.002	
Urban	0.823		0.821	
Region				
North	0.061		0.058	
Northeast	0.265		0.266	
Central-west	0.073		0.071	
Southeast	0.431		0.436	
South	0.170		0.169	
Mother's education				
No formal education	0.123		0.148	
1-4 years	0.307		0.328	
5-8 years	0.277		0.256	
9-11 years	0.211		0.191	
12 or more years	0.082		0.077	
Family income (logged)	5.515	3.902	5.679	3.841
Number of siblings	1.394	1.273	1.510	1.415
Family structure				
Two parents	0.810		0.791	
Mother only	0.186		0.206	
Other	0.004		0.003	
N	378406		128688	

Source: PNAD 1992-2009

Table 2. Odds ratios from logistic regression predicting age-grade disparity, First-born children age 10-18, Brazil, 1992-2009

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Maternal age at first birth (ref=22-32)							
16 or younger	2.183***	2.392***	2.348***	2.003***	2.068***	1.800***	1.954***
	(0.040)	(0.047)	(0.047)	(0.041)	(0.043)	(0.038)	(0.042)
17-18	1.606***	1.724***	1.684***	1.501***	1.517***	1.346***	1.409***
	(0.020)	(0.023)	(0.023)	(0.021)	(0.021)	(0.019)	(0.021)
19	1.428***	1.510***	1.486***	1.343***	1.338***	1.214***	1.240***
	(0.021)	(0.023)	(0.023)	(0.022)	(0.022)	(0.020)	(0.021)
20-21	1.267***	1.317***	1.296***	1.221***	1.210***	1.125***	1.129***
	(0.013)	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)
33-45	1.334***	1.278***	1.227***	0.981	1.008	1.175***	1.178***
	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.018)	(0.019)
Female		0.609***	0.603***	0.579***	0.570***	0.563***	0.553***
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Age		1.240***	1.250***	1.249***	1.267***	1.255***	1.269***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Race (ref=white)							
Black		2.483***	2.277***	1.878***	1.918***	1.797***	1.965***
		(0.049)	(0.046)	(0.040)	(0.041)	(0.039)	(0.043)
Mulatto		2.273***	1.747***	1.427***	1.449***	1.392***	1.492***
		(0.018)	(0.016)	(0.013)	(0.014)	(0.013)	(0.015)
Asian		0.493***	0.509***	0.615***	0.636***	0.610***	0.631***
		(0.036)	(0.037)	(0.051)	(0.054)	(0.052)	(0.054)
Other		2.624***	2.059***	1.789***	1.837***	1.634***	1.816***
		(0.284)	(0.219)	(0.199)	(0.206)	(0.187)	(0.213)
Mother's education (ref=12 years or more)							
No formal education				9.134***	7.748***	7.215***	7.753***
				(0.197)	(0.169)	(0.158)	(0.174)
1-4 years				6.564***	5.509***	5.311***	5.238***
				(0.118)	(0.101)	(0.098)	(0.101)
5-8 years				3.542***	3.226***	3.206***	3.352***
				(0.062)	(0.058)	(0.058)	(0.063)
9-11 years				1.612***	1.573***	1.608***	1.757***
				(0.029)	(0.029)	(0.030)	(0.033)
Family income (logged)					0.899***	0.906***	0.887***
					(0.001)	(0.001)	(0.003)
Number of siblings						1.274***	1.231***
						(0.005)	(0.005)
Family structure (ref=two parents)							
Mother only						1.384***	1.401***
						(0.015)	(0.016)
Other						1.458***	1.289***
						(0.095)	(0.086)
Constant	1.157***	0.050***	0.073***	0.016***	0.027***	0.021***	0.010***
	(0.006)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)
Observations	378,406	378,406	378,406	378,406	378,406	378,406	378,406

Source: PNAD 1992-2009

Notes: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.10. Data are weighted. Models include controls for urbanicity (ref=urban), region (ref=south), and year (ref=1992).

Table 3. Unstandardized coefficients from OLS regression predicting age-standardized educational attainment, First-born children age 10-18, Brazil, 1992-2009

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Maternal age at first birth (ref=22-32)							
16 or younger	-0.394***	-0.338***	0.314***	-0.251***	-0.259***	-0.184***	-0.214***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
17-18	-0.229***	-0.192***	-0.169***	-0.135***	-0.136***	-0.073***	-0.091***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
19	-0.168***	-0.141***	-0.124***	-0.097***	-0.093***	-0.042***	-0.051***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
20-21	-0.098***	-0.082***	-0.068***	-0.057***	-0.051***	-0.012**	-0.014***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
33-45	-0.174***	-0.159***	-0.121***	0.012*	0.002	-0.086***	-0.083***
	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Female		0.248***	0.239***	0.234***	0.234***	0.235***	0.235***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age		-0.011***	-0.010***	0.001	-0.003***	0.004***	0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Race (ref=white)							
Black		-0.429***	-0.356***	-0.243***	-0.244***	-0.210***	-0.242***
		(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Mulatto		-0.412***	-0.236***	-0.134***	-0.136***	-0.113***	-0.139***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Asian		0.239***	0.200***	0.107***	0.087***	0.109***	0.101***
		(0.024)	(0.022)	(0.023)	(0.023)	(0.023)	(0.023)
Other		-0.532***	-0.372***	-0.261***	-0.268***	-0.206***	-0.242***
		(0.054)	(0.046)	(0.042)	(0.040)	(0.040)	(0.039)
Mother's education (ref=12 years or more)							
No formal education				-1.063***	-0.955***	-0.898***	-0.903***
				(0.007)	(0.007)	(0.007)	(0.007)
1-4 years				-0.652***	-0.556***	-0.528***	-0.519***
				(0.005)	(0.005)	(0.005)	(0.005)
5-8 years				-0.338***	-0.284***	-0.280***	-0.301***
				(0.005)	(0.005)	(0.005)	(0.005)
9-11 years				-0.072***	-0.055***	-0.068***	-0.115***
				(0.004)	(0.005)	(0.005)	(0.005)
Family income (logged)					0.044***	0.039***	0.038***
					(0.000)	(0.000)	(0.001)
Number of siblings						-0.116***	-0.099***
						(0.001)	(0.001)
Family structure (ref=two parents)							
Mother only						-0.113***	-0.120***
						(0.004)	(0.004)
Other						-0.160***	-0.106***
						(0.022)	(0.021)
Constant	0.261***	0.471***	0.152***	0.553***	0.298***	0.384***	0.512***
	(0.002)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.014)
Observations	378,406	378,406	378,406	378,406	378,406	378,406	378,406
R-squared	0.014	0.081	0.167	0.271	0.302	0.322	0.357

Source: PNAD 1992-2009

Notes: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.10. Data are weighted. Models include controls for urbanicity (ref=urban), region (ref=south), and year (ref=1992).

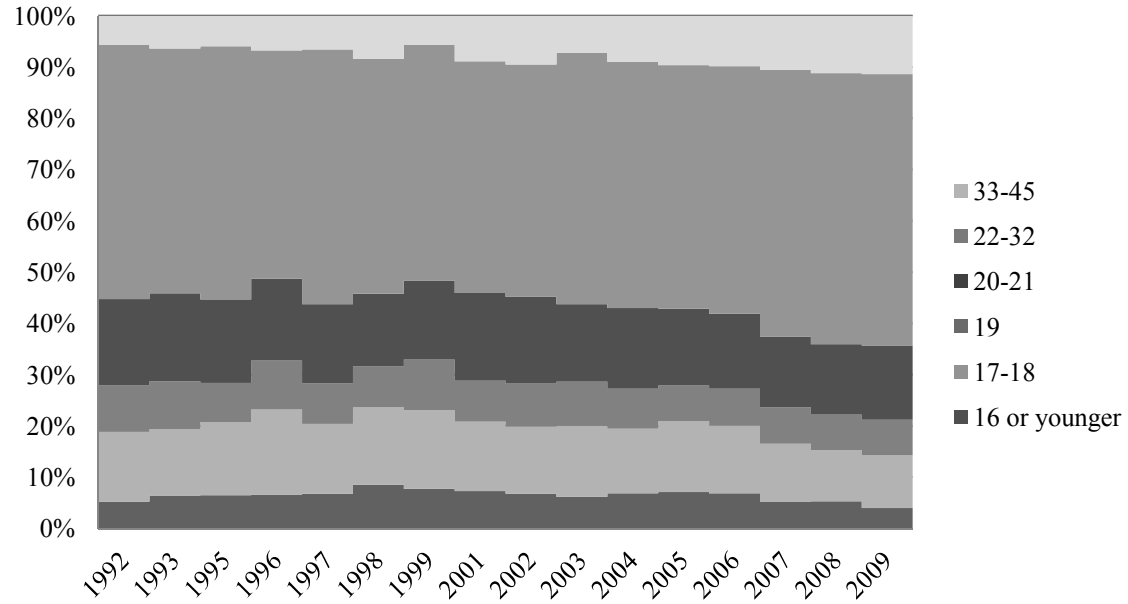
Table 4. Odds ratios from logistic regression predicting primary school completion, First-born children age 16-18, Brazil, 1992-2009

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Maternal age at first birth (ref=22-32)							
16 or younger	0.485***	0.538***	0.528***	0.556***	0.537***	0.640***	0.585***
	(0.015)	(0.018)	(0.018)	(0.020)	(0.020)	(0.025)	(0.023)
17-18	0.643***	0.694***	0.692***	0.713***	0.706***	0.825***	0.782***
	(0.014)	(0.016)	(0.016)	(0.018)	(0.018)	(0.021)	(0.020)
19	0.692***	0.732***	0.725***	0.743***	0.745***	0.850***	0.829***
	(0.017)	(0.019)	(0.020)	(0.022)	(0.022)	(0.026)	(0.025)
20-21	0.833***	0.859***	0.859***	0.853***	0.867***	0.963~	0.955*
	(0.015)	(0.016)	(0.017)	(0.018)	(0.018)	(0.021)	(0.021)
33-45	0.677***	0.680***	0.745***	1.038	1.024	0.839***	0.860***
	(0.013)	(0.014)	(0.016)	(0.024)	(0.024)	(0.020)	(0.022)
Female		1.946***	1.954***	2.042***	2.106***	2.145***	2.221***
		(0.026)	(0.027)	(0.030)	(0.031)	(0.032)	(0.034)
Age		1.372***	1.399***	1.504***	1.512***	1.543***	1.563***
		(0.011)	(0.012)	(0.013)	(0.014)	(0.014)	(0.015)
Race (ref=white)							
Black		0.391***	0.421***	0.517***	0.502***	0.551***	0.501***
		(0.011)	(0.013)	(0.017)	(0.017)	(0.018)	(0.017)
Mulatto		0.404***	0.548***	0.677***	0.661***	0.701***	0.648***
		(0.005)	(0.008)	(0.011)	(0.011)	(0.012)	(0.011)
Asian		2.629***	2.359***	1.922***	1.963***	2.049***	1.978***
		(0.389)	(0.346)	(0.309)	(0.330)	(0.345)	(0.338)
Other		0.610**	0.773~	0.888	0.843	0.969	0.906
		(0.096)	(0.119)	(0.144)	(0.137)	(0.159)	(0.151)
Mother's education (ref=12 years or more)							
No formal education				0.051***	0.062***	0.067***	0.064***
				(0.002)	(0.003)	(0.003)	(0.003)
1-4 years				0.093***	0.112***	0.118***	0.119***
				(0.004)	(0.005)	(0.005)	(0.006)
5-8 years				0.192***	0.212***	0.213***	0.203***
				(0.009)	(0.010)	(0.010)	(0.010)
9-11 years				0.493***	0.507***	0.494***	0.449***
				(0.023)	(0.024)	(0.024)	(0.022)
Family income (logged)					1.123***	1.112***	1.134***
					(0.003)	(0.003)	(0.008)
Number of siblings						0.776***	0.806***
						(0.005)	(0.005)
Family structure (ref=two parents)							
Mother only						0.685***	0.666***
						(0.013)	(0.013)
Other						0.636***	0.683**
						(0.083)	(0.088)
Constant	1.800***	0.010***	0.003***	0.008***	0.003***	0.004***	0.005***
	(0.016)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	128,688	128,688	128,688	128,688	128,688	128,688	128,688

Source: PNAD 1992-2009

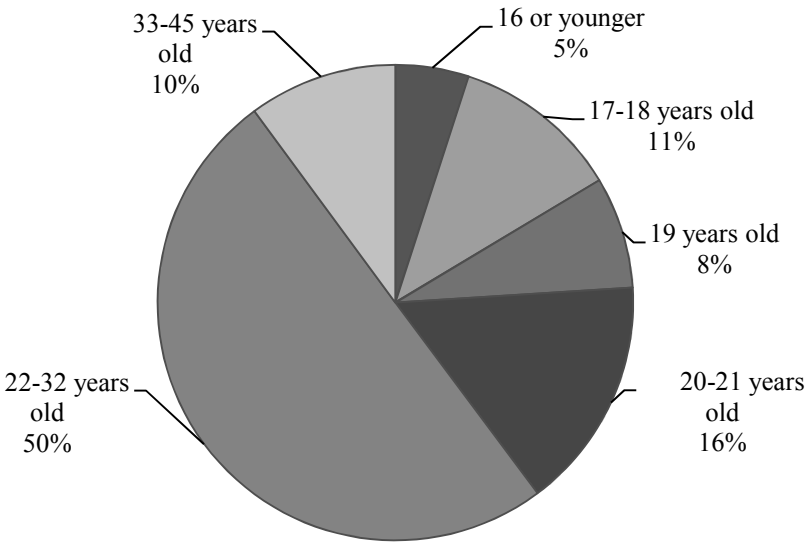
Notes: Standard errors in parentheses. *** p<0.001, ** p<0.01, * p<0.05, ~ p<0.10. Data are weighted. Models include controls for urbanicity (ref=urban), region (ref=south), and year (ref=1992).

Figure 1. Proportion of first-born children born each year by mother's age at birth Brazil, 1992-2009



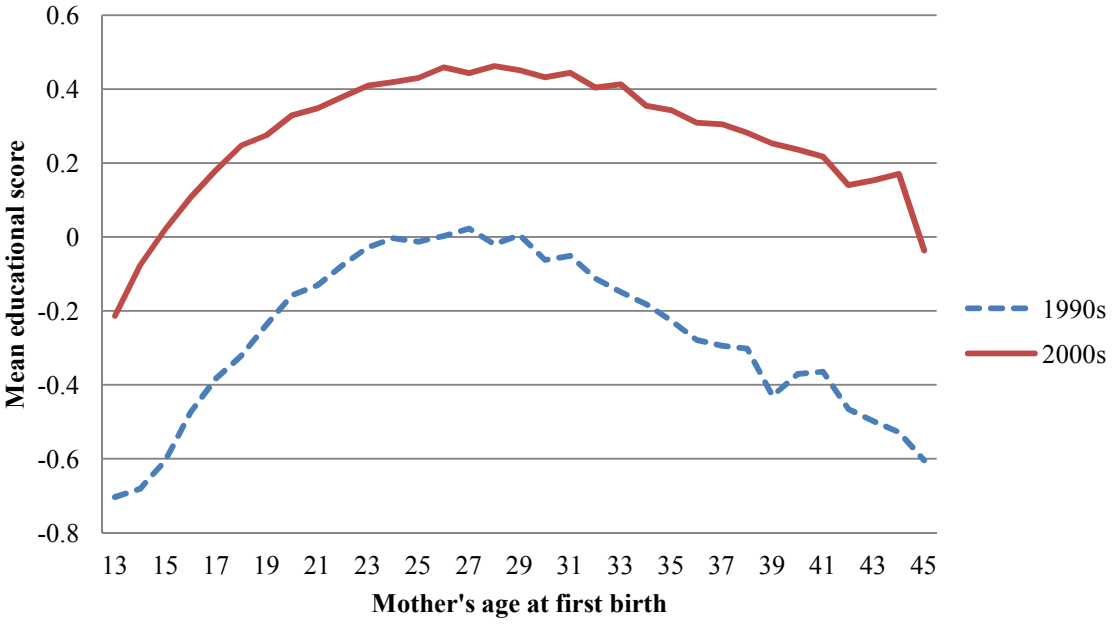
Source: PNAD 1992-2009

Figure 2. Distribution of mother's age at first birth, Children age 10-18, Brazil, 1992-2009



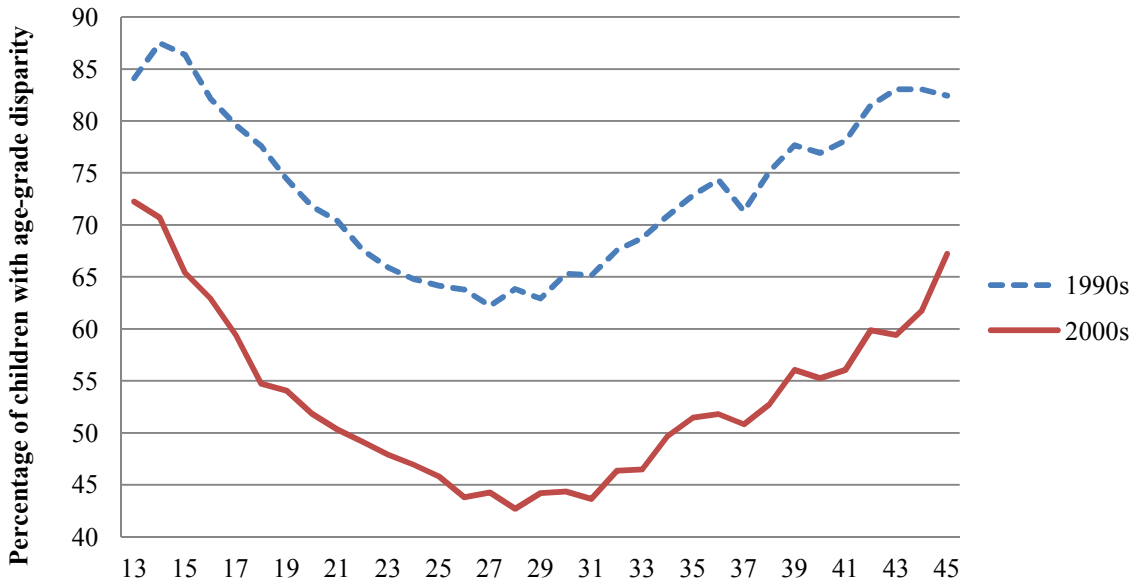
Source: PNAD 1992-2009

Figure 3. Mean age-standardized educational score by mother's age at first birth for first-born children age 10-18, Brazil, 1992-2009

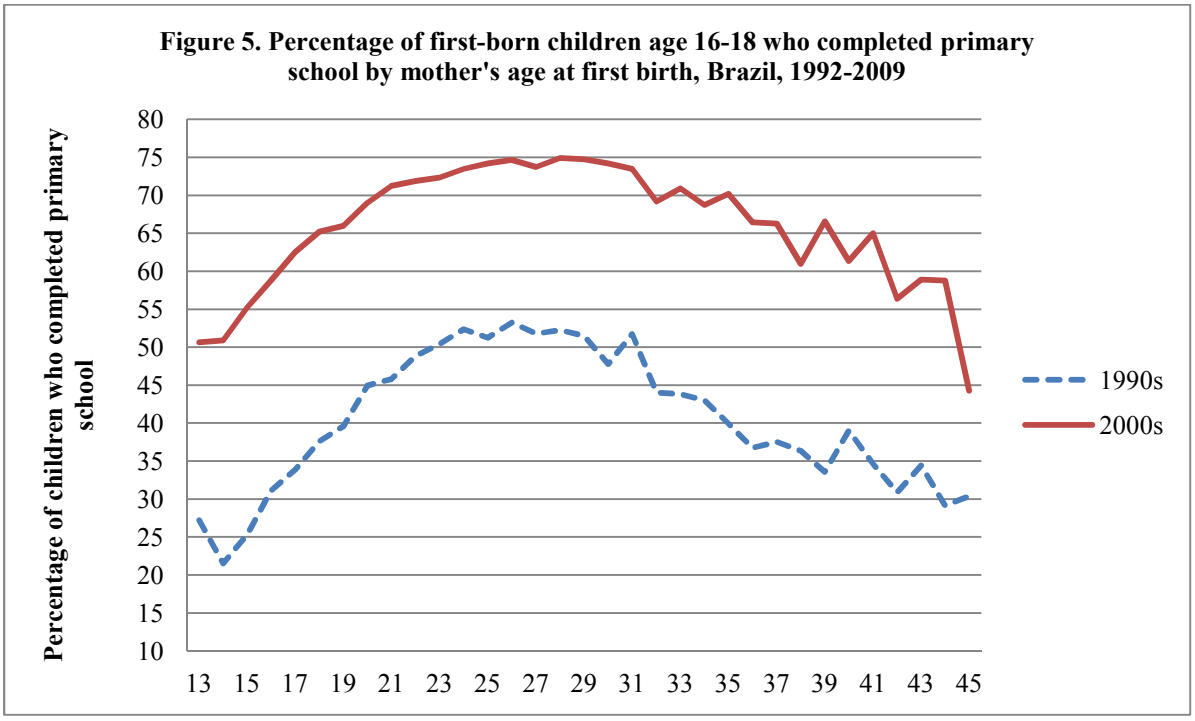


Source: PNAD 1992-2009

Figure 4. Percentage of first-born children age 10-18 with an age-grade disparity by mother's age at first birth, Brazil, 1992-2009



Source: PNAD 1992-2009



Source: PNAD 1992-2009