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Maternal age at first birth and adolescent education in Brazil

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Abstract

BACKGROUND—Brazil has witnessed dramatic changes in its fertility patterns in recent decades. The decline to below-replacement fertility has been accompanied by increases in the proportion of children born to young mothers. Yet we know little about the well-being of children born to young mothers in Brazil.

OBJECTIVE and METHODS—Using data from the 2006 *Pesquisa Nacional de Demografia e Saúde* and a quasi-natural experimental approach, this study examines the implications of maternal age at first birth for the education of Brazilian adolescents.

RESULTS—We find that being born to a young mother is associated with educational disadvantages in adolescence, but that these disadvantages are attenuated once we account for mothers' selection into early childbearing. We also find that, in southern Brazil, adolescents born to young mothers have poorer educational outcomes compared with their peers born to older mothers, but that in northern Brazil no such disparities exist.

CONCLUSIONS—Adolescent educational disadvantages associated with being born to a young mother are not an artifact of selectivity, at least in southern Brazil. Regional variation in the effect of maternal age at first birth on adolescent education suggests the important role of the extended family and the father's presence as mechanisms through which disadvantages operate.

1. Introduction

Brazil, the largest country in Latin America, reached below-replacement fertility at the end of the last decade. The most recent Demographic and Health Survey for Brazil, the *Pesquisa Nacional de Demografia e Saúde* (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 increases in adolescent fertility that eventually plateaued in the 2000s (Berquó and Cavenaghi 2005b). Although young childbearing is generally perceived as socially detrimental for mothers, there is much less evidence regarding the well-being of children born to young mothers, particularly for developing countries such as Brazil, where the context of adolescent childbearing often differs from that of developed countries such as the United States. For example, differently from the U.S. where nearly all births to women age 15–19 take place outside of wedlock, a larger proportion of adolescent childbirths in Brazil take place in or lead to a marital union (Flórez and Núñez 2001; Martin et al. 2010). In addition, extended family arrangements are common in many parts of Brazil, and remain based on principles of intergenerational obligations in that parents continue to provide the social and economic conditions for adult children and grandchildren in exchange for old-age

security. As a result the extended family may mitigate the negative consequences of early childbearing, as co-residence with the extended family, grandparents in particular, and with fathers, may benefit children of young mothers in several ways (Marteleto and Souza 2012).

Stark regional variation in social, economic, and demographic conditions, most prominently between the less developed Northeast and North regions versus the more developed South and Southeast regions, also make Brazil an ideal site for studying contextual variation in the relationship between adolescent childbearing and children's educational outcomes. Importantly, young mothers' patterns of family formation and living arrangements vary significantly in the northern compared to the southern regions of Brazil.

The goal of this paper is to examine the intergenerational consequences of early childbearing for the education of Brazilian adolescents. We use rich nationally representative data from the 2006 PNDS to examine an important educational outcome in adolescence-age-grade disparity. Our analysis proceeds in two parts. First, we implement logistic regression models to estimate the association between maternal age at first birth and age-grade disparity and to assess whether the association varies by region. Second, because part of the associations we find between mother's age at first birth and age-grade disparity might be explained by selection into early motherhood (Geronimus et al. 1994; Hotz et al. 2005; Hotz et al. 1997), we use a quasi-natural experimental approach to address the possibility of selection into early motherhood. Following past research, we use mothers' teen miscarriage as an instrumental variable; that is, we compare children of teen mothers with children of mothers who had a miscarriage during adolescence and postponed childbearing until at least after age 19 (Hotz et al. 2005; Levine et al. 2007).

Our study begins to fill a gap in the literature about the intergenerational consequences of young childbearing in developing countries in at least three key ways. First, we use nationally representative data to study this issue in the Brazilian context. The few studies that have examined the intergenerational consequences of early childbearing in developing countries—particularly studies that account for selection into early childbearing—have used samples with small geographic representation. The question of whether early childbearing is consequential for children is increasingly important for developing countries such as Brazil that have recently witnessed unprecedented large sizes of cohorts of young people (Lam and Marteleto 2008). The size of the adolescent and young populations recently reached a historical peak in several developing countries, generating the largest number of young people these countries will ever see (Lam 2011; Lam and Marteleto 2005). Even though the growth rate of the adolescent population is significantly lower today than it was 40 years ago in almost all developing countries, the large sizes of the incoming youth cohorts are likely to result in increases in the absolute numbers of teenage births, even if adolescent birth rates remain constant. Second, we use a quasi-natural experimental approach to address issues of selectivity into early childbearing. Such an approach allows us to evaluate the extent to which the negative associations hold after selection is accounted for, unmasking whether being born to a young mother has a causal effect on adolescent education. Third, our study addresses the significance of contextual differences in the intergenerational implications of early childbearing. Exploring contextual differences in the relationship between mother's age at first birth and children's educational outcomes is especially important in the case of Brazil, because of its high levels of social inequality and stark regional differences.

We organize our discussion by first talking about the empirical evidence of the intergenerational consequences of adolescent childbearing and then situating our study within the Brazilian context.

2. Intergenerational consequences of adolescent childbearing

The period in women's life course when they give birth has important consequences for their life trajectories and that of all of their children (Powell et al. 2006). Of particular importance is whether girls give birth during adolescence, when they have not yet finished a successful educational path or established a career. Social concerns about the implications of adolescent parenthood arise because of its association with truncated educational careers, reduced earnings potential, lower chances of community participation, and a greater risk of living in poverty (Lloyd et al. 2005). For example, women who become mothers at older ages are more likely to hold higher-paid jobs and thus tend to have more resources. In addition to having more resources, older mothers are more likely to spend more on their children than younger mothers (Espenshade 1984). According to this resource allocation perspective, children born to younger mothers are at a clear disadvantage vis-à-vis children born to older mothers (McLanahan 2004).

Another strand of research focuses on young mothers' lack of psychological and emotional readiness to offer an optimal environment for their children. Young mothers may be less likely to be ready for parenthood, with preferences and tastes that are not conducive to fostering a supportive learning environment for their children. This view contends that young mothers have less adequate parenting skills than they would have if they postponed childbearing (Furstenberg et al. 1989). Younger mothers are also less likely to have the tools to supervise and control their children's behavior. They may still be in school or work in jobs that are less flexible and require more hours, and therefore have less time to supervise their children. Children of young mothers can also be at a disadvantage because they are less likely to be born into stable unions and are less likely to spend time with their fathers than children of older mothers (Sigle-Rushton and McLanahan 2004). The overall idea is that young mothers are systematically different from older mothers in that they are less likely to be able to offer the material and emotional conditions necessary for an optimal environment for their children. The empirical evidence confirms that lower socioeconomic status and poorer socio-emotional parenting are important pathways through which children of adolescent mothers are disadvantaged compared to children of older mothers (Mollborn and Dennis 2012).

Two generations of studies have provided mixed empirical evidence on the relationship between early childbearing and children's outcomes. The first generation of studies mostly confirmed a strong correlation between adolescent childbearing and many adverse outcomes, for both adolescent mothers [3] and their children, in both developed (Brooks-Gunn and Furstenberg 1986; Hofferth 1987) and developing countries (Buvinic 1998; Gupta and Leite 1999). These early studies assessed the association between being born to an adolescent mother and children's outcomes without accounting for the potential selectivity into early childbearing.

The second generation of studies considered that women who give birth at a young age have a trajectory of limited education and lower earnings irrespective of whether they gave birth as teenagers or not, and that these poor conditions reflect on their children's outcomes irrespective of the timing of birth. Children of adolescent mothers therefore fare worse than children of older mothers because social inequality and disadvantages contribute both to selection into adolescent motherhood and to worse intergenerational outcomes (Geronimus et al. 1994). This second generation of studies has attempted to account for selectivity into adolescent childbearing by trying to find a better comparison group for adolescent mothers (Geronimus and Korenman 1993; Hotz et al. 1997; Lee 2010) and their children (Branson et

[3]We do not review the extensive literature on the implications of adolescent childbearing for adolescents themselves.

al. 2011; Francesconi 2008; Geronimus et al. 1994; Hotz et al. 2005; Levine et al. 2007; Mollborn and Dennis 2012; Ranchhod et al. 2011; Rios-Neto and Miranda-Ribeiro 2009; López Turley 2003). Here again there are studies focusing on both developed and developing countries, though the literature on developing countries, particularly accounting for selection into adolescent childbearing, is much scarcer. The general idea is to identify women who are similar to young mothers, so that it may be inferred that differences between these groups are largely due to maternal age at the child's birth rather than other background factors.

This body of research has relied on several different methodological approaches to account for mothers' selection into early childbearing, yielding mixed findings. The only clear finding from the literature on the intergenerational consequences of young childbearing from both developed and developing countries is that the traditional analysis seems to overstate the negative consequences of teenage childbearing. Most studies accounting for selectivity into early childbearing report substantially reduced or no effects.

One approach is the use of cousin and sibling fixed effects (Francesconi 2008; Hoffman et al. 1993; Levine et al. 2007) following the work of Geronimus and Korenman (1993). Although this method has the benefit of accounting for unobserved heterogeneity, birth order effects are confounded in the sister design (Francesconi 2008). Another approach has been to reweight the data using propensity score matching based on either within-school characteristics (Levine and Painter 2003) or pre-fertility characteristics (Branson et al. 2011; Ranchhod et al. 2011) to generate a more appropriate counterfactual group. A third approach is a quasi-natural experiment that compares young mothers with older mothers who miscarried as adolescents (Hotz et al. 2005; Levine et al. 2007). Researchers have also used age at menarche as an instrumental variable (Rios-Neto and Miranda-Ribeiro 2009). Finally, in the few cases where data are available, studies have attempted to account for detailed measures of adolescents' family background and parental involvement in children's education and health (Mollborn and Dennis 2012). Collectively, this body of research has reached less definitive conclusions on whether adolescent childbearing leads to harmful consequences for young mothers and their children.

Geronimus and colleagues did not find negative effects of teen childbearing for early child development (Geronimus et al. 1994). López Turley confirmed the lack of harmful consequences of teen childbearing for test scores and behavior problems during adolescence such as depression and peer conflict (2003). Children born to older mothers did not fare better than their cousins born to younger mothers, suggesting that adolescent disadvantages associated with having been born to a young mother were due to young mothers' disadvantaged family background and selection into early childbearing (López Turley 2003). Also using sibling fixed-effect models, D'Onofrio and colleagues found that children of adolescent mothers present disruptive behaviors (2009). Using several identification strategies to control for mothers' background factors, Levine and colleagues (2007) found conflicting evidence on whether adolescent childbearing leads to harmful consequences for their children. Focusing on younger children, Mollborn and Dennis (2012) found that children of teen mothers are disadvantaged across several domains: they experience riskier home environments and unfavorable parenting behaviors such as delayed prenatal care. They also exhibit worse health and developmental outcomes such as low birth weight and worse cognitive and behavioral indicators at age two (Mollborn and Dennis 2012).

The few studies that have attempted to account for the possibility of selection into early childbearing in developing countries also suggest mixed evidence. Branson and colleagues showed that children of young South African mothers are more likely to be underweight at birth and stunted (2011). However, this study did not find educational disadvantages among

adolescents born to teen mothers (2011). Using age at menarche as an instrumental variable applied to data from two cities in Brazil, Rios-Neto and Miranda-Ribeiro found an educational gap and higher infant mortality for children of adolescent mothers (2009).

Despite an inconsistent set of findings, this literature points to at least two dimensions along which the relationship between early childbearing and child outcomes may vary. The first is the nature of the outcome examined. The literature suggests that maternal age at first birth is more consequential with regards to parenting behaviors of young mothers towards their children and health outcomes (Branson et al. 2011; Mollborn and Dennis 2012). Studies focusing on educational outcomes provide more mixed evidence: some studies report smaller or no effects related to children's educational outcomes (Branson et al. 2011; Geronimus et al. 1994), while others report significant negative effects (Hotz et al. 2005; Rios-Neto and Miranda-Ribeiro 2009). A second likely source of variation is the context studied. Adolescent childbearing likely has different implications depending on the social context in which it takes place. For example, adolescent childbearing may be less consequential to children's outcomes in contexts in which adolescent childbearing is more common or in which adolescent mothers have more family resources available. Brazil provides an ideal setting for studying contextual variation in the relationship between maternal age at first birth and children's educational attainment because of its drastic regional diversity in socioeconomic conditions. We next turn to a discussion of the patterns of adolescent fertility in Brazil.

3. Adolescentc hildbearing in Brazil

Brazil has recently undergone a process of sharp fertility decline[4] (Potter 1999). The TFR fell from 6.15 in 1960 to 5.38 in 1970, reaching 2.45 by 2000 (United Nations Population Division 2010) and below replacement levels by 2006 (Ministério da Saúde 2008). Although it is difficult to identify one reason for Brazil's fertility decline[5], it is safe to say that the country's demographic regime, with a TFR of 1.80 in 2006, is now typical of a late-industrializing country (Ministério da Saúde 2008). An important aspect of Brazil's current fertility regime is the high fertility rates at young ages (Berquó and Cavenaghi 2005a; Diniz and Cavenaghi 2009).

In addition to the overall rejuvenation of its fertility schedule, Brazil has also witnessed an uptick in its adolescent fertility rate. Adolescent fertility in Brazil increased in the 1980s and 1990s while fertility rates for all other age groups fell. Barbosa's (2008) tabulations of Brazilian census data for the year 2000 indicate that 8.3% of women between the ages of 15–17 have at least one child, compared to only 4.7% in 1980. In addition the relative weight of teen fertility in Brazil's TFR has increased: according to estimates from the 2000 Census, nearly 20% of children were born to teenage mothers between the ages of 15–19, compared to 9% in 1990 (Berquó and Cavenaghi 2005; Gupta 2000). The adolescent fertility

[4]The speed of Brazil's fertility decline is comparable to that of other large developing countries that have implemented aggressive family planning programs, except that Brazil's fertility decline took place in the absence of governmental family planning programs (Martine 1996), which suggests a strong and rapid shift from a regime where individuals lacked fertility control to one marked by fertility control. Contraceptive practice throughout the fertility transition centered on female sterilization and use of the pill (Potter 1999). While prevalence has increased rapidly over time, the range of methods used has remained limited, still centering on female sterilization and the pill. Another important feature is that the North and Northeast regions presented the country's highest levels of fertility in the 1960s and 1970s (Potter et al. 2010). Although this is still true in 2005, the differences have declined significantly—the total fertility rate in 2005 was 1.7 in the southern regions of Brazil; compared to 2.3 in the North and 2.0 in the Northeast (Potter et al. 2010). The analysis of fertility decline by region by Potter and colleagues also shows that the early transitions typical of the southern regions were much slower than the later transitions of the northern regions, suggesting that regional differences in fertility reduced greatly over the course of the transition (Potter et al. 2010).

[5]Demographers attribute the fertility decline in Brazil to several factors: ideational change accompanied by material change (Potter, Schmertmann, and Cavenaghi 2002); increasing use of contraception, including female sterilization (Martine 1996); and increased schooling (Lam and Duryea 1999).

rate subsequently plateaued in the 2000s and has remained at almost constant levels since then (Berquó and Cavenaghi 2005; Diniz and Cavenaghi 2009). This suggests that although fertility has declined historically in the region—reaching replacement levels in several countries such as Brazil—there is no clear evidence of delayed childbearing. The high rates of adolescent fertility and the rejuvenated fertility schedule underscore the importance of examining the consequences of early childbearing for the children of young mothers. Because adolescent fertility is more normative in Brazil than in other countries with the same low fertility regime, it is possible that the consequences of early childbearing are smaller in Brazil. Within disadvantaged populations early childbearing may not be deviant: rather, a pattern of early fertility may be responsive to social-structural constraints and limited opportunities (Geronimus et al. 1994).

An important feature of young childbearing in Brazil is that it often takes place within or leads to a marital union (Cabral and Heilborn 2005). A study of three metropolitan areas reports that the birth of a child led to a marital union for 31.3% of the young mothers; another 21.8% were already in a union at the time of the birth (Dias and Aquino 2006). This is very different from the patterns of adolescent childbearing in the U.S. and other developed countries, where adolescent childbearing rarely takes place within or leads to a marital union (Martin et al. 2010).

The extended family also plays an important role in the lives of adolescent parents in Brazil. Regardless of whether young mothers are in a marital union or not at the time of the birth, the majority of young mothers and their children co-reside with the extended family. A study of three Brazilian capitals reports that nearly 40% of all adolescent mothers continue to live in the parental home after a birth (Aquino et al. 2003); 71% of those out of a marital union were living with their extended families (Dias and Aquino 2006). This suggests that a large proportion of young parents do not form a new household, likely because of limited income opportunities. Qualitative evidence suggests that lack of economic and emotional conditions is the main problem faced by young parents (Castro et al. 2004).

A high proportion of births within (or leading to) marital unions and of co-residence with the extended family suggests that the negative consequences of adolescent childbearing might be lower than in contexts where adolescent childbearing rarely results in a marital union and where the extended family is largely absent. There are several reasons why living with the extended family and/or with the child's father can alleviate the negative consequences of early childbearing for the children of young mothers. First, by living with grandparents, children of young mothers have access to more resources than if they lived with their mother only or, in some circumstances, even with both parents. Grandparents can provide support by pooling resources that might enable children to attend better schools, for example. They can also offer emotional support to both children and young parents. Similarly, the father's involvement in children's lives is higher when they co-reside. Under these circumstances being born to a young mother may be less consequential to children throughout several points of their life course.

Lacking retrospective information on family arrangements at birth, we indirectly address this question[6] by examining regional variation in the extent to which young mothers co-reside with the extended family and with the child's father at the time of birth. As we mentioned previously, socioeconomic differences between northern and southern Brazil make region one of the most salient contextual characteristics to consider in this study. In the absence of longitudinal data and retrospective information on adolescents' living

[6]The PNDS does not include information on the living arrangements when adolescents were young, a limitation faced by most social surveys everywhere but in developing countries in particular.

arrangements at birth, we use a sample of newborn children (age 0) in the PNDS data to get a sense of the different living arrangements of adolescent mothers across Brazil's northern and southern regions.

Figure 1 shows that the living arrangements of the children (age 0) of young mothers vary in two dimensions in the northern compared to the southern regions of Brazil. The first dimension is the higher levels of co-residence with the extended family in northern compared to southern Brazil. Although slightly more children live with both parents in the northern versus the southern regions (82.92% in the southern regions and 89.56% in the northern regions), a larger proportion of northern compared to southern children living with both parents also co-reside with other family members (32.17% in the southern regions versus 43.88% in the northern regions). This suggests that the children of adolescent mothers in the northern parts of Brazil have more support from the extended family, at least in the form of co-residence, which could help buffer the negative consequences of adolescent childbearing in this region. Such a high proportion of children of young mothers living with the extended family in northern Brazil is in line with research on intergenerational living arrangements in Brazil: studies have documented a higher proportion of the elderly co-residing with adult children in northern compared to southern Brazil, also pointing out that such intergenerational households are formed largely by adult children's needs rather than the elderly's (Camarano et al. 2006; Saad 1999).

Another dimension along which the living arrangements of the children of young mothers vary across regions is regarding the father's presence. Only 8.96% of the northern children lived in single-mother families compared to 17.08% of the southern children. This suggests that children of adolescent mothers co-reside with fathers at higher rates in the northern compared to the southern parts of Brazil. Together, the larger proportions of children living with their fathers and with the extended family at birth suggest that the disparities between children born to young versus older mothers may be smaller in the northern than in the southern regions.

We address this issue by empirically assessing 1) whether mothers' age at first birth is a source of educational stratification for adolescents in Brazil; 2) whether there is regional variation in the relationship between mothers' age at first birth and adolescent education; and 3) whether these associations persist after accounting for mothers' selection into adolescent childbearing.

4. Data and methods

We used data from the 2006 *Pequisa Nacional Demografia e Saúde* (PNDS), the most recent Demographic and Health Survey (DHS) available for Brazil. With a nationally representative sample of 15,575 women of reproductive age (15–49), the DHS is well suited to our research questions because it is one of the few datasets that contains detailed information about Brazilian women's fertility histories as well as information about the well-being of their children. Specifically, it provides information about the demographic and educational characteristics of children who live in the household with the interviewed mother.

Our study relied on an analytic sample of adolescent children aged 10–16 who were living in the household with their mother at the time of the survey. Although the PNDS collects educational information about children as young as 4 years old, we chose to use age 10 as our cutoff point because we observed little variation in our selected educational outcomes among children younger than 10 years old. At the same time, because of variability in educational outcomes by age, we focus on an educational outcome—age-grade disparity—

that is standardized by age, as we explain in more detail below. Of the 7,956 children in the original 10–16 year-old sample, we eliminated 1,104 observations due to missing information on the covariates, resulting in a final sample size of 5,715 adolescent children.

5. Measures

We constructed our dependent variable, age-grade disparity, by dividing the child's completed years of schooling by the child's current age minus 7, the mandated age for starting school in Brazil. For example, a child who started school at age 7 and advanced a grade each year without repeating or dropping out should be in the seventh grade by age 14. This child would therefore have an age-grade indicator of 1, meaning that her current grade corresponds to her age. In contrast, an age-grade indicator of less than 1 would mean that the child is old for her grade, suggesting that she likely repeated a grade or dropped out at some point in time. Because our goal was to determine the existence of an age-grade disparity and not the extent of the age-grade gap, we collapsed this variable into a dichotomous indicator in which we assigned a 1 to children who presented an age-grade disparity and a 0 to children who did not.

Our key independent variable of interest is mother's age at first birth. We created a set of dummy variables that distinguished children whose mothers' age at first birth was 16 or younger, 17, 18–19, and 20 and older. We estimated all analyses with alternate specifications of mother's age at first birth and obtained results that were substantively consistent with those presented here. However, for methodological and conceptual reasons we opted for the categorical specification and for considering those whose mothers gave birth at ages 19 and under as children of adolescent mothers. Concerns about the consequences of adolescent childbearing arise because of its association with school exit, reduced earnings potential, and greater risk of living in poverty (Lloyd et al. 2005). As such, the term "adolescent parenthood" is often used to connote parenthood that takes place "before an age when young people have typically acquired the full complement of skills, experience, and social network connections that will enable them to perform the role of parent well and to fulfill the other obligations of adulthood to the best of their ability." (Lloyd et al. 2005: 507). Social, economic, biological, and demographic transitions during adolescence set the stage for adult life and are likely to shape individuals' entire future. Although some studies differentiate early from older adolescent childbearing as we do, virtually all studies of adolescent childbearing—from the classic studies by Geronimus and Korenman (1993) and Geronimus, Korenman, and Hillemeier (1994) to recent studies focusing on developing countries (Eloundou-Enyegue and Stokes 2004; Berquó and Cavenaghi 2005; Cavenaghi and Alves 2011), to the few studies using the same methodological tools we use (Levine et al. 2007; Francesconi 2008), to cite a few — consider age 19 and under as adolescent.

We also controlled for various demographic and family background characteristics. Our demographic controls included child's sex, child's birth order [7] (first, second, third, or higher), age in years, mother's race (white, *pardo* or mixed-race, black, other) and urbanicity (urban/rural). *Pardo* refers to those labeled as mixed-race. We included mother's race rather than child's race because the PNDS only collects information about the race of the mother. Our family background controls included mother's years of education and the log of family income. We also included a measure of family structure that is coded as

[7]We tested several specifications of birth order. The log-likelihood statistics of the model with a categorical specification of birth order is larger than the log-likelihood of the model with a linear specification of birth order. Some of the interaction terms of birth order and maternal age at first birth were statistically significant. Notably, some of the coefficients representing first- versus second-born adolescents were statistically significant at the .01 level. We therefore find support for coding birth order categorically.

mother and father only (reference group), single mother, mother and father plus other relatives/household members, and single mother plus other relatives/household members.

6. Analytic strategy

Our analysis proceeded in two parts. First, we used multivariate logistic regression models to examine the relationship between mother's age at first birth and children's age-grade disparity. To explore the possibility of contextual variation in this relationship we estimated separate models for the most disparate regions of the country—the North/Northeast and the South/Southeast. We find theoretical and methodological support for splitting our analysis between northern and southern Brazil. After confirming significant interaction effects for region and maternal age at first birth, we opted to show the logistic regression models separately by region for ease of interpretation[8]. Conceptually, Brazil is a large country with stark social, economic, and demographic differences between its regions, most prominently between the Northeast and North versus the South and Southeast regions. The disparities between these regions are large in several aspects of social life but, particular to this research, are staggering in terms of access to education and economic conditions, with the southern parts of Brazil presenting overall higher levels of socio-economic conditions.

Second, we estimated two-stage least squares (2SLS) linear regression models,[9] also separately by region, using mother's teen miscarriage as an instrument for assessing how mother's selection into teen childbearing may influence the relationship between teen childbearing and child well-being. The use of miscarriage as instrumental variable for the study of the consequences of adolescent childbearing is based on the idea that a miscarriage is out of parents' control and results in an unexpected delay in childbearing (Hotz et al. 2005; Hotz et al. 1997). Although it is not without limitations, the use of miscarriage as instrumental variable arguably isolates the causal effect of maternal age at first birth on children's outcomes. We return to the limitations of our analytical approach in the discussion section.

We restricted the sample for the instrumental variables analyses to children whose mothers' first pregnancy occurred when they were teens (<20)[10]. Within this sample we followed the work of Hotz et al. (1997) by distinguishing children whose mothers' first pregnancy ended in a live birth from children whose mothers' first pregnancy ended in miscarriage and who delayed childbearing until after adolescence[11]. The first-stage statistics presented below confirm that our models do not have a problem with weak instruments, as the F-statistics are

[8]Models with interaction terms between region and maternal age at first birth yield better goodness-of-fit statistics than models without region interactions, and some of the interaction terms between maternal age at first birth and region were statistically significant at the 0.01 level (not shown).

[9]For computational reasons and to ensure comparability with the literature in this area (see Angrist et al 2010, for example), we use linear probability models for a categorical outcome.

[10]Although we differentiate the intergenerational effects of maternal age at birth using a set of dummy variables, our instrument considers adolescent mothers to be those who gave birth before age 20. This is in line with all past research, which has used the same analytical technique (Hotz et al. 2005; Hotz et al. 1997; Francesconi 2008; Levine et al. 2007).

[11]Identifying teen miscarriage for mothers of children in the adolescent sample of the PNDS required inference based on three variables: mother's age at first pregnancy, mother's age at first birth, and mother's report of ever having had an abortion. We first assessed the difference between the mother's age at first pregnancy and mother's age at first birth. If the difference between mother's age at first pregnancy and mother's age at first birth was greater than one year, we noted that the mother's first pregnancy did not end in a live birth. If mothers whose first pregnancy did not end in a live birth reported never having had an abortion, we assumed that the loss of their first pregnancy was the result of a miscarriage (technically, it could have ended in stillbirth). We recognize that the inferential method of identifying teen miscarriage before first birth likely produced an underestimate of the number of children whose mothers' first pregnancy ended in miscarriage. Our results are therefore based on a conservative estimate of adolescent miscarriage. Nonetheless, it is important to note that there is no other recent nationally representative Brazilian data that allows for analysis accounting for selection into early childbearing, and so for yielding a more precise estimate of the intergenerational effects of maternal age at birth.

all above 50 (Cameron and Trivedi 2009). We also point out that in the 2SLS models, we used mother's age at first birth as a continuous variable.

7. Results

Table 1 shows the descriptive statistics for the sample of children ages 10–16 by a dichotomous indicator of maternal age at first birth (first birth at age 19 or younger vs. first birth at age 20 or older). We observe important differences between the characteristics of children born to teen mothers and children born to non-teen mothers. Overall, children born to teen mothers exhibit a less favorable socioeconomic profile: they have lower average family income and lower average maternal education. We also find evidence of racial disparities in adolescent childbearing, with non-white mothers, particularly those with mothers labeled as black and *parda*, over-represented among children born to teen mothers. We find that 39% of children born to non-teen mothers have mothers labeled white compared with only 29% of children born to teen mothers. Children born to teen mothers are also disproportionately located in northern Brazil, in the poorest parts of the country: 46% of children born to teen mothers live in the northern regions, compared with 34% in the southern regions. These numbers suggest possible selection into early childbearing and the need to methodologically account for such selectivity.

Turning to the multivariate analyses, Table 2 presents the results from logistic regression models examining the relationships between mother's age at first birth and age-grade disparity for the sample of those aged 10–16. Models 1–3 in Panel A correspond to the southern regions while Models 1–3 in Panel B correspond to the northern regions of Brazil. It is important to note that an odds ratio larger than one signifies an undesirable association with our outcome, age-grade disparity, even though the association in statistical terms is positive.

All coefficients corresponding to each maternal age at first birth dummy in Models 1A and 1B are statistically significant, suggesting higher probabilities of age-grade disparity. In Model 2 we include controls for child's gender, child's age, and birth order. We find that, even after accounting for these factors, young maternal ages at birth are associated with higher probabilities of age-grade disparity in both regions. In Model 3 we add controls for mother's race, mother's education, log of family income, household structure, and urbanicity. In the southern regions our findings suggest that a maternal age at first birth of 16 or younger is associated with 96% higher odds of having an age-grade disparity compared to a maternal age at first birth of 20 or higher. Similarly, in the northern regions, a maternal age at first birth of 16 or younger is associated with 84% higher odds of age-grade disparity compared to a maternal age at first birth after age 20. These results suggest that children born to the youngest teen mothers are at higher risk of grade retention than are children born to non-teen mothers. The coefficients representing maternal ages at first birth of 17 and 18–19 also show higher odds of grade retention but are statistically significant only in the south; this suggests that disadvantages associated with early maternal age at birth are more prevalent in southern Brazil. We next examine whether these important findings are robust after addressing the issue of selection into young motherhood through 2SLS regression models[12].

The control variables work in the expected directions. Higher levels of log of family income and maternal education are associated with lower odds of grade retention in both northern

[12]As an additional robustness check, we also tested a continuous version of the educational outcomes of the children in our sample. Results of OLS regression models for completed years of education also point to educational disadvantages associated with young maternal age at first birth (not shown). Because age-grade disparity is standardized by age, we opted to show the results for this educational outcome.

and southern regions. Children of mothers labeled *pardo* have higher odds of grade retention vis-à-vis children of mothers labeled white; such disadvantage extends to children of black mothers in the southern regions. In line with research showing an educational advantage of girls over boys in Latin America (Grant and Behrman 2010) and elsewhere (Buchmann, DiPrete, and McDaniel 2008), we find that females have lower odds of age-grade disparity than males. Interestingly, in the southern parts of the country children in all family structures have higher odds of experiencing grade retention than those in nuclear two-parent families. In northern Brazil, on the other hand, only children in nuclear single mother families are marginally disadvantaged when compared to children in nuclear two-parent families. This likely relates to the prominent role of the extended family in northern Brazil.

Do the observed educational disadvantages associated with young maternal age at first birth persist after accounting for mother's selection into adolescent childbearing? To address this question we turn to the results of the 2SLS regression models in Table 3. We report only the coefficients for the instrument (teen miscarriage) and the key variables of interest (maternal age at first birth), both of which are taken from the full model with all control variables included.

The first-stage estimates for all outcomes are strong and interesting on their own, and suggest that a teen miscarriage delays a first birth by around 5.2 years in northern Brazil and 4.3 years in southern Brazil. This is in line with previous research that reported that a teen miscarriage delayed a first birth by 4.4 years on average when considering post-teenage births (Hotz et al. 2005). The F-statistics for the first stage are above 50, indicating that there are no concerns with teen miscarriage being a weak instrument for the analyses.

We next examine the results from the second stage, which estimate the relationship between mother's age at first birth and age-grade disparity. Although the coefficients for the control variables are not shown in the 2SLS models, they all work in the directions reported in the logistic models shown in Table 2. Column A in Table 3 presents the results for the sample of adolescents in southern Brazil, while column B shows results for the sample in northern Brazil. The idea here is to explore two very different contexts as a way to tap into the reasons behind the negative implications of adolescent childbearing for the children of young mothers. On methodological grounds, Brazil offers unusually high-quality nationally representative data with large enough sample sizes to tackle the implications of maternal age at first birth for children of teen mothers in the northern versus the southern regions of the country. As explained above, on conceptual grounds, southern and northern Brazil are different in several aspects of social, demographic, and economic life.

The 2SLS results for the regional analysis reveal stark differences. They indicate that the educational disadvantages associated with early maternal age at first birth hold for those children and adolescents living in the southern regions of the country. Children of mothers who postpone childbearing by one year have a 4.3 lower point probability of grade retention compared to those children whose mothers started childbearing sooner (−0.043 coefficient significant at the 0.05 level). Importantly, the maternal age at first birth coefficient generated through the 2SLS model corresponding to the southern regions is estimated precisely enough that the associated 95% confidence interval excludes the corresponding OLS estimate. [13] In southern Brazil, using miscarriage as instrument, the estimated effect of maternal age at first birth on children's age-grade disparity is significantly different from zero and substantially larger than the corresponding OLS estimate.

[13]Of particular interest in 2SLS analysis is whether the IV estimates can be distinguished from the corresponding OLS estimates (Wooldridge 2013). We therefore ran OLS regression models; the goal is simply to compare the coefficients of maternal age at first birth estimate estimated through equivalent 2SLS and OLS models.

The coefficients representing maternal age at first birth for the northern regions models, on the other hand, are not statistically significant; this suggests that, within the northern regions, children born to younger mothers fare no worse than their counterparts born to older mothers. Our data is limited in that it does not offer much about the mechanisms through which such advantage (or disadvantage) among children of adolescent mothers operates. Our regional analysis is a step in this direction.

8. Discussion and conclusion

The primary goal of this study was to examine whether children of young mothers are academically disadvantaged relative to their peers born to older mothers. This is an important question everywhere, but even more so for developing countries such as Brazil, where the size of the adolescent and young populations have recently reached a historical peak that has generated the largest number of young people these countries likely will ever see. Furthermore, although the country now exhibits below-replacement fertility levels, it has recently experienced a pattern of rejuvenation of the fertility schedule with increases in the share of adolescent fertility in the total fertility rate. Such trends have generated concerns about the implications of being born to a young mother for the well-being of their offspring.

This study addressed the longstanding debate about whether the association between maternal age at birth and disadvantages for young mothers and their children is contaminated by selection into early childbearing of girls who were already disadvantaged, irrespective of early motherhood. We used miscarriage during adolescence as a quasi-experiment, where we compare children of young mothers with children of mothers who would have been adolescent mothers had they not miscarried.

Our results suggest that being born to a young mother is consequential for adolescents' education, at least in southern Brazil. Importantly, the negative associations between maternal age at first birth that we found in the multivariate analyses for southern Brazil hold when we account for selection into early childbearing through a quasi-experimental approach. Our findings suggest that the disadvantages coming from being born to a young mother are not an artifact of selectivity, at least in southern Brazil, an area of low fertility and higher levels of socio-economic development.

The secondary goal of this study was to explore regional variation in the relationship between maternal age at first birth and children's educational outcomes. Findings from this analysis suggest that a negative effect exists in the southern regions of Brazil, where young mothers' co-residence with the extended family is less frequent and where early childbearing is less associated with a marital union. We find no effect in the northern regions where families often operate under extended household arrangements in which the responsibilities and economic costs of raising children are more consistently shared across the extended family. Our results show that, under these circumstances, being born to a young mother is not consequential to adolescents' education. This highlights the important role of the social and familial contexts within which adolescent childbearing takes place, in line with classic frameworks highlighting the importance of extended family systems for an array of demographic phenomena, including marriage and fertility patterns (Davis 1955). Although limitations in the Brazilian data, which are also common in data from all developing countries, prevent us from testing this claim directly, our analysis suggests that the regional differences in the effect of early childbearing and adolescent education may be due to family and social contexts. In particular, the higher rates of marital unions and extended family living arrangements in the northern regions compared to the southern regions may mitigate the negative consequences of early childbearing for children born to young mothers in northern Brazil. By living with grandparents and other relatives in

extended households, children have access to resources—financial and emotional—that enable them to succeed in school. In addition, the higher overall poverty level within the northern regions relative to the southern regions could mean that being born to a young mother in the northern regions does not confer any further disadvantage to those children. Our finding that families, particularly household and family living arrangements, are important social institutions for the subsistence of young mothers and their children in Brazil is in line with evidence that families consist of an institution that provides for individuals in the absence of a strong central state (Fussell and Palloni 2004). Our results suggest the central role of families in buffering the negative effects of early childbearing on the offspring of adolescent mothers.

Brazil's current demographic regime presents low yet young fertility which, combined with an upward trend in female labor force participation, suggests that future cohorts of grandmothers will be in the workforce at high rates and therefore unable to provide extensive childcare for grandchildren. Thus, it is important for policies to focus on providing affordable and high-quality childcare for the children of young mothers, to ensure that they continue their educational careers and achieve high-paid employment. In addition, because the school day ends early in Brazil, it is equally important to ensure that the children of adolescent mothers, particularly those living in impoverished areas, have access to safe and effective after-school activities that promote academic and social development.

Despite its significant findings, this study has important limitations. The PNDS data does not provide direct retrospective information on living arrangements and union patterns of young mothers at the time of first birth. Unfortunately such lack of large samples of longitudinal data is an issue in most developing countries. Although our study helps to fill a gap in the literature on the intergenerational effects of adolescent childbearing, and our analytical approach addresses the severe problem of selection into early childbearing, the use of miscarriage as a quasi-natural experiment is not without limitations. First, this method is based on comparing children whose mothers miscarried during adolescence to children of adolescent mothers. While a powerful tool, our analytical approach uses a small set of the population and therefore results should be interpreted with caution. Because of the selection of the comparison group, small sample size can also be an issue. Even a large dataset such as the PNDS/DHS contains few cases of miscarriage to precisely estimate models testing for mechanisms and further differences in the intergenerational effects of adolescent childbearing. For example, in addition to regional variation, different groups—boys and girls, for example—might also experience early maternal age at first birth differently. A second limitation is that the data is based on self-reports, and information on miscarriages tends to be underreported. Abortions may be misreported as miscarriages because of the stigma associated with abortion, and some of the women who miscarried might have chosen an abortion had they not miscarried. Third, for the instrument to be valid, we must assume that miscarriages do not directly influence children's education. While it is less problematic to assume negligible effects of a miscarriage on the offspring of adolescent mothers than on adolescent mothers themselves (Neugebauer et al. 2007), miscarriages may ultimately affect children.

A fruitful direction for research extending this study's findings would be to examine the intergenerational consequences of maternal age at first birth for additional outcomes and at different ages. Whenever data is available, it would also be interesting to consider the significance of paternal age at first birth. Another significant contribution would be to compare the intergenerational effects of maternal age at birth across several developing countries while accounting for selection into early childbearing. Such analysis would allow us to reflect on whether different family organizations and prevalence of adolescent fertility across countries imply varying consequences for the children of young mothers, therefore

highlighting the important role of the context within which adolescent childbearing takes place.

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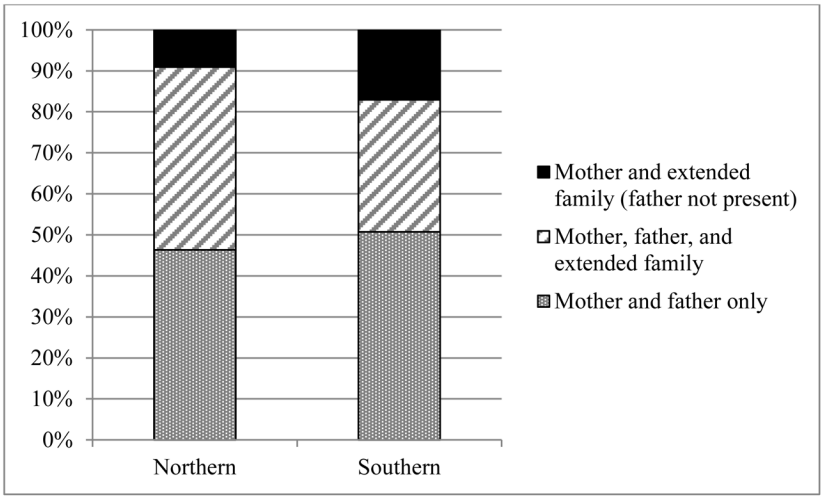

Figure 1. Percentage of newborn children of young mothers by household structure and region
Source: PNDS (DHS) Brazil 2006

Table 1

Descriptive statistics for sample of children age 10–16, Brazil, 2006

Variables	Total	Mother's age at first birth ≤ 19	Mother's age at first birth ≥ 20
Maternal age at first birth			
16 or younger	0.16	0.42	
17	0.10	0.24	
18–19	0.23	0.33	
20 or older	0.51		
Female	0.49	0.49	0.50
Age in years	12.79 (1.97)	12.74 (1.96)	12.84 (1.98)
Mother's race		0.29	0.39
White	0.34	0.29	0.39
Black	0.10	0.13	0.08
Parda	0.51	0.54	0.49
Other race	0.02	0.02	0.02
Mother's years of education	6.24 (3.73)	5.35 (3.48)	7.08 (3.77)
Log of family income	5.95 (1.92)	5.75 (1.85)	6.14 (1.97)
Household structure			
Two parents only	0.72	0.71	0.72
Two parents and other relatives	0.13	0.15	0.11
Mother only	0.11	0.10	0.11
Mother and other relatives	0.04	0.04	0.04
Urban	0.65	0.61	0.69
Region			
North	0.40	0.46	0.35
South	0.40	0.34	0.46
Midwest	0.20	0.20	0.19
Education outcomes			
Age-grade disparity	0.39	0.47	0.32
N	5,715	2,788	2,927

Source: PNDS (DHS) Brazil 2006.

Note: Mean or proportion shown. Standard deviations in parentheses.

Table 2

Odds ratios from logistic regression models predicting age-grade disparity, 10–16 year-olds, northern and southern Brazil, 2006

Region	A. Southern Region			B. Northern Region		
	Model 1A	**Model 2A**	**Model 3A**	**Model 1B**	**Model 2B**	**Model 3B**
Maternal age at first birth (ref=20 or older)						
16 or younger	2.459*** (0.335)	2.551*** (0.370)	1.964*** (0.298)	2.287*** (0.268)	2.313*** (0.286)	1.837*** (0.242)
17	2.357*** (0.370)	2.232*** (0.374)	1.904*** (0.332)	1.569** (0.216)	1.534** (0.222)	1.324~ (0.207)
18–19	1.465*** (0.170)	1.391** (0.170)	1.255~(0.160)	1.324** (0.140)	1.289* (0.143)	1.191 (0.143)
Female		0.560*** (0.054)	0.552*** (0.055)		0.525*** (0.047)	0.487*** (0.047)
Age in years		1.339*** (0.033)	1.359*** (0.035)		1.253*** (0.029)	1.287*** (0.032)
Birth order (ref= First born)						
Second born		1.010 (0.118)	0.928 (0.113)		0.979 (0.112)	0.905 (0.111)
Third born or higher		1.693*** (0.199)	1.210 (0.153)		1.885*** (0.197)	1.151 (0.134)
Mother's race (ref=White)						
Black			1.890*** (0.296)			1.074 (0.206)
Parda			1.342** (0.151)			1.368* (0.180)
Other race			1.638* (0.390)			1.648~(0.445)
Mother's years of education			0.901*** (0.015)			0.826*** (0.012)
Log of family income			0.855*** (0.027)			0.911*** (0.024)
Household structure (ref=Two parents only)						
Two parents and other relatives			1.378* (0.209)			0.905 (0.121)
Mother only			1.312~(0.202)			1.321~(0.222)
Mother and other relatives			1.909* (0.480)			1.215 (0.276)
Urban			1.347** (0.152)			0.966 (0.107)
Log-likelihood	−1387.48	−1288.27	−1221.52	−1559.68	−1458.18	−1311.79
N	2,306			2,291		

Note: Standard errors in parentheses.

*** p<0.001,

** p<0.01,

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* p<0.05,

~ p<0.10.

Source: PNDS (DHS) Brazil 2006.

Table 3

Results from two-stage least squares (2SLS) regression models predicting age-grade disparity, 10–16 year-olds, northern and southern Brazil, 2006

Region	A. Southern Region		B. Northern Region	
	First Stage	Second Stage	First Stage	Second Stage
Instrument: Mother had teen miscarriage	4.28*** (0.286)		5.26*** (0.263)	
Maternal age at first birth		−0.043* (−.081, −.003)		0.003 (−.029, .023)
N	979		1,322	

Source: PNDS (DHS) Brazil 2006.

Note: Standard errors in parentheses for first stage models. Confidence intervals in parentheses for second stage models.

*** p<0.001,

** p<0.01,

* p<0.05,

~ p<0.10.

Models include controls for sex, age, mother's race, mother's education, family structure, family income, urbanicity, and region.