sociological science

# Parental Age and Cognitive Disability among Children in the United States

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**Abstract:** Some risks of having children at older ages are widely documented, and the "biological clock" is a popular media concern, but the association between cognitive disability generally and both mothers' and fathers' age is not well known. This article assesses descriptively the relationship between children's cognitive disability and parents' age at birth, using a sample of 353,119 children aged five to eleven living with two married parents from the 2009-2011 American Community Survey. Cognitive disability varied by parental age categories from 1.8 percent to 5.4 percent, with overall rates of 2.2 percent. Odds of disability were much more strongly associated with mothers' age at birth than with fathers' age at birth, with the highest odds for children whose mothers were age 45 or higher at the time of their birth (adjusted odds ratio 2.7 relative to age 30 to 34) and the lowest for those born to mothers in their early 30s. These results demonstrate that the risk is strongly associated with the mother's age at birth—but not the father's. This is consistent with previous research showing that it is the mother's health, rather than age per se, that is most important for the health of their children.

**Keywords:** parental age; cognitive disability; child well-being; maternal health

**Editor(s):** Jesper Sørensen, Stephen Morgan; **Received:** September 20, 2013; **Accepted:** December 6, 2013; **Published:** April 4, 2014

**Citation:** Cohen, Philip N. 2014. "Parental Age and Cognitive Disability among Children in the United States." Sociological Science 1: 102-110. **DOI:** 10.15195/v1.a8



Biological parents' age has been linked to a wide variety of cognitive disabilities and mental health conditions for their children. The incidence of autism spectrum disorders (ASD) is elevated when children are born to older parents (Sandin et al. 2012; Bilder et al. 2009; Parner et al. 2012), as is incidence of Down syndrome (Sherman et al. 2007), schizophrenia (Miller et al. 2011), and behavioral problems (Gray, Indurkhya & McCormick 2004). Many other health conditions also are related to parental age. Older mothers are more likely to have children with intellectual disabilities generally, partly through increased risk of low birth weight (Griffith, Mann & McDermott 2011). Because the trend of increasing rates of ASD coincides with rising paternal age at birth, recent research suggests increased *de novo* mutations in men's sperm as they age may play a role in this trend (Kong et al. 2012; Liu, Zerubavel & Bearman 2010).

Most research about maternal age focuses on health during pregnancy and delivery, finding that older mothers are more likely to have preeclampsia, stillbirths, and adverse perinatal outcomes (Griffith et al. 2011; O'Leary et al. 2007). In addition, mothers with health conditions such as diabetes, asthma, and anemia are more likely to have children with intellectual disabilities and ASD (Leonard et al. 2006). Because low birth weight, small size for gestational age, and perinatal complications are risk factors for ASD and other conditions, and their incidence also rises with a mother's age, such factors may be pathways by which maternal age influences cognitive disabilities (Moore et al. 2012; Glasson et al. 2004). On the other hand, a variety of harmful conditions have also been associated with very young maternal age, including intimate partner violence, although these may be related to poor socioeconomic background (Silverman et al. 2006; Geronimus & Korenman 1993).

Some studies have reported independent effects of both maternal and paternal age, for example on odds of low birth weight and ASD (Croen et al. 2007; Reichman & Teitler 2006; Shelton, Tancredi & Hertz-Picciotto 2010). But it is difficult to identify statistical relationships in studies with small samples, the ages of a child's mother and father are highly correlated, and many studies examine only one or the other. The present study relies on a large sample of U.S. Census data (see below), including thousands of parents who were in their forties when their children were born.

Children's health is better on average in families with higher income, and whose parents have higher levels of education (Schor et al. 2003). The prevalence of developmental disabilities and intellectual disability is thus higher in low-income families, although autism may be more often diagnosed in families with more highly educated parents (Leonard et al. 2011; Durkin et al. 2010; King & Bearman 2011). Some conditions, such as intellectual disability and Down syndrome, are found at varying rates across racial and ethnic groups in the U.S., although the mechanisms for these patterns are unknown (Griffin, Mann & McDermott 2011; Sherman et al. 2010). In this study, parental education, family income, and race and ethnicity are controlled. Because the study was limited to married-couple families in which both parents were in their first marriage (see below), family structure variables were not included.

Some sources of cognitive disability are unevenly distributed among children by sex. Intellectual disabilities are more commonly diagnosed among boys, as are ASDs and schizophrenia (Boyle et al. 2011; Liu, Zerubavel & Bearman 2010; Aleman, Kahn & Selten 2003). In addition, the age of a child's father has been implicated in autism and schizophrenia in particular, due to *de novo* mutations (Kong et al. 2012). Initial tests showed non-significant differences in coefficients by sex, so this study analyzes boys and girls together.

The strength of this analysis is its use of a large, high quality dataset with sufficient samples to examine the children of older mothers and fathers, as well as a general measure of cognitive disability that avoids some of the ambiguity in diagnosis that affects studies based on clinical data. On the other hand, that general measure does not permit analysis of specific health conditions. An additional weakness is the lack of covariates measured at the time of birth, or health histories of parents and children before the time of the survey. However, no available data can overcome these weaknesses while providing large samples of older parents. These descriptive results help establish the prevalence and relative odds of cognitive disabilities in children by the age of their parents, which will be useful for consideration in future studies of small populations and specific health conditions.

# Methods

The analysis uses data from the 2009 to 2011 American Community Survey (ACS), conducted by the U.S. Census Bureau, made available by IPUMS (Ruggles et al. 2010). Three years of data are pooled to increase reliability. The sample consists of 353,119 children ages five to eleven (of whom 51 percent were boys) living with married parents. The sample is constructed to minimize several potential threats to validity. Because the ACS does not include family histories, parents' age at birth must be ascertained from current ages of co-residing family members. To maximize the likelihood that children in the sample were the biological children of both mother and father in the household, the sample is restricted to those (a) listed as biological children of the householder, (b) in households where the householder was married to a spouse of different sex, (c) both husband and wife were in their first marriage, and (d) the child was born after the year of the parents' marriage. Under these conditions, we may reasonably assume that the age difference between children and their parents represents the biological parents' age when the child was born—the only exceptions being the rare cases in which married couples produced children with the biological contribution of a third adult. Step, adopted, and foster children are excluded from the analysis, as are a very small number of children whose mothers were older than 49 at their birth.

The five to eleven age range was chosen to maximize sample size without compromising the disability measure. The survey does not report on disability status for children younger than five. From age five to eleven the incidence of cognitive disability increases with age, representing diagnoses occurring as children mature. As children age, the likelihood of disability resulting from lived experience increases (e.g., contracted illnesses, accidents); since this article focuses on disabilities related to parents' age at birth, older children were excluded. An unknown number of children born with disabilities were excluded from this analysis if they are not living with both of their parents, or if they have died.

The ACS assesses cognitive disability with the following question: "Because of a physical, mental, or emotional condition, does this person have serious difficulty concentrating, remembering, or making decisions?" This question is based on a disability framework (from the World Health Organization's International Classification of Functioning, Disability, and Health), rather than a diagnosis of disease. Therefore, people with disabilities are classified regardless of the origin of their condition, which may be psychological or neurological, resulting from genetic conditions, gestational or birth complications, or events or illnesses in the first years of life. The question used here reflects a Census Bureau change in 2008, when they replaced "mental" with "cognitive" and replaced "difficulty learning, remembering or concentrating" with "serious difficulty concentrating, remembering, or making decisions." As a result about one percent of children – presumably those with learning disabilities—were no longer identified as having disabilities (Brault 2009).

In order to isolate the association between parental age and cognitive disability, the following are statistically controlled: the child's age and age squared; education of the mother and father (as *less than high school complete,* or *high school only complete,* or *college degree or higher complete);* family income (natural log of dollars); and race or ethnicity (coded into mutually exclusive categories for white, Latino, American Indian, Asian, black, and Pacific Islander). The bivariate relationship between parental age at birth and children's disability rates is assessed first, followed by multivariate logistic regression models for the odds of having a reported cognitive disability. Because the age at birth of a child's mother and father are highly correlated ($r$=.80), separate models are estimated for each before they are combined. All analyses use the survey's population weights.

Institutional review board approval was not required for this study because it involved secondary data prepared by the U.S. Census Bureau to exclude identifying information. Data files and computer code for all analyses will be made public upon publication.

## Results

The sample yields an overall rate of 2.2 percent of children with cognitive disabilities. Variables used in the analysis are presented in Table 1. The unadjusted relationship between mothers' and fathers' age and cognitive disabilities is presented in Figure 1. Children born when either their mothers or fathers were in their early 30s have the lowest cognitive disability rates (1.8 to 1.9 percent). There are higher disability rates for children born to parents younger than 30, and then increasing rates of disability for parents older than 35 (for mothers) and 40 (for mothers and fathers). The unadjusted relationship between age and disability only differs substantially between mothers and fathers above age 40, when the children of older mothers have higher disability rates than those of older fathers.

Logistic regression results are presented in Table 2. The first two models, which include fathers' age and mothers' age respectively, with controls for the demographic covariates, are consistent with the unadjusted cognitive disability rates reported in Figure 1, with the lowest odds found among children born to parents in their early 30s, and higher odds at both older and younger ages. The comparison between models shows that the father's age is more weakly associated with cognitive disability. The change of likelihood ratio $\chi^2$ from Model 2 to Model 3 shows that adding paternal age does not add significantly to the predictive power of the model ($\chi^2 = 7.0, 6d.f.$, $p > .30$). Further, the coefficients for the mother's age in Model 3 are reduced only slightly, but those for father's age are reduced much more. Odds ratios based on Model 3 are plotted in Figure 2.

## Discussion

Using a large, national sample from the U.S. Census Bureau's American Community Survey for 2009-2011, this study finds a cognitive disability rate of 2.2 percent. That is lower than the 4.1 percent reported by the National Health Interview Survey for children in this age range who were "ever told they have mental retardation or

**Table 1:** Variables used in the analysis

| | Proportion | Mean | Standard Deviation |
|---|---|---|---|
| Cognitive disability | 0.022 | | |
| Parents' age at birth | | | |
| Father < 25 | 0.094 | | |
| Father 25−29 | 0.249 | | |
| Father 30−34 | 0.338 | | |
| Father 40−44 | 0.079 | | |
| Father 45−49 | 0.019 | | |
| Father 50+ | 0.004 | | |
| Mother < 25 | 0.168 | | |
| Mother 25−29 | 0.304 | | |
| Mother 30−34 | 0.327 | | |
| Mother 35−39 | 0.161 | | |
| Mother 40−44 | 0.036 | | |
| Mother 45−49 | 0.005 | | |
| Male | 0.512 | | |
| Parents' education | | | |
| Both parents college graduate | 0.324 | | |
| Mother only college graduate | 0.115 | | |
| Father only college graduate | 0.103 | | |
| Both parents high school graduate | 0.328 | | |
| Mother only high school graduate | 0.037 | | |
| Father only high school graduate | 0.028 | | |
| Neither parent high school graduate | 0.065 | | |
| Race/ethnicity | | | |
| White | 0.637 | | |
| Black | 0.063 | | |
| Asian/Pacific Islander | 0.091 | | |
| American Indian | 0.008 | | |
| Age | | 7.93 | 11.56 |
| Age$^2$ | | 66.90 | 185.35 |
| Family income (natural log) | | 11.18 | 5.96 |

Note: $N$=353,119. Cognitive disability refers to “serious difficulty concentrating, remembering, or making decisions.” Proportions and means are weighted.

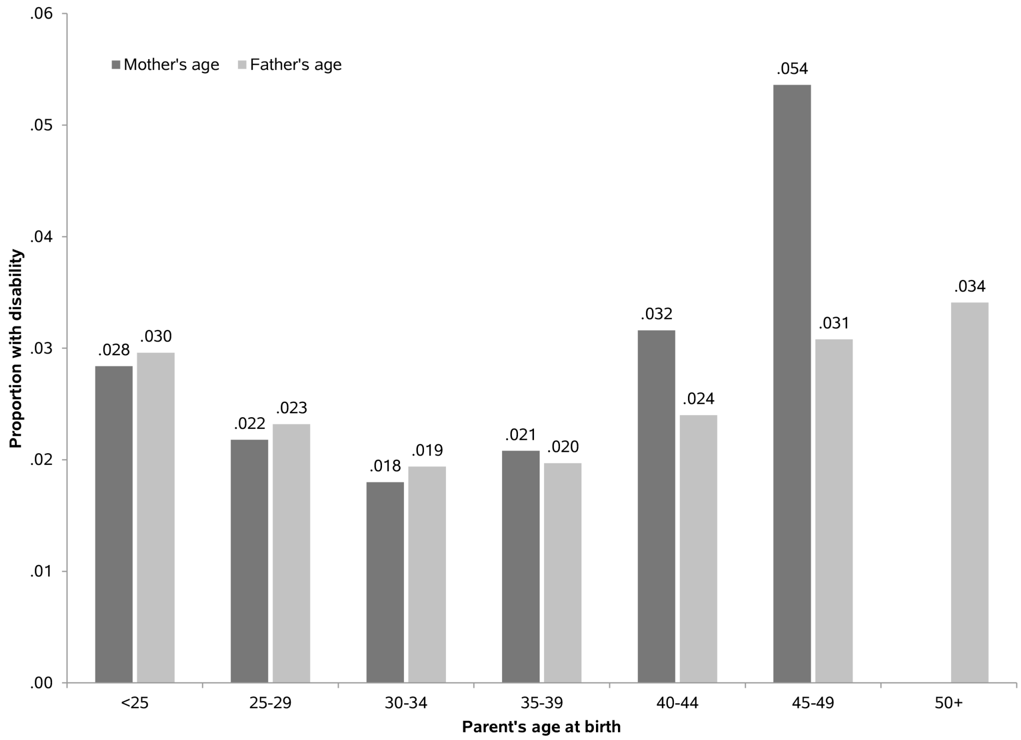


**Figure 1:** Proportion of children with cognitive disabilities, by mother's and father's age at birth.

any developmental delay" (Blackwell 2010). The difference may result from divergent definitions and survey methods, but it is likely also a consequence of the relatively privileged status of the sample used in this study, which includes only children living with two married parents in the first marriage for each parent. Among all children ages five to eleven in the 2009-2011 ACS, 3.9 percent were reported to have cognitive disabilities. In particular, one group excluded from this study, those living in group quarters, has much higher rates of cognitive disability (26 percent). Without knowing the age of those children's biological parents, however, we cannot know the implication of this exclusion for the questions in this analysis.

For this sample, the analysis shows that rates of cognitive disability are associated with mothers' and fathers' age at birth for boys and girls aged five to eleven. The rates follow a J-shaped pattern, with lowest rates for children born to parents in their early 30s, and higher rates for parents both younger than 30 and older than 35. However, the relationship with maternal age is much stronger and is robust to statistical controls for demographic factors known to be associated with cognitive disability. After adjustment for demographic covariates, the relationship between paternal age and cognitive disability is very small (and not significantly different from zero at conventional levels).

Cognitive disability in children may be caused by a variety of conditions with different risk profiles. Potential parents seeking guidance for their reproductive decisions understandably may have difficulty comparing risks associated with age for different conditions, some of which carry considerable ambiguity in their diagnosis (Mandell et al. 2009). The use of all-condition cognitive disability in this study, based on a large, population-based sample, contributes to our understanding of the overall risks.

Despite the considerable attention that men's "biological clock" has received recently (Shulevitz 2012), these results do not lend support to the narrative in which men's age has an inde-

**Table 2:** Logistic regression coefficients (standard errors) for cognitive disability on parents' age at birth and other characteristics

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Intercept | −4.475 | −4.478 | −4.448 |
| | (0.237) | (0.236) | (0.237) |
| Father < 25 (reference) | | | |
| Father 25−29 | −0.126 | | −0.072 |
| | (0.040) | | (0.045) |
| Father 30−34 | −0.201 | | −0.094 |
| | (0.040) | | (0.051) |
| Father 35−39 | −0.164 | | −0.103 |
| | (0.043) | | (0.057) |
| Father 40−44 | 0.029 | | −0.041 |
| | (.052) | | (0.069) |
| Father 45−49 | 0.270 | | 0.039 |
| | (0.079) | | (0.096) |
| Father 50+ | 0.323 | | 0.010 |
| | (0.145) | | (0.159) |
| Mother < 25 (reference) | | | |
| Mother 25−29 | | −0.129 | −0.092 |
| | | (.033) | (0.039) |
| Mother 30−34 | | −0.234 | −0.185 |
| | | (0.035) | (0.047) |
| Mother 35−39 | | −0.067 | −0.029 |
| | | (.040) | (0.056) |
| Mother 40−44 | | 0.343 | 0.342 |
| | | (0.058) | (0.075) |
| Mother 45+ | | 0.864 | 0.823 |
| | | (0.115) | (0.133) |
| Likelihood ratio $\chi^2$ | 2,103.2 | 2,202.1 | 2,109.1 |
| Degrees of freedom | 20 | 19 | 25 |

Note: $N = 353{,}119$. Coefficients for control variables (see text) not shown.

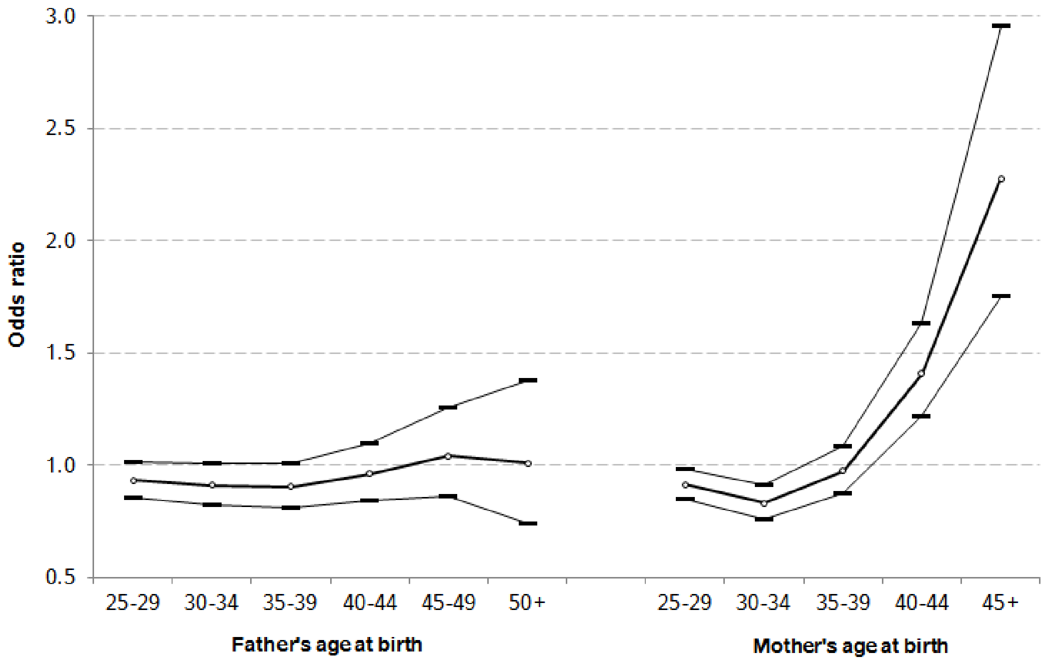


**Figure 2:** Relative odds of cognitive disability, by mother's and father's age at birth, with age <25 as the reference category for each (from Model 3 in Table 2, showing 95% confidence intervals).

pendent biological effect on children's cognitive outcomes. Using a broad measure of disability, and considering mothers' and fathers' ages together, these results show that maternal age is much more strongly associated with children's cognitive disability. The results for paternal age are not consistent with the suggestion that *de novo* mutations in older men increase the risk of conditions such as autism spectrum disorder that may be triggered by such mutations (Kong et al. 2012). Maternal age (but not paternal age) affects children partly because it is associated with the mother's health (which declines at older ages) at the time of pregnancy and delivery (Geronimus & Korenman 1993). Such a mechanism, consistent with these results, suggests the importance of a policy emphasis on improving maternal health.

## References

Aleman, Andre, René S. Kahn, and Jean-Paul Selten. 2003. "Sex differences in the risk of schizophrenia: evidence from meta-analysis." *Archives of General Psychiatry* 60: 565-571. http://dx.doi.org/10.1001/archpsyc.60.6.565

Bilder, Deborah, Judith Pinborough-Zimmerman, Judith Miller, and William McMahon. 2009. "Prenatal, perinatal, and neonatal factors associated with autism spectrum disorders." *Pediatrics* 123: 1293-1300. http://dx.doi.org/10.1542/peds.2008-0927

Blackwell, Debra L. 2010. "Family structure and children's health in the United States: Findings from the National Health Interview Survey, 2001–2007." *Vital Health Statistics* 10(246). http://www.cdc.gov/nchs/data/series/sr_10/sr10_246.pdf.

Boyle, Coleen A., Sheree Boulet, Laura A. Schieve, Robin A. Cohen, Stephen J. Blumberg, Marshalyn Yeargin-Allsopp, Susanna Visser, and Michael D. Kogan. 2011. "Trends in the prevalence of developmental disabilities in US children, 1997-2008." *Pediatrics* 127: 1034-1042. http://dx.doi.org/10.1542/peds.2010-2989

Brault, Matthew W. 2009. "Review of changes to the measurement of disability in the 2008 American Community Survey." U.S.

Census Bureau working paper. http://www.census.gov/people/disability/files/2008ACS_disability.pdf.

Coker, Ann L., Maureen Sanderson, and Beili Dong. 2004. "Partner violence during pregnancy and risk of adverse pregnancy outcomes." *Paediatric and Perinatal Epidemiology* 18: 260-269. http://dx.doi.org/10.1111/j.1365-3016.2004.00569.x

Croen, Lisa A., Daniel V. Najjar, Bruce Fireman , Judith K. Grether. 2007. "Maternal and paternal age and risk of autism spectrum disorders." *Archives of Pediatrics and Adolescent Medicine* 161: 334-340. http://dx.doi.org/10.1001/archpedi.161.4.334

Durkin. Maureen S., Matthew J. Maenner, F. John Meaney, Susan E. Levy, Carolyn DiGuiseppi,Joyne S. Nicholas, Russell S. Kirby, Jennifer A. Pinto-Martin, and Laura A. Schieve. 2010. "Socioeconomic inequality in the prevalence of autism spectrum disorder: evidence from a U.S. cross-sectional study." *PloS One* 5: e11551. http://dx.plos.org/10.1371/journal.pone.0011551.

Geronimus, Arline. T. and Sanders Korenman. 1993. "Maternal youth or family background? On the health disadvantages of infants with teenage mothers." *American Journal of Epidemiology* 137: 213-25.

Glasson, Emma J., Carol Bower, Beverly Petterson, Nick de Klerk, Gervase Chaney, and Joachim Hallmayer. 2004. "Perinatal factors and the development of autism: a population study." *Archives of General Psychiatry* 61: 618-627. http://dx.doi.org/10.1001/archpsyc.61.6.618

Gray, Ronald F., Alka Indurkhya, and Marie C. McCormick. 2004. "Prevalence, stability, and predictors of clinically significant behavior problems in low birth weight children at 3, 5, and 8 years of age." *Pediatrics* 114: 3 736-743.

Griffith, Margaret I., Joshua R. Mann, and Suzanne McDermott. 2011. "The risk of intellectual disability in children born to mothers with preeclampsia or eclampsia with partial mediation by low birth weight." *Hypertension in Pregnancy* 30: 108-115.

King, Marissa D.and Peter S. Bearman. 2011. "Socioeconomic status and the increased prevalence of autism in California." *American Sociological Review* 76: 320-346. http://dx.doi.org/10.1177/0003122411399389

Kong, Augustine, Michael L. Frigge, Gisli Masson, Soren Besenbacher, Patrick Sulem, et al. 2012. "Rate of *de novo* mutations and the importance of father's age to disease risk." *Nature* 488: 471-475. http://dx.doi.org/10.1038/nature11396

Leonard, Helen, Nick de Klerk, Jenny Bourke, and Carol Bower. 2006. "Maternal health in pregnancy and intellectual disability in the offspring: a population-based study." *Annals of Epidemiology* 16: 448-454. http://dx.doi.org/10.1016/j.annepidem.2005.05.002

Leonard, Helen, Emma Glasson, Natasha Nassar, Andrew Whitehouse, Ami Bebbington, et al. 2011. "Autism and intellectual disability are differentially related to sociodemographic background at birth." *PLoS One* 6: e17875. http://dx.plos.org/10.1371/journal.pone.0017875.g005. http://dx.doi.org/10.1371/journal.pone.0017875

Liu, Kayuet, Noam Zerubavel, and Peter Bearman. 2010. Social demographic change and autism. *Demography* 47(2)327-343. http://dx.doi.org/10.1353/dem.0.0101

Mandell, David S., Lisa D. Wiggins, Laura A. Carpenter, Julie Daniels, Carolyn DiGuiseppi, et al. 2009. "Racial/ethnic disparities in the identification of children with autism spectrum disorders." *American Journal of Public Health* 99: 493-498. http://dx.doi.org/10.2105/AJPH.2007.131243

Miller, Brian, Jaana Suvisaari, Jouko Miettunen, Marjo-Riitta Jarvelin, Jari Haukka, et al. 2011. "Advanced paternal age and parental history of schizophrenia." *Schizophrenia Research* 133: 125-132. http://dx.doi.org/10.1016/j.schres.2011.08.013

Moore, Gaea S., Anna W. Kneitel, Cheryl K. Walker, William M. Gilbert, and Guibo Xing. 2012. "Autism risk in small- and large-for-gestational-age infants." *American Journal of Obstetrics and Gynecology* 206: 314.e1.

O'Leary, Colleen M., Carol Bower, Matthew Knuiman, and Fiona J. Stanley. 2007. "Changing risks of stillbirth and neonatal mortality associated with maternal age in Western Australia 1984–2003." *Paediatric and Perinatal Epidemiology* 21: 541-549. http://dx.doi.org/10.1111/j.1365-3016.2007.00849.x

Parner Erik T , Simon Baron-Cohen, Marlene B. Lauritsen, Meta. Jorgensen, Laura A. Schieve, et al. 2012. "Parental age and autism spectrum disorders." *Annals of Epidemiology* 22: 143-150. http://dx.doi.org/10.1016/j.annepidem.2011.12.006

Reichman, Nancy E. and Julien O. Teitler. 2006. "Paternal age as a risk factor for low birthweight." *American Journal of Public Health* 96: 862-866. http://dx.doi.org/10.2105/AJPH.2005.066324

Ruggles, Steven J., Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, et al. 2010. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota.

Sandin, Sven, Christina M. Hultman, Alexander Kolevzon, Raz Gross, James H. MacCabe, et al. 2012. "Advancing maternal age is associated with increasing risk for autism: a review and meta-analysis." *Journal of the American Academy of Child and Adolescent Psychiatry* 51: 477-486. http://dx.doi.org/10.1016/j.jaac.2012.02.018

Schor, Edward L., Marilyn M. Billingsley, Alma L. Golden, Julia A. McMillan, Linda D. Meloy, et al. 2003 "Report of the task force on the family." *Pediatrics* 111: 1541-1571.

Shelton, Janie F., Daniel J. Tancredi, and Irva Hertz-Picciotto. 2010. "Independent and dependent contributions of advanced maternal and paternal ages to autism risk." *Autism Research* 3: 30-39. http://dx.doi.org/10.1002/aur.116

Sherman, Stephanie L., Emily G. Allen, Lora H. Bean, and Sallie B. Freeman. 2007. "Epidemiology of Down syndrome." *Mental Retardation and Development Mental Disabilities Research Reviews* 13: 221-227.http://dx.doi.org/10.1002/mrdd.20157

Shulevitz, Judith. 2012. "How older parenthood will upend American society: the scary consequences of the grayest generation." *New Republic,* December 6, 2012. Retrieved June 1, 2013 http://www.newrepublic.com/article/politics/magazine/110861/how-older-parenthood-will-upend-american-society

Silverman, Jay G., Michele R. Decker, Elizabeth Reed, and Anita Raj. 2006. "Intimate partner violence victimization prior to and during pregnancy among women residing in 26 U.S. states: Associations with maternal and neonatal health." *American Journal of Obstetrics and Gynecology* 195: 140-148. http://dx.doi.org/10.1016/j.ajog.2005.12.052

**Acknowledgements:** I thank Jeehye Kang and Lucia Lykke for research assistance.

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