

## **Advanced Maternal Age and Offspring Outcomes: Reproductive Ageing and Counterbalancing Period Trends**

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Women are having children later in the developed world. The mean age at first birth has increased in each of the 23 OECD countries since 1970, now averaging 28, and advanced-age fertility has also been increasing. Advanced maternal age is associated with increased risk of poor perinatal outcomes, as well as an increased risk of mortality and cancer in offsprings' adulthood. The research documenting these negative outcomes, however, neglects the potential benefits of being born at a later date. For a prospective parent, delaying parenthood means that the child is born in a later birth cohort. This is beneficial, as for many important outcomes from health to educational attainment, secular trends are positive. We illustrate this general principle using data from Sweden, and show that the macro level contextual trends outweigh the individual risk factors. As a result, fertility postponement even beyond age 40 is positively associated with long-term offspring outcomes.

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## **Advanced Maternal Age and Offspring Outcomes: Reproductive Ageing and Counterbalancing Period Trends**

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Women and men in the developed world are having children at later ages. Since 1970 the mean age at first birth has increased in each of the 23 OECD countries for which data are available, at a rate of 0.08 years per calendar year, and now averages 28 years. Over the period 1995–2011, postponement of childbearing has been increasing faster, at 0.10 years per calendar year. In Germany and the UK, the mean age at first birth exceeds 30 years (OECD 2014). Advanced-age fertility has also been increasing: in Sweden in 2013, a quarter of all births were to mothers aged 35 or older. The potential consequences of postponement are numerous, including decreasing period fertility (Bongaarts and Feeney 1998) and negative health outcomes for children as a result of reproductive aging (Jacobsson, Ladfors, and Milson 2004). Although parental socioeconomic resources typically increase with age (Powell, Steelman, and Carini 2006), advanced maternal age is associated with increased risks of Down syndrome, childhood cancer, and autism (Durkin et al. 2008; Johnson et al. 2009; Yip, Pawitan, and Czene 2006).

The research documenting these negative child outcomes, however, neglects the potential *benefits* of being born at a later date. For many important outcomes such as health and educational attainment, secular trends across the OECD countries are positive, so being born into a later birth cohort would appear to be beneficial. We illustrate this proposition using data from Sweden and a sibling–comparison design. We show that the macro-level trends outweigh the individual-level risk factors. In the process, we find that fertility postponement even up to maternal ages above 40 is associated with positive long-term outcomes for children.

These results are likely to extend to other countries where health has been improving and educational access has been expanding, such as the United States and much of Europe.

Figure 1 illustrates the changing patterns in fertility timing in Sweden. In 1968, approximately 75 percent of all births were to mothers aged less than 30, and fewer than 10 percent of births were to mothers aged 35 or above. Over a 45-year period childbearing at later ages at all parities has become more common; by 2013 approximately 60 percent of births were to mothers aged 30 or older, and 5 percent to mothers aged 40 or older. There are many reasons for the increase in the mean of maternal age at birth over these years. Much of the fertility postponement has been attributed to the use of the contraceptive pill, the expansion of career opportunities for women, and increasing economic uncertainty (Kohler, Billari, and Ortega 2002; Sobotka 2004). In the United States attitudinal and structural changes in the 1960s and 1970s increased opportunities for women in education and the labor market, as did the introduction of oral contraception (Goldin and Katz 2002), leading to improvements in gender equality.

**\*\*\* Figure 1 – Approximately Here \*\*\***

While Sweden did not have a strong feminist movement (Gelb 1989), the country's high level of gender equality relative to other countries can largely be attributed to the fact that achieving equality has been a goal of successive governments since the 1960s (Hoem 1995). Women in Sweden today have greater educational attainment than men (OECD 2013), and the tendency to delay childbearing until completing one's education is likely to be part of the explanation for

the increase in maternal age over time, as are increased career opportunities, particularly in the large public sector, and financial resources (Blossfeld and Huinink 1991). Since the 1960s in Sweden there have been a number of notable shifts in fertility and family formation behavior, collectively labeled the second demographic transition (Van de Kaa 1987; Lesthaeghe 2010). One of these has been an increase in the prevalence of less-committed relationships, which is likely to help explain why more women delay childbearing to older ages. Furthermore, Sweden's political and social system has been described as one of "statist individualism" (Berggren and Trägårdh 2006; Eklund, Trägårdh, and Berggren 2011). The country's tax and welfare systems are designed to minimize dependence on the family and enable individuals to pursue their own goals (Trägårdh 1990), making the timing of childbearing a choice that is likely to be relatively independent of familial pressures.

Delayed childbearing may be desirable from a woman's own life-course perspective and beneficial for the child, especially among younger mothers for whom socioeconomic position and resources may be rising rapidly. However, fertility postponement increasingly means a rise in advanced-age motherhood rather than a decline in young-age motherhood. This is potentially alarming as there are known risks associated with childbearing at older ages, and it has been suggested that mothers may not be fully aware of these risks (Benzies 2008). Advanced maternal age is associated with a gradual deterioration of the intrauterine environment and decreased viability of embryos due to an age-dependent decrease in oocyte quality (Abdalla et al. 1993).<sup>1</sup> These changes mean that older mothers are at higher risk of pregnancy complications. The risks of miscarriage, preterm birth, low birth weight, stillbirth, and Down syndrome increase exponentially with age (Jacobsson, Ladfors, and Milson 2004; Yoon et al. 1996; Andersen et al. 2000). Danish register data for

the period 1978 to 1992, for instance, showed that 9 percent of pregnancies intended to be carried to full term to mothers aged 20–24 ended in spontaneous abortion, while the corresponding figure was 20 percent for ages 35–39 and 41 percent for ages 40–44 (Andersen et al. 2000). Research has also shown that the disadvantages for the offspring of older mothers can extend throughout adulthood. Children born to older mothers are at greater risk of Alzheimer’s disease (Rocca et al. 1991), hypertension (Brion et al. 2008), diabetes (Gale 2010), cancer (Hemminki and Kyyrönen 1999), and mortality (Kemkes-Grottenthaler 2004), and those born to the oldest mothers also have lower self-rated health and are more likely to be obese (Myrskylä and Fenelon 2012).

It is possible that these negative long-term outcomes are a consequence of low birth weight or pre-term birth, since not all studies have been able to adjust for those mediating factors. Research suggests that lower birth weight has a negative causal impact on height, as well as on cognitive ability in adulthood, educational attainment, and earnings (Conley and Bennett 2000; Black, Devereux, and Salvanes 2007). Research has also shown that below-average birth weight is associated with increased mortality risk in adulthood (Osler et al. 2003). While well-defined physiological mechanisms account for the relationship between advanced maternal age and poor perinatal and infant outcomes, it is unclear whether the long-term negative effects on children of being born to an older mother are causal. Recent studies suggest that the increased mortality of the offspring of older mothers in adulthood is at least partially explained by the death of parents when the offspring are younger (Myrskylä and Fenelon 2012; Myrskylä et al. 2014).

A fact that has yet to receive much attention is that the age at which a woman chooses to have a child is related to period conditions. A woman born in 1960 who had a child at age 20 would have given birth in 1980. If the same woman had chosen to have a child at age 40, that child would be born in 2000. This makes a significant difference to the expected health and education of the average child, since the second half of the twentieth century has witnessed a number of secular improvements. These include improving medical and public health conditions, indicated by lower age-specific mortality and an increasing life expectancy (Oeppen and Vaupel 2002); and by increases in average height, a useful indicator of improvements in early-life conditions, of populations across the developed world (Komlos and Lauderdale 2007) . The second half of the twentieth century and the beginning of the twenty-first have also been characterized by a steady expansion of educational systems across Western Europe and the United States (Breen and Jonsson 2007; Breen et al. 2009; Breen 2010). Today more people than ever continue their formal education beyond the legally defined minimal age. The expansion of access to tertiary education has been particularly striking: in the 1940s and 1950s only a small fraction of the population obtained a bachelor's degree. While we should not ignore other long-term trends such as increasing socioeconomic inequality or rising rates of obesity, the positive progress in public health conditions and educational access has extended the opportunity for longer lives and advanced learning to more people than ever before.

In this study we examine the extent to which these secular improvements outweigh the disadvantages that have been shown to be associated with being born to an older mother. One previous study used a comparable research design. Myrskylä et al. (2013) analyzed IQ at age 18 by maternal age and found that secular

positive trends outweigh any potential individual aging-related outcomes, so that IQ increased monotonically with maternal age. This study, however, analyzed only men and focused on a measure of cognitive ability that has been claimed to be increasing over successive cohorts without any real gains in intelligence (Flynn 1987; Emanuelsson and Svensson 1990). It is unclear whether the same pattern would be observed for women and for outcomes for which measurement is reliably consistent over birth cohorts.

For Swedish men and women born between 1960 and 1991 we show that individuals born to older mothers, including those at the oldest ages, are taller, remain longer in the educational system, are more likely to attend university, and perform better on standardized tests than their siblings who were born when their mothers were younger. Analyzing these multiple outcomes requires us to use several data sets, each of which is based on high-quality Swedish administrative register data. Our results show that in a regime characterized by improving social conditions, postponing parenthood is beneficial for children even when the individual maternal aging-related effects might be negative. These results are also likely to apply to other countries where health is improving and education is expanding. Before we present our data and results, we summarize the changes that have been taking place in Sweden with respect to education, height, and physical fitness.

*Education.* Education in Sweden is state funded at all levels, and tertiary education is free for Swedish and European Union citizens (Högskoleverket 2012). Students in tertiary education are eligible for financial support from the Swedish state for living costs in the form of study grants and low-interest student loans. The cohorts on whom we focus in this study were born between 1960 and 1982. This means that

they were in secondary school between around 1976 and 1998, a period of substantial change in the Swedish educational system (Halldén 2008). Between the 1960s and 2000s, tertiary education enrollment increased substantially (Breen et al. 2009). In 2012 approximately 33 percent of the Swedish population had attained post-secondary education, slightly higher than the OECD average. This educational expansion has clearly benefited individuals born into later birth cohorts, which has implications for patterns of educational attainment by maternal age at the time of birth.

*Height.* Research suggests that taller individuals have lower mortality (Davey Smith et al. 2000), greater health-related quality of life (Christensen et al. 2007), and superior cognitive ability (Case and Paxson 2008). Height in adulthood is strongly related to both length at birth (Sørensen et al. 1999) and height in childhood, with a correlation of approximately 0.7 (Power, Lake, and Cole 1997). Mothers of infants with greater birth weight also have lower all-cause and cause-specific mortality (Davey Smith, Whitley, Gissler, and Hemminki 2000).

The overall pattern suggests that healthier mothers give birth to longer infants, who retain a height advantage into adulthood and also have greater relative health themselves. Swedes have been growing taller since at least the early nineteenth century and gained approximately 10cm between 1900 and 2000 (Gustafsson et al. 2007). A similar historical increase in height, attributable to improvements in nutrition and public health (Hatton 2013), is found in a wide range of other countries (Komlos and Lauderdale 2007), and greater stature in historical populations is also associated with lower premature mortality (Gunnell, Rogers, and Dieppe 2001).



*Physical fitness.* Physical fitness is a component of overall health. By physical fitness we mean aerobic fitness, the ability of the body to deliver oxygen to the muscles and use it to generate energy for physical activity; the most common measure of that capacity is maximal oxygen uptake (Armstrong and Welsman 2007). We use a closely correlated measure called maximal working capacity, explained below.

Greater physical fitness is associated with lower mortality risk at all ages (Blair et al. 1996) and with greater self-rated health (Shirom et al. 2008). Unlike height, it is far less clear whether the physical fitness of the Swedish population has improved in recent decades. One study found that the aerobic fitness of adolescents in Sweden decreased between 1974 and 1995 (Westerstahl et al. 2003), but it is not known whether this was due to an increase in body mass index or to less daily physical activity. Other research has found that while the functional fitness of the healthiest group of adolescents was approximately the same in 2001 as it was in 1987, the fitness of the least-healthy group of adolescents has fallen substantially (Ekblom, Oddsson, and Ekblom 2004). Taking a global perspective, Tomkinson and Olds (2007) present data which indicate that aerobic fitness among 6–19-year-olds was improving from 1958 to the 1970s, but since the 1970s has been in steady decline worldwide.

## **Data**

This study uses Swedish administrative register data. Because of different data availability for various outcome variables, we will study several cohort groups, which we describe in more detail below. Details on selecting the final sample for each set

of analyses are given in Table S1.\* The range of birth cohorts that we study is 1960–1991. In Sweden each individual has a unique personal identification number (PIN), which enables us to link the records of an individual across the various administrative registers. We draw heavily upon the Swedish multi-generational register, which contains information on each individual as well as that individual's parents. The main family members of interest are the mother, father, and siblings. We use information on the biological mother and father to identify the sibling group and use information on the biological mother to calculate maternal age at the time of birth.

Our main analyses use fixed effects specified at the level of the sibling group, so the regressions identify the parameters of interest from between-siblings comparison. Given our use of sibling fixed effects, we omit only children. We also drop sibling groups with twins and other multiple birth individuals since those individuals exhibit no variation in maternal age at the time of birth. The term “cohort cut” in Table S1 refers to individuals who are lost when restricting the sample to specific birth cohorts. All of the descriptive statistics and results presented below are based on the final sample that is detailed in Table S1.

Because children born to older parents may benefit from the accumulation of parental socioeconomic resources, we also adjusted for the time-varying occupational status of parents and for time-varying household income. Data on occupational status are available only from censuses prior to the 1990s, so we draw data from the 1960, 1970, 1975, 1980, 1985, and 1990 censuses. Using data on the mother and father, we categorize household socioeconomic status according to the higher of the two parents' occupational statuses. A reliable measure for parental

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\* Supplemental tables are available at the supporting information tab at [wileyonlinelibrary.com/journal/pdr](http://wileyonlinelibrary.com/journal/pdr).

income is available only from 1970 because of changes in how individuals and households were taxed. Our measure for parental income combines the earnings of the mother and father in the year before the index child was born, to account for the fact that parental income typically decreases immediately after the birth of a child owing to lower levels of labor market participation. The 1970s was a period of high inflation in Sweden (Edvinsson and Söderberg 2011), hence we adjust our measure of combined parental income for a measure of inflation based on the consumer price index.

### Educational attainment

To examine educational attainment, we use data on cohorts born 1960–1982. We examine educational attainment in the year in which individuals turn 30, using two different measures. The first is the number of years of educational attainment achieved by that age. This measure is based on the number of years that correspond to the specific level of education achieved by age 30, and may not in all cases reflect the actual number of years that an individual spent in the educational system. The second measure is a binary variable indicating whether individuals had entered tertiary education by age 30. The reason for using this second measure is that not all individuals in Sweden have finished their education by age 30, but the vast majority of people who earn a bachelor's degree would have started that degree before age 30 (Högskoleverket 2012).

The Swedish education system today is divided into three sections: nine years of compulsory schooling, three additional years of upper secondary education, and tertiary education (Halldén 2008). Tertiary education consists of two parts: a traditional university education and vocational tertiary education. The variable for

highest educational level and the corresponding years of education required to reach that level come from the Swedish education registers and Statistics Sweden (Halldén 2008; Statistics Sweden 2000). In the analyses of educational attainment, we also adjust for birth order, since research consistently demonstrates that later-born children have lower educational attainment than first-borns (Black, Devereux, and Salvanes 2005; Barclay 2015).

#### Grade point average at age 16

The data on grade point average (GPA) are taken from grades earned during the final year of compulsory education, at which time students are typically 16 years old. The system for assigning grades in the Swedish high school system has changed several times over the past decades, so we limit our analyses to the period 1998–2007, during which the grade system stayed constant. This means studying cohorts born 1982–1991, who were aged 16 between 1998 and 2007. During this period in the Swedish compulsory school system, grades ranged from pass with special distinction to pass with distinction, pass, or fail. To construct an overall score, each of these grades was assigned a numerical score (Skolverket 2010). The overall GPA score for each child was calculated by summing his or her grades based on the best grades in 16 subjects, and the scores ranged from 0 to 320 (Skolverket 2010; Turunen 2014). A score between 0 and 159 represents a mean mark of fail, and a score between 160 and 239 is equivalent to a mean mark of pass. In these analyses of GPA we again also adjust for birth order, as research has shown that later-born children have lower educational performance than first-borns even in high school (Kantarevic and Mechoulan 2006; Härkönen 2014).

## Physical fitness and height

To examine physical fitness and height we use data from the Swedish military conscription register on cohorts born between 1965 and 1977. Only men were required to attend conscription tests. Our outcome measure for examining physical fitness is maximal working capacity (MWC). MWC, the maximum resistance attained in watts when riding on a stationary bicycle for a period of 5 to 10 minutes, is an important predictor of mortality among men (Sandvik et al. 1993). Height is measured in centimeters.

In our analyses of physical fitness and height, we also adjust for birth order, as research demonstrates that, compared to first-borns, later-born children have lower physical fitness (Barclay and Myrskylä 2014) and are shorter (Myrskylä et al. 2013). We also include a covariate for the age at which individuals took the conscription test, ranging from 17 to 20, to adjust for any potential differences in physical fitness or height by age.

## **Statistical analyses**

We present results based upon several cohort groups and outcomes. While there are some small variations, described below, we pursue the following general strategy. Model 1 is a standard regression model (OLS or logistic) estimating a between-family comparison for the bivariate relationship between maternal age at the time of birth and the outcome variable in question. Model 2 is a fixed-effects regression model (OLS or logistic) comparing siblings within the same family to one another to estimate the relationship between maternal age at the time of birth and the outcome variable. In these models we also adjust for birth order. In the analyses using the military conscription register, we also adjust for age at the time of the

conscription tests; for the vast majority (99.9 percent) of individuals eligible under our criteria (see Table S1), this is between 17 and 20. Model 3 is a fixed-effects regression model (OLS or logistic) that is the same as Model 2 except for the inclusion of a categorical variable for year of birth, in individual years.

Model 2 captures the total effect of maternal age on child outcomes. This total effect includes not only the potential individual-level factors such as reproductive aging and accumulation of social resources, but also the impact of changing period conditions. For an individual, the period conditions systematically change with maternal age; thus Model 2 describes how child outcomes change with changing maternal age for an individual mother. Model 3 removes the influence of changing period conditions and estimates the net effect of maternal age.

The use of fixed effects in Models 2 and 3 means that we perform a within-family comparison, comparing siblings within the same family to one another. This estimator minimizes residual confounding by inherently adjusting for all factors that are shared by the siblings and remain constant, such as parental height, parental cognitive skills, and the size of the sibling group. We demonstrate the hierarchy of our models based upon the approach for studying educational attainment measured in years by age 30:

$$y_{ij} = \alpha + \beta_1 \text{MAB} + \beta_2 \text{SEX} + \varepsilon_{ij} \quad (\text{Model 1})$$

$$y_{ij} = \alpha_j + \beta_1 \text{MAB} + \beta_2 \text{SEX} + \beta_3 \text{BIRTHORDER} + \varepsilon_{ij} \quad (\text{Model 2})$$

$$y_{ij} = \alpha_j + \beta_1 \text{MAB} + \beta_2 \text{SEX} + \beta_3 \text{BIRTHORDER} + \beta_4 \text{BIRTHYEAR} + \varepsilon_{ij} \quad (\text{Model 3})$$

where  $y_{ij}$  is the measure on each of the outcome variables for individual  $i$  in sibling group  $j$ . Model 1 does not use fixed effects and is a standard OLS model performing a between-family comparison. In Models 2 and 3  $\alpha_j$  is introduced as the sibling fixed

effect.  $MAB_{ij}$  is age of the mother at the time of birth for individual  $i$  in sibling group  $j$  in five-year categories;  $BIRTHORDER_{ij}$  is the birth order of individual  $i$  in sibling group  $j$ ; and  $BIRTHYEAR_{ij}$  is the year of birth of individual  $i$  in sibling group  $j$ . In the analyses of educational outcomes, we adjust for  $SEX_{ij}$ , the sex of individual  $i$  in sibling group  $j$ , although the sex ratio at birth does not meaningfully vary by maternal age (James 1987). The key coefficient of interest is  $\beta_1$ , the estimate for maternal age at the time of birth.

## Results

### Summary statistics

Table 1 provides summary statistics for the analytical sample for each of the cohort groups. For each of the outcomes the descriptive statistics suggest an inverse U-shaped association by maternal age so that those born to the youngest and oldest mothers score lowest. In addition, the summary statistics suggest an improvement in the outcomes over time.

For the number of years of education the highest mean was among individuals born to mothers aged 30–34, with 13.1 years of schooling. As the mother's age increases or decreases, the mean years of education decrease. Compared to an individual born to a mother aged 30–34, an individual born to a mother aged 15–19 had spent 70 percent of a standard deviation less time in education by the time he or she had reached age 30, and the equivalent figure for an individual born to a mother aged 45 and older was 35 percent of a standard deviation.

For GPA at age 16 (range 0–320), children born to mothers aged 35–39 had the highest mean scores, at 218.7. Those born to mothers 45 and older had a mean

score of 206.0, which is 20 percent of standard deviation lower. The lowest mean scores were for those born to mothers aged 15–19, at 165.9, which is only slightly above a mean mark of failure (159 points). For children born to teenage mothers in cohorts 1990–1991, the mean GPA is actually below the failure threshold.

The summary statistics for physical fitness show that the highest mean MWC, at 304W, was among male children born to mothers aged 25–29. The mean MWC decreases for both younger and older maternal ages. Men born to teenage mothers had an MWC of 290W, or 29 percent of a standard deviation lower than those born to mothers aged 25–29, while men born to mothers aged 40–44 had an MWC of 294W, which is 21 percent of a standard deviation lower than those born to mothers aged 25–29. Previous research examining how MWC varies by age in Sweden has shown that the mean value for men aged 20–29 is 303W (Wohlfart and Farazdaghi 2003), slightly below the mean score for men born to mothers aged 25–29. The same study found that the mean score for men aged 30–39 was 288W, which implies that men born to teenage mothers have a level of physical fitness approximately equivalent to being at least ten years older than they were when taking these conscription tests. The pattern by birth year shows that the mean MWC increased slightly between those born in 1965–1969 and those born in 1970–1974, but then generally decreased for those born in 1975–1977. The only groups in which the mean level of physical fitness increases across all three cohorts are those born to mothers aged 40 or older.

The summary statistics for height show that the mean height in our sample group was 179.5cm. The tallest individuals were those born to mothers aged 30–34, at 180.0cm. Those born to teenage mothers had a mean height of 178.5cm, which is 23 percent of a standard deviation lower than those born to mothers aged 30–34.



Those born to the oldest mothers, aged 45 and older, had a mean height of 179.4cm, which is 9 percent of a standard deviation lower than those born to mothers aged 30–34. The pattern by year of birth shows a small increase in mean height between those born in 1965 and those born in 1977.

### Regression analyses

*Educational outcomes.* Figure 2 shows the regression results for years of education achieved by age 30. The full results, including the estimates for control variables, are given in Table S2. Model 1, the descriptive plot, shows the relationship between maternal age at the time of birth after adjusting for sex of offspring using a standard OLS model. This model replicates the inverse U-shape result shown in Table 1: relative to individuals born to mothers aged 25–29, individuals born to mothers aged 15–19 have 1.4 years less education by age 30. Individuals born to mothers aged 30–34 have the highest educational attainment, spending almost a quarter of a year longer in education by age 30 than those born to mothers aged 25–29. At maternal ages above 35, educational attainment starts to decrease. Maternal age 40–44 is associated with almost a third of a year less education and maternal age of 45 or older with 0.6 years less education than maternal age 25–29.

**\*\*\* Figure 2 – Approximately Here \*\*\***

Model 2 introduces controls for sibling-group fixed effects and birth order. After accounting for these factors, the results show a clear positive gradient by maternal age, with those born to teenage mothers performing the worst and those

born to mothers aged 45 or older performing the best, with an overall difference of more than 1.5 years between those two groups.

Model 3 is the same as Model 2, except it additionally adjusts for birth year. Doing so removes the positive gradient in educational attainment by maternal age at the time of birth. The results from Model 3, the fully adjusted model, show no substantive difference in educational attainment by maternal age, and children born to the oldest or youngest mothers do not have any clear disadvantage. Comparison of Models 2 and 3 tells a clear story. Increasing maternal age is strongly associated with increased educational outcomes (Model 2). This positive association, however, disappears when we control for time trend (Model 3). Thus, delaying motherhood improves a child's educational outcome solely because delay means that the child is born in a later birth cohort.

**\*\*\* Figure 3 – Approximately Here \*\*\***

The pattern we observe for number of years of education is consistent in the other education-related outcome measures. We also investigated whether the likelihood of entering tertiary education by age 30 follows the same pattern as the results for educational attainment measured in years attained by age 30. We did so because the results for increasing educational attainment could be driven by an increase in the proportion of individuals entering upper secondary school. The results from these additional analyses for entering tertiary education, shown in Figure 3, are very similar to those seen in Figure 2 for years of educational attainment. Full results are given in Table S3. In these additional analyses we use logistic regression, where the outcome is a binary variable for whether individuals

entered tertiary education by age 30. These analyses were conducted on the same population as the analyses for educational attainment measured in years attained by age 30, which were men and women in cohorts born 1960–1982.

The results for the third education-related outcome measure, GPA at age 16, are seen in Figure 4, and the full results appear in Table S4. Descriptive Model 1 shows the results from a standard OLS model, adjusting for sex. Men and women born to teenage mothers have the lowest GPA score, over 40 points lower than individuals born to mothers aged 25–29. GPA peaks at maternal age 30–39 and declines slowly at higher maternal ages.

**\*\*\* Figure 4 – Approximately Here \*\*\***

The results from Model 2 are based on a fixed-effects OLS model, adjusting for birth order and sex. The results from Model 2 show a statistically significant but substantively small disadvantage in GPA for those born to mothers below age 25 in comparison to those born to mothers aged 25–29. However, there is a clear advantage for those born to mothers aged 30 or older, and the highest GPA is found for those born to mothers aged 45 or older. The total difference in GPA score between individuals born to teenage mothers and those born to mothers aged 45 or older is 17 points. Another way of interpreting this GPA difference is that it is roughly the difference between failing in any one class and obtaining a grade of pass with distinction. Model 3, which introduces a control variable for birth year, shows no clear differences by maternal age once the beneficial effect of being born to a later birth cohort is removed.

*Physical fitness and height.* The results for height can be seen in Figure 5, and the full results appear in Table S5. Descriptive Model 1 shows the inverse U-shaped pattern. Individuals born to teenage mothers are 1.3cm shorter than those born to mothers aged 25–29, while those born to mothers aged 40–44 are 0.4cm shorter.

**\*\*\* Figure 5 – Approximately Here \*\*\***

The results from the fixed-effects model without a control variable for birth year, Model 2, show a positive monotonic relationship between maternal age and height up to maternal age 40–44. The difference in height between those born to teenage mothers and those born to mothers aged 40–44 is 1.0cm. Individuals born to mothers aged 45 or older do not have a statistically significant advantage over those born to mothers aged 25–29. Model 3 removes the beneficial effect of being born to a later birth cohort among individuals born to older mothers, and shows a fairly flat gradient in height by maternal age at time of birth and no statistically significant differences.

Figure 6 shows the results for maximal working capacity, our measure of physical fitness. The full results are in Table S6. Descriptive Model 1 shows a non-linear pattern similar to that seen for the educational outcomes, where men born to the youngest and oldest mothers have the lowest score for MWC. Those born to teenage mothers have a score almost 15W lower than those born to mothers aged 25–29, while those born to mothers aged 40–44 have a score more than 10W lower than those born to mothers aged 25–29.

**\*\*\* Figure 6 – Approximately Here \*\*\***

Model 2 estimates the total effect of parental age and shows a pattern similar to the one observed for educational attainment. Increasing maternal age is positively associated with physical fitness, although the gradient is not steep. When Model 3 introduces the control variable for year of birth, there are no statistically significant differences by maternal age at the time of birth.

As noted in the data section, we also conducted analyses to check the robustness of our results to controls for time-varying parental occupational status and income. Adjusting for these additional variables had no meaningful impact on the net or the total effect of maternal age on the various outcomes. Full estimates from those models are given in Tables S7–S16.<sup>2</sup>

## **Discussion**

Women in the developed world are having children at later ages. Mean age at first birth, which has increased in each of the 23 OECD countries since 1970, now averages 28 years. Advanced-age fertility has also been increasing. Advanced maternal age is associated with increased risk of poor perinatal outcomes and increased risk of mortality and cancer in adulthood. The research documenting these negative outcomes, however, neglects the potential benefits of being born at a later date. Delaying parenthood means that the child is born in a later birth cohort. This is beneficial, since for many important outcomes related to health and educational attainment, long-term trends are positive. We used Swedish population register data to examine multiple educational and health-related outcomes with several birth cohorts to illustrate this general principle. We find that the total effect of increasing maternal age—which includes individual-level factors such as reproductive aging

and changing social resources, as well as the positive impact of improving macro-level period conditions—is consistently positive. This is true even in cases where the individual-level effect is negative, because the macro-level positive trends more than offset the negative effect.

The distinction between the results that allow the positive macro trends to influence the total effect and results that control for the macro trend is important. In fully adjusted models that remove the influence of the positive time trend, we found no substantively or statistically significant disadvantage for outcomes in adulthood for those born to older mothers, not even for those born to mothers aged 45 or older. Overall, we found that the gradient for the point estimates for the relationship between maternal age and the educational and health outcomes was flat, with a small standard error and narrow confidence intervals indicating that our results are a precise indicator of the absence of a substantive relationship. While other studies show physiological evidence for a disadvantage for the offspring of the oldest mothers in terms of perinatal outcomes, our results suggest that offspring who survive until adulthood do not suffer from any disadvantage.

To the contrary, when we do not control for period changes most of our analyses show an advantage for individuals who are born to older mothers in comparison to their older siblings.<sup>3</sup> Regression coefficients are typically interpreted as the effect of  $x$  on  $y$ , holding the other covariates constant. In reality, however, the world does not remain constant simply because we include a control variable for birth cohort. For the results for years of education achieved by age 30, the likelihood of entering tertiary education, high school GPA at age 16, and height in early adulthood, individuals born to older mothers fare better. This pattern is explained by secular improvements in public health conditions and by educational expansion.

These secular improvements mean that when a woman decides to delay her childbearing, her children are likely to fare better in absolute terms in adulthood. This finding is in sharp contrast to much of the public discussion of this topic. While we do not find a similar advantage for the offspring of older mothers in terms of physical fitness, that is not surprising given that secular improvements have not been observed in that domain (Westerstahl et al. 2003).

Are the results relevant beyond the specific Swedish cohorts analyzed in this study? For at least the past 60 years, secular changes in educational access and public health conditions have been positive in Sweden. More individuals have spent more time in the educational system, and rates of morbidity and mortality have decreased. If these secular changes were to plateau, or to reverse, the advantage of delayed childbearing for the offspring of older mothers would no longer exist, or would turn into a disadvantage. While that point is important, improvements in educational access and public health conditions are likely to continue both in Sweden and across the developed world (Oeppen and Vaupel 2002). What, then, do the advantages enjoyed by the offspring of older mothers, such as spending more time in the educational system, and greater height, actually mean?

While it would appear that improvements in health are unambiguously positive, the advantages of general improvements in educational performance and attainment may be less clear depending upon the national context. Education develops an individual's ability to think critically, to engage pro-actively with his or her environment, to develop ambitions, and to pursue self-actualization.

Furthermore, research has indicated that educational expansion may be beneficial for social mobility, as the correlation between socioeconomic status at birth and in adulthood is weaker among those with higher levels of educational qualifications in

countries like the United States (Hout 1988), France (Vallet 2004), and Sweden (Erikson and Jonsson 1996). In Sweden educational expansion has been shown to increase social mobility (Breen and Jonsson 2007). On the other hand, educational expansion is less unambiguously a positive development if the labor market is unable to accommodate all of these new graduates because of structural conditions. For example, the number of graduate-level jobs may not increase at the same pace as the number of university graduates.<sup>4</sup>

There are also other factors to consider when evaluating improvements in educational performance. One such factor is whether improvements in GPA are attributable to grade inflation. The Swedish National Agency for Education reports that the mean GPA of students in compulsory education in Sweden rose between 1998 and 2004 but was relatively constant between 2004 and 2007 (Skolverket 2010, p. 23). If grade inflation explains the increase in GPA scores by maternal age, then the improvement is meaningless. Furthermore, since men and women typically compete against their contemporaneous peers in the labor market and for university admission, relative differences in performance within each cohort are more important than absolute improvements by cohort, even if those improvements are real rather than an artifact of the testing procedure. Another question is whether increasing attendance and graduation rates at university lead to measurable changes in abstract and critical thinking abilities. Recent research in the United States has shown that a large percentage of undergraduate students do not demonstrate any measurable improvement in tests designed to measure critical thinking and complex reasoning (Arum and Roksa 2011). Unfortunately comparable assessments of the cognitive gains of students in Sweden are not available.



While we do not observe any negative causal effect of advanced maternal age on long-term outcomes, the lack of a difference in outcomes might be attributable to the accumulation of socioeconomic resources by parents counteracting the negative effect of maternal physiological decline (Abdalla et al. 1993). However, for all women there is an exponential increase in risk of poor perinatal outcomes and genetic problems with increasing maternal age (Yoon et al. 1996). The average pattern of financial resource accumulation certainly does not follow an exponential curve, instead increasing gradually after entry into the labor market before leveling off in the late 30s and early 40s (Statistics Sweden 2003). This means we would expect that the exponential physiological decline would lead the offspring of mothers aged 40 or older to fare much worse than the offspring of mothers who are in their early 30s in the fully adjusted model, but we do not observe any significant difference between these two groups of offspring.

We have thus far assumed that our results and conclusions will be applicable beyond Sweden. The key drivers of our results are secular improvements in height and educational attainment. Educational expansion has been documented across the United States and Western Europe (Breen and Jonsson 2007; Breen et al. 2009; Breen 2010), and height has also been increasing in these societies (Komlos and Lauderdale 2007). Thus the key drivers behind our results are also operating in other contexts. For our results to apply to these other countries, it is not necessary for the distribution of maternal age at birth to be comparable to Sweden, or for the causes of fertility postponement to be similar to those that have been proposed to explain these developments in the Nordic region. If secular changes in educational attainment and life expectancy are positive, then the choice to delay childbearing by

any individual mother would mean that her child would be born into a more favorable environment.

Part of the explanation for our results may be related to selection into our analytical population. There are at least two dimensions to this. First, the individuals who were born to older mothers were born to women who were able to conceive at older ages, which previous research shows is a positive marker of their physical health (Smith, Mineau, and Bean 2002; Grundy and Kravdal 2008). Second, the children conceived by these older mothers survived to adulthood, meaning that they did not have adverse perinatal or infant outcomes. This means that the individuals we observe in adulthood who were born to older mothers were relatively robust babies from strong mothers, and this may explain why there is no negative causal effect of being born to an older mother. As a consequence of this consideration, we cannot make the policy recommendation that it is better for women to delay childbearing to an older age. For one, difficulties with conceiving increase with age. Second, empirical studies consistently demonstrate a higher risk of miscarriage (Andersen et al. 2000) and negative perinatal outcomes for children born to older mothers (Jacobsson, Ladfors, and Milson 2004). Clearly it is important for women to carefully consider these facts. Nevertheless, in absolute terms, offspring who are born to an older mother in contemporary Sweden and survive to adulthood do better than their older siblings who were born when their mother was at her peak level of reproductive health.

## Notes

- 1 Research on the interaction between the age of oocyte donors and the age of donor recipients suggests that it is primarily the decline in the quality of the

oocyte with age that explains the increasing difficulty of conception with maternal age and the increased risk of miscarriage (Abdalla et al. 1993).

- 2 For all of the models and outcome variables presented above, we also conducted additional analyses to test the sensitivity of the results to the inclusion of a variable for the father's age at the time of birth. Advanced paternal age at the time of birth is associated with an increased risk of birth defects such as Down syndrome and other chromosomal mutations, although the reported association is relatively weak (Yang et al. 2007). Our results, fully consistent with the patterns presented here, are available upon request.
- 3 Although we cannot empirically assess whether our results are being driven by cohort or period improvements, that distinction is not important for the overall conclusions drawn from our analyses.
- 4 Research using data from the UK shows a recent increase in downward social mobility (Bukodi et al. 2015). The reason for this is that while the number of professional and managerial jobs increased from the 1950s through the 1970s (Goldthorpe and Mills 2004), this expansion has not continued; thus, many of the children raised in these high socioeconomic status families have been unable to find occupations that allow them to maintain their socioeconomic position of origin (Bukodi et al. 2015). This example indicates the importance of considering structural labor market conditions when evaluating the benefits of educational expansion. In relation to the decision by a potential mother about whether to delay childbearing, the results of this study show that because of secular improvements, the outcomes of delayed childbearing for children are likely to be better in absolute terms, but not in relative terms.

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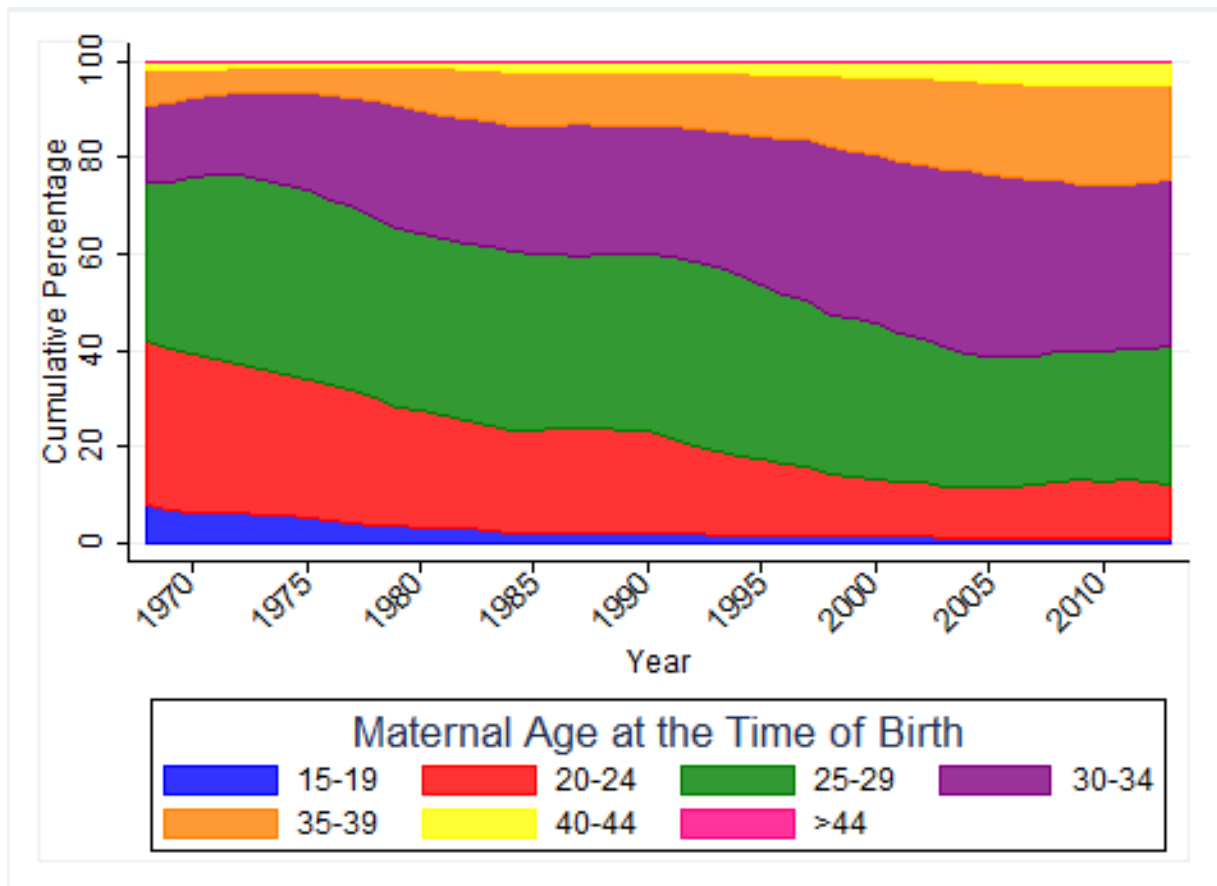
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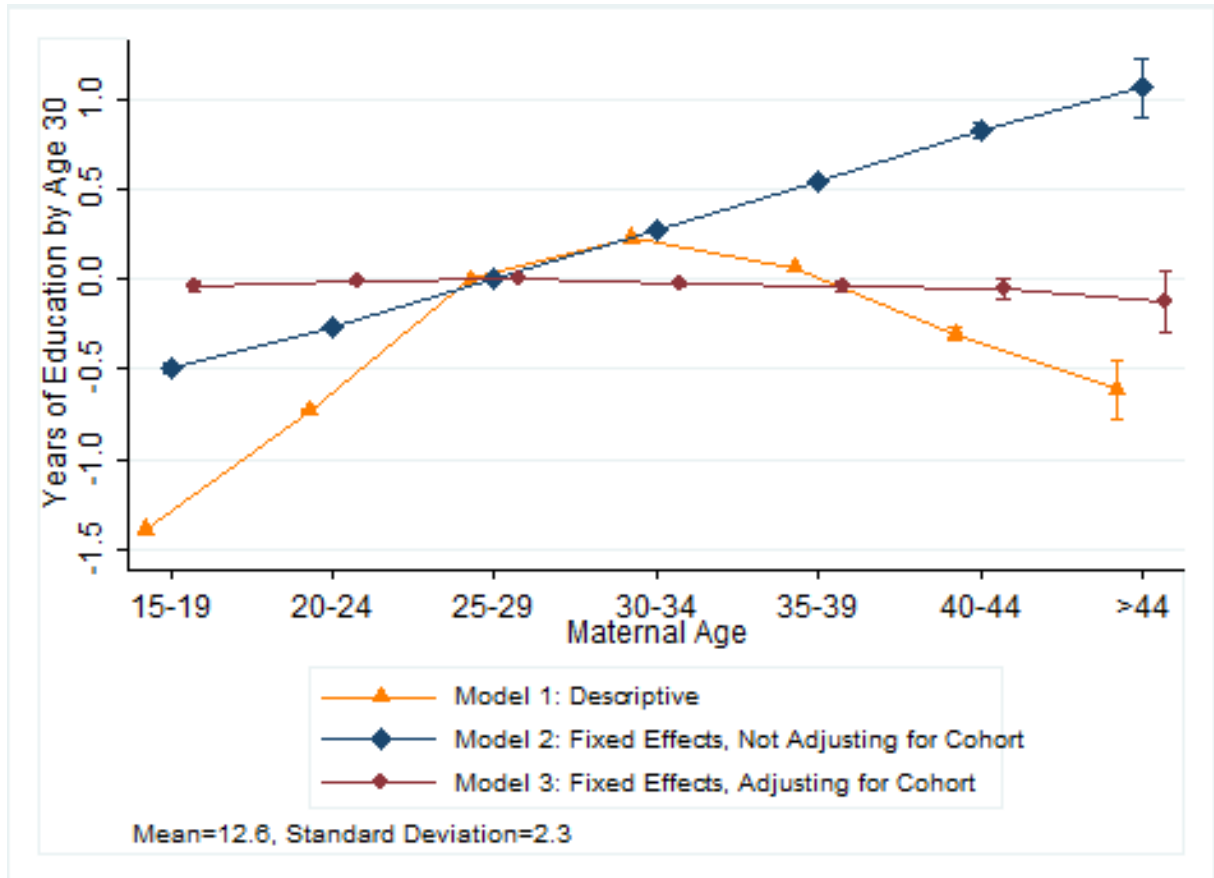
**TABLE 1 Descriptive statistics for years of educational attainment by age 30, grade point average (GPA) at age 16, and physical fitness and height at ages 17 to 20, by maternal age at the time of birth, Sweden**

		Maternal age								
		15-19	20-24	25-29	30-34	35-39	40-44	45+	All	
Educational attainment at age 30	N	87,160	489,445	597,801	306,903	93,687	15,823	794	1,591,613	
	%	5.5	30.8	37.6	19.3	5.9	1.0	0.0	100.0	
	Female	%	48.9	48.6	48.5	48.6	48.3	49.4	46.9	48.5
	Birth order	Mean	1.1	1.5	1.8	2.3	2.8	3.5	4.3	1.9
	Birth year	Mean	1967.6	1969.5	1971.1	1972.2	1972.0	1971.1	1971.1	1970.7
	Education by birth year	All years	11.5	12.2	12.9	13.1	13.0	12.6	12.3	12.6
		1960-1964	11.2	11.7	12.2	12.2	12.0	11.7	11.4	11.9
		1965-1969	11.4	11.8	12.4	12.4	12.2	12.0	11.6	12.1
		1970-1974	11.8	12.4	13.1	13.1	12.9	12.7	12.3	12.8
		1975-1979	12.2	12.9	13.6	13.8	13.7	13.5	13.5	13.4
1980-1982	11.9	12.6	13.4	13.8	13.9	13.8	13.3	13.4		
GPA at age 16	N	8,558	127,390	236,545	154,746	48,460	6,709	183	582,591	
	%	1.5	21.9	40.6	26.6	8.3	1.2	0.0	100.0	
	Female	%	48.5	49.1	48.6	48.6	48.4	48.7	48.1	48.7
	Birth order	Mean	1.1	1.4	1.8	2.1	2.5	2.8	3.4	1.8
	Birth year	Mean	1985.2	1986.1	1986.7	1987.3	1987.8	1988.2	1988.3	1986.8
	Education by birth year	All years	165.9	189.9	207.9	217.2	218.7	214.8	206.0	206.8
		1982-1984	166.4	191.0	211.7	218.6	216.3	207.5	185.9	205.7
		1985-1989	166.3	190.6	208.7	218.5	218.9	215.8	206.8	207.7
1990-1991	155.3	182.2	200.3	213.2	219.1	215.0	208.0	205.1		
Physical fitness and height	N	11,991	71,340	85,522	37,103	9,233	1,379	65	216,633	
	%	5.5	32.9	39.5	17.1	4.3	0.6	0.0	100.0	
	Conscription age	Mean	17.7	17.8	17.8	17.8	17.8	17.8	17.8	17.8
	Birth order	Mean	1.1	1.5	1.9	2.4	2.9	3.6	4.1	1.8
	Birth year	Mean	1968.5	1969.7	1971.0	1971.9	1971.9	1971.7	1972.6	1970.7
	Physical fitness (MWC) by birth year	All years	289.5	298.1	304.2	303.3	299.2	293.7	297.8	300.9
		1965-1969	285.9	294.0	300.3	299.2	293.3	291.7	286.0	296.0
		1970-1974	297.2	303.4	307.7	306.4	302.0	293.3	298.9	305.4
		1975-1977	289.0	295.0	301.5	301.3	299.8	296.8	300.9	300.0
	Height by birth year	All years	178.5	179.1	179.7	180.0	179.9	179.5	179.4	179.5
		1965-1969	178.4	179.0	179.6	179.8	179.4	178.9	179.6	179.2
		1970-1974	178.6	179.2	179.9	180.1	180.2	179.6	179.7	179.7
	1975-1977	178.4	179.0	179.7	180.1	180.1	180.0	178.5	179.7	

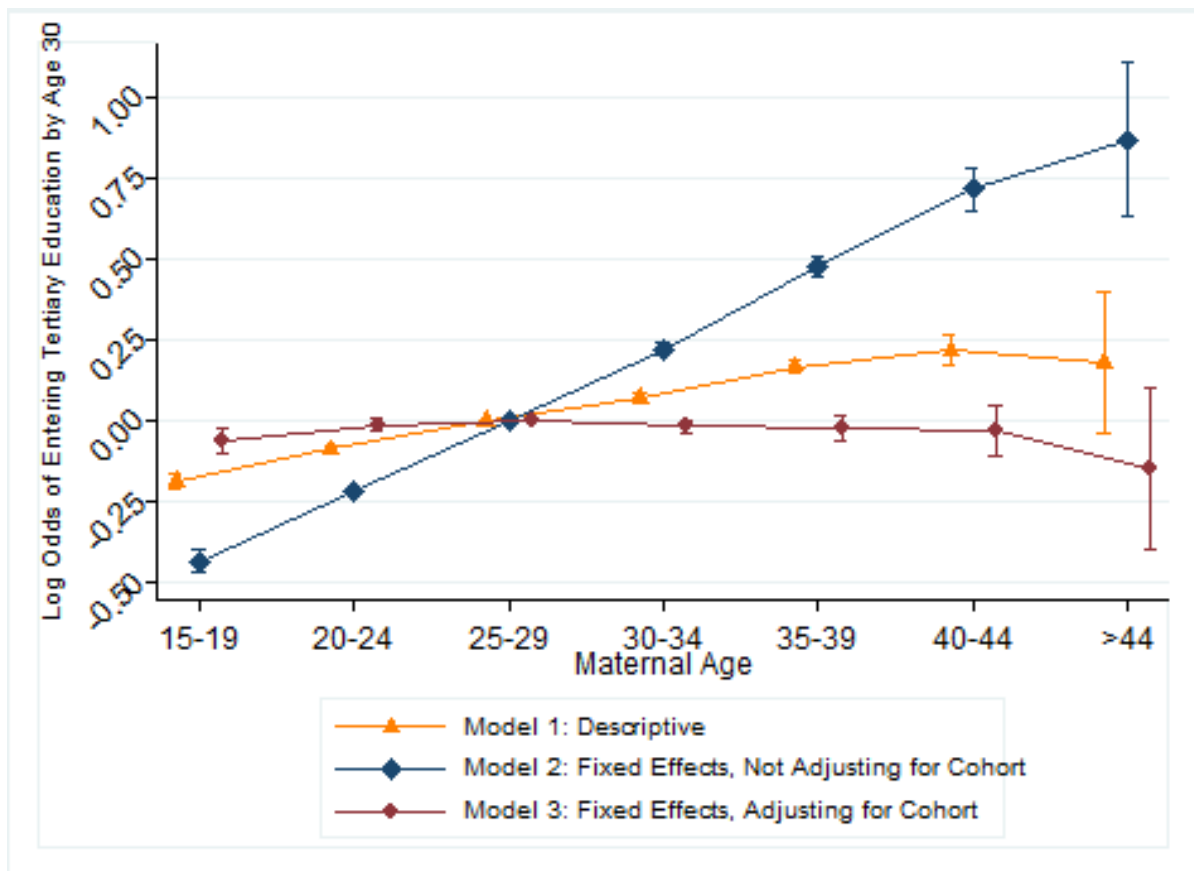
**NOTE: See text for description of samples and units of measurement.**



**FIGURE 1. Percentage of Births Each Year by Age of Mother at the Time of Birth, 1968-2013. Compiled by the authors.**

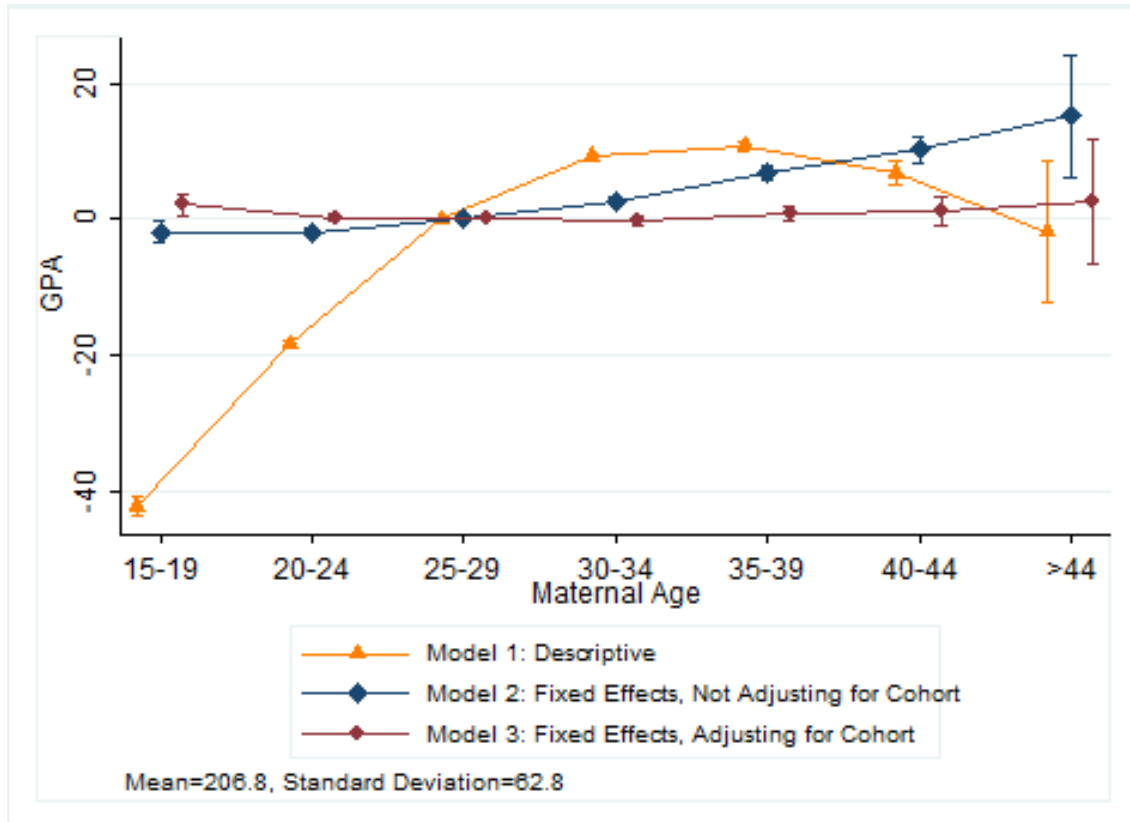


**FIGURE 2. Men and Women Born in Sweden 1960-1982: Educational Attainment Measured by Years of Education at Age 30 by Maternal Age at the Time of Birth. The vertical bars show 95% confidence intervals.**

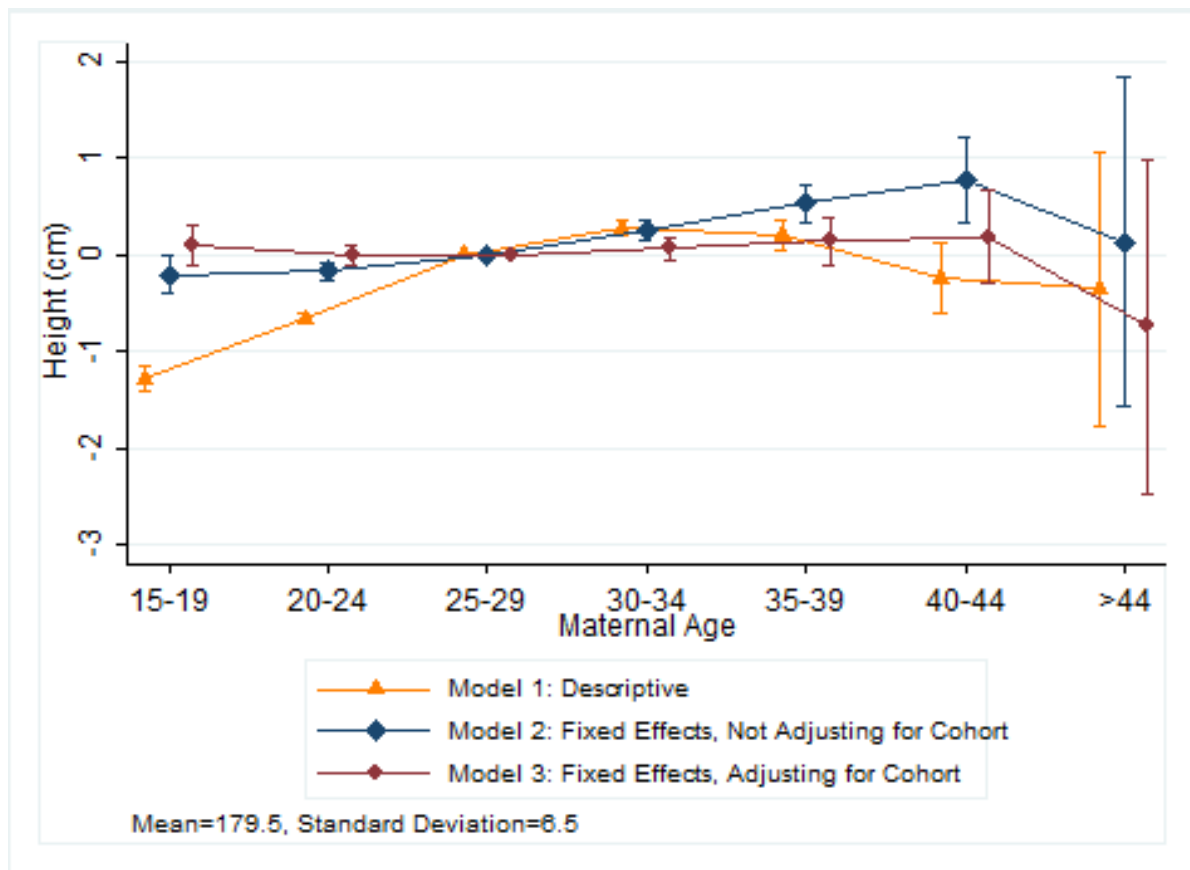


**FIGURE 3. Men and Women Born in Sweden 1960-1982: Log Odds for Entering Tertiary Education by Age 30 by Maternal Age at the Time of Birth.**

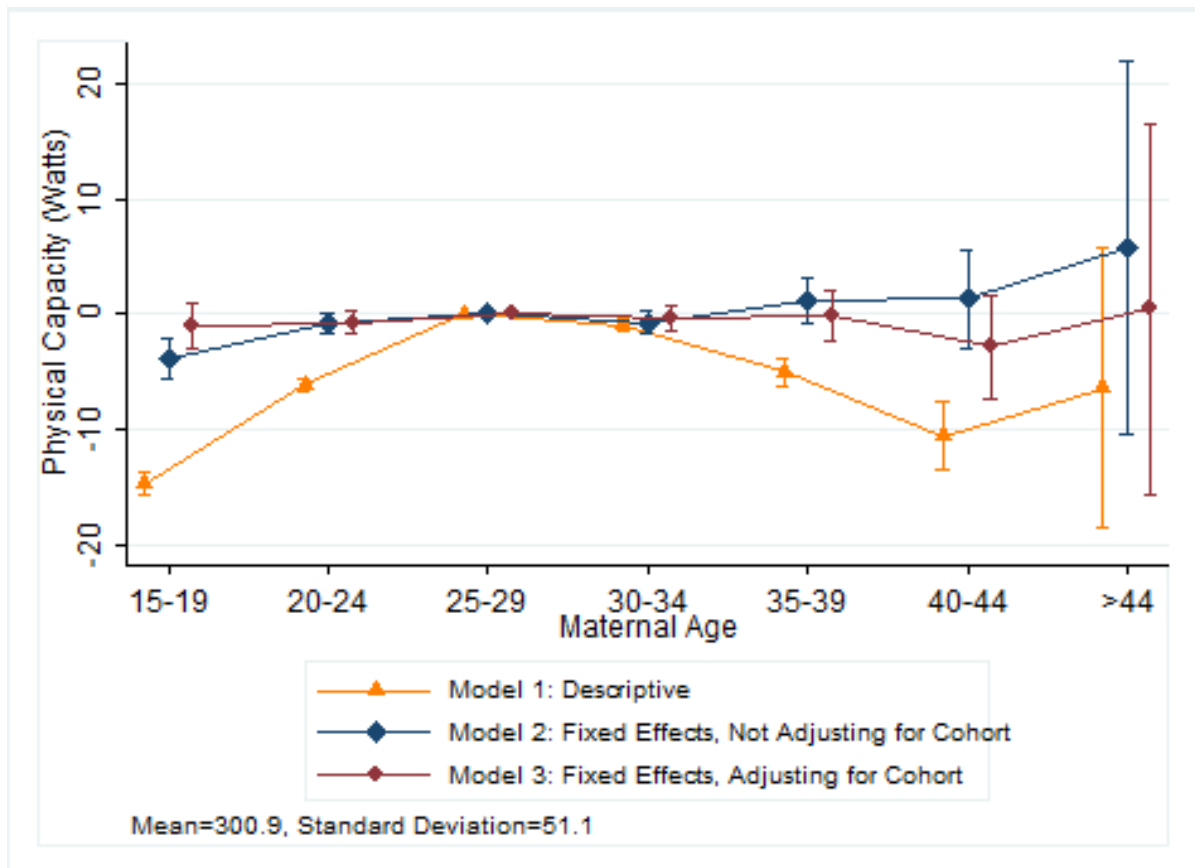




**FIGURE 4. Men and Women Born in Sweden 1982-1991: High School GPA at Age 16 by Maternal Age at the Time of Birth. The vertical bars show 95% confidence intervals.**



**FIGURE 5. Men Born in Sweden 1965-1977: Height by Maternal Age at the Time of Birth. The vertical bars show 95% confidence intervals.**



**FIGURE 6. Men Born in Sweden 1965-1977: Physical Fitness by Maternal Age at the Time of Birth. The vertical bars show 95% confidence intervals.**

## APPENDIX

TABLE S1. Sample Exclusion Process.

Cohorts	Outcome	Exclusion Criteria	N	N Excluded
1960-1982	Years of Education by Age 30	Total Born in Sweden 1960-1982	2,435,773	
		ID for both parents	2,405,610	30,163
		All siblings born in Sweden	2,364,749	40,861
		No multiple births	2,304,319	60,430
		No only children	1,928,268	376,051
		Cohort cut	1,677,142	251,126
		No missing values on any variables	1,591,613	85,529
		Final	1,591,613	
1982-1991	GPA at Age 16	Total Born in Sweden 1982-1991	1,055,744	
		ID for both parents	1,046,777	8,967
		All siblings born in Sweden	1,028,280	18,497
		No multiple births	996,256	32,024
		No only children	846,151	150,105
		Cohort cut	608,928	237,223
		No missing values on any variables	582,591	26,337
		Final	582,591	
1965-1977	Height and Physical Fitness	Total Born in Sweden 1965-1977	1,426,689	
		ID for both parents	1,411,005	15,684
		All siblings born in Sweden	1,385,197	25,471
		No multiple births	1,352,158	33,039
		No only children	1,125,699	226,459
		No women	579,103	546,596
		Cohort cut	249,338	329,765
		No missing values on any variables	216,633	32,705
		Final	216,633	

**Table S2. Men and Women Born in Sweden 1960-1982: Educational Attainment Measured by Years of Education at Age 30 by Maternal Age at the Time of Birth**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.38	0.01	-1.40, -1.37	-0.49	0.01	-0.51, -0.47	-0.04	0.01	-0.07, -0.01
	20-24	-0.73	0.00	-0.74, -0.72	-0.27	0.01	-0.28, -0.26	-0.01	0.01	-0.02, 0.00
	25-29	0.00			0.00			0.00		
	30-34	0.23	0.01	0.22, 0.24	0.27	0.01	0.25, 0.28	-0.02	0.01	-0.04, -0.01
	35-39	0.06	0.01	0.05, 0.08	0.55	0.01	0.52, 0.57	-0.04	0.01	-0.07, -0.02
	40-44	-0.31	0.02	-0.34, -0.27	0.82	0.02	0.78, 0.87	-0.05	0.03	-0.11, 0.00
	>44	-0.61	0.08	-0.77, -0.45	1.06	0.08	0.90, 1.22	-0.13	0.08	-0.29, 0.04
Gender	Men	0.00			0.00			0.00		
	Women	0.40	0.00	0.40, 0.41	0.41	0.00	0.40, 0.42	0.41	0.00	0.40, 0.42
Birth Order	1				0.00			0.00		
	2				-0.14	0.00	-0.15, -0.13	-0.29	0.01	-0.30, -0.28
	3				-0.12	0.01	-0.13, -0.10	-0.44	0.01	-0.46, -0.42
	4				-0.08	0.01	-0.11, -0.06	-0.52	0.02	-0.55, -0.49
	5				-0.07	0.02	-0.12, -0.03	-0.61	0.02	-0.66, -0.56
	6				0.00	0.03	-0.07, 0.07	-0.62	0.04	-0.69, -0.55
	7+				0.02	0.05	-0.07, 0.11	-0.70	0.05	-0.80, -0.60
Birth Year	1960							-0.72	0.02	-0.77, -0.68
	1961							-0.68	0.02	-0.72, -0.64
	1962							-0.64	0.02	-0.68, -0.61
	1963							-0.60	0.02	-0.63, -0.56
	1964							-0.53	0.01	-0.56, -0.50
	1965							-0.49	0.01	-0.51, -0.46
	1966							-0.43	0.01	-0.46, -0.41
	1967							-0.38	0.01	-0.40, -0.36
	1968							-0.33	0.01	-0.35, -0.31
	1969							-0.26	0.01	-0.29, -0.24
	1970							0.00		
	1971							0.13	0.01	0.11, 0.15
	1972							0.30	0.01	0.28, 0.32
	1973							0.46	0.01	0.44, 0.49
	1974							0.64	0.01	0.62, 0.67
	1975							0.86	0.01	0.83, 0.88
	1976							0.97	0.02	0.94, 1.00
1977							0.99	0.02	0.96, 1.03	
1978							0.94	0.02	0.90, 0.97	
1979							1.00	0.02	0.96, 1.04	
1980							1.14	0.02	1.10, 1.18	
1981							1.15	0.02	1.10, 1.19	
1982							1.18	0.02	1.13, 1.22	
N		1,591,613			1,591,613			1,591,613		

**Table S3. Men and Women Born in Sweden 1960-1982: Log Odds for Entering Tertiary Education by Age 30 by Maternal Age at the Time of Birth.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-0.19	0.01	0.00, -0.21	-0.44	-4.48	-0.47, -0.40	-0.06	-3.95	-0.10, -0.02
	20-24	-0.09	0.01	0.00, -0.10	-0.22	-4.98	-0.24, -0.20	-0.01	-4.60	-0.03, 0.01
	25-29	0.00			0.00			0.00		
	30-34	0.07	0.01	0.00, 0.05	0.22	-4.49	0.20, 0.24	-0.02	-4.51	-0.04, 0.00
	35-39	0.17	0.01	0.00, 0.14	0.47	-3.64	0.44, 0.50	-0.03	-3.85	-0.07, 0.02
	40-44	0.21	0.02	0.00, 0.17	0.71	-2.69	0.65, 0.78	-0.03	-3.25	-0.11, 0.04
	>44	0.18	0.11	0.11, -0.04	0.87	-1.23	0.63, 1.11	-0.15	-2.21	-0.40, 0.10
Sex	Men	0.00			0.00			0.00		
	Women	0.43	0.01	0.00, 0.42	0.43	-4.82	0.42, 0.44	0.43	-4.82	0.42, 0.44
Birth Order	1				0.00			0.00		
	2				-0.20	-5.29	-0.21, -0.19	-0.34	-5.20	-0.36, -0.33
	3				-0.24	-4.68	-0.26, -0.21	-0.53	-4.71	-0.56, -0.50
	4				-0.21	-4.11	-0.25, -0.17	-0.63	-4.32	-0.68, -0.58
	5				-0.18	-3.54	-0.25, -0.11	-0.69	-3.93	-0.77, -0.61
	6				-0.19	-3.08	-0.30, -0.08	-0.78	-3.60	-0.90, -0.67
	7+				-0.06	-2.60	-0.22, 0.09	-0.76	-3.24	-0.92, -0.59
Birth Year	1960							-0.64	-4.06	-0.70, -0.58
	1961							-0.63	-4.13	-0.69, -0.57
	1962							-0.58	-4.17	-0.63, -0.53
	1963							-0.52	-4.21	-0.57, -0.47
	1964							-0.47	-4.26	-0.51, -0.42
	1965							-0.41	-4.29	-0.45, -0.37
	1966							-0.36	-4.34	-0.40, -0.33
	1967							-0.29	-4.35	-0.33, -0.26
	1968							-0.22	-4.32	-0.26, -0.19
	1969							-0.15	-4.24	-0.18, -0.12
	1970							0.00		
	1971							0.12	-3.99	0.09, 0.15
	1972							0.27	-3.83	0.24, 0.30
	1973							0.37	-3.68	0.34, 0.41
	1974							0.46	-3.52	0.42, 0.50
	1975							0.60	-3.29	0.56, 0.64
	1976							0.72	-3.08	0.67, 0.76
	1977							0.70	-3.01	0.66, 0.75
	1978							0.76	-2.88	0.70, 0.81
	1979							0.87	-2.69	0.82, 0.93
1980							0.99	-2.48	0.93, 1.05	
1981							1.01	-2.38	0.94, 1.08	
1982							1.08	-2.24	1.01, 1.15	
N		626,207			626,207			626,207		

**Table S4. Men and Women Born in Sweden 1960-1982: High School GPA at Age 16 by Maternal Age at the Time of Birth.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-42.01	0.74	-43.46, -40.56	-1.86	0.78	-3.39, -0.33	2.10	0.80	0.53, 3.68
	20-24	-18.15	0.22	-18.58, -17.72	-1.87	0.28	-2.43, -1.32	0.26	0.30	-0.33, 0.86
	25-29	0.00			0.00			0.00		
	30-34	9.35	0.20	8.95, 9.75	2.69	0.27	2.16, 3.21	-0.13	0.30	-0.72, 0.46
	35-39	10.82	0.34	10.14, 11.49	6.89	0.50	5.92, 7.86	0.92	0.58	-0.22, 2.06
	40-44	6.91	0.89	5.17, 8.66	10.20	1.01	8.21, 12.18	1.17	1.11	-1.01, 3.35
	>44	-1.80	5.29	-12.18, 8.58	15.15	4.61	6.11, 24.19	2.58	4.65	-6.54, 11.69
Sex	Men	0.00			0.00			0.00		
	Women	22.41	0.16	22.10, 22.73	21.82	0.15	21.52, 22.12	21.81	0.15	21.51, 22.11
Birth Order	1				0.00			0.00		
	2				-6.91	0.16	-7.23, -6.59	-9.92	0.24	-10.39, -9.44
	3				-10.61	0.32	-11.23, -9.98	-17.28	0.49	-18.24, -16.32
	4				-13.28	0.56	-14.38, -12.17	-23.12	0.78	-24.66, -21.58
	5				-17.49	1.03	-19.50, -15.47	-30.15	1.24	-32.59, -27.71
	6				-19.19	1.80	-22.72, -15.66	-34.44	1.99	-38.33, -30.54
	7+				-21.29	2.98	-27.12, -15.45	-39.67	3.14	-45.83, -33.51
Birth Year	1982							-6.52	0.43	-7.36, -5.68
	1983							-3.55	0.38	-4.30, -2.80
	1984							-2.02	0.36	-2.72, -1.32
	1985							0.00		
	1986							2.35	0.33	1.70, 3.00
	1987							4.35	0.34	3.67, 5.03
	1988							6.18	0.39	5.41, 6.96
	1989							7.15	0.46	6.24, 8.05
	1990							7.68	0.55	6.60, 8.76
	1991							9.27	0.64	8.02, 10.52
N		582,591			582,591			582,591		

**Table S5. Men Born in Sweden, 1965-1977: Height (cm) by Maternal Age at the Time of Birth.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.29	0.06	-1.41, -1.16	-0.20	0.09	-0.39, -0.02	0.10	0.10	-0.11, 0.30
	20-24	-0.66	0.03	-0.72, -0.60	-0.17	0.05	-0.26, -0.08	0.00	0.05	-0.11, 0.10
	25-29	0.00			0.00			0.00		
	30-34	0.27	0.04	0.19, 0.35	0.24	0.05	0.14, 0.34	0.06	0.06	-0.06, 0.18
	35-39	0.20	0.08	0.05, 0.35	0.53	0.10	0.32, 0.73	0.14	0.12	-0.11, 0.38
	40-44	-0.24	0.19	-0.61, 0.13	0.76	0.23	0.32, 1.20	0.18	0.25	-0.31, 0.67
	>44	-0.36	0.72	-1.78, 1.06	0.13	0.87	-1.58, 1.84	-0.75	0.88	-2.48, 0.98
Conscription Age	17				-0.36	0.03	-0.42, -0.29	-0.35	0.03	-0.42, -0.28
	18				0.00			0.00		
	19				0.51	0.08	0.35, 0.67	0.49	0.08	0.34, 0.65
	20				0.81	0.25	0.32, 1.30	0.82	0.25	0.33, 1.30
Birth Order	1				0.00			0.00		
	2				-0.08	0.03	-0.14, -0.01	-0.23	0.04	-0.31, -0.14
	3				-0.09	0.06	-0.21, 0.04	-0.42	0.09	-0.59, -0.25
	4				-0.11	0.11	-0.32, 0.11	-0.59	0.14	-0.87, -0.32
	5				-0.11	0.19	-0.48, 0.26	-0.74	0.22	-1.17, -0.31
	6				0.10	0.30	-0.49, 0.68	-0.65	0.33	-1.29, -0.01
	7+				0.85	0.43	0.01, 1.69	-0.01	0.46	-0.91, 0.88
Birth Year	1965							-0.34	0.10	-0.54, -0.15
	1966							-0.34	0.09	-0.51, -0.17
	1967							-0.45	0.08	-0.60, -0.30
	1968							-0.22	0.07	-0.36, -0.09
	1969							-0.15	0.07	-0.28, -0.02
	1970							0.00		
	1971							0.25	0.06	0.13, 0.38
	1972							0.28	0.07	0.15, 0.41
	1973							0.24	0.07	0.09, 0.39
	1974							0.40	0.09	0.23, 0.57
	1975							0.36	0.10	0.17, 0.56
1976							0.57	0.12	0.34, 0.80	
1977							0.38	0.13	0.13, 0.64	
N		216,633			216,633			216,633		



**Table S6. Men Born in Sweden, 1965-1977: Physical Fitness (watts) by Maternal Age at the Time of Birth.**

	Model 1			Model 2			Model 3			
	Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI	
Mother Age	15-19	-14.66	0.50	-15.63, -13.68	-3.78	0.89	-5.51, -2.04	-1.02	0.97	-2.92, 0.88
	20-24	-6.12	0.26	-6.63, -5.61	-0.82	0.44	-1.68, 0.04	-0.67	0.49	-1.64, 0.29
	25-29	0.00			0.00			0.00		
	30-34	-0.89	0.32	-1.51, -0.27	-0.70	0.48	-1.65, 0.25	-0.37	0.55	-1.46, 0.72
	35-39	-5.02	0.58	-6.16, -3.88	1.19	0.98	-0.74, 3.12	-0.11	1.14	-2.35, 2.13
	40-44	-10.52	1.48	-13.43, -7.62	1.36	2.16	-2.86, 5.59	-2.79	2.29	-7.29, 1.71
	>44	-6.38	6.16	-18.46, 5.70	5.78	8.28	-10.45, 22.01	0.43	8.18	-15.60, 16.46
Conscription	17			-4.71	0.32	-5.33, -4.08	-2.40	0.31	-3.01, -1.78	
Age	18			0.00			0.00			
	19			-0.94	0.77	-2.45, 0.57	-0.01	0.75	-1.48, 1.46	
	20			-7.03	2.36	-11.65, -2.41	-6.84	2.30	-11.34, -2.33	
Birth Order	1			0.00			0.00			
	2			0.62	0.31	0.02, 1.22	-1.67	0.40	-2.46, -0.88	
	3			1.86	0.59	0.71, 3.01	-4.13	0.80	-5.70, -2.57	
	4			6.84	1.05	4.79, 8.89	-3.87	1.30	-6.42, -1.33	
	5			8.95	1.81	5.41, 12.50	-6.18	2.04	-10.17, -2.19	
	6			10.03	2.85	4.45, 15.61	-9.53	3.03	-15.47, -3.59	
	7+			15.59	4.08	7.60, 23.58	-6.24	4.22	-14.52, 2.04	
Birth Year	1965						-37.79	0.92	-39.60, -35.98	
	1966						-17.29	0.81	-18.87, -15.71	
	1967						-3.20	0.71	-4.59, -1.81	
	1968						-1.89	0.64	-3.15, -0.64	
	1969						-4.15	0.60	-5.33, -2.97	
	1970						0.00			
	1971						-2.51	0.59	-3.68, -1.35	
	1972						-4.93	0.62	-6.15, -3.71	
	1973						-6.00	0.69	-7.36, -4.64	
	1974						-10.33	0.79	-11.88, -8.77	
	1975						-10.46	0.92	-12.27, -8.66	
	1976						-12.96	1.07	-15.06, -10.86	
	1977						-7.77	1.21	-10.13, -5.40	
N	216,633			216,633			216,633			

**Table S7. Men and Women Born in Sweden 1960-1982: Educational Attainment Measured by Years of Education at Age 30 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.38	0.01	-1.40, -1.37	-0.45	0.01	-0.48, -0.43	-0.04	0.01	-0.07, -0.02
	20-24	-0.73	0.00	-0.74, -0.72	-0.25	0.01	-0.27, -0.24	-0.01	0.01	-0.02, 0.00
	25-29	0.00			0.00			0.00		
	30-34	0.23	0.01	0.22, 0.24	0.26	0.01	0.25, 0.27	-0.02	0.01	-0.04, -0.01
	35-39	0.06	0.01	0.05, 0.08	0.54	0.01	0.52, 0.56	-0.05	0.01	-0.07, -0.02
	40-44	-0.31	0.02	-0.34, -0.27	0.82	0.02	0.77, 0.86	-0.06	0.03	-0.11, 0.00
	>44	-0.61	0.08	-0.77, -0.45	1.06	0.08	0.90, 1.22	-0.13	0.08	-0.30, 0.04
Sex	Men	0.00			0.00			0.00		
	Women	0.40	0.00	0.40, 0.41	0.41	0.00	0.40, 0.42	0.41	0.00	0.40, 0.42
Household SES	Unskilled manual				-0.05	0.01	-0.07, -0.03	0.01	0.01	-0.01, 0.03
	Skilled manual				0.00			0.00		
	Lower non-manual				0.02	0.01	-0.01, 0.04	0.01	0.01	-0.01, 0.03
	Intermediate non-manual				0.03	0.01	0.01, 0.05	0.00	0.01	-0.02, 0.02
	Managers and professionals				0.00	0.01	-0.03, 0.02	-0.04	0.01	-0.07, -0.01
	Self-employed professionals				-0.19	0.08	-0.34, -0.03	-0.22	0.08	-0.38, -0.07
	Other self-employed				0.11	0.02	0.08, 0.14	0.03	0.02	-0.01, 0.06
	Farmers				0.15	0.02	0.11, 0.20	0.09	0.02	0.04, 0.13
Birth Order	Missing				-0.17	0.01	-0.19, -0.15	0.03	0.01	0.01, 0.05
	1				0.00			0.00		
	2				-0.15	0.00	-0.16, -0.14	-0.29	0.01	-0.30, -0.28
	3				-0.14	0.01	-0.15, -0.12	-0.43	0.01	-0.45, -0.41
	4				-0.10	0.01	-0.13, -0.08	-0.52	0.02	-0.55, -0.49
	5				-0.09	0.02	-0.14, -0.05	-0.61	0.02	-0.66, -0.56
	6				-0.02	0.03	-0.09, 0.05	-0.62	0.04	-0.69, -0.55
7+				0.00	0.05	-0.09, 0.09	-0.70	0.05	-0.80, -0.60	
Birth Year	1960							-1.59	0.03	-1.64, -1.53
	1961							-1.54	0.03	-1.59, -1.49
	1962							-1.51	0.03	-1.56, -1.46
	1963							-1.46	0.02	-1.51, -1.41
	1964							-1.40	0.02	-1.44, -1.35
	1965							-1.35	0.02	-1.39, -1.31
	1966							-1.30	0.02	-1.34, -1.26
	1967							-1.25	0.02	-1.28, -1.21
	1968							-1.20	0.02	-1.23, -1.17
	1969							-1.13	0.02	-1.16, -1.10
	1970							-0.86	0.01	-0.89, -0.83
	1971							-0.73	0.01	-0.75, -0.70
	1972							-0.56	0.01	-0.58, -0.53
	1973							-0.40	0.01	-0.42, -0.37
	1974							-0.22	0.01	-0.24, -0.19
	1975							0.00		
	1976							0.12	0.01	0.09, 0.14
1977							0.14	0.01	0.11, 0.16	
1978							0.08	0.01	0.05, 0.10	
1979							0.14	0.01	0.11, 0.17	
1980							0.29	0.02	0.26, 0.32	
1981							0.29	0.02	0.26, 0.32	
1982							0.32	0.02	0.28, 0.35	
N		1,591,613			1,591,613			1,591,613		

**Table S8. Men and Women Born in Sweden 1960-1982: Log Odds for Entering Tertiary Education by Age 30 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-0.19	0.01	-0.21, -0.16	-0.41	0.02	-0.44, -0.37	-0.06	0.02	-0.10, -0.02
	20-24	-0.09	0.01	-0.10, -0.08	-0.21	0.01	-0.23, -0.19	-0.01	0.01	-0.03, 0.01
	25-29	0.00			0.00			0.00		
	30-34	0.07	0.01	0.05, 0.08	0.22	0.01	0.20, 0.23	-0.02	0.01	-0.04, 0.00
	35-39	0.17	0.01	0.14, 0.19	0.47	0.02	0.44, 0.50	-0.03	0.02	-0.07, 0.02
	40-44	0.21	0.02	0.17, 0.26	0.71	0.03	0.65, 0.78	-0.03	0.04	-0.11, 0.05
	>44	0.18	0.11	-0.04, 0.40	0.87	0.12	0.63, 1.11	-0.15	0.13	-0.40, 0.10
Sex	Men	0.00			0.00			0.00		
	Women	0.43	0.01	0.42, 0.44	0.43	0.01	0.42, 0.44	0.43	0.01	0.42, 0.44
Household SES	Unskilled manual				-0.03	0.01	-0.06, -0.01	0.00	0.01	-0.02, 0.03
	Skilled manual				0.00			0.00		
	Lower non-manual				0.02	0.02	-0.01, 0.05	0.01	0.02	-0.02, 0.04
	Intermediate non-manual				0.01	0.01	-0.01, 0.04	-0.01	0.01	-0.03, 0.02
	Managers and professionals				0.01	0.02	-0.03, 0.06	-0.02	0.02	-0.06, 0.03
	Self-employed professionals				-0.18	0.12	-0.42, 0.06	-0.22	0.12	-0.46, 0.02
	Other self-employed				0.07	0.02	0.03, 0.12	0.01	0.02	-0.03, 0.06
	Farmers				0.11	0.03	0.04, 0.17	0.07	0.03	0.00, 0.13
Birth Order	Missing				-0.12	0.01	-0.15, -0.09	0.00	0.02	-0.03, 0.03
	1				0.00			0.00		
	2				-0.21	0.01	-0.22, -0.20	-0.34	0.01	-0.36, -0.33
	3				-0.25	0.01	-0.28, -0.23	-0.53	0.02	-0.56, -0.50
	4				-0.23	0.02	-0.27, -0.19	-0.63	0.02	-0.68, -0.58
	5				-0.20	0.04	-0.27, -0.13	-0.69	0.04	-0.77, -0.61
	6				-0.21	0.06	-0.32, -0.10	-0.78	0.06	-0.90, -0.67
	7+				-0.08	0.08	-0.24, 0.07	-0.76	0.08	-0.92, -0.59
Birth Year	1960							-1.24	0.04	-1.32, -1.15
	1961							-1.23	0.04	-1.31, -1.15
	1962							-1.18	0.04	-1.25, -1.10
	1963							-1.11	0.04	-1.18, -1.05
	1964							-1.06	0.03	-1.13, -1.00
	1965							-1.00	0.03	-1.06, -0.94
	1966							-0.96	0.03	-1.02, -0.91
	1967							-0.89	0.03	-0.94, -0.84
	1968							-0.82	0.02	-0.87, -0.77
	1969							-0.74	0.02	-0.79, -0.70
	1970							-0.60	0.02	-0.64, -0.56
	1971							-0.48	0.02	-0.51, -0.44
	1972							-0.32	0.02	-0.36, -0.29
	1973							-0.22	0.02	-0.26, -0.19
	1974							-0.14	0.02	-0.17, -0.11
	1975							0.00		
	1976							0.12	0.02	0.09, 0.15
1977							0.11	0.02	0.07, 0.14	
1978							0.16	0.02	0.12, 0.20	
1979							0.28	0.02	0.24, 0.32	
1980							0.39	0.02	0.35, 0.44	
1981							0.41	0.02	0.36, 0.46	
1982							0.48	0.03	0.43, 0.53	
N		626,207			626,207			626,207		

**Table S9. Men and Women Born in Sweden 1960-1982: High School GPA at Age 16 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-42.01	0.74	-43.46, -40.56	-1.82	0.78	-3.35, -0.28	2.09	0.81	0.52, 3.67
	20-24	-18.15	0.22	-18.58, -17.72	-1.85	0.28	-2.41, -1.29	0.27	0.30	-0.33, 0.86
	25-29	0.00			0.00			0.00		
	30-34	9.35	0.20	8.95, 9.75	2.65	0.27	2.13, 3.17	-0.14	0.30	-0.73, 0.45
	35-39	10.82	0.34	10.14, 11.49	6.84	0.50	5.87, 7.81	0.93	0.58	-0.21, 2.07
	40-44	6.91	0.89	5.17, 8.66	10.15	1.01	8.17, 12.14	1.20	1.11	-0.98, 3.38
	>44	-1.80	5.29	-12.18, 8.58	15.10	4.61	6.06, 24.14	2.64	4.65	-6.47, 11.76
Sex	Men	0.00			0.00			0.00		
	Women	22.41	0.16	22.10, 22.73	21.82	0.15	21.52, 22.11	21.81	0.15	21.51, 22.10
Household SES	Unskilled manual				0.63	0.38	-0.11, 1.37	0.51	0.38	-0.24, 1.25
	Skilled manual				0.00			0.00		
	Lower non-manual				1.04	0.47	0.13, 1.96	0.73	0.47	-0.18, 1.65
	Intermediate non-manual				1.09	0.43	0.25, 1.93	0.74	0.43	-0.10, 1.58
	Managers and professionals				1.57	0.57	0.46, 2.68	1.12	0.57	0.00, 2.23
	Self-employed professionals				-3.02	2.55	-8.01, 1.97	-2.83	2.54	-7.82, 2.16
	Other self-employed				0.90	0.62	-0.32, 2.11	0.82	0.62	-0.39, 2.04
	Farmers				0.42	0.92	-1.39, 2.23	1.39	0.93	-0.43, 3.21
Missing				0.18	0.47	-0.75, 1.10	0.24	0.47	-0.68, 1.17	
Birth Order	1				0.00			0.00		
	2				-6.95	0.17	-7.27, -6.62	-9.91	0.24	-10.39, -9.44
	3				-10.67	0.32	-11.30, -10.05	-17.27	0.49	-18.23, -16.31
	4				-13.36	0.57	-14.47, -12.25	-23.10	0.78	-24.63, -21.56
	5				-17.59	1.03	-19.61, -15.58	-30.11	1.24	-32.55, -27.67
	6				-19.30	1.80	-22.83, -15.77	-34.38	1.99	-38.28, -30.48
	7+				-21.38	2.98	-27.21, -15.54	-39.57	3.14	-45.73, -33.41
Birth Year	1982							-6.47	0.43	-7.32, -5.63
	1983							-3.51	0.39	-4.26, -2.75
	1984							-1.97	0.36	-2.68, -1.27
	1985							0.00		
	1986							2.34	0.33	1.69, 2.99
	1987							4.34	0.34	3.66, 5.02
	1988							6.17	0.39	5.40, 6.95
	1989							7.13	0.46	6.22, 8.04
	1990							7.62	0.55	6.54, 8.70
	1991							9.19	0.64	7.94, 10.44
N		582,591			582,591			582,591		

**Table S10. Men Born in Sweden, 1965-1977: Height (cm) by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.29	0.06	-1.41, -1.16	-0.18	0.09	-0.37, 0.00	0.08	0.11	-0.12, 0.29
	20-24	-0.66	0.03	-0.72, -0.60	-0.15	0.05	-0.25, -0.06	0.00	0.05	-0.11, 0.10
	25-29	0.00			0.00			0.00		
	30-34	0.27	0.04	0.19, 0.35	0.23	0.05	0.13, 0.33	0.06	0.06	-0.06, 0.17
	35-39	0.20	0.08	0.05, 0.35	0.51	0.10	0.31, 0.71	0.12	0.12	-0.12, 0.37
	40-44	-0.24	0.19	-0.61, 0.13	0.75	0.23	0.31, 1.20	0.17	0.25	-0.32, 0.65
	>44	-0.36	0.72	-1.78, 1.06	0.12	0.87	-1.59, 1.82	-0.77	0.88	-2.50, 0.96
Age at Conscription Test	17				-0.36	0.03	-0.42, -0.29	-0.35	0.03	-0.41, -0.28
	18				0.00			0.00		
	19				0.51	0.08	0.35, 0.67	0.49	0.08	0.33, 0.65
	20				0.80	0.25	0.31, 1.28	0.80	0.25	0.32, 1.29
Household SES	Unskilled manual				-0.14	0.06	-0.26, -0.02	-0.09	0.06	-0.21, 0.04
	Skilled manual				0.00			0.00		
	Lower non-manual				0.02	0.08	-0.15, 0.18	0.02	0.08	-0.14, 0.19
	Intermediate non- manual				0.04	0.07	-0.10, 0.17	0.00	0.07	-0.13, 0.14
	Managers and professionals				0.03	0.10	-0.17, 0.24	0.02	0.10	-0.19, 0.22
	Self-employed professionals				0.15	0.60	-1.02, 1.33	0.11	0.60	-1.07, 1.28
	Other self-employed				-0.05	0.12	-0.28, 0.17	-0.12	0.12	-0.35, 0.11
	Farmers				0.43	0.16	0.12, 0.74	0.39	0.16	0.08, 0.70
Missing				-0.11	0.07	-0.24, 0.02	0.02	0.07	-0.12, 0.16	
Birth Order	1				0.00			0.00		
	2				-0.09	0.03	-0.16, -0.03	-0.23	0.04	-0.31, -0.14
	3				-0.12	0.06	-0.24, 0.00	-0.42	0.09	-0.59, -0.25
	4				-0.15	0.11	-0.37, 0.07	-0.60	0.14	-0.88, -0.33
	5				-0.16	0.19	-0.54, 0.21	-0.75	0.22	-1.18, -0.32
	6				0.04	0.30	-0.55, 0.63	-0.66	0.33	-1.30, -0.02
	7+				0.78	0.43	-0.07, 1.62	-0.04	0.46	-0.93, 0.86
Birth Year	1965							-0.70	0.16	-1.02, -0.38
	1966							-0.70	0.15	-1.00, -0.41
	1967							-0.80	0.14	-1.07, -0.54
	1968							-0.58	0.12	-0.82, -0.34
	1969							-0.51	0.11	-0.73, -0.29
	1970							-0.36	0.10	-0.56, -0.17
	1971							-0.11	0.09	-0.29, 0.06
	1972							-0.09	0.08	-0.24, 0.07
	1973							-0.12	0.07	-0.27, 0.03
	1974							0.04	0.07	-0.11, 0.19
	1975							0.00		
	1976							0.21	0.09	0.04, 0.38
	1977							0.02	0.09	-0.15, 0.20
N		216,633			216,633			216,633		

**Table S11. Men Born in Sweden, 1965-1977: Physical Fitness (watts) by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-14.66	0.50	-15.64, -13.69	-4.76	0.90	-6.53, -3.00	-1.05	0.98	-2.96, 0.87
	20-24	-6.12	0.26	-6.63, -5.61	-1.08	0.44	-1.94, -0.22	-0.70	0.49	-1.67, 0.26
	25-29	0.00			0.00			0.00		
	30-34	-0.89	0.32	-1.51, -0.27	-0.66	0.49	-1.62, 0.29	-0.37	0.56	-1.46, 0.72
	35-39	-5.02	0.58	-6.16, -3.88	1.10	0.99	-0.83, 3.04	-0.20	1.15	-2.45, 2.05
	40-44	-10.52	1.48	-13.43, -7.62	1.12	2.16	-3.11, 5.35	-2.96	2.30	-7.47, 1.55
	>44	-6.38	6.16	-18.46, 5.70	5.37	8.28	-10.86, 21.59	0.11	8.18	-15.93, 16.15
Age at Conscription Test	17				-4.70	0.32	-5.32, -4.07	-2.40	0.31	-3.01, -1.78
	18				0.00			0.00		
	19				-0.93	0.77	-2.45, 0.58	-0.02	0.75	-1.50, 1.45
	20				-7.18	2.36	-11.80, -2.56	-6.93	2.30	-11.43, -2.43
Household SES	Unskilled manual				0.55	0.58	-0.59, 1.69	0.59	0.57	-0.53, 1.71
	Skilled manual				0.00			0.00		
	Lower non-manual				0.12	0.81	-1.46, 1.70	0.10	0.78	-1.44, 1.64
	Intermediate non- manual				-0.02	0.65	-1.28, 1.25	-0.90	0.63	-2.14, 0.33
	Managers and professionals				-0.28	0.99	-2.22, 1.65	-0.29	0.96	-2.18, 1.59
	Self-employed professionals				-1.66	5.70	-12.84, 9.51	-1.27	5.56	-12.16, 9.61
	Other self- employed				-0.91	1.11	-3.09, 1.26	-0.79	1.09	-2.92, 1.34
	Farmers				1.52	1.51	-1.43, 4.48	2.16	1.47	-0.73, 5.05
	Missing				3.47	0.63	2.24, 4.71	0.36	0.65	-0.91, 1.63
Birth Order	1				0.00			0.00		
	2				0.99	0.31	0.37, 1.60	-1.64	0.41	-2.44, -0.85
	3				2.53	0.60	1.36, 3.70	-4.12	0.80	-5.69, -2.56
	4				7.62	1.05	5.55, 9.68	-3.91	1.30	-6.46, -1.36
	5				9.72	1.81	6.17, 13.27	-6.32	2.04	-10.32, -2.32
	6				10.75	2.85	5.17, 16.32	-9.80	3.03	-15.74, -3.85
	7+				16.42	4.08	8.42, 24.42	-6.49	4.22	-14.77, 1.79
Birth Year	1965							-27.53	1.52	-30.52, -24.55
	1966							-7.06	1.39	-9.79, -4.34
	1967							7.02	1.26	4.55, 9.50
	1968							8.30	1.15	6.05, 10.55
	1969							6.04	1.04	3.99, 8.08
	1970							10.47	0.92	8.67, 12.27
	1971							7.98	0.82	6.37, 9.59
	1972							5.55	0.74	4.10, 6.99
	1973							4.47	0.69	3.11, 5.83
	1974							0.13	0.69	-1.24, 1.49
	1975							0.00		
	1976							-2.48	0.79	-4.02, -0.93
	1977							2.70	0.83	1.07, 4.34
N		216,633			216,633			216,633		

**Table S12. Men and Women Born in Sweden 1971-1982: Educational Attainment Measured by Years of Education at Age 30 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status and Inflation-adjusted Household Income.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.49	0.01	-1.52, -1.47	-0.30	0.02	-0.34, -0.25	-0.05	0.02	-0.10, 0.00
	20-24	-0.76	0.01	-0.77, -0.74	-0.16	0.01	-0.18, -0.14	-0.01	0.01	-0.03, 0.01
	25-29	0.00			0.00			0.00		
	30-34	0.31	0.01	0.29, 0.32	0.14	0.01	0.11, 0.16	-0.04	0.01	-0.06, -0.01
	35-39	0.28	0.01	0.25, 0.31	0.27	0.02	0.23, 0.31	-0.08	0.02	-0.13, -0.03
	40-44	0.05	0.04	-0.03, 0.13	0.44	0.05	0.34, 0.53	-0.09	0.05	-0.20, 0.02
	>44	0.00	0.23	-0.45, 0.46	0.68	0.25	0.19, 1.16	-0.12	0.25	-0.61, 0.37
Sex	Men	0.00			0.00			0.00		
	Women	0.64	0.01	0.63, 0.65	0.65	0.01	0.63, 0.66	0.65	0.01	0.63, 0.66
HH Income					0.00	0.00	0.00, 0.00	0.00	0.00	0.00, 0.00
Household SES	Unskilled manual				0.01	0.01	-0.01, 0.04	0.02	0.01	-0.01, 0.04
	Skilled manual				0.00			0.00		
	Lower non-manual				0.00	0.02	-0.03, 0.03	0.00	0.02	-0.04, 0.03
	Intermediate non-manual				-0.05	0.02	-0.08, -0.02	-0.02	0.02	-0.05, 0.01
	Managers and professionals				-0.07	0.02	-0.12, -0.03	-0.06	0.02	-0.11, -0.02
	Self-employed professionals				-0.20	0.11	-0.41, 0.02	-0.18	0.11	-0.39, 0.03
	Other self-employed				0.01	0.02	-0.03, 0.06	-0.01	0.02	-0.05, 0.04
	Farmers				0.10	0.04	0.03, 0.18	0.08	0.04	0.00, 0.15
Missing				0.00	0.02	-0.03, 0.04	0.04	0.02	0.00, 0.07	
Birth Order	1				0.00			0.00		
	2				-0.09	0.01	-0.10, -0.08	-0.27	0.01	-0.29, -0.26
	3				-0.04	0.01	-0.07, -0.02	-0.42	0.02	-0.46, -0.38
	4				0.05	0.03	0.00, 0.11	-0.50	0.03	-0.57, -0.44
	5				0.12	0.05	0.02, 0.22	-0.59	0.06	-0.70, -0.48
	6				0.24	0.08	0.07, 0.40	-0.63	0.09	-0.80, -0.46
	7+				0.25	0.12	0.01, 0.49	-0.79	0.13	-1.04, -0.54
Birth Year	1971							-0.71	0.02	-0.75, -0.68
	1972							-0.53	0.02	-0.57, -0.50
	1973							-0.38	0.01	-0.41, -0.35
	1974							-0.21	0.01	-0.24, -0.18
	1975							0.00		
	1976							0.11	0.01	0.09, 0.14
	1977							0.13	0.01	0.11, 0.16
	1978							0.07	0.02	0.04, 0.10
	1979							0.13	0.02	0.10, 0.17
	1980							0.28	0.02	0.24, 0.32
	1981							0.28	0.02	0.23, 0.33
1982							0.32	0.03	0.26, 0.37	
N		652,630			652,630			652,630		

**Table S13. Men and Women Born in Sweden 1960-1982: Log Odds for Entering Tertiary Education by Age 30 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status and Inflation-adjusted Household Income.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-0.11	0.02	-0.15, -0.07	-0.30	0.03	-0.36, -0.24	-0.06	0.03	-0.13, 0.00
	20-24	-0.05	0.01	-0.07, -0.03	-0.15	0.01	-0.18, -0.12	-0.01	0.02	-0.04, 0.02
	25-29	0.00			0.00			0.00		
	30-34	0.04	0.01	0.02, 0.07	0.15	0.01	0.12, 0.18	-0.03	0.02	-0.06, 0.01
	35-39	0.11	0.02	0.08, 0.14	0.33	0.03	0.27, 0.38	-0.03	0.04	-0.10, 0.04
	40-44	0.13	0.05	0.03, 0.22	0.49	0.07	0.35, 0.63	-0.05	0.08	-0.20, 0.10
	>44	0.02	0.28	-0.52, 0.56	0.56	0.30	-0.03, 1.15	-0.23	0.31	-0.83, 0.38
Sex	Men	0.00			0.00			0.00		
	Women	0.75	0.01	0.73, 0.76	0.75	0.01	0.73, 0.76	0.75	0.01	0.73, 0.76
HH Income					0.00	0.00	0.00, 0.00	0.00	0.00	0.00, 0.00
Household SES	Unskilled manual				0.01	0.02	-0.03, 0.05	0.01	0.02	-0.03, 0.05
	Skilled manual				0.00			0.00		
	Lower non-manual				0.01	0.02	-0.03, 0.06	0.01	0.02	-0.04, 0.06
	Intermediate non-manual				-0.02	0.02	-0.06, 0.03	-0.01	0.02	-0.05, 0.03
	Managers and professionals				-0.03	0.03	-0.09, 0.04	-0.03	0.03	-0.09, 0.03
	Self-employed professionals				0.02	0.17	-0.32, 0.36	0.00	0.17	-0.34, 0.34
	Other self-employed				0.03	0.03	-0.03, 0.09	0.00	0.03	-0.06, 0.06
	Farmers				0.09	0.05	-0.01, 0.19	0.07	0.05	-0.03, 0.17
	Missing				-0.01	0.02	-0.05, 0.04	0.01	0.02	-0.04, 0.06
Birth Order	1				0.00			0.00		
	2				-0.16	0.01	-0.18, -0.14	-0.34	0.01	-0.36, -0.31
	3				-0.20	0.02	-0.24, -0.16	-0.56	0.03	-0.61, -0.50
	4				-0.18	0.04	-0.25, -0.10	-0.69	0.05	-0.78, -0.60
	5				-0.13	0.07	-0.27, 0.01	-0.78	0.08	-0.93, -0.62
	6				-0.16	0.12	-0.40, 0.08	-0.92	0.13	-1.17, -0.67
	7+				-0.24	0.18	-0.59, 0.12	-1.15	0.19	-1.52, -0.78
Birth Year	1971							-0.47	0.03	-0.52, -0.41
	1972							-0.31	0.02	-0.36, -0.26
	1973							-0.21	0.02	-0.25, -0.17
	1974							-0.13	0.02	-0.17, -0.09
	1975							0.00		
	1976							0.13	0.02	0.09, 0.16
	1977							0.11	0.02	0.07, 0.15
	1978							0.16	0.02	0.11, 0.20
	1979							0.29	0.03	0.24, 0.34
	1980							0.40	0.03	0.35, 0.46
	1981							0.42	0.03	0.36, 0.49
1982							0.50	0.04	0.43, 0.57	
N		251,398			251,398			251,398		



**Table S14. Men and Women Born in Sweden 1960-1982: High School GPA at Age 16 by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status and Inflation-adjusted Household Income.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-42.01	0.74	-43.46, -40.56	-1.86	0.79	-3.40, -0.32	1.98	0.81	0.40, 3.57
	20-24	-18.15	0.22	-18.58, -17.72	-1.86	0.28	-2.42, -1.30	0.27	0.30	-0.33, 0.86
	25-29	0.00			0.00			0.00		
	30-34	9.35	0.20	8.95, 9.75	2.66	0.27	2.13, 3.18	-0.15	0.30	-0.74, 0.45
	35-39	10.82	0.34	10.14, 11.49	6.86	0.50	5.88, 7.84	0.91	0.58	-0.23, 2.05
	40-44	6.91	0.89	5.17, 8.66	10.18	1.01	8.19, 12.17	1.16	1.11	-1.02, 3.35
	>44	-1.80	5.29	-12.18, 8.58	15.14	4.61	6.10, 24.18	2.58	4.65	-6.53, 11.70
Sex	Men	0.00			0.00			0.00		
	Women	22.41	0.16	22.10, 22.73	21.82	0.15	21.52, 22.11	21.81	0.15	21.51, 22.10
HH Income				0.00, 0.00	0.00	0.00	0.00, 0.00	0.00	0.00	-0.01, 0.00
Household SES	Unskilled manual				0.63	0.38	-0.11, 1.37	0.49	0.38	-0.25, 1.24
	Skilled manual				0.00			0.00		
	Lower non-manual				1.04	0.47	0.13, 1.96	0.72	0.47	-0.19, 1.64
	Intermediate non-manual				1.09	0.43	0.26, 1.93	0.74	0.43	-0.10, 1.58
	Managers and professionals				1.57	0.57	0.46, 2.68	1.13	0.57	0.01, 2.24
	Self-employed professionals				-3.02	2.55	-8.01, 1.97	-2.82	2.54	-7.81, 2.16
	Other self-employed				0.89	0.62	-0.32, 2.11	0.80	0.62	-0.41, 2.02
	Farmers				0.42	0.92	-1.39, 2.22	1.36	0.93	-0.45, 3.18
Birth Order	Missing				0.16	0.47	-0.77, 1.09	0.18	0.47	-0.74, 1.11
	1				0.00			0.00		
	2				-6.94	0.17	-7.26, -6.61	-9.94	0.24	-10.41, -9.46
	3				-10.65	0.32	-11.28, -10.02	-17.29	0.49	-18.25, -16.33
	4				-13.32	0.57	-14.43, -12.20	-23.10	0.78	-24.64, -21.57
	5				-17.53	1.03	-19.55, -15.50	-30.09	1.24	-32.53, -27.65
	6				-19.22	1.81	-22.76, -15.68	-34.32	1.99	-38.22, -30.43
7+				-21.26	2.98	-27.10, -15.42	-39.45	3.14	-45.61, -33.29	
Birth Year	1982							-6.50	0.43	-7.34, -5.66
	1983							-3.53	0.39	-4.28, -2.77
	1984							-1.98	0.36	-2.69, -1.28
	1985									
	1986							2.36	0.33	1.71, 3.02
	1987							4.41	0.35	3.74, 5.09
	1988							6.28	0.40	5.50, 7.06
	1989							7.27	0.47	6.36, 8.19
	1990							7.78	0.56	6.70, 8.87
	1991							9.39	0.64	8.13, 10.65
N		582,591			582,591			582,591		

**Table S15. Men Born in Sweden, 1965-1977: Height (cm) by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status and Inflation-adjusted Household Income.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-1.24	0.13	-1.49, -0.99	0.33	0.19	-0.05, 0.70	0.31	0.20	-0.08, 0.70
	20-24	-0.69	0.06	-0.80, -0.58	-0.05	0.09	-0.22, 0.12	-0.06	0.09	-0.24, 0.12
	25-29	0.00			0.00			0.00		
	30-34	0.25	0.07	0.11, 0.39	0.01	0.10	-0.18, 0.20	0.02	0.11	-0.19, 0.23
	35-39	0.09	0.16	-0.22, 0.39	0.08	0.23	-0.37, 0.54	0.10	0.25	-0.38, 0.59
	40-44	-0.04	0.45	-0.91, 0.84	0.10	0.58	-1.04, 1.24	0.14	0.59	-1.02, 1.31
	>44	1.02	2.04	-2.98, 5.02	-1.00	3.23	-7.33, 5.34	-0.84	3.24	-7.19, 5.50
Age at Conscription	17				-0.20	0.06	-0.32, -0.07	-0.20	0.06	-0.32, -0.07
	18				0.00			0.00		
Test	19				0.49	0.14	0.22, 0.76	0.48	0.14	0.21, 0.76
	20				0.62	0.46	-0.28, 1.52	0.62	0.46	-0.27, 1.52
HH Income					0.00	0.00	0.00, 0.00	0.00	0.00	0.00, 0.00
Household SES	Unskilled manual				-0.17	0.13	-0.42, 0.08	-0.17	0.13	-0.42, 0.08
	Skilled manual				0.00			0.00		
	Lower non-manual				0.03	0.16	-0.28, 0.34	0.03	0.16	-0.28, 0.34
	Intermediate non-manual				-0.02	0.13	-0.28, 0.23	-0.03	0.13	-0.29, 0.23
	Managers and professionals				0.27	0.19	-0.11, 0.65	0.27	0.19	-0.11, 0.65
	Self-employed professionals				-0.38	1.11	-2.54, 1.79	-0.37	1.11	-2.53, 1.80
	Other self-employed				0.20	0.23	-0.25, 0.65	0.20	0.23	-0.25, 0.65
	Farmers				0.29	0.37	-0.43, 1.01	0.29	0.37	-0.43, 1.02
	Missing				-0.02	0.15	-0.32, 0.28	-0.03	0.16	-0.33, 0.28
Birth Order	1				0.00			0.00		
	2				-0.09	0.06	-0.20, 0.02	-0.08	0.10	-0.27, 0.11
	3				-0.06	0.12	-0.30, 0.17	-0.04	0.19	-0.42, 0.34
	4				-0.43	0.25	-0.91, 0.06	-0.39	0.33	-1.04, 0.26
	5				-0.73	0.49	-1.68, 0.22	-0.68	0.56	-1.78, 0.43
	6				-0.86	0.78	-2.40, 0.67	-0.81	0.86	-2.50, 0.87
	7+				-1.18	1.11	-3.35, 1.00	-1.15	1.18	-3.47, 1.17
Birth Year	1971							0.11	0.16	-0.21, 0.43
	1972							0.12	0.13	-0.14, 0.38
	1973							0.06	0.11	-0.16, 0.27
	1974							0.15	0.10	-0.04, 0.34
	1975							0.00		
	1976							0.24	0.10	0.03, 0.44
	1977							-0.05	0.12	-0.27, 0.18
N		70,659		70,659		70,659		70,659		

**Table S16. Men Born in Sweden, 1965-1977: Physical Fitness (watts) by Maternal Age at the Time of Birth, Adjusting for Parental Socioeconomic Status and Inflation-adjusted Household Income.**

		Model 1			Model 2			Model 3		
		Beta	SE	95% CI	Beta	SE	95% CI	Beta	SE	95% CI
Mother Age	15-19	-11.06	0.97	-12.97, -9.15	0.77	1.78	-2.72, 4.26	-1.11	1.85	-4.74, 2.51
	20-24	-5.21	0.46	-6.11, -4.32	0.18	0.82	-1.43, 1.78	-0.95	0.88	-2.66, 0.77
	25-29	0.00			0.00			0.00		
	30-34	-1.68	0.56	-2.78, -0.58	-2.87	0.92	-4.68, -1.07	-1.76	0.99	-3.71, 0.19
	35-39	-5.37	1.21	-7.74, -3.00	-3.10	2.17	-7.35, 1.16	-0.87	2.31	-5.40, 3.66
	40-44	-11.75	3.53	-18.67, -4.83	-8.35	5.44	-19.02, 2.32	-5.16	5.56	-16.06, 5.74
	>44	0.78	15.54	-29.68, 31.24	6.34	30.26	-52.97, 65.65	9.42	30.29	-49.94, 68.78
Age at Conscription Test	17				-1.09	0.60	-2.26, 0.08	-1.27	0.60	-2.44, -0.10
	18				0.00			0.00		
	19				-2.10	1.30	-4.64, 0.45	-1.85	1.30	-4.39, 0.69
	20				-4.04	4.29	-12.44, 4.36	-3.11	4.28	-11.51, 5.28
HH Income Household SES	Unskilled manual				-0.01	0.01	-0.03, 0.00	-0.01	0.01	-0.02, 0.01
	Skilled manual				0.25	1.20	-2.10, 2.61	0.45	1.20	-1.90, 2.80
	Lower non- manual				-0.93	1.48	-3.83, 1.96	-0.91	1.48	-3.80, 1.98
	Intermediate non-manual				-2.00	1.23	-4.41, 0.41	-2.16	1.23	-4.57, 0.25
	Managers and professionals				1.19	1.80	-2.34, 4.72	1.04	1.80	-2.50, 4.57
	Self-employed professionals				-17.73	10.35	-38.02, 2.56	-18.07	10.34	-38.33, 2.20
	Other self- employed				-1.41	2.15	-5.62, 2.80	-1.44	2.15	-5.65, 2.76
	Farmers				3.12	3.45	-3.65, 9.89	2.97	3.45	-3.79, 9.74
	Missing				-3.23	1.44	-6.05, -0.41	-2.50	1.46	-5.35, 0.35
	Birth Order	1				0.00			0.00	
2					-5.15	0.52	-6.18, -4.13	-2.23	0.90	-3.99, -0.47
3					-11.82	1.11	-14.00, -9.65	-6.09	1.82	-9.65, -2.53
4					-14.73	2.31	-19.25, -10.21	-6.32	3.11	-12.42, -0.22
5					-25.13	4.55	-34.06, -16.21	-14.42	5.28	-24.77, -4.06
6					-33.26	7.34	-47.64, -18.88	-19.52	8.03	-35.26, -3.77
7+					-40.69	10.38	-61.04, -20.34	-24.73	11.06	-46.42, -3.05
Birth Year	1971							7.26	1.53	4.26, 10.26
	1972							6.08	1.24	3.64, 8.52
	1973							4.67	1.01	2.68, 6.66
	1974							0.59	0.90	-1.18, 2.35
	1975							0.00		
	1976							-0.47	0.96	-2.36, 1.42
	1977							3.54	1.08	1.42, 5.65
N		70,659			70,659			70,659		