Age at first birth and late-life self-rated health

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Abstract

This study investigates the association of parenthood, age at first birth (AFB) and education with self-rated health of European women in old age. The study investigates whether a persistent accumulation of advantage exists by delaying age at first birth for late-life health, or alternatively, any health advantage can be attributed to an indirect effect of delayed education on late-life health through AFB. The data used are the third and fourth wave of the Survey of Health and Retirement Europe (SHARE and SHARELIFE) for women aged 50- 84 in 13 European countries. A welfare state regime framework is used to analyse countries and the analysis is stratified by country. I use a three-part generalized structural equation model to account for the selection into parenthood and to test mediation between education and AFB on health. Using a Heckman selection model, I first account for selection into parenthood based on measures of childhood socioeconomic status and health. In the second part, two hypotheses are tested: a) age at first birth mediates the effect of education on health but also has an independent effect on health; or that b) age at first birth only mediates the effect of education on health, and does not have an independent effect on health. Results show that remaining in school longer delays childbirth in almost all countries, and age at first birth is associated with self-rated health in the conservative regimes (Austria, Germany, Netherlands, Switzerland) and the Eastern-European regimes (Czech Republic and Poland). There is a notable absence of direct effect of age at first birth on self-rated health in the Mediterranean regimes (Greece, France, Italy), as well as in Denmark and Belgium.

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1.1 Introduction

In the life course literature in social epidemiology, demography and public policy research there is a great interest in health problems that arise in old age and contribute to a lower quality of life. Parenthood and age at first birth (AFB) are related to health, as research has already shown that family processes correlate with health problems across a wide range of specific diseases, symptoms, and impairments. Previous studies of the consequences of parenthood and its timing from the US have shown that parental status and the age of becoming a parent may account for differences in depressive mood (Mirowsky & Ross, 2002) and perceived health, physical impairment, and chronic conditions among other measures (Mirowsky, 2002). Both early and late parenthood can be one of the risks that cumulate over the life course and lead to disease and disability in later life. In addition, early-life health and socioeconomic condition (in childhood and adolescence) are important for late-life health as advantages and disadvantages can accumulate over the life course (see Kuh & Ben-Shlomo, 2004).

European societies have been experiencing a shift from early to late childbearing known as the "postponement transition" (Kohler et al., 2002). From a biological perspective it is known that fecundity starts to decline from age 25, with the decline accelerating in the mid-30s (Bongaarts, 1975; Wood, 1989). Previous research focusing on women's health relied on the assumption that long-term health consequences must result from the complications of pregnancy. Consequently, a stream of research has investigated the medical complications of pregnancy and birth for women who give birth at particularly young (15-19) or old age (over 40) (e.g., Smith & Pell, 2001; Luke & Brown, 2007). However, there is an argument that the medical complications themselves might reflect social disadvantage more than intrinsic biological risk relating to the development of reproductive systems (Zuckerman et al., 1984; Mirowsky, 2002).

For women educational, employment and career opportunities have fundamentally altered the temporal pattern of reproductive behaviour, particularly AFB (Van de Kaa, 1987; Goldin, 2006). The challenges women face in reconciling the pursuit of education and motherhood has produced a conflict between becoming a parent and attaining higher education at the same time. With regards to socioeconomic status (SES), studies have linked early childbearing to a high motherhood wage penalty and have shown that the postponement of motherhood is followed by increases in earnings. This was evident particularly for the higher educated women of the birth cohorts from 1922 to 1970 (Hofferth & Moore, 1979; Taniguchi, 1999; Joshi, 2002), as well as for women in younger cohorts (Amuedo-Dorantes, 2006; Amuedo-Dorantes & Kimmel, 2005; O'Donoghue et al., 2011). Conversely, dropping out of the labour force after giving birth has been associated not only with lower wages but also with a depreciation of job-specific human capital (Albrecht et al., 1999; Gupta & Smith, 2002).

In addition, early parenthood usually indicates a poor start in life as it reflects a disordered or disadvantaged transition from adolescence into adulthood. Studies from the US found that early AFB deters the completion of high school (Hoffman, Foster & Furstenberg, 1993), discourages entry into college (Hofferth & Moore, 1979), prevents the completion of college (McElroy, 1996; Moore & Waite, 1977; Waite & Moore, 1978), and it is associated with later poverty and low SES (Moore et al., 1993). Another line of research has attempted to test the assumption that early childbearing leads to health disadvantages in later life (Mirowsky, 2002; 2005; Mirowsky & Ross, 2002; Stein & Susser, 2000). The results suggested that education, history of unemployment, and economic hardship largely explain the association between AFB and later health (Mirowsky, 2002). Most of the evidence of the association between age at first birth and health has come from US where the rates of early childbearing are much higher compared to Europe. For example, adolescent birthrates in the 15-19 age group over the period 1970-1995 vary from below 15 (per 1,000) in Austria, the Netherlands, Denmark, Belgium, France, Italy, Spain, Sweden Switzerland and Greece to 54.4 in the US (Singh & Darroch, 2000).

Modern contraceptive technology, differences in access to higher education for women, women's labor force participation, as well as the differences in rights and obligations afforded to men and women (gender system) in societies are among the most prominent explanations for the postponement of childbearing in European countries (Mills, Rindfuss, McDonald & te Velde, 2011). There is a great variation between welfare regimes regarding these factors and differences in the welfare state across Europe might be a large contributing factor that shapes the relationship between AFB, education and health.

Nonetheless, very few studies to date have examined how AFB is related to general health outcomes throughout the life course, including middle age (Mirowsky, 2002; 2005). Due to lack of data and methodological limitations no study has focused on the far-reaching consequences on health in old age. Although education and SES have been linked to both AFB and health in later life, the association between AFB and late-life health remains a strong theoretical hypothesis without conclusive empirical evidence. This study investigates how age at first birth is related to late-life self-rated health for older women. Taking into consideration that education and AFB intertwine to impact health over the life course, I investigate how AFB is related to self-rated health for women over 50 in 13 European countries (Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Italy, Netherlands, Poland, Spain, Sweden and Switzerland). Further, I explore if AFB influences late-life health independently of educational attainment, or the relationship between AFB and late-life health is a residue of the effect educational attainment has on late-life health. Lastly, I aim to answer whether there is a cumulative effect of AFB and education on health (a so called advantage accumulation).

1.2 Theoretical background

1.2.1 Age at first birth and health outcomes for women

Age at first birth has been associated with lower or higher risk for certain diseases, such as various cancers. The association between later AFB and an elevated risk of breast cancer is a consistent finding in epidemiological research (Colditz et al., 1993; Kvåle, 1992). In contrast, later AFB and age at last birth is associated with a significantly reduced risk of ovarian cancer, net of parity (Whiteman et al., 2003). Younger AFB is related to an increased risk of cervical and endometrial cancers (Merrill et al., 2005), myocardial infarction (Palmer, Rosenberg, & Shapiro, 1992), and ischemic heart disease (Beard, Fuster & Annegers, 1984, Cooper et al., 1999; Palmer et al., 1992; Rosenberg et al., 1999).

Studies consistently point out to infertility, spontaneous abortions, birth defects, and complications of pregnancy and childbearing of delayed parenting (de La Rochebrochard & Thonneau, 2002; Heffner, 2004; Maconochie, Doyle, Prior & Simmons, 2007). Next to being associated with low educational attainment, higher risk of poverty and low SES in later life, early first birth is also associated with premarital parenthood, unstable marriage, and high fertility (Heaton, 2002; Quesnel-Vallée & Morgan, 2003). Therefore, AFB is an important component in the life course process of cumulative advantage and disadvantage, linking biological factors to social and psychological characteristics of parents. Recent research suggests that delayed parenthood could be an effective strategy for more successfully balancing the demands of career and family. There is evidence that later AFB might have long-run social benefits for the children that outweigh the problematic pregnancies and congenital anomalies (Stein & Susser, 2000). There is also evidence that the association between advanced maternal age and worse adult health of the offspring is associated with a lifespan overlap between mother and child instead of the physiological health of the mother at conception and birth (Myrskylä & Fenelon, 2012).

Mirowsky (2002) found a generally positive link between physical health and the timing of transition to parenthood, namely for mothers the relationship was quadratic (parabolic) indicating that there might be a limit to health benefits for women in the US who delay parenthood beyond the optimal age of approximately 30.5 years. Adjustment for education, history of unemployment, and economic hardship largely explained this association. Therefore, there are two main mechanisms that can be responsible for the advanced maternal age–late-life health link. One is related to the physiobiological maturity that reflects long-lasting complications of pregnancy and adverse effects resulting from compromised birth or suboptimal post-birth development of the child. An alternative mechanism is one that postulates that advanced AFB is linked to late-life health through SES after birth and over the life course. Older mothers are more affluent, have a higher educational attainment, and higher SES than younger mothers (Hofferth & Moore, 1979; Hoffman et al., 1993; Moore et al., 1993), and this in turn is associated with better health outcomes. Due to contradicting biological and socioeconomic factors the association between AFB and health is bound not to be linear.

1.2.2 Education in European context

So far education is the best-documented predictor of late-life health (Ross & Wu, 1995, 1996). Highly educated individuals are more likely to enjoy better health due to better living and working conditions (McKeown, 1979), and lifestyle factors as they are less likely to smoke, more likely to exercise, to get health check-ups and to drink moderately (Pampel, Krueger & Denney, 2010). In addition, they are more likely to have financial stability and rewarding careers (Grzywacz & Dooley, 2003) and psychosocial factors such as less stress, greater sense of control over their lives and more social support also are conducive to good health (Berkman, Glass, Brissette & Seeman, 2000; Holt-Lunstad, Smith & Layton, 2010; Ross & Wu, 1995).

Educational attainment of women varies across European countries. The differences are partly due to differences in individual abilities and preferences, but also depend on the degree of decommodification, social stratification, and employment opportunities embodied in welfare regimes. Based on Esping-Andersen's (1990) welfare typology that corresponds to national markets, institutions and values related to education, European countries in the study are classified into four clusters: conservative (Austria, Belgium, Germany, Switzerland and the Netherlands), Mediterranean (France, Greece, Italy, and Spain), social-democratic (Sweden and Denmark), and post-communist European type (Poland and Czech Republic).

In conservative welfare regimes such as Austria, Belgium, Germany, Switzerland and the Netherlands the institutional arrangements, rules and understanding that guide social policy are designed to preserve traditional status positions in order to maintain social integration and support for traditional family structures (Willemse & Beer, 2012). High vocational specificity, standardization and strong hierarchy in education combined with support for traditional family structures in these countries have been barriers for women to pursue education and compete with men on the labor market.

Countries such as France, Greece, Italy, and Spain (also called Mediterranean in the educational attainment literature, see Green, Preston & Janmaat, 2006; West & Nikolai, 2013) have stratified education systems. Selection at the upper secondary school system assigns students to high schools, technical institutes or vocational institutes. Each of the school tracks is associated with different socioeconomic outcomes in adulthood. In Mediterranean regimes, the educational attainment of women of older age is considerably lower than their male counterparts, with women catching up as late as the 1990s, and older women have had a low attachment to the labour force, as well as modest occupational expectations (José González, Jurado & Naldini, 1999).

In social-democratic regimes such as Sweden and Denmark enrolment rates into higher education for both men and women are much higher compared to the conservative countries

(Willemse & Beer, 2012). In addition, the investment in education at higher levels and spending on education as a share of total public spending is higher too (Hega & Hokenmaier, 2002). This implies that the chances for women to not drop out of school are higher because the schools systems are non-selective, publicly funded and cover the entire period of compulsory education (see Wiborg, 2009). Policy reforms dating before the 1960s encouraged women to stay in school longer and participate in the labour force, and in both Sweden and Denmark a dual breadwinner family model was promoted (Ellingsaeter, 1998). Thus, social-democratic regimes are characterized with more equality of opportunity in terms of access to all levels of education for women (West & Nikolai, 2013).

Women in post-communist European regimes such as Poland and Czech Republic are considered to enjoy greater gender equality than the former USSR counterparts (Fenger, 2007). Poland and Czech Republic have egalitarian welfare policies regarding education with universal and equal access to education (Eurydice, 2015). After the Second World War, there was a great public expenditure on education in these countries despite economic difficulties (Łuczak, 2013). Both in Poland and in Czech Republic the average educational attainment (years in school) increased greatly since 1940, with rapid expansion until 1970. Women increased their educational attainment more than men and by 1975, and in both countries the difference between men and women with regards to years of schooling had virtually disappeared (Ganzeboom & Nieuwbeerta, 1999).

Age at finishing school is an important determinant for the age at first birth and other demographic events in early adulthood, as most women do not have children while being enrolled in education (Blossfeld & Huinink, 1991). An important reason why individuals tend to finish education before entering parenthood is that young adults sequence their events in adulthood according to scripts, and completing educational careers typically precedes childbearing (Corijn, 1996; Marini, 1984). Becker (1991), Oppenheimer (1988), Heckman and Walker (1990), Gustafsson (2003), along with many other studies, argue that postponement of childbearing constitutes a rational response of women (and couples) to the changes in opportunity costs due to increased education. Later AFB might be one of the factors through which longer education improves health. Alternatively, each factor may stand as an independent health fundamental with lifelong effects on health not explained by the other.

Following the rationale of direct health effects of AFB on late-life health I hypothesize H1: Age of first birth has a direct effect on late-life health.

Further, a direct mediational view is that years of schooling influences age at first birth, which in turn increases educational attainment, and thus leads to higher SES in later life. Higher education and higher SES provide women an access to resources like health literacy, higher income and higher quality medical care (so called health benefits) over the life course that result in greater self-rated health in late-life. Therefore, I hypothesize that AFB mediates the effect of education on health, with two alternative scenarios:

H2a: Age at first birth mediates the effect of education on health, but also has an independent effect on health; or that there is both a direct of AFB on health and an indirect effect of education on health (accumulation hypothesis).

H2b: Age at first birth only mediates the effect of education on health, and does not have an independent (direct) effect on health (chains of risk hypothesis).

Both scenarios are plausible taking into consideration the physiobiological and materialistic explanations of the association between AFB and later health. I expect that the differences between observing persistent direct effects of AFB on health (and no indirect effects of education through AFB) versus observing only indirect effects of education on health through AFB are linked to welfare regime differences in educational opportunities. Thus, I hypothesize that the first alternative (H2a) is more plausible in countries with more egalitarian welfare practices where women in average have more years of education (such as the social-democratic and the post-communist countries). In countries where policies are tailored to decouple the individual's welfare from the market, class structures and divisions contribute less to socio-economic and health inequality, and the social effect of delayed education might be less pertinent for late-life health. Greater childcare availability, flexible working (e.g., high part-time work), universal health coverage and other arrangements available to women in a non means-tested programs are likely to dampen the effect of individual educational attainment, and thus AFB and education are likely to both have a direct effect on health.

On the other hand, I expect that AFB will be only a mediator of education on health in countries with fewer educational opportunities for women (H2b), where delaying first birth might be more essential for higher SES in later life, and consequentially, better health (in the conservative and Mediterranean regimes). In the second scenario the social advantage of high education is a greater predictor of late-life health than any possible physiological effect of AFB, and individual differences in educational attainment are greater force for late-life health differences.

1.3 Data and methods

I use a three-part generalized structural equation model to account for the selection into parenthood and to test mediation between education and AFB on health. The benefit of using a complex approach lies in its ability to address several theoretically relevant associations in a joint framework, and in addition, it is grounded on explicit statistical assumptions. There are several challenges the relationships between education, AFB and health pose, especially in light of how AFB impacts late-life health from a non-medical perspective. First, investigating only women who are mothers (and excluding non-parents) runs a risk of sample selection bias. Parents possess individual characteristics to the extent that the outcome (health) correlates with parenthood net of those characteristics. Thus, not accounting for selection into parenthood on earlier life events and other individual characteristics runs the risk of vastly underestimating or overestimating the effects of AFB on health. Second, AFB and education might temporally overlap, as women who already have a child can still proceed with further education. Third, it is well established that due to biological factors the relationship between AFB and health is not linear, and after a certain threshold delaying childbearing can have negative effects on the birth outcome, and on both mother's and infant's immediate health. Mirowsky (2002) finds a parabolic (curvilinear) association between AFB and health, with negative consequences for health starting after the age of 30.5. Fourth, a life course development assumes that there are early-life factors such as childhood socioeconomic position and health that influence both AFB (Dietz et al. 1999; Hillis et al., 2004; Hobcraft, & Kiernan, 2001), and health (Danese et al., 2009; Dube et al., 2003; Gilman et al., 2002). This poses a challenge to empirically discern the impact of childhood conditions on education and later-life health in a joint framework. Fifth, a multi-contextual setting across countries implies that the relationship between AFB, education and health might differ between welfare regimes, as different educational systems and cross-national variations in systems of social provision shape the relationship between education and later-life health.

1.3.1 The GSEM model

A generalized structural equation model provides a framework to test the hypotheses by laying out clear assumptions that a) the responses ($Y_1, Y_2, \ldots, Y_n$) are correlated or clustered, i.e., cases are not independent, b) covariates can be nonlinear transformations of the original independent variables, and they can be included in interaction terms, c) the homogeneity of variance does not need to be satisfied, d) errors are correlated, e) a quasi-likelihood estimation is used to obtain estimates, rather than maximum likelihood estimation (MLE) or ordinary least squares (OLS), but these coincide in some cases, and f) the covariance structure of the correlated responses is explicitly specified (Skrondal & Rabe-Hesketh, 2004). An additional important assumption is that the dependent variable (self-rated health) is normally distributed following a Gaussian distribution, which is met both in the pooled sample and in each country sample.

Because some women in the sample have never given birth the estimates of the effects of AFB and education can be biased by sample selection (Groves & Couper, 1998). To correct for this I apply Heckman's two-stage model for sample selection (Heckman, 1979; Winship & Mare, 1992). The Heckman selection model used is a two-equation SEM – one linear regression (for the continuous outcome of age at first birth) and the other censored regression (for selection into parenthood) — with a latent variable L_i added to both equations. The first part of this procedure is a selection equation that models whether the respondents are parents, or more precisely, if they have ever given birth based on a retrospective life course history of their fertility and socioeconomic childhood conditions (i.e., the selection model). Identifying instruments for the selection equation (also referred as a censored regression) are: a) a latent variable L_i constrained to have a variance 1 and to have a coefficient 1 in the selection equation (leaving only the coefficient in the continuous-outcome equation of age at first birth to be estimated); and b) a series of variables capturing childhood socioeconomic position that affect the response (parenthood) while not directly affecting the outcome (AFB), as well as c) a measure of childhood health.

The second part of the joint model is estimating AFB conditional on women being selected into parenthood. This equation includes the latent variable L_i and the age of the respondent to account for age-cohort associations with age at first birth.

The third part of the joint model is a linear regression equation for a continuous outcome of self-rated health for those who are observed both in Wave 3 (retrospective life history) and Wave 4 (when self-rated health is reported). This equation includes a different measure of childhood health, measures of age at first birth (the outcome of the post-selection equation), education, as well as a set of variables that previous empirical research found related to self-rated health, such as age (Ross &Wu, 1996), parity (Grundy & Holt, 2000), employment (Aldabe et al., 2010; Präg et al., 2014), depression (Demakakos et al., 2008; Präg et al., 2016), marital status (Huijts et al., 2010; Huijts & Kraaykamp, 2011) and lifestyle factors (if respondents smoke, drink or exercise regularly) (Layte & Whelan, 2009; Pampel et al., 2010). In the last part of the model I estimate the indirect and total effects of AFB and education on self-rated health by embedding a mediation path in the equation in part 3. The three-part model is estimated for each country separately. The full model is graphically shown in Figure 1. The technical details of the model are elaborated in Appendix section Technical description of a GSEM model.

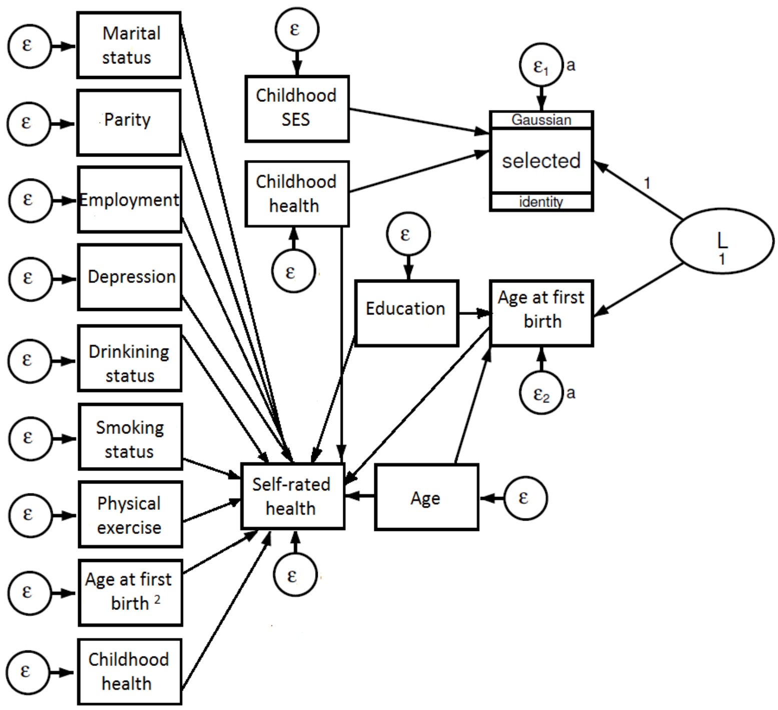


Figure 1: Generalized structural equation path model

1.3.2 Data

The paper uses data from the third and fourth wave (2008 and 2010) of the Survey of Health, Ageing and Retirement in Europe (SHARE), a multidisciplinary, cross-national bi-annual household panel survey. The survey collects data on health, socio-economic status, and social and family networks for nationally representative samples of people over 50 in the participating countries. The third and fourth waves cover 13 countries, representing different European regions, from Scandinavia (Denmark, Sweden) through Central Europe (Austria, Belgium, France, Germany, the Netherlands, Switzerland) and Mediterranean countries (Greece, Italy, Spain) to Eastern European countries (Poland and the Czech Republic). The third wave of SHARE (SHARELIFE) has been implemented to collect retrospective histories of the SHARE respondents who participated in any of the two previous waves in order to obtain information about the lives of respondents before the baseline year of the survey (2004). The use of retrospective questionnaires about childhood health and social conditions is a way to overcome the lack of large nationally representative cohort studies connecting the earliest years of life to later stages of the life course. In SHARELIFE, the accuracy of the collected information was assessed by Garrouste and Paccagnella (2010), and Havari and Mazzonna (2015). They found an overall strong consistency across waves (with less than 10% recall errors over all events).

This paper restricts attention to women aged 50–84 at the time of the fourth wave interview, who also answered the life course module (Wave 3). These selection criteria give a working sample of 11,585 women from 13 European countries, out of which 10,275 are parents. Table 1 on page 11 shows the composition of the working sample by country, including the empirical sample as well as the samples without missing values. The estimated models are with partial incomplete data using the quasi-likelihood estimation method available to generalized structural equation models. This assumes that a multiple equation model will handle missing data in a way that if there are missing observations in the observed exogenous variables x_n that appear in the first equation but not in equation 2; and equation 1 predicts y_1; then if the endogenous variable y_1 is observed and of Gaussian family, but without censoring the missing observations will be ignored in making calculations related to equation 1, and the missing observations will also be ignored in making calculations related to equation 2 because y_1, a function of x_1, appears in them; whereas the calculations for the other equation such as equation 3 will include missing observation (StataCorp, 2015).

Measures

Self-rated health is measured using an indicator of self-reported health at wave 4 (ranges from 1=poor to 5=very good). *Education* is measured by years spent in schooling reported in wave 4 (ranges from 0 to 25 years). Age at first birth is reported in retrospective wave 3. The sample characteristics of self-rated health, education and age at first for each country and the pooled sample is presented in Table 1.

Table 1: Composition of working sample and sample characteristics for self-rated health, education and age at first birth

Measures	Self-rated health		Education		Age at first birth		Age at first birth (centered)		n(full model)	n(full model)	N (listwise deletition)
	m	sd	m	sd	m	sd	m	sd	all	parents	all
Austria	2.99	1.04	7.33	4.72	23.62	4.62	-1.38	4.62	368	321	328
Germany	2.83	0.93	12.29	3.14	24.29	4.57	-1.61	4.57	796	717	610
Sweden	3.35	1.14	11.85	3.93	24.76	4.65	-1.14	4.65	765	677	670
Netherlands	3.07	1.04	10.99	3.37	25.44	4.26	-1.23	4.26	920	787	751
Spain	2.45	0.95	6.79	4.78	25.19	4.30	-1.57	4.30	790	694	526
Italy	2.62	1.02	7.42	4.11	25.06	4.43	-1.73	4.43	1,159	1,040	840
France	2.87	0.97	11.46	3.71	24.76	4.73	-1.11	4.73	995	881	726
Denmark	3.47	1.17	7.74	5.55	24.34	44.75	-1.12	44.75	944	848	683
Greece	3.10	0.91	8.44	4.11	25.65	4.93	-2.11	4.93	1,240	1,049	939
Switzerland	3.42	1.00	10.61	4.68	25.80	4.27	-1.53	4.27	587	479	379
Belgium	3.03	1.00	11.63	3.38	24.63	4.07	-1.10	4.07	1,197	1,072	1077
Czech Republic	2.72	0.93	11.64	2.25	23.33	4.47	-1.12	4.47	938	887	268
Poland	2.27	0.98	10.23	2.87	22.74	3.48	-1.62	3.48	886	823	343
Pooled	2.97	1.06	9.90	4.44	24.75	0.45	-1.42	0.45	11,585	10,275	8140

Own calculations using data from SHARELIFE and SHARE wave 4

Self-rated health in all countries follows the Gaussian normal distribution, whereas educational attainment has greater distributional skew over countries. Further, in Germany, the Netherlands, Sweden, France, Belgium, Switzerland, Czech Republic, and Poland women have in average more than 10 years of schooling, whereas in Spain, Italy and Austria the average of years of schooling is around 7 years.

The average AFB across countries ranges from 22.74 in Poland to 25.80 in Switzerland, and AFB follows approximately the Gaussian distribution in all countries. To capture the effect of the social context rather than the biological variation of AFB related to health I centre AFB around the country mean by subtracting the individual values off the country mean of AFB. Primarily for medical reasons AFB is expected to have a non-linear relationship with health (Mirowsky, 2002, 2005), therefore I also introduce a quadratic function of the country-centred AFB as an additional variable. Using a country-centred variable in combination with its quadratic term is useful in this case as it avoids the correlation that would otherwise arise if a non-centred measure of AFB is used; it allows for a parabolic association between AFB and health without imposing arbitrary values where the expected curve should bend; and it allows for a different (convex or concave) curve in different countries to capture the association between AFB and health, independent of education (Kline, 2011). Moreover, the centred variable has a same SD as the non-centred AFB which facilitates the interpretation of results.

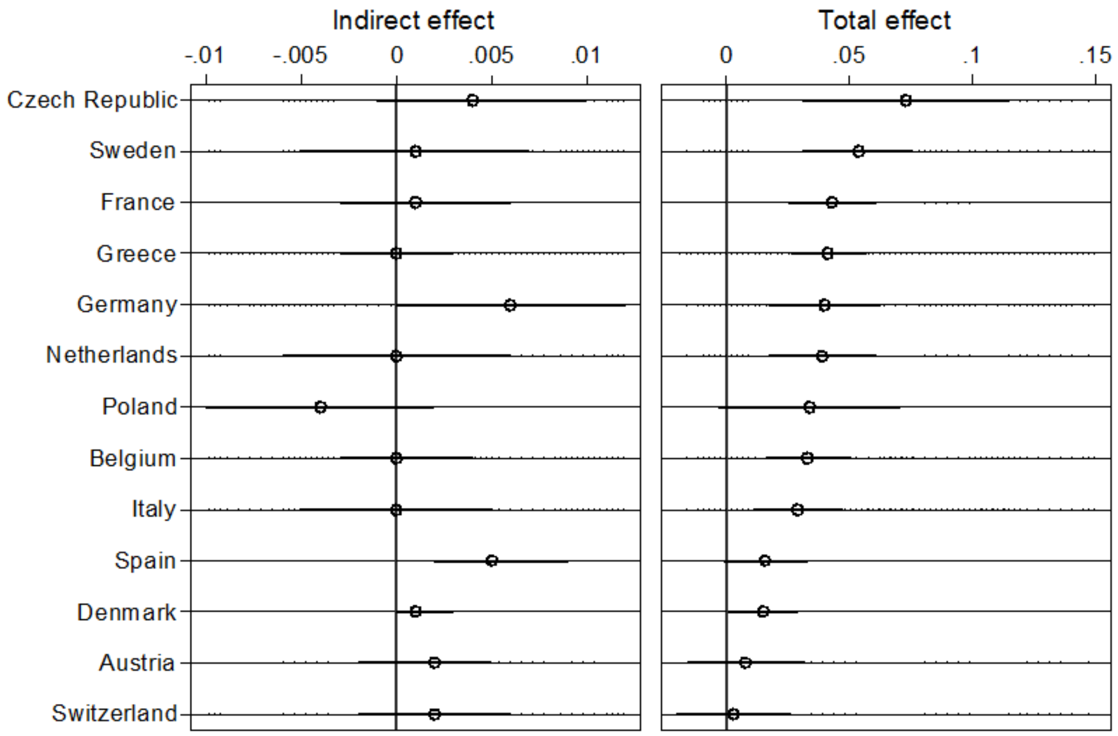
Age is used as a year of birth (higher year of birth denotes younger age)*,* and a measure of *marital status* is based on the current legal status and distinguishes between four groups (married or registered partnership, never-married, divorced or legally separated, and widowed). *Employment status* of the respondent is included as well (retired, in work, never worked or a homemaker, and other). *Number of children* is used as a continuous variable, ranging from 0 to 3 and more. A binary measure of *current smoking* status is used, and another binary measure is included to capture whether the respondent drinks on a regular basis (reported drinking more than 5 times a week). A measure for *currently exercises* is a binary indicator that is positive if the respondent engages in vigorous physical activity for 1–3 times a week. *Depression* is operationalized using the EURO-D scale measuring depressive mood (range 1–12) where a higher score signifies more depressive symptoms. EURO-D was constructed by harmonizing five depression measures into a 12-item scale including depression, pessimism, suicidality (wishing death), guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness. With regards to validity, the scale was shown to correlate well with other well-known health measures (Prince et al., 1999).

Childhood SES. I use proxies of the household SES from the retrospective information on childhood socio-economic background collected in the third wave (SHARELIFE) that contains information on living conditions when respondents were 10 years old. Four indicators of the household SES are constructed: rooms per capita in their accommodation (excluding bathrooms and kitchens); facilities in the accommodation (fixed bath, cold and hot running water supply, inside toilet and central heating); estimated number of books at home; and the occupation of the main breadwinner. The first two indicators reflect the household's dwelling and are usually considered as asset indicators and serve as proxies for household long-run wealth (McKenzie, 2005). The estimated number of books—asked in terms of number of shelves and bookcases that can be filled, is a proxy for the cultural background (Esping-Andersen, 2008), and reflects parents' education. The breadwinner's main occupation is recorded in ISCO-88 code, and occupations are divided into three groups that refer to their assumed skill level: 1 "low", 2 "medium" and 3 "high" (Case, Paxon & Islam, 2009; Mazzonna, 2014). The proxy for a breadwinner's main occupation is also considered to be reflective for the household's income level. All indicators have different distributions over countries (as shown in Mazzonna, 2014). Mediterranean countries and Poland rank the lowest on all indicators, and have the biggest fraction of respondents that grew up in poor households. On the other hand, Scandinavian countries and Switzerland exhibit the biggest fraction of respondents that grew up in better off households. The measures of childhood SES are centred at the country level by subtracting the values off the country mean. *Childhood health* is measured by using an indicator of self-reported health at age 10 (1=poor, 5=very good) as a predictor of self-rated health, and another measure if the respondent did not spend more than one month in hospital is used in the selection equation (0=was in hospital; 1=was not in hospital).

1.4 Results

Table 2 on page 19 shows the estimates for the three equations in a model with all confounders for each country, including estimates of the mediation of AFB and education on self-rated health. Prior to fitting the final (full) model I estimated empty models by country and followed a stepwise approach to feed the basic model with additional confounders based on theoretical assumptions summarized in Figure 1 (please refer to Sensitivity analyses). Because the generalized structural equation model uses quasi-likelihood estimation to estimate parameters rather than maximum likelihood estimation (MLE) or ordinary least squares (OLS) the usual measures of fit like the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) are not available to assess model fit. However, likelihood ratio Chi-squared tests ($\chi_{ms}{}^{2}$), as well as the Akaike's (AIC) and Schwarz's Bayesian (BIC) information criteria are used to assess the improvement for each stepwise model (Kline, 2011; Skrondal & Rabe-Hesketh, 2004). Lower values of AIC and BIC information criteria (in absolute value) are a considered as a better model fit. The fit measures of the models without mediation of AFB and education, and with mediation (AFB and education) per country are available in Appendix Table A 1. If the model with mediation has a lower AIC and BIC information criteria than the one without I conclude that estimating indirect and total effects of the mediation of age at first birth and education is warranted. From Table A 1 we observe that in all countries there is an improvement in model fit, therefore I proceed to estimate indirect and total effects. The indirect and the total effect of the mediation is assessed by a nonlinear combination of parameters (described in step 4. Mediation in the Technical description of a GSEM model). Figure 2 shows the indirect effects and the total effects of the mediation of AFB and education on health in each country (coefficients of indirect and total effects are presented in Appendix Table A 2; direct effects are shown in Table 2).

Figure 2: Indirect and total effects of age at first birth and education on health



With regards to the first hypothesis that AFB has a direct effect on late-life health, the results from the full model with mediation presented in Table 2 reveal that in Austria, Sweden, Spain and Poland the association persists between AFB and self-rated health (direct effects). In Germany, Netherlands, Switzerland and the Czech Republic the direct effects of AFB on health are very small and not statistically significant. Notably, there are no direct effects observed in Greece, France, Italy, Belgium and Denmark when all additional parameters are included in the model. At first glance, there is an absence of direct effect in the Mediterranean and the conservative countries.

To investigate in which context AFB mediates the effect of education on health, but also has an independent effect on health (H2a) I inspect in which countries there is both a direct effect of AFB on health, and an indirect effect of education on health. The assumption is that AFB only mediates the effect of education on health, and does not have an independent (direct) effect on health (H2b) in countries with less educational opportunities for women, and weaker welfare. Next, by looking at the total effects I explore if there is a cumulative effect of AFB and education on health (so-called advantage accumulation).

In social-democratic regimes like Sweden and Denmark I find limited support for a direct effect of AFB on health (H2a). In Sweden AFB has a direct effect on health, albeit very small one (b=-0.01, CI=-0.01,-0.01), and education does not have a direct effect on health, but on AFB (b=0.30, CI=0.21, 0.39), with a noticeable big total effect of AFB and education on health (b= 0.054, CI=0.031, 0.076). However, in Denmark education is associated with AFB (b=0.09, CI=0.04, 0.14), but there are no direct effects of AFB or education observed on health, while there is a sizeable total effect of AFB and education on health (b=0.015, CI=0.001, 0.029).

In the countries belonging to the conservative regime I find some support for a direct mediation (H2b). In Austria AFB has a small direct effect on late-life health following a parabolic association (b=0.03, CI=0.00-0.05), and AFB is not a mediator on health. In Germany there is a sizable total effect of AFB and education on health (b= 0.040, CI=0.017, 0.063) as well as of education on AFB (b=0.38, CI=0.29, 0.47), and AFB is a modest mediator of education on health (b =0.006, CI = 0.000, 0.012). In the Netherlands AFB does not seem to have a direct effect on health, and only a total effect of AFB and education is observed (b=0.039, CI=0.017, 0.061), while education is associated with AFB (b=0.35, CI=0.26, 0.44) and late-life health (b=0.04, CI=0.02, 0.06). In Belgium as well only a total effect of AFB and education is observed (b=0.033, CI=0.016, 0.050), with education having a strong direct effect on AFB. So far the results lend support to the expectation that in countries with fewer educational opportunities and more rigid social stratification systems, a direct effect of education on AFB is observed. Only in Switzerland (from all the analysed countries) there is an absence of any direct and indirect effect of both AFB and education on health that does not go in line with any of the expectations.

In Spain, there is both a direct effect of AFB on health following a linear pattern (b=0.04, CI =0.02, 0.06) and a persisting indirect effect of education on health through AFB (b=0.005, CI=0.002, 0.009). Spain is a case that is clearly supporting hypothesis H2b. In France and Italy, there is no direct effect of AFB on health observed, while education is associated both with AFB and self-rated health, and strong total effects of AFB and education on health are observed (for France b=0.043, CI=0.025, 0.061; for Italy b=0.029, CI=0.011, 0.047). Results from France and Italy lend support for hypothesis H2b not in a sense that AFB is a mediator, but to the extent that AFB does not have a direct effects on self-rated health. In Greece only a total effect of AFB and education is observed (b=0.041, CI=0.026, 0.057) with education having a strong direct effect on AFB (b=0.27, CI=0.19, 0.35), thus also partially supporting H2b.

For the post-communist type or Eastern-European regimes I find that in the Czech Republic AFB might have a direct effect on health following a linear pattern, albeit a very small one (b=0.02, CI=0.00, 0.05). Education has a direct effect on health, as well as on AFB (b=0.20, CI=0.11, 0.29), with a big total effect of AFB and education on health (b= 0.073, CI=0.031, 0.115). In Poland, there is a direct effect of AFB on health observed following a linear pattern where delay in AFB is related to poor self-rated health (b=-0.01, CI=-0.01, 0.03), whereas education does not directly influence health but has a direct effect on AFB (b=-0.01, CI=-0.01, 0.03). The results from Poland and Czech Republic do not clearly support H2a that AFB has both a direct and indirect effect on health, however in both countries there is a direct effect of AFB observed.

Self-rated health is associated with demographic characteristics, and with indicators of socioeconomic position as also shown by previous research (Präg et al., 2014). Age, marital status, and indicators of socioeconomic status are included in the full model to obtain adjusted estimates of their associations with health. I find that to a great degree age, depressive mood, being employed, as well as life style factors such as regular exercise to be predictive of good self-rated health. This is in accord with findings from previous research (Demakakos et al., 2008, Layte & Whelan, 2009; Pampel et al., 2010), whereas marital status and parity in most countries do not have significant associations with health.

1.5 Sensitivity analyses

There are no statistically significant differences in the reports of self-rated health between parents and non-parents by country; however there is a strong selection of childhood SES and health into parenthood in each country, estimated by logitistic models for becoming a parent (results not shown here).

Alternative models ignoring sample selection (models without Heckman's selection correction) overestimate the effects of age at first birth (significant results are obtained) on self-rated health in each country.

Alternative models without Heckman's selection correction where age at first birth is modelled with B-splines and cut-offs at 19, 25, 30 and 35 years reveal relatively similar curves by country of the ones produced by using a centered AFB and its quadratic term. B-spline is a spline function that has minimal support with respect to a given degree, smoothness, and domain partition. Any spline function of a given degree can be expressed as a linear combination of B-splines of that degree.

Alternatively, childhood SES can be measured by using a construct as a single index that is able to summarize the information provided by these proxies using a principal component analysis (PCA). The first principal component captures the common variance between these indicators best (0.71% of variance explained for the pooled sample; range from 0.65 % for Austria to 0.75% for Italy) and provides a linear weighting system of the variables which explains the largest proportion of the total variance, hence is taken to represent childhood SES status (min = -3.12, max= 10.60). Childhood health can be measured by using a single indicator using PCA that combines self-reported health at age 10 (1=poor, 5=very good), whether the participants had missed school for more than one month, and whether the participants recall being confined to bed for more than one month. The first principal component has 0.68% explained variance for the overall sample (ranging from 0.58% for

Greece to 0.72% for Switzerland; min=-6.06, max=0.90). Using these indicators instead of the four childhood SES variables and the measure of self-reported childhood health did not produce substantively different results in the models.

I estimated full models with complete data (without missing values) which did not estimate substantively different results from the models estimated with partial incomplete data.

1.6 Conclusion and discussion

The base of the theoretical inquiry in this study is the assumption that childhood circumstances, AFB and education have both direct and indirect effects on old-age health. I utilize a complex GSEM model to test the theoretical hypotheses of accumulation and chains of risk that early-life characteristics influence health in old age, and AFB is a possible contributor to the chained risks for self-rated health (Ploubidis et al., 2014). The results from a three-part GSEM model show that in some countries AFB has a persisting direct effect on self-rated health across welfare regimes. The strongest effects are observed in Austria, Sweden, Spain and Poland. Nonetheless, in Eastern European countries (the Czech Republic and Poland) and social-democratic countries (Sweden and Denmark) I find evidence for direct effects of AFB on health and strong direct effects of education on AFB.

The benefits of delayed childbearing are thus not merely effects of pursuing higher education as the chains of risk hypothesis postulates. Instead, both early-life and education influence AFB, and AFB influences late-life health, thus lending support for an accumulation hypothesis. The findings show that in most countries there is an accumulation of risk or advantage where early-life health, AFB and education synergistically influence later-life health. It seems that the beneficial effects of delayed parenting and education hold true in all countries with a varying degree. The results mostly go in line with a partial accumulation of advantage, or in other words they point out that late-life health is the sum of early-life health and the effect of education on late-life health if we observe the total effects of education and AFB on health, as well as the individual associations between education and health. Only in Spain, I find clear support for the chain of risk hypothesis that age of first birth mediates the effect of education on health, but also has an independent effect on health.

The results show that remaining in school indeed delays childbirth and this is a consistent finding across all countries. We observe that staying in school one additional year delays birth in average for a quarter of a year (results vary from 6 weeks in Denmark, around 4 months in Italy and France, to around 5 months in Germany and the Netherlands). The results also support the initial assumption that a socioeconomic selection into parenthood exists. Women with more affluent parental background are more likely to become parents in Germany, Belgium, Sweden, France and Poland, while the opposite holds true for Switzerland, Netherlands, Denmark, and Spain.

Nonetheless, there are a number of limitations of this study that need to be acknowledged. Given the reliance on cross-sectional and self-reported data, which is a widespread problem in cross-national research on health inequalities (Beckfield, Olafsdottir & Bakhtiari, 2013), it is difficult to make strong causal claims based on the findings at hand. Proxies for early-life health and SES condition are used in the analysis to model selection into parenthood, and it is possible that recall bias is present given the fact that a self-rated health indicator is used. Given the fact that age at first birth in average might be differently distributed across cohorts we did not engage in cohort specific analyses. Instead, an indicator of age was used to account for the differences in AFB (in the second equation) and a strong assumption is made that the effects of AFB are primarily country driven, rather than cohort driven. Another limitation is that we cannot directly compare the effects between countries as each of them is analysed separately, and the variation in model fit between countries indicates that there are significant differences how the model fits the data over countries. However, using a comprehensive and identical model across countries gives a clear overview of the theoretical relations between early-life conditions, AFB, education and late-life health. Under the conditions of explicit theoretical and statistical assumptions instead of a search for the best fitting model per country, the same model is fitted for all countries to show relative differences and test explicit hypotheses.

Despite these limitations, my results extend previous findings on the relationship between AFB and health, and in particular on health in old age. The complexity of the observed associations was tested in a joint framework highlighting the need for further research on the mechanism that links early-life health with aspects of partnership and fertility in order to identify meaningful target areas for health policies. The findings of the study also support the need for a life course approach as several relationships hold true, such as the non-negligible contribution of early-life conditions, as well as the accumulation over the life course which has been frequently theorized, but less frequently tested. In addition, the study shows that in each context (in different countries) the assumptions about a curvilinear relationship between AFB and health do not hold true as for some countries delaying AFB seems to have a linear relationship with a better late-life health, while in others there is a parabolic association. Further research utilizing cohort studies and prospective data will be more informative about the differences between cohorts and delve into the social mechanism how policies can attenuate the negative consequences of late age at first birth on health in a life course framework.

Table 2: Estimates from a three-part generalized equation model

	Austria			Germany			Sweden			Netherlands		
	b	95% CI		b	95% CI		b	95% CI		b	95% CI	
Outcome : Self-rated health												
Age at first birth (centered)	0.03*	0.00	0.05	0.02†	0.00	0.03	0.00	-0.02	0.02	0.00	-0.02	0.02
Age at first birth (quadratic)	-0.00*	-0.01	0.00	0.00	0.00	0.00	-0.01**	-0.01	-0.01	0.00†	-0.00	0.01
Age	0.03**	0.01	0.05	0.01	-0.01	0.02	-0.01	-0.02	0.01	0.00	0.01	0.00
Health at age 10	0.38*	0.03	0.74	-0.03	-0.28	0.22	0.27	-0.03	0.58	0.15	-0.09	0.39
Education	0.01	-0.02	0.03	0.03**	0.01	0.06	0.05***	0.03	0.08	0.04**	0.02	0.06
Depression	-0.14***	-0.20	-0.09	-0.15***	-0.19	-0.11	-0.19***	-0.23	-0.14	-0.17***	-0.20	-0.13
Exercise status	0.10	-0.13	0.33	0.30***	0.16	0.45	0.19*	0.03	0.36	0.37***	0.22	0.52
Smoking status	-0.46**	-0.76	-0.15	-0.05	-0.25	0.14	-0.08	-0.30	0.14	-0.14	-0.30	0.02
Drinking status	-0.04	-0.43	0.34	0.14	-0.08	0.36	0.40*	0.06	0.74	0.22**	0.06	0.37
Employment (ref: retired)												
In work	0.07	-0.33	0.47	0.18	-0.04	0.41	0.52***	0.28	0.75	0.37**	0.13	0.61
Never worked	-0.16	-0.42	0.11	0.01	-0.20	0.23	0.17	-0.48	0.83	0.12	-0.07	0.31
Other	0.14	-0.34	0.61	-0.22	-0.50	0.06	0.00	-0.44	0.44	-0.52***	-0.79	-0.24
Number of children	-0.02	-0.11	0.06	-0.02452	-0.09	0.04	0.07	-0.01	0.15	0.07	0.01	0.13
Marital Status (ref: married)												
Never married	0.00	-0.72	0.71	-0.1795	-0.70	0.34	0.53	0.07	0.99	0.08	-0.81	0.96
Divorced or separated	0.13	-0.20	0.46	0.04	-0.22	0.29	-0.09	-0.36	0.17	-0.01	-0.25	0.24
Widowed	0.18	-0.10	0.47	-0.04	-0.27	0.19	0.19	-0.10	0.48	0.19	-0.03	0.41
intercept	-53.90**	-88.72	-19.09	-12.57	-40.02	14.88	14.46	-18.62	47.54	6.12	-17.56	29.80
Outcome: Age at first birth												
Age	-0.08*	0.14	-0.02	-0.08***	-0.11	-0.04	-0.06**	-0.11	-0.02	-0.06**	-0.10	-0.02
Education	0.06	-0.04	0.17	0.38***	0.29	0.47	0.30***	0.21	0.39	0.35***	0.26	0.44
L	-3.77***	-5.52	-2.01	4.89***	4.60	5.18	5.21***	4.90	5.52	4.65***	4.35	4.96
Intercept	154.60*	36.32	272.89	139.95***	65.05	214.85	117.83**	30.77	204.90	115.49**	40.51	190.46
Outcome: parent (selection equation)												
Health at age 10	0.54	-0.07	1.14	0.10*	0.00	0.20	0.13**	0.05	0.21	0.03	-0.06	0.12
Number of books	0.05	-0.47	0.57	0.03	-0.06	0.12	-0.05	-0.13	0.03	0.00	-0.09	0.09
Number of facilities	0.20	-0.16	0.57	-0.10**	-0.17	-0.04	0.02	-0.04	0.07	-0.02	-0.12	0.08
Breadwinner's occupation	-0.52	-1.28	0.23	-0.08	-0.20	0.04	-0.08	-0.20	0.04	-0.13*	-0.26	0.00
Rooms per capita	0.48	-0.66	1.62	0.01	-0.26	0.28	-0.23	-0.48	0.02	0.17	-0.12	0.45
intercept	1.15	-0.55	2.84	0.88***	0.51	1.25	0.73***	0.41	1.04	1.10***	0.76	1.45
N	368			796			765			920		

Notes: L is constrained to 1 in selection equation.

Table 2: Estimates from a three-part generalized equation model (con't)

	Spain			Italy			France		
	b	95% CI		b	95% CI		b	95% CI	
Outcome : Self-rated health									
Age at first birth (centered)	0.04***	0.02	0.06	0.00	-0.02	0.01	0.00	-0.01	0.02
Age at first birth (quadratic)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Age	0.03***	0.02	0.04	0.02**	0.01	0.03	0.01*	0.00	0.03
Health at age 10	-0.03	-0.49	0.42	0.33*	0.01	0.65	-0.04	-0.37	0.29
Education	0.01	-0.01	0.03	0.03**	0.01	0.05	0.04***	0.02	0.06
Depression	-0.13***	-0.15	-0.10	-0.14***	-0.16	-0.11	-0.13***	-0.16	-0.11
Exercise status	0.46***	0.32	0.61	0.47***	0.34	0.60	0.30***	0.17	0.44
Smoking status	0.10	-0.13	0.33	-0.04	-0.20	0.13	-0.05	-0.24	0.13
Drinking status	0.14	-0.08	0.36	0.18**	0.05	0.32	0.06	-0.10	0.21
Employment (ref: retired)									
In work	0.04	-0.25	0.32	0.17	-0.06	0.39	0.22*	0.01	0.42
Never worked	0.01	-0.18	0.21	0.00	-0.15	0.14	0.20	0.00	0.41
Other	-0.05	-0.36	0.25	-0.23	-0.51	0.05	-0.15	-0.43	0.13
Number of children	0.00	-0.05	0.05	0.06*	0.01	0.12	0.00	-0.05	0.05
Marital Status (ref: married)									
Never married	0.50	-0.15	1.15	-0.20	-1.18	0.78	0.13	-0.23	0.49
Divorced or separated	-0.03	-0.41	0.35	-0.41	-0.84	0.02	0.19	-0.01	0.38
Widowed	0.21*	0.01	0.41	0.07	-0.11	0.24	-0.01	-0.18	0.16
intercept	-47.84***	-69.06	-26.62	-30.87**	-51.01	-10.72	-25.24*	-48.51	-1.96
Outcome: Age at first birth									
Age	-0.12***	-0.16	-0.08	-0.13***	-0.16	-0.09	-0.04*	-0.07	-0.01
Education	0.13***	0.06	0.20	0.32***	0.25	0.38	0.30***	0.22	0.37
L	4.84***	4.54	5.15	4.68***	4.45	4.90	5.18***	4.87	5.49
Intercept	225.90***	151.66	300.13	238.02***	177.23	298.82	69.11*	9.90	128.32
Outcome: parent (selection equation)									
Health at age 10	0.03	-0.07	0.13	0.06	-0.02	0.13	0.06*	0.00	0.12
Number of books	-0.07	-0.19	0.04	-0.09	-0.21	0.02	-0.02	-0.09	0.06
Number of facilities	-0.12***	-0.20	-0.04	-0.04	-0.10	0.02	0.00	-0.05	0.05
Breadwinner's occupation	-0.01	-0.20	0.18	-0.09	-0.25	0.06	-0.04	-0.15	0.07
Rooms per capita	-0.05	-0.23	0.12	0.03	-0.23	0.28	-0.16*	-0.31	0.00
intercept	1.17	0.79	1.56	1.04***	0.76	1.33	0.86***	0.61	1.11
N	790			1159			995		

Notes: L is constrained to 1 in selection equation.

Table 2: Estimates from a three-part generalized equation model

	Denmark			Greece			Switzerland		
	b	95% CI		b	95% CI		b	95% CI	
Outcome : Self-rated health									
Age at first birth (centered)	0.02	0.00	0.04	0.00	-0.01	0.01	0.01	-0.01	0.04
Age at first birth (quadratic)	0.00	0.00	0.00	0.00	0.00	0.00	0.00†	-0.00	0.00
Age	0.02*	0.00	0.04	0. 02***	0.01	0.03	0. 03**	-0.01	0.05
Health at age 10	0.14	-0.13	0.42	0.21	-0.34	0.75	0.54**	0.17	0.92
Education	0.01	0.00	0.03	0.04***	0.03	0.06	0.00	-0.02	0.02
Depression	-0.20***	-0.24	-0.16	-0.14***	-0.17	-0.11	-0.09***	-0.14	-0.03
Exercise status	0.37***	0.22	0.53	0.15*	0.03	0.26	0.39	0.17	0.60
Smoking status	-0.12	-0.29	0.05	0.19**	0.06	0.32	0.05	-0.17	0.28
Drinking status	0.24*	0.05	0.43	0.20	-0.13	0.54	0.00	-0.25	0.25
Employment (ref: retired)									
In work	0.15	-0.14	0.43	0.09	-0.09	0.27	-0.02	-0.37	0.32
Never worked	0.24	-0.40	0.88	0.03	-0.11	0.16	-0.04	-0.35	0.27
Other	-0.83***	-1.14	-0.51	-0.28	-0.64	0.07	-0.42	-0.90	0.07
Number of children	-0.04	-0.12	0.03	0.02	-0.05	0.09	0.12**	0.03	0.20
Marital Status (ref: married)									
Never married	-0.14	-0.56	0.27	1.54**	0.45	2.64	0.69	-0.56	1.94
Divorced or separated	0.10	-0.12	0.31	-0.10	-0.32	0.11	0.38**	0.10	0.65
Widowed	-0.09	-0.32	0.15	0.02	-0.12	0.17	-0.13	-0.44	0.18
intercept	-35.06*	-66.50	-3.62	-33.60***	-51.23	-15.97	-51.22**	-86.27	-16.16
Outcome: Age at first birth									
Age	-0.01	-0.04	0.02	-0.10***	-0.13	-0.06	-0.06**	-0.10	-0.02
Education	0.09***	0.04	0.14	0.27***	0.19	0.35	0.15***	0.07	0.22
L	4.93***	4.67	5.19	5.50***	5.21	5.78	5.28***	4.87	5.69
Intercept	20.45	-43.10	84.00	183.08***	112.71	253.46	108.53***	28.31	188.75
Outcome: parent (selection equation)									
Health at age 10	0.05	-0.03	0.12	0.08	-0.03	0.20	0.04	-0.05	0.12
Number of books	-0.03	-0.10	0.03	-0.04	-0.16	0.08	-0.08*	-0.15	-0.01
Number of facilities	-0.04	-0.09	0.00	0.00	-0.07	0.07	-0.03	-0.09	0.03
Breadwinner's occupation	-0.14*	-0.26	-0.03	-0.08	-0.22	0.06	-0.03	-0.14	0.07
Rooms per capita	-0.12	-0.34	0.09	-0.03	-0.37	0.31	0.04	-0.14	0.23
intercept	1.03	0.69	1.36	0.77**	0.25	1.30	0.80***	0.47***	1.13
N	944			1240			587		

Notes: L is constrained to 1 in selection equation.

Table 2: Estimates from a three-part generalized equation model

	Belgium			Czech Republic			Poland		
	b	95% CI		b	95% CI		b	95% CI	
Outcome : Self-rated health									
Age at first birth (centered)	0.00	-0.01	0.01	0.02†	0.00	0.05	-0.02	-0.05	0.01
Age at first birth (quadratic)	0.00	0.00	0.00	0.00	-0.01	0.00	-0.01**	-0.01	0.03
Age	0.02***	0.01	0.03	0.01	-0.01	0.04	0.01	0.00	0.01
Health at age 10	0.11	-0.14	0.36	0.26	-0.03	0.56	-0.11	-0.46	0.25
Education	0.03***	0.02	0.05	0.07**	0.03	0.11	0.04	0.00	0.08
Depression	-0.14***	-0.16	-0.11	-0.11***	-0.15	-0.06	-0.11***	-0.15	-0.08
Exercise status	0.35***	0.24	0.47	0.43***	0.23	0.63	0.28**	0.07	0.48
Smoking status	-0.08	-0.24	0.09	0.22*	0.03	0.42	0.09	-0.11	0.28
Drinking status	0.10	-0.03	0.23	0.26	-0.08	0.61	0.75	-0.22	1.73
Employment (ref: retired)									
In work	0.20*	0.02	0.39	0.24	-0.05	0.52	0.06	-0.22	0.34
Never worked	0.13	-0.01	0.27	0.46	-1.09	2.00	-0.17	-0.54	0.19
Other	-0.23*	-0.44	-0.02	-0.01	-0.39	0.37	-0.44**	-0.72	-0.17
Number of children	0.02	-0.03	0.06	0.02	-0.09	0.13	-0.01	-0.08	0.07
Marital Status (ref: married)									
Never married	-0.02	-1.04	1.00	-0.45	-1.57	0.67	-0.46	-1.32	0.41
Divorced or separated	-0.05	-0.23	0.13	-0.08	-0.30	0.15	-0.14	-0.46	0.18
Widowed	0.21**	0.05	0.36	-0.05	-0.33	0.23	0.19	-0.06	0.45
intercept	-33.37***	-51.50	-15.23	-25.80	-66.97	15.37	-18.67	-57.18	19.83
Outcome: Age at first birth									
Age	-0.05***	-0.08	-0.02	-0.01	-0.04	0.02	-0.04*	-0.07	0.00
Education	0.24***	0.17	0.31	0.20***	0.11	0.29	0.19***	0.11	0.27
L	4.51***	4.29	4.73	4.10***	3.90	4.31	3.92***	3.71	4.12
Intercept	97.68***	42.75	152.61	14.93	-47.63	77.49	66.50*	5.18	127.82
Outcome: parent (selection equation)									
Health at age 10	0.11**	0.03	0.19	-0.05	-0.18	0.08	0.14**	0.05	0.22
Number of books	-0.05	-0.13	0.02	0.02	-0.09	0.13	-0.10	-0.24	0.03
Number of facilities	0.04	-0.02	0.10	0.03	-0.05	0.11	-0.02	-0.11	0.07
Breadwinner's occupation	-0.02	-0.15	0.10	-0.06	-0.23	0.11	0.01	-0.18	0.20
Rooms per capita	-0.02	-0.18	0.13	-0.25	-0.65	0.16	0.38	-0.08	0.83
intercept	0.87***	0.58	1.16	1.72***	1.21	2.24	0.87***	0.54	1.20
N	1197			938			886		

Notes: L is constrained to 1 in selection equation.

1.7 Appendix

1.7.1 Technical description of a GSEM model

Step 1: The Selection Equation

Here I illustrate the selection into being a parent where w_i is an age women give birth (AFB), $X_i\beta$ is a vector of unknown parameters and ε_i are unobserved scalar random variables (errors).

$w_i = X_i\beta + \varepsilon_i$

Not all women have a child, and w is observed only for those women who give birth and it is not observed for nonparents. Women give birth if

$Z_i\gamma + \xi_i > 0$

where

$\varepsilon_i \sim N(0, \sigma^2)$

$\xi_i \sim N(0, 1)$

$corr(\varepsilon, \xi) = \rho$

Z is a vector of explanatory variables, γ is a vector of unknown parameters, and *ρ* is the correlation between unobserved determinants of the propensity to become a parent ε and unobserved determinants of age at first birth ξ; or ξi are errors of the selection equation, ε_i are errors of the the observed-data equation (where w is the outcome) and they are allowed to be correlated.

The Heckman selection model used is a two-equation SEM – one linear regression (for the continuous outcome AFB) and the other censored regression (for selection) – and with a latent variable L_i added to both equations. The latent variable is constrained to have variance 1 and to have coefficient 1 in the selection equation, leaving only the coefficient in the continuous-outcome equation predicting age at first birth to be estimated. For identification, the variance from the censored regression will be constrained to be equal to that of the linear regression.

$$\beta = \beta^* \quad (1)$$

$$\gamma = \gamma^*/\sqrt{\sigma^2 + 1}$$
$$\sigma^2 = \sigma^{2*} + k^2$$

$$\rho = k/\sqrt{(\sigma^{2*} + k^2)\,(\sigma^{2*} + 1)}$$

$k = L_i$

k denotes estimate parameters L_i; β, γ. β refers to the coefficients on the continuous-outcome (age at first birth) equation. γ refers to the selection equation, and because $\gamma = \gamma^* / \sqrt{\sigma^2 + 1}$, the reported coefficients are divided by the square root of $\sigma^2 + 1$. Therefore, the scaled probit has a variance $\sigma^2 + 1$, and afterwards it is transformed back to the standard probit model, which has variance 1.

Step 2: Age at first birth

Y_2=AFB (2)

$Y_2 = \beta x_n + k$

Step 3: Self-rated health

Y_3= health (3)

$Y_3 = \beta + \beta x_{1} + \ldots \beta x_n$

Step 4: Mediation

If

$Y_3 = \beta_1 + \beta_3 + \ldots \beta x_n$

$Y_2 = \beta_2 + \beta x_n + k$

where

β_1 = path coefficient for health ← age at first birth

β_2 = path coefficient for age at first birth ← education

β_3 = path coefficient for health ← education

then the indirect effect of education on health = $\beta_1 {}^* \beta_2$; and the total effect of education and AFB on health= $\beta_3 + \beta_1 {}^* \beta_2$

A 1: Measures of fit for models with mediation and models without mediation of AFB and education

Country	AIC		BIC		Log likelihood		Likelihood-ratio test	
	Mediation	No mediation	Mediation	No mediation	Mediation	No mediation	(df) value	p
Austria	2970.766	2976.457	3084.100	3085.884	-1456.38	-1460.23	(1) 7.69	0.006
Germany	5961.291	6025.611	6096.999	6156.640	-2951.65	-2984.81	(1) 66.32	0.000
Sweden	6237.719	6292.286	6372.276	6422.203	-3089.86	-3118.14	(1) 56.57	0.000
Netherlands	6945.380	7022.226	7085.286	7157.339	-3443.69	-3483.11	(1) 39.42	0.000
Spain	5659.830	5687.741	5795.319	5818.558	-2800.92	-2815.87	(1) 29.91	0.000
Italy	8511.341	8603.489	8657.945	8745.038	-4226.67	-4273.75	(1) 94.15	0.000
France	7423.138	7505.394	7565.318	7642.671	-3682.57	-3724.7	(1) 84.26	0.000
Denmark	7179.852	7211.865	7320.506	7347.668	-3560.93	-3577.93	(1) 34.01	0.000
Greece	9125.548	9269.019	9274.111	9412.459	-4533.77	-4606.51	(1) 145.47	0.000
Switzerland	4103.798	4126.515	4230.674	4249.015	-2022.90	-2035.26	(1) 24.72	0.000
Belgium	9333.740	9377.930	9481.280	9520.382	-4637.87	-4660.97	(1) 46.19	0.000
Czech Republic	5891.023	5906.961	6031.491	6042.586	-2916.51	-2925.48	(1) 17.94	0.000
Poland	5641.264	5659.495	5780.079	5793.523	-2791.63	-2801.75	(1) 20.23	0.000

A 2: Indirect and total effects of age at first birth and education on health

Country	Indirect effect			Total effect		
	b	95	CI	b	95	CI
Austria	0.002	-0.002	0.005	0.008	-0.016	0.032
Germany	0.006†	0.000	0.012	0.040**	0.017	0.063
Sweden	0.001	-0.005	0.007	0.054***	0.031	0.076
Netherlands	0.000	-0.006	0.006	0.039**	0.017	0.061
Spain	0.005**	0.002	0.009	0.016†	-0.001	0.033
Italy	0.000	-0.005	0.005	0.029**	0.011	0.047
France	0.001	-0.003	0.006	0.043***	0.025	0.061
Denmark	0.001	0.000	0.003	0.015*	0.001	0.029
Greece	0.000	-0.003	0.003	0.041***	0.026	0.057
Switzerland	0.002	-0.002	0.006	0.003	-0.020	0.026
Belgium	0.000	-0.003	0.004	0.033***	0.016	0.050
Czech Republic	0.004	-0.001	0.010	0.073**	0.031	0.115
Poland	-0.004	-0.010	0.002	0.034†	-0.003	0.071

1.8 References

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