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Early life circumstances and labor market outcomes over the life cycle

Manuel Flores[1] · Pilar García-Gómez[2] · Adriaan Kalwij[3]

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Abstract

Some consequences of adverse events early in life for labor market outcomes may emerge early and others only later in adult life. We use data from the Survey of Health, Ageing and Retirement in Europe to investigate how early life circumstances—childhood health and socioeconomic status (SES)—are associated with various labor market outcomes over an individual's entire life cycle. Our main new finding is that these associations change significantly over the life cycle. For instance, the association of childhood SES with lifetime earnings is shown to become stronger over the life cycle and to operate through both working years and annual earnings. We discuss how our findings can explain some of the mixed evidence on these associations in previous literature. Our results also shed light on the potential gains in the different labor market outcomes of public policies that invest in children's health and parents' SES.

Keywords Early life circumstances · Labor market · Lifetime earnings · Life cycle · SHARE

JEL classification D10 · I14 · J14 · J24 · J31 · O15

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✉ Manuel Flores
mflores@uic.es

Pilar García-Gómez
garciagomez@ese.eur.nl

Adriaan Kalwij
a.s.kalwij@uu.nl

Extended author information available on the last page of the article

1 Introduction

There is a growing literature that demonstrates that individuals' early life circumstances have long-lasting effects on their later life health and socioeconomic status (SES)-related outcomes such as earnings and work effort (Almond and Currie 2011a; Almond et al. 2018; Black and Devereux 2011). However, to the best of our knowledge, there is no empirical study to date that has quantified how such early life circumstances relate to individuals' earnings and other labor market outcomes over their *entire* life cycle. This is particularly worthy of investigation if some consequences of adverse events early in life may not become apparent until later in adult life, as predicted by the *fetal origins hypothesis* (Barker 1995; Almond and Currie 2011b), or if their impacts accumulate over the life cycle, as *life course models* suggest (Kuh and Wadsworth 1993). Therefore, studies that focus on a single age later in life—as is common in this literature—are likely to give an incomplete picture of the association between individuals' early life circumstances and labor market outcomes over the entire life cycle.[1]

Our main contribution to the literature is, therefore, that we empirically investigate whether some of these associations show up early in adult life or at later ages, and whether they vanish or persist over the life cycle. Using data from thirteen European countries, we measure the associations of both childhood health and parental SES with lifetime earnings at various ages, i.e. we observe individuals' complete work careers. In this way we provide a more complete picture on how these associations evolve over the life cycle than previous studies which, first, focus mostly on either childhood health or childhood SES, and, second, have information on labor market outcomes for at most a limited range of ages. Our results show that, for both men and women, there is evidence of a cumulative impact of childhood SES on lifetime earnings over the life cycle. For men, however, this association is negative at early stages of their working life and reverses sign from negative to positive in their mid-thirties. To a lesser extent, childhood health also shows a positive, long-term association with lifetime earnings over the life cycle. While for men an association is already present at the beginning of their working life (at age 25), for women an association is present just from age 30.

Parental income is widely known to be positively associated with individual's later life earnings in the literature on intergenerational mobility in earnings. Moreover, these associations vary across gender, time, country and age of both the parents and offspring (Black and Devereux 2011). More recently, two studies have explored the role of income shocks induced by changes in the labor market status of a parent due to firm closures, providing evidence for Canada (Oreopoulos et al. 2008) but no evidence for Norway (Bratberg et al. 2008) of an effect of parental income on children's earnings early in adulthood. Brunello et al. (2017) used a similar dataset to our study and tackle the aforementioned life cycle bias by examining the associations of early life circumstances with men's total lifetime earnings. They found a long-term association between access to books in the parental home—a measure for parents' cultural background or education—and total lifetime earnings for men in Europe, but provided no evidence on how these associations with accumulated earnings evolve over a life cycle.

Previous studies have also looked into the relationship between childhood health and later life earnings. Black et al. (2007), using administrative data for a sample of Norwegian twins, found a positive association between birth weight—a measure for health in utero—and

[1] In the literature on intergenerational earnings mobility this is referred to as a life cycle bias that stems from a changing association over the child's life cycle between (annual) earnings of the child and lifetime earnings of the parent (e.g. Haider and Solon 2006).

earnings in early adulthood (at ages 25–35). Likewise, Behrman and Rosenzweig (2004) found a positive association between birth weight and hourly wages in mid adulthood (at ages 39–58) among a sample of US female twins. Alternatively, studies using the 1918 Influenza Pandemic as a health shock around birth have reported mixed results. For example, Almond (2006) found that it reduced annual wage income of US men in mid adulthood, while Nelson (2010) did not find a significant effect on hourly wages of relatively old males (above age 65) in Brazil. In a paper that is closely tied to our work, Goodman et al. (2011), using British data, found that childhood psychological problems are associated with about 15% lower hourly wages from early adulthood into middle age (at ages 23, 33, 42 and 50). They also found an increasing association of (low) birth weight with family income between ages 23 and 50, but a rather constant one for summary indices of minor and major physical health problems. Finally, Smith (2009a) used a sample of U.S. siblings aged 25–47 to estimate the associations of both childhood self-reported health (SRH) status and parental income during childhood with an individual's initial level of (annual) earnings at age 25 and its average growth between ages 25 and 47. He found that about 50% of their overall impact is already present at age 25, while the remaining 50% is the consequence of faster individual income growth after age 25. He further argued that these findings are consistent with both the fact that some consequences of poor childhood health do not appear until later in adult life (i.e. after age 25) and also that their impacts might be cumulative.

The existing evidence regarding the associations of early life circumstances with employment is scarcer and also mixed. For example, Case et al. (2005) used data from a 1958 British birth cohort and reported that the employment probability in mid adulthood is negatively associated with (early life) chronic conditions and positively associated with parental income at age 16. In contrast, Black et al. (2007) found that the positive association between birth weight and the probability of working full time in early adulthood for Norwegian twins disappears after controlling for twin fixed effects, and Smith (2009a) reported no evidence of an association of childhood health with (annual) weeks worked at age 25 for US twins, but a positive one with the change in weeks worked from age 25 onward. Goodman et al. (2011) found that childhood psychological problems for British individuals are associated with about 11% lower employment probability from early adulthood into middle age.

An additional contribution of our paper is that we shed light on the implicit labor market behavior behind the association of early life circumstances with lifetime earnings. For both men and women, we find that the association of childhood SES with earnings strengthens over the life cycle and that it operates through both working years and annual earnings. Most importantly, we show that the associations between early life circumstances and (accumulated) labor market outcomes are not constant over an individual's life cycle. In particular for working years, we find a strong negative association with childhood SES at the beginning of the working life which decreases with age as individuals with a higher childhood SES−who study longer−also enter the labor market and those with a low childhood SES accumulate more employment gaps. This finding could explain Smith's (2009a) result of an insignificant association of parental income and educational levels with (annual) weeks worked in adulthood (at ages 25–47), and also Case et al.'s (2005) result for British men of a positive association between family income at age 16 and the employment probability at age 42, one that is, however, insignificant at age 33. We also find that the smaller, quite persistent, positive long-term association between childhood health and lifetime earnings operates mainly through annual earnings and only to a lesser extent through working years.

A final contribution relates to the argument made in previous studies such as Condliffe and Link (2008) that parental income buffers children from the negative effects of adverse childhood health, the so-called buffering hypothesis. We provide insights into this hypothesis and find some evidence in favor of a buffering effect for women but not for men.

The remainder of the paper is organized as follows. Section 2 describes the data. Next, Section 3 discusses our empirical findings. Robustness checks are carried out in Section 4. Section 5 summarizes and concludes.

2 Data and descriptive statistics

We use individual-level data from the first three waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE; http://www.share-project.org/); a multidisciplinary and representative cross-national panel of the European population aged 50 and over. The first two waves were conducted in 2004/2005 and 2006/2007, respectively. These waves include information on, for instance, sociodemographic background characteristics, current health and socioeconomic status (education, employment, and earnings), and expected retirement age. Most of our data, however, stem from the third wave, carried out in 2008/2009 and referred to as SHARELIFE. This third wave has used a life history calendar approach to collect retrospective information on the entire life histories of about 75% of the individuals who participated in waves 1 or 2. This information ranges from early life circumstances to work careers and other social, economic and health events occurring in the course of a lifetime.[2] In our analysis, we combine this with cleaned information provided in the retrospective SHARE Job Episodes Panel Data. This retrospective panel contains the start and end dates of all the job spells that SHARELIFE respondents had during their work career, plus some job characteristics such as job income and whether they work full- or part-time, and some additional information on year of retirement and unemployment spells (see Brugiavini et al. (2013) for details).[3]

Our initial sample consists of 10,988 male and 13,154 female European respondents (and spouses) aged 50 and over in the interview year of SHARELIFE. We drop male and female respondents who had never worked or did not report any wage in SHARELIFE, nor in waves 1 or 2 (2155 and 3080 cases respectively), and also those who with very short employment histories (less than five years; 310 cases). We also exclude male and female respondents for whom only one wage point is available as it prevents estimating a wage profile (1379 and 1454 cases, respectively).[4] Trimming compounded labor income by 1 % from above and below in each country sets 304 values to missing. After dropping missing values in the childhood SES variables (429 cases), and childhood health variables (58 cases), we end up with our final

[2] Currently, six waves of SHARE data are available. The fourth to sixth waves do not contain information on (net) wages. We use, however, wave 4 data to update and replace missing values on expected retirement age for individuals who participated in waves 1 to 3.

[3] Regarding the validity of retrospective reports of adverse childhood experiences in late adulthood, Smith (2009b) showed that prevalence rates of the reported diseases in childhood in the Health and Retirement Study (the US sister study of SHARE) are consistent with external historical records from the National Health and Nutrition Examination Surveys. In addition, Havari and Mazzonna (2015), using SHARELIFE data, found no evidence of recall error in objective childhood health measures.

[4] See online Appendix A.1 for a further detailed discussion on whether our sample selection introduces a selectivity bias into our analysis.

sample of 7803 males and 7170 females from thirteen European countries. Table A2 reports the number of individuals by country and gender.

Our procedure to construct lifetime earnings follows Alessie et al. (2013), with the main difference being that we exclude pension benefits. This avoids a possible problem of double counting as would be the case if some pension benefits are funded by savings on (net) income from employment (Brunello et al. 2017). In addition, and differently from these latter two studies, we adjust for differences in working hours (part-time and full-time work) when constructing our measure of lifetime earnings. For each prior job spell we have information about start and end dates, and the first net monthly wage or net income in nominal local currencies, depending on whether the respondent worked as an employee or as a self-employed during that job spell. If the respondent was retired by the time of interview, (s)he also reports the last net monthly wage or income in the main job. A linear interpolation between the first wage on each job and the last wage of the main job is used to obtain a complete wage path. Further details on the construction of lifetime earnings can be found in

Table 1 Lifetime earnings regressions for men and women in Europe

	Men		Women	
	(1)	(2)	(1)	(2)
Low childhood HI	−0.061***		−0.076***	
	(0.020)		(0.027)	
Medium childhood HI	−0.045**		−0.038	
	(0.020)		(0.029)	
Low childhood SES	−0.241***		−0.420***	
	(0.022)		(0.030)	
Medium childhood SES	−0.106***		−0.203***	
	(0.019)		(0.025)	
Low HI * Low SES		−0.309***		−0.491***
		(0.035)		(0.048)
Low HI * Medium SES		−0.181***		−0.279***
		(0.031)		(0.042)
Low HI * High SES		−0.096***		0.001
		(0.029)		(0.040)
Medium HI * Low SES		−0.310***		−0.398***
		(0.035)		(0.054)
Medium HI * Medium SES		−0.164***		−0.194***
		(0.033)		(0.044)
Medium HI * High SES		−0.065*		−0.054
		(0.034)		(0.043)
High HI * Low SES		−0.267***		−0.382***
		(0.035)		(0.052)
High HI * Medium SES		−0.135***		−0.147***
		(0.032)		(0.048)
Buffering hypothesis[a]		0.873		0.049
R-squared	0.247	0.247	0.180	0.181
Observations	7803	7803	7170	7170

Notes: Based on the estimation of linear models on the logarithm of lifetime earnings using OLS. All models include both country dummies and birth-year dummies. Robust standard errors in parentheses. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

[a] Reported is the p-value corresponding to testing the null hypothesis that $\beta_{\text{HighHI*LowSES}} - \beta_{\text{LowHI*LowSES}} = \beta_{\text{HighHI*HighSES}} - \beta_{\text{LowHI*HighSES}}$ against the alternative hypothesis that $\beta_{\text{HighHI*LowSES}} - \beta_{\text{LowHI*LowSES}} > \beta_{\text{HighHI*HighSES}} - \beta_{\text{LowHI*HighSES}}$, where the βs are the regression coefficients corresponding to the variables in the subscripts and $\beta_{\text{HighHI*HighSES}} = 0$

online appendix A.2. Table A2 shows cross-country patterns of mean and median (lifetime average) annual earnings for men and women. For men, these patterns are similar to the ones reported in Alessie et al. (2013, Table 1, pp. 314).

We measure childhood SES with four variables that capture different dimensions of the respondent's SES at age 10. First, we include the number of rooms per person and the number of facilities in the household (see Table A4 for details), as these have been shown to be good proxies for the parents' financial status (Cavapozzi et al. 2011). Second, we consider the estimated number of books at home to capture the parents' cultural background or education (Cavapozzi et al. 2011). Last, we use the main breadwinner's occupation (in ISCO-88 skill levels) as a measure of the household's work status. We construct a single index of childhood SES using principal component analysis (PCA). We take the first principal component (PC), which explains the largest proportion of the total variance, as a measure of an individual's SES during childhood. We estimate the index using the pooled sample of all individuals in all thirteen European countries. The index explains 50.5% of the total variance and all the factor loadings on the first PC have the expected positive sign (see Table A4).

We also use PCA to construct a single index of childhood health. We combine subjective with (self-reported) objective health measures referred to when the respondent was less than 16 years old to generate a childhood health index (HI) for each respondent. We use for our subjective health measure childhood self-assessed health and for objective health measures the number of respiratory problems, infectious diseases, cardiovascular diseases, neurological and psychiatric diseases, disorders of the sense organs, and the number of neoplastic diseases and other serious health conditions (see Table A5 for details). PCA is applied to the pooled sample and we keep the first PC as a measure of an individual's childhood health (cf. Poterba et al. 2017). The index explains 20.2% of the total variance and all the factor loadings on the first PC have the expected positive sign (see Table A5). The childhood HI is turned into an index of good health, and both indices are transformed into terciles.

We include birth-year dummies in all equations to control for possible secular or cohort-specific events that may have affected both an individual's early life circumstances and life cycle labor market behavior. Moreover, we include country dummies to control for institutional differences between European countries.

3 Empirical results

3.1 Early life circumstances and total lifetime earnings

The estimates of Table 1, columns (1), show a strong association between childhood SES and (the logarithm of) total lifetime earnings, and most notably for women. For instance, men and women with a low childhood SES (in the bottom tercile of the childhood SES distribution) earn, respectively, up to 21%[5] and 34% less income during their working life than individuals who had a high SES during childhood (those in the highest tercile of the childhood SES distribution). To a lesser extent, we also find a positive association with childhood health: Men and women with a low childhood HI (in the bottom tercile of the childhood health distribution)

[5] This percentage is obtained as follows: 100 x (exp(−0.241) − 1) = 21 where −0.241 is the corresponding coefficient. This transformation has been applied for all other percentages related to coefficients of log-level models.

earn up to, respectively, 6 and 7% less income during their working life than those who had a high HI during childhood (in the highest tercile of the childhood health distribution).

Previous studies such as Condliffe and Link (2008) argue that income buffers children from the negative effects of chronic conditions. In Columns (2) interaction terms between the childhood health and SES terciles are added to provide insights into this buffering hypothesis. If childhood SES has a protective effect, i.e. there is a buffering effect, we would expect the difference in lifetime earnings between persons with a high childhood HI and a low childhood HI to be smaller for persons with a high childhood SES than for persons with a low childhood SES (see Table 1, note a). As the bottom part of the table shows, we reject the null of equal differences for persons with a high and low SES for women but not for men, which may suggest that there is a buffering effect of childhood SES for women but not for men.

3.2 How does the association between early life circumstances and lifetime earnings evolve over the life cycle?

To investigate how the associations between early life conditions and lifetime earnings evolve during the entire work career we have estimated these with lifetime earnings measured at five-year age intervals between the ages of 25 and the end of working life (at age 65). Our interest lies in understanding how the association between early life circumstances and lifetime earnings evolves over the life cycle until resulting in the correlations at the end of the working life shown in the previous section. Hereby, we focus our attention on the association with *accumulated earnings until different ages* instead of *earnings at different ages*, which is what previous studies—including Smith (2009a) and Goodman et al. (2011)—have done.[6] The coefficient estimates and 95% confidence intervals are shown in Fig. 1 and we refer to Table A6 for the full set of estimates and Fig. A1 in the online appendix for p values from tests where the null hypothesis is that the coefficients across the low and medium SES and HI groups are equal.

Panel A in Fig. 1 shows that, compared to men with a high childhood HI, those with a low and medium childhood HI accumulate significantly fewer earnings over their whole working life, but that these associations are small and remain more or less constant (between 5 and 8%). On the other hand, those with a low childhood SES accumulate more earnings at younger ages (around 26% more at age 25), most likely because they get less schooling and start working earlier (see next section), but end up with about 21% lower lifetime earnings (at age 65) than men with a high childhood SES. Men with a high childhood SES have already caught up in (accumulated) earnings by their early thirties.

Panel B in Fig. 1 shows that women with a low childhood HI present a similar pattern to that of men with low childhood HI. The association between low childhood HI and (accumulated) earnings is not present at the beginning of their working life, but becomes evident as early as of age 30. Instead, women with a medium and in particular a low childhood SES start accumulating increasingly fewer earnings over their working life at an earlier age than their male counterparts, already from age 30.[7]

[6] Our approach, we believe, might be more informative of the possible cumulative impacts that early life circumstances have on earnings. Section 3.3 presents as well estimates of an individual's *cumulative* (average) annual earnings at different ages, which are more comparable to the results of previous studies.

[7] We find that life cycle profiles in lifetime earnings are heterogeneous between those with a medium and low childhood SES but not between those with a medium and low childhood HI (see Fig. A1).

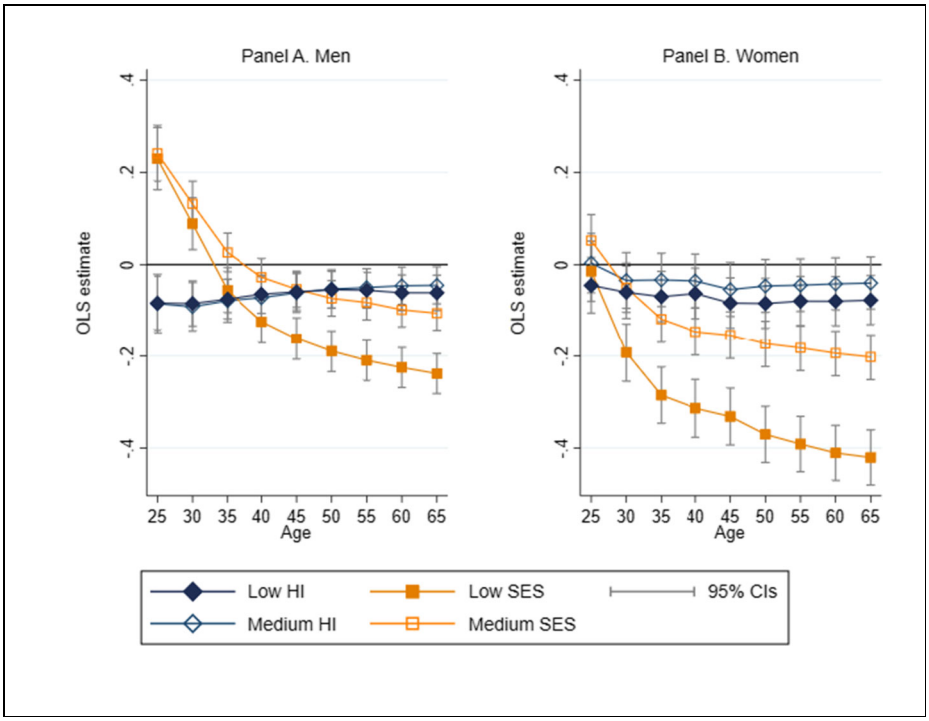

Fig. 1 Estimates from log lifetime earnings regressions over men and women's life cycle. Notes: The graphs show OLS estimates for Low and Medium childhood HI and Low and Medium childhood SES obtained from estimating linear models on the logarithm of accumulated earnings at different ages over an individual's working life. The reference categories are, respectively, High childhood HI and High childhood SES. All models include country dummies and birth-year dummies. Table A6 contains the full set of estimates and Fig. A1 contains *p*-values from tests where the null hypothesis is that the coefficients of, correspondingly, Low and Medium childhood HI and Low and Medium childhood SES are equal

In addition, we find that parental SES does not buffer bad childhood health at any point of the life cycle for men, while for women it buffers (part of) the negative association between childhood health and lifetime earnings towards the end of working life only (see Table A7). In particular, for women the negative association between earnings and having a low HI during childhood is larger for those who also had a low childhood SES compared to those with a low childhood HI but a high childhood SES, and this difference increases over the life cycle. In fact, we find evidence that parental SES buffers (part of) the negative association between childhood health and lifetime earnings in the oldest age intervals, 55–60 and 60–65 (see Table A7).

3.3 What is the implicit labor market behavior in the association between early life circumstances and lifetime earnings over the life cycle?

The (cumulative) association of early life circumstances with accumulated lifetime earnings may operate through working years and/or average annual earnings. To shed light on this issue we have estimated linear models for the associations of early life circumstance with the logarithm of (accumulated) years worked (Fig. 2 Panel A) and the logarithm of (average)

annual earnings (Fig. 2 Panel B). Estimates for the bottom SES and health terciles are shown in Fig. 2.[8] Figure 2 shows that men and women with a low childhood SES start working earlier, but individuals with a high childhood SES catch up, and women with a low childhood SES actually end up working fewer years than those with a high childhood SES. Men and women with a low childhood SES also have, respectively, about 19 and 28% lower annual earnings at age 25. But while for women this difference remains constant over their working life, for men it increases to 25% in their mid-thirties and remains constant afterwards. These results suggest that the pattern (i.e. the different magnitudes and even different signs) in the association between childhood SES and lifetime earnings over the life cycle is driven by working years rather than by (average) annual earnings. Moreover, men with low childhood SES compensate to some extent their lower annual earnings by working more years.

In addition, men with a low childhood health have already lower annual earnings at the start of their work career, but do not work significantly less over their working life than those with a high childhood health. For their part, women with a low childhood health also have lower annual earnings, although over a shorter age interval (from about age 30 to age 50), and work significantly less after age 40. However, in contrast to the results for childhood SES, the difference in average annual earnings for individuals with a high and low childhood health shrinks over time; for men from 8% at age 25 to 5% at age 45 and over, and for women it even becomes insignificant after age 50. Hence, while for men the association between childhood health and lifetime earnings over the life cycle operates through average annual earnings rather than through working years, for women, this association appears to be driven by annual earnings from their early thirties to mid-forties and mainly by the number of years worked after age 50.

We find that individuals from a low-SES background accumulate a larger number of working years at the beginning of their working life and that this difference declines over time. Moreover, the evolution over the life course differs by gender so that women and men in the lowest SES tercile end up working at the end of their careers almost 10% fewer and 5% more years than their peers from the highest tercile a, respectively. This suggests that individuals with a low childhood SES may have more employment gaps during their working life and/or are more likely to leave the labor market earlier than individuals with a high childhood SES. This pattern may be different for men and women.

Figures 3 and 4 present estimates for the bottom health and SES terciles on the accumulated number of career gaps[9] and on the probability of leaving the labor market over the life cycle, respectively, for both men and women (the full set of estimates can be found in Tables A10 and A11 in the online appendix). The difference in the number of career gaps between low- and high-childhood SES individuals is larger among women. Those with a low childhood SES accumulate more gaps from the beginning of their working life and the difference increases from around two gaps at age 25 to five gaps at age 55, and diminishes after age 60, although it remains as high as 4.6 career gaps at the end of their working life. The pattern is similar for men, although the largest estimated marginal effect is about 1.6. These results can explain to some extent why the negative association between childhood SES and working years diminishes over the life cycle.

[8] All the estimates shown in this section are from regressions that also control for medium SES and HI. The full set of estimates can be found in Tables A8 and A9 and Figures A2 and A3 show p-values from tests for homogeneous effects between low and medium groups for HI and SES.

[9] As there is a large number of individuals without career gaps, we estimate Tobit models and present marginal effects in Fig. 3.

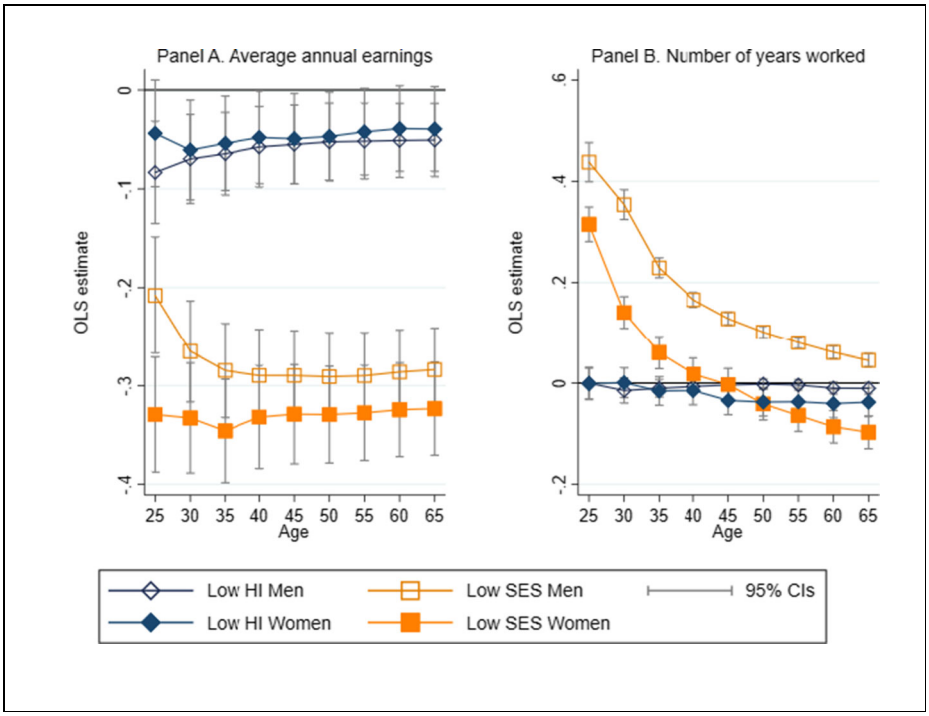

Fig. 2 Estimates for low childhood SES and childhood health from regressions on log average annual earnings and log years worked over men and women's life cycle. Notes: The graphs show OLS estimates for Low childhood HI and Low childhood SES obtained from estimating linear models on the logarithm of (average) annual earnings and the logarithm of (accumulated) years worked at different ages over an individual's working life. The reference categories are, respectively, High childhood HI and High childhood SES. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. Tables A8 and A9 contain the full set of estimates and Figs. A2 and A3 contain *p* values from tests where the null hypothesis is that the coefficients of, correspondingly, Low and Medium childhood HI and Low and Medium childhood SES are equal

Furthermore, men and women with a low childhood SES are not more likely to leave the labor market before age 50 than individuals with high childhood SES (Fig. 4). However, men, and to a lesser extent also women, are more likely to retire early from that age onward than individuals with a high childhood SES.

Women with a low childhood health also accumulate significantly more career gaps during their late twenties and during their thirties (see Fig. 3) and in addition have a higher probability of leaving the labor market until age 50 (see Fig. 4) than women who had a high childhood health. For men we do not find such associations.

3.4 Are there differences between country-groups in life cycle profiles?

In the previous analyses, we have estimated European-average labor market responses over the life cycle to childhood health and SES. However, there are large cross-country differences in the levels of development over the period in which the individuals in our sample were born and raised. As argued by Flores and Kalwij (2014), these large differences in economic resources and access to medical treatments may affect the associations between early life circumstances and later life outcomes. Moreover, equality of opportunities in educational attainment and

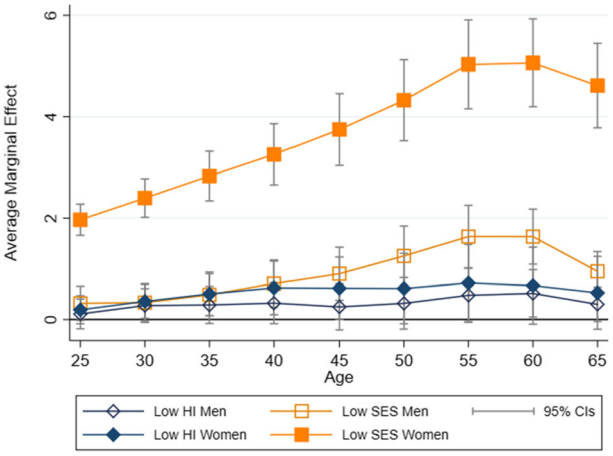

Fig. 3 Marginal effects on the number of gaps over men and women's life cycle. Notes: The graph shows marginal effects (conditional on being uncensored) for Low childhood HI and Low childhood SES based on the estimation of Tobit models on the (accumulated) number of employment gaps at different ages over an individual's working life. The reference categories are, respectively, High childhood HI and High childhood SES. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. Table A10 contains the full set of estimates along with tests where the null hypothesis is that the coefficients of, correspondingly, Low and Medium childhood HI and Low and Medium childhood SES are equal

social protection policies may enhance the intergenerational income mobility, and therefore we would expect a lower association between childhood SES and lifetime earnings in more egalitarian countries (see, e.g., Björklund et al. 2017).

We investigate these conjectures more closely by allowing the estimates to differ between four groups of countries: i) Nordic (Sweden and Denmark), ii) Continental (Netherlands,

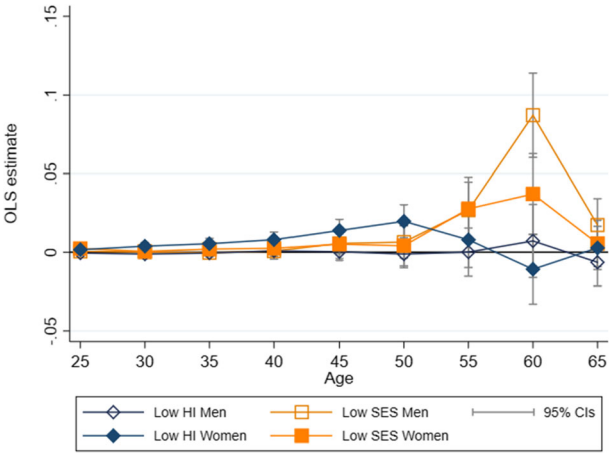

Fig. 4 Estimates of the probability of leaving the labor market over men and women's life cycle. Notes: The graph shows OLS estimates for Low childhood HI and Low childhood SES obtained from estimating linear models on the probability of leaving the labor market at different ages over an individual's working life. The reference categories are, respectively, High childhood HI and High childhood SES. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. Table A11 contains the full set of estimates along with tests where the null hypothesis is that the coefficients of, correspondingly, Low and Medium childhood HI and Low and Medium childhood SES are equal

Switzerland, Austria, Germany, France and Belgium), iii) Mediterranean (Spain, Italy and Greece) and iv) Transitional (Czech Republic and Poland). We use the country-group-specific distributions of childhood SES and health (instead of the distribution from the pooled sample) to create the terciles of childhood SES and health to ensure that these are equally distributed within country-groups. Figure 5 shows estimates for low childhood HI and low childhood SES on the logarithm of life-cycle lifetime earnings (the full set of estimates can be found in Table A12).

It is mostly in the Mediterranean countries that individuals with a low childhood health accumulate fewer earnings during their work career, and to some extent also for men in Nordic and women in Continental countries. Moreover, while for Mediterranean men most of this association is already present early in their working life, for Mediterranean women it tends to kick in a bit later, but is also larger and slightly increasing with age (Panels A and B in Fig. 5).[10]

The profiles of the association between low childhood SES and earnings over the life cycle are similar in all country-groups for men (Panel C in Fig. 5), and the estimated associations are not statistically different (results available upon request). At age 65, those with a low childhood SES have between 16 and 22% lower lifetime earnings in all country-groups. For women, these profiles are slightly more heterogeneous (Panel D in Fig. 5). For instance, at age 25 the association between childhood SES and lifetime earnings is positive in Nordic and Mediterranean countries and already negative in Continental and Transitional countries, but from age 35 onward, women with a low childhood SES from Continental and Mediterranean countries accumulate increasingly lower lifetime earnings.[11,12]

4 Robustness of the results

Table 2 shows that our lifetime earnings regression results are robust to several sensitivity analyses.[13] To facilitate comparison, we repeat in Row 0 our main estimation results from Table 1.

First, we show that our results are robust to the method and sample used to construct our indices of childhood health and SES. The estimates are similar in Row 1, where we use the polychoric correlation matrix to perform the PCA, which takes into account the discrete nature of some of the variables used to measure childhood SES and childhood health. Similarly, the results in Row 2 show that using country- and gender-specific distributions to construct the terciles of childhood SES and childhood HI do not affect our main estimation results.

[10] Statistical tests mostly reject the null of equal associations across country groups at a 5% level of significance for men and at a 10% level for women. Pairwise comparisons indicate that the differences between Mediterranean and Transitional countries are significant at a 5% level at virtually all ages (results available upon request).

[11] We find strong evidence of heterogeneous associations across all country groups for women and at all ages. From age 55, the differences between Nordic and Continental or Mediterranean and between Transitional and Continental are significant at a 5% level (results available upon request).

[12] Further and more detailed country-groups analyses are included in the online appendix A.3.

[13] We present estimates for the bottom health and SES terciles obtained from estimating linear models on the logarithm of lifetime earnings of men and women in Europe, together with the R-squared and the number of observations (the full estimation results are available upon request).

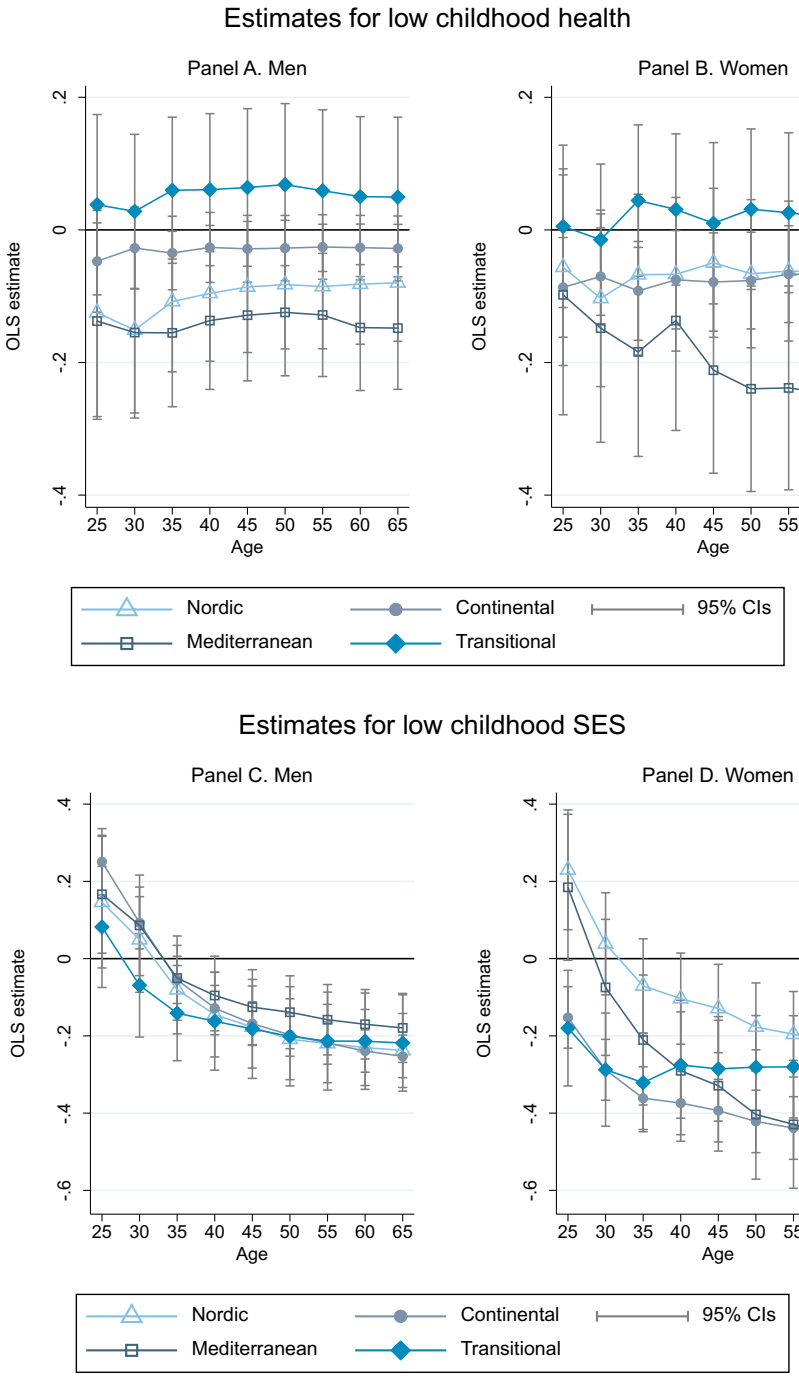

Fig. 5 Estimates from log lifetime earnings regressions over men and women's life cycle in Nordic, Continental, Mediterranean and Transitional countries. Notes: The graphs show OLS estimates for Low childhood HI and Low childhood SES obtained from estimating linear models on the logarithm of accumulated earnings at different ages over an individual's working life by country-groups and for men and women. The reference categories are, respectively, High childhood HI and High childhood SES. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. See Table A12 for details

Table 2 Estimates for low childhood HI and low childhood SES from lifetime earnings regressions for men and women in Europe (sensitivity analyses I)

	Men Low HI coefficient (standard error)	Low SES coefficient (standard error)	R^2	N	Women Low HI coefficient (standard error)	Low SES coefficient (standard error)	R^2	N
0. Basic results from Table I	−0.061*** (0.020)	−0.241*** (0.022)	0.247	7803	−0.076*** (0.027)	−0.420*** (0.030)	0.180	7170
1. Polychoric correlation matrix for PCA	−0.063*** (0.020)	−0.241*** (0.022)	0.247	7803	−0.091*** (0.028)	−0.409*** (0.030)	0.179	7170
2. Country-specific distributions for terciles	−0.053*** (0.020)	−0.223*** (0.020)	0.247	7803	−0.081*** (0.027)	−0.365*** (0.028)	0.178	7170
3. Excluding self-employed	−0.043** (0.021)	−0.246*** (0.024)	0.273	6070	−0.070** (0.029)	−0.412*** (0.032)	0.188	6246
4. Without adjusting for part-time/full-time work	−0.059*** (0.019)	−0.243*** (0.022)	0.252	7803	−0.063** (0.027)	−0.404*** (0.030)	0.203	7207
5. Assuming zero unemployment benefits	−0.062*** (0.020)	−0.243*** (0.022)	0.246	7803	−0.072*** (0.027)	−0.433*** (0.031)	0.179	7170
6. Excluding Greece and Poland	−0.066*** (0.020)	−0.243*** (0.022)	0.208	6785	−0.068** (0.028)	−0.389*** (0.030)	0.168	6387
7. Median regression	−0.037** (0.018)	−0.217*** (0.021)	–	7803	−0.063** (0.030)	−0.408*** (0.033)	–	7170
8. Rank regression	−1.784*** (0.660)	−9.176*** (0.757)	0.058	7803	−1.889** (0.734)	−11.635*** (0.820)	0.084	7170
9. Controlling for years in full-time education	−0.063*** (0.019)	−0.191*** (0.023)	0.252	7803	−0.074*** (0.027)	−0.320*** (0.032)	0.194	7170
10. Controlling for height	−0.056*** (0.019)	−0.223*** (0.022)	0.251	7739	−0.074*** (0.027)	−0.412*** (0.031)	0.179	7123
11. WLS regression	−0.053 (0.036)	−0.331*** (0.041)	0.211	7780	−0.082 (0.051)	−0.519*** (0.056)	0.176	7158

Notes: Based on the estimation of linear models on the logarithm of lifetime earnings using OLS, except in Rows 7 and 11, where median and WLS regression is used. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. Robust standard errors in parentheses, except for median regression in Row 7. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Second, we tested the influence of some of our assumptions for constructing lifetime earnings. In Row 3 we exclude those individuals who have been self-employed at any stage during their working life, and obtain similar results. The results are also robust to not adjusting for differences in working hours (cf. Alessie et al. 2013; Brunello et al. 2017) when constructing our measure of lifetime earnings (Row 4)[14]; and they are also robust to assigning no unemployment benefits during unemployment spells instead of 80% of the previous wage (Row 5).

Third, as one could be concerned about the influence of possible extreme values due to measurement error in lifetime earnings, we exclude Greece and Poland from our sample as these two countries have rather high (undiscounted) annual lifetime earnings (see Table A2), which may seem unreliable. This exclusion does not change our main results (see Row 6). Similarly, we use median regression to estimate the log lifetime earnings equations as mean values might be influenced by outliers, and obtain similar results (see Row 7). Nevertheless, our lifetime earnings variable is likely subject to measurement error, which is a common

[14] This increases the female sample somewhat, as fewer observations are dropped because of working less than five years (see Section 2).

problem to studies that compute intergenerational income elasticities. Nybom and Stuhler (2017) show that rank-based estimates may be more robust to measurement issues, including life cycle bias. Our results are consistent when using within-country percentile ranks in lifetime earnings as dependent variable (see Row 8).

Fourth, we test the influence of two possible mediating factors in our analyses. For childhood SES, in particular, the main mechanism could simply be own human capital as childhood SES correlates with educational attainment (Flores and Kalwij 2014) and age-earnings profiles differ by level of education (Heckman et al. 2006). Controlling for years in full-time education in our lifetime earnings regressions leaves the coefficient estimates of childhood health unchanged and lowers somewhat the ones of childhood SES, but does not change our main conclusions (see Row 9).[15] Next, some studies (e.g. Case and Paxson 2008) have used height as an indicator for early life circumstances to explore the height premium in earnings that is typically observed in adulthood. We re-estimate our main models for lifetime earnings controlling also for self-reported height (at the time of the SHARELIFE interview) and the estimates for the bottom childhood health and SES terciles remain virtually the same (Row 10), which suggests that the association of these early life circumstances with lifetime earnings is not mediated through height.[16]

Finally, as sample sizes in SHARE largely differ across countries in a way that is unrelated to a country's actual population size, we also use Weighted Least Squares (WLS) based on sample design weights. Although WLS reduces (compared to LS) significance of the coefficient of childhood health, the one of childhood SES remains large and significant at any standard level of statistical significance (see Row 11).

Table 3 explores the robustness of our life cycle analyses. We replicated all the robustness analyses of Table 2 using as dependent variable the growth in log lifetime earnings between the ages 25 and 55 rather than the log of the level of lifetime earnings. This allows testing whether the changes in the associations of early life circumstances with accumulated earnings over the life cycle are affected by changes in, for instance, the mediating role of schooling or in measurement error in the earnings variables. Our life cycle results are fully robust to all these sensitivity analyses. They are as well consistent with the patterns of estimates in Fig. 1. For instance, differently from childhood SES, the change in log lifetime earnings between age 25 and 55 between individuals with a low and high childhood HI is insignificant in Table 3, which is in line with a difference appearing early in the life cycle and remaining more or less constant afterwards (Fig. 1). These findings for childhood HI in particular, underscore the need to study the associations of early life circumstance with labor market outcomes over individuals' entire working lives.

5 Conclusions and discussion

To the best of our knowledge, this study is the first to investigate how individuals' early life circumstances—as measured by two indices of childhood health and socioeconomic status

[15] In the literature on intergenerational earnings mobility, few studies so far have explored the role of possible mediating factors behind IGEs. Björklund et al. (2017) is one notable exception. They show that about 1/3 of intergenerational correlations in earnings in the UK and Sweden can be attributed to factors associated with education (which is in line with our reduction in the childhood SES coefficient).

[16] The coefficient for a 10 cm increase in height with standard error in parentheses is 0.063 (0.012) for men and 0.045 (0.018) for women.

Table 3 Estimates for low childhood HI and low childhood SES from regressions on the growth in log lifetime earnings between age 25 and 55 for men and women in Europe (sensitivity analyses II)

	Men Low HI coefficient (standard error)	Low SES coefficient (standard error)	R^2	N	Women Low HI coefficient (standard error)	Low SES coefficient (standard error)	R^2	N
0. Basic results	0.027 (0.023)	−0.420*** (0.028)	0.088	7060	−0.012 (0.026)	−0.382*** (0.029)	0.138	6505
1. Polychoric correlation matrix for PCA	0.022 (0.023)	−0.416*** (0.028)	0.087	7060	−0.019 (0.027)	−0.376*** (0.029)	0.137	6505
2. Country-specific distributions for terciles	0.015 (0.024)	−0.371*** (0.026)	0.084	7060	−0.004 (0.027)	−0.350*** (0.027)	0.138	6505
3. Excluding self-employed	0.032 (0.026)	−0.434*** (0.031)	0.103	5502	−0.007 (0.028)	−0.372*** (0.030)	0.152	5682
4. Without adjusting for part-time/full-time work	0.028 (0.023)	−0.421*** (0.028)	0.087	7060	0.002 (0.026)	−0.365*** (0.029)	0.122	6530
5. Assuming zero unemployment benefits	0.028 (0.023)	−0.421*** (0.028)	0.089	7060	−0.010 (0.026)	−0.391*** (0.030)	0.139	6505
6. Excluding Greece and Poland	0.024 (0.024)	−0.426*** (0.029)	0.086	6159	−0.016 (0.027)	−0.376*** (0.029)	0.131	5885
7. Median regression	−0.004 (0.022)	−0.374*** (0.025)	–	7060	−0.038 (0.028)	−0.315*** (0.031)	–	6505
8. Rank regression	0.173 (0.725)	−14.156*** (0.830)	0.103	7060	−0.774 (0.877)	−13.139*** (0.984)	0.063	6505
9. Controlling for years in full-time education	0.014 (0.022)	−0.251*** (0.028)	0.151	7060	−0.010 (0.025)	−0.205*** (0.031)	0.185	6505
10. Controlling for height	0.029 (0.023)	−0.403*** (0.028)	0.090	7001	−0.009 (0.026)	−0.378*** (0.030)	0.139	6464
11. WLS regression	0.071 (0.049)	−0.495*** (0.063)	0.139	7038	0.021 (0.044)	−0.465*** (0.049)	0.117	6494

Notes: Based on the estimation of linear models on the growth in the logarithm of lifetime earnings between age 25 and 55 using OLS, except in Rows 7 and 11, where median and WLS regression is used. The sample sizes are somewhat smaller to those in Table 2 because some respondents start working after age 25. All models include Medium childhood HI, Medium childhood SES, country dummies and birth-year dummies. Robust standard errors in parentheses, except for median regression in Row 7. Significance levels: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

(SES)—are associated with their earnings and other labor market outcomes over the *entire* working life. In particular, we have focused on accumulated earnings, average annual earnings, number of years worked, number of career gaps, and the timing of retirement.

Our results show that in general childhood SES has a much stronger association with individual's life cycle labor market outcomes than childhood health, and most notably for women. For women only, we find evidence of a buffering effect, that is, that a higher parental SES reduces the negative association of poor health during childhood with lifetime earnings. Our results furthermore show that these associations, and especially those with childhood SES, are not constant over the life cycle. While women with a low childhood SES accumulate increasingly fewer earnings almost from the beginning of their working life (18% less as early as age 30), men with a low childhood SES accumulate significantly more earnings up to that age (still about 9% more at age 30). These associations operate both through annual earnings and number of working years. The association with annual earnings is persistent and fairly constant during working life favoring individuals with a high childhood SES, while the role of working years varies over the life cycle. At the beginning of the working life, this latter

mechanism favors individuals with a low childhood SES (who get less schooling and start working earlier), but the differences in working years diminish thereafter as these individuals accumulate more career gaps than individuals with a high childhood SES. For women, the association between childhood SES and working years even reverses sign after age 45, favoring women with a high childhood SES. With regard to childhood health, its smaller, fairly persistent, positive long-term association with lifetime earnings appears to operate through (lower) annual earnings rather than through working years, except for women.

Hence, our results for working years are to some extent in line with Smith's (2009a) finding of a positive association between childhood health and earnings that operates in part through a greater adult work effort. However, we show that this finding is driven by women and, moreover, that this positive association becomes significant only after age 40. In addition, we show that while for men the association between childhood health and lifetime earnings is already present at the beginning of their working life (at age 25), for women it kicks in just after that age.

Our results also point to some differences and similarities in these life cycle profiles across European country-groups. For instance, the relatively small and positive long-term association between childhood health and earnings over the life cycle is mainly present in the Mediterranean countries and overall more heterogeneous across country groups for men than for women. On the other hand, the relatively strong cumulative association between childhood SES and earnings over the life cycle is present in all country-groups and for men and women. Nevertheless, while for men the life cycle profiles do not differ significantly across country-groups, for women they are larger in the Mediterranean and Continental countries than in Nordic and Transitional countries.

A question that arises when interpreting the relatively larger association of childhood SES than of childhood health with life cycle labor market outcomes is whether this is due to measured changes in childhood SES being more severe than those in childhood health. Our descriptive evidence does not support this argument. Although individuals in the bottom tercile of the distribution of childhood SES lived, on average, in relatively small and badly equipped houses, with few books, and a predominantly low-skilled breadwinner,[17] also the shift from the highest to the lowest tercile of childhood health is large and possibly even more extreme. Basically, it implies comparing individuals who on average suffered from none of the conditions listed in Table A5 (except for infectious diseases) and without anyone reporting a poor, fair or changing childhood health with individuals who to some extent suffered from all these conditions (19% from respiratory problems, 2% from cardiovascular diseases, 13% from neurological and psychiatric diseases, 13% from disorders of the sense organs, 14% from neoplastic and other serious health conditions) and with 22% reporting a fair, poor or changing childhood health. Hence, a more plausible explanation for the larger associations with childhood SES than with childhood health could be that children are exposed for a longer period to their parents' SES than to any specific health condition.[18] Alternatively, the larger

[17] Individuals in the bottom (top) tercile lived in accommodations with 0.48 (1.00) rooms per person and of these 56 (1) percent had none of the facilities included in Table A4. Of individuals in the bottom (top) tercile, 98 (16) percent did not have enough books to fill one bookcase and 39 (5) percent were part of a household whose main breadwinner is low-skilled.

[18] The persistence in earnings and employment—which we do not model—could also explain why early life circumstances, and in particular childhood SES, have such long-term associations with earnings.

Other typical problems in this context such as differential mortality or parental efforts to compensate the negative effects of childhood health problems may—if anything—also attenuate our estimates of childhood health (and SES) towards zero (Palloni et al. 2009).

associations with childhood SES may be the result of measurement error, or more specifically recall error, being more severe in childhood health conditions than in childhood SES. An earlier validation study finds, however, no evidence of recall error in these health conditions (Havari and Mazzonna 2015).

As far as we know, there is no exogenous variation that can be used to identify the causal effects of both childhood health and childhood SES on labor market outcomes. However, illustration of the relative importance of these associations and how they evolve over the life cycle provides a comprehensive picture that allows explaining some of the a priori contradictory results and poses further hypothesis for causal analysis. In this respect, further research could extend our analyses to assess the causal effects of early life circumstances on labor market outcomes over the life cycle and shed light on the underlying mechanisms that drive these relationships. This will make it possible to assess the influence of confounding factors in the results presented here and show how the causal effects and underlying mechanisms found elsewhere evolve over the life cycle.[19]

All in all, our empirical findings show that following a life cycle approach like ours is important because—as some theoretical models stipulate and our results confirm—some consequences of adverse (health) events early in life may not become apparent until later in adult life. Moreover, some outcomes, in particular those related to childhood SES, may differ or strengthen over the life cycle (see also OECD 2017). Our findings also shed light on the potential gains in terms of different labor market outcomes for public policies that invest in children's health and parents' SES. Therefore, we show the importance of considering the possibility that the associations between poor health during childhood and lifetime earnings are larger for some groups (in our case, women with a low SES background). The benefits of such interventions may well extend to other domains such as individual health. For instance, a recent evaluation of a public cash transfer program to mothers of poor children implemented in the early twentieth century in the U.S. confirms that compared to children of rejected applicants, those of accepted applicants lived significantly longer mainly because they had higher incomes during adulthood (Aizer et al. 2016). Finally, our results also help identifying who is more likely to leave the labor market at earlier ages, which can facilitate the design of policies aimed at attaining higher labor market participation rates over the life cycle.

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[19] In our sample the variation in accumulated and average earnings diminishes with age (Table A15). This could be due to, e.g., age-varying measurement error in earnings that is potentially correlated with early life circumstances or slightly negative trends over time in overall earnings inequality in our sample countries. Nevertheless, this evidence does not explain why, over the life cycle, the childhood SES coefficients increase in absolute terms for accumulated earnings (Figure 1) or remain stable for annual earnings (Figure 2). We thank one referee for pointing out this possibility.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Affiliations

Manuel Flores[1] **· Pilar García-Gómez**[2] **· Adriaan Kalwij**[3]

[1] Research Institute for Evaluation and Public Policies (IRAPP), Universitat Internacional de Catalunya, Immaculada 22, 08017 Barcelona, Spain

[2] Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute and Network for Studies on Pensions, Aging and Retirement (Netspar), Burgemeester Oudlaan 50, PO Box 1738, 3000 DR Rotterdam, The Netherlands

[3] Utrecht University School of Economics and Network for Studies on Pensions, Aging and Retirement (Netspar), Kriekenpitplein 21-22, P.O. Box 80125, 3508 TCUtrecht, The Netherlands