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Younger, Dissatisfied, and Unhealthy - Relative Age in Adolescence

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Abstract. We investigate whether relative age (i.e. the age gap between classmates) affects life satisfaction and health in adolescence. We analyse data on students between 10 and 17 years of age from the international survey 'Health Behaviour in School-Aged Children' and find robust evidence that a twelve-month increase in relative age (i.e. the hypothetical maximum age gap between classmates) i) increases life satisfaction by 0.168 standard deviations, ii) increases self-rated general health by 0.108 standard deviations, iii) decreases psychosomatic complaints by 0.072 standard deviations, and iv) decreases chances of being overweight by 2.4%. These effects are comparable in size to the effects of students' household socio-economic status. Finally, gaps in life satisfaction are the only ones to reduce with the increase in absolute age, but only in countries where the first tracking of students occurs at 14 years of age or later.

Keywords: Academic Settings; Adolescent Characteristics; Education Policy; Life-Satisfaction; Health Outcomes

JEL-Classification: C26, D04, I21, I24, I31

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1 Introduction

Differences in age between students in the same academic class, also known as 'relative age,' affect human capital accumulation in youth. Such differences are due to the distance between a student's birthdate and the cutoff date (i.e. the date that determines the 'academic year' or the grade[1] to which the student is assigned). Relative age is mirrored by maturity differences and, in turn, by gaps in students' performance and (non)cognitive abilities (Fumarco & Schultze, 2019; Fumarco & Baert, 2019; Peña, 2017; Schwandt & Wuppermann, 2016; Patalay et al., 2015; Ponzo & Scoppa, 2014; Black et al., 2011; Mühlenweg et al., 2012; Dhuey & Lipscomb, 2010; Sprietsma, 2010; Mühlenweg, 2010; Elder & Lubotsky, 2009; Dhuey & Lipscomb, 2008; Bedard & Dhuey, 2006; Lien et al., 2005; Allen & Barnsley, 1993). These gaps are also known as 'relative age effects' (RAEs), and it is legitimate to expect that, in any class of students, they are reflected by the younger students' lower well-being.

We investigate this possibility using data on subjective well-being, an individual-founded measurement of well-being (OECD, 2013). Originating from research in psychology, subjective well-being has received considerable attention in economics in recent years (Frey & Stutzer, 2018). Many national and international surveys provide information about subjective well-being, and especially about two of its main components: happiness and life satisfaction (Diener et al., 1999). Scholars often use subjective well-being, 'happiness', and 'life satisfaction' interchangeably. However, these terms are not equivalent: subjective well-being is a latent, unobservable characteristic that consists of observable phenomena, namely positive affect (e.g. joy, optimism), negative affect (e.g. sadness, anger), and the evaluation of life as a whole, i.e. life satisfaction. The latter is a self-assessment of respondents' life as a whole, and it is regarded as an overall cognitive appraisal of how well the respondent fares in his or her life. As such, life satisfaction is not susceptible to change because of short term emotional reactions to life events (Bruni & Porta, 2007). This is why life satisfaction is widely used as a measure of subjective well-being. This measure is usually reflected in answers to questions such as 'All things considered, how satisfied are you with your life as a whole these days?' (van Praag et al., 2003). Various studies confirmed that subjective measures of well-being provide reliable information about an individual's well-being. For instance, people's evaluations of their well-being correlate

[1] For instance, in Austria the cutoff date is September 1st, which implies an academic year such that in the same grade there are students born between September 1st of year t and August 31st of year t+1.

with objective measures of well-being such as heart rate, blood pressure, frequency of Duchenne smiles, and neurological tests of brain activity (Blanchflower & Oswald, 2004; van Reekum et al., 2007). Measures of subjective well-being are strongly correlated with other proxies of subjective well-being (Schwarz & Strack, 1999; Wanous & Hudy, 2001; Schimmack et al., 2010) and with judgements about the respondent's happiness provided by friends, relatives, or clinical experts (Schneider & Schimmack, 2009; Kahneman & Krueger, 2006; Layard, 2005). Moreover, studies from the so-called happiness economics literature uncovered meaningful associations between economic variables and measures of well-being. Rich people are on average more satisfied than poor people (Gardner & Oswald, 2007); unemployed people are on average less satisfied with their life than employed people (Blanchflower & Oswald, 2000). A major concern, in particular among economists, is the difficulty of comparing life satisfaction scores across people. If respondents set the reference for their well-being differently, a condition that respondent A considers sufficient to be satisfied with his/her life may be considered insufficient by respondent B. In other words, what 'being satisfied' means differs from person to person, thus making the comparison of life satisfaction across people impossible. We cannot exclude that the reference level of well-being differs; however, evidence from psychological (Lucas et al., 2012) and economic (Ng, 1997; Gruber & Mullainathan, 2006; Kristoffersen, 2017) studies is encouraging as it suggests that, if this difference exists, it has negligible consequences. In sum, the reliability and wide availability of measures of subjective well-being allowed scholars to address important issues in various domains: in economics, to analyse the impact of issues such as poverty, inequality, unemployment, and inflation on people's well-being (Di Tella & Mac-Culloch, 2008; Alesina et al., 2004; Diener et al., 2009; Clark et al., 2012, 2013); in sociology and politics to study ageing, gender issues, marital and employment status, as well as the quality of political institutions (Frey & Stutzer, 2000; Powdthavee, 2007; Stutzer & Frey, 2012). In the present work, we use life satisfaction as a measure of subjective well-being to check whether relative age affects students' well-being. Although scholars developed measures of well-being for adults, a number of studies documented their reliability when applied to adolescents as well (Blanchflower & Oswald, 2000; Funk et al., 2006; Haranin et al., 2007; Jovanović, 2016).

Some studies investigated RAEs on outcomes correlated with well-being (i.e. on students' self-esteem, see Thomson et al., 2004), and on the suicide rate of young adults (Thompson et al., 1999; and Matsubayashi & Ueda, 2015). In particular, Bahrs and Schumann (2019) studied whether younger students in a class have a higher probability of developing smoking habits and poor health and whether these effects persist into adulthood. By applying a fuzzy regression discontinuity design to German Socio-Economic Panel data, the authors document that increasing the school starting age by one year reduces the long-term risk of smoking by 1.3 percentage points, and it increases the likelihood of reporting to have good health by 1.6 percentage points. While Bahrs and Schumann (2019) focus on absolute age at school entry, we contribute by focusing on relative age effects and their impact on life satisfaction. That is, we measure how relative age impacts a direct self-assessment of how well the students fare with their lives, using a large international sample of European students. We also add to the evidence by Ando et al. (2019) who found that being younger than classmates (their measure of relative birth date) correlates negatively to well-being in a sample of 10-year-old pupils in Japan.[2] Those authors argue that the lower academic performance and being bullied mediate the negative relationship between relative age and well-being. Ando et al. (2019) measure well-being using the WHO-5 well-being index, which evaluates a respondent's well-being using five questions to which pupils reply using a six-point Likert scale.[3] Compared to that study, our test adds evidence from a large sample of European countries. This provides a larger set of institutional frameworks, using life satisfaction as a single measure of subjective well-being. Moreover, we test the robustness of our findings using three additional health-related variables as detailed below.

Our study contributes to the literatures on relative age and on subjective well-being by investigating whether there is direct evidence of RAEs on subjective well-being. The relationship between RAEs and adolescents' life satisfaction is relevant for three reasons. The first is that the well-being of young people is, in general, regarded as a desirable goal per se. The second reason is that adolescents' well-being is an important predictor of well-being and emotional health in adulthood. For instance, using more than 17,000 observations from British Cohort Study panel data, Clark et al. (2018) show that the emotional health of children predicts adults' life satisfaction, and it correlates negatively with criminal records in adulthood. Admittedly, this evidence is limited as it is based on a single country and the R-squared of the model is low, as it is often the case with regressions of life satisfaction. However, Frijters et al.

[2] The study exploits data from the Tokyo Early Adolescence Survey and it uses an OLS regression model.
[3] These are the questions: 'I have felt cheerful and in good spirits,' 'I have felt calm and relaxed,' 'I have felt active and vigorous,' 'I woke up feeling fresh and rested,' and 'My daily life has been filled with things that interest me.' Pupils could answer each statement using a six-point Likert scale in which higher scores indicate more agreement.

(2014) estimate that 30-45% of adult life satisfaction is fixed. This suggests that 55-70% is transitory in nature and that a wide range of observed childhood circumstances captures about 15% of the fixed component. Frijters and colleagues ground their evidence on two sources of data. The first is the National Child Development Study, which includes about 17,400 children born in 1958 who were followed up until 2008-09. The second is the British Cohort Study, which provides information on about 17,000 children from 1970 until 2008/09. Jointly, Clark and colleagues and Frijters and colleagues provide compelling evidence suggesting that well-being during childhood predicts life satisfaction at later stages in life. The third reason our study is relevant is that well-being has economically relevant consequences. For instance, a number of studies using experimental data, survey data, employer-employee matched data, and official statistics showed that satisfied people are more productive, less absent from the workplace, and more cooperative than others (Harter et al., 2003; Böckerman & Ilmakunnas, 2012; Oswald et al., 2015; Peroni et al., 2019).

We conduct our study on a representative sample of European adolescents, from the international survey, 'Health Behaviour in School-Aged Children (HBSC).' The HBSC survey has a unique feature compared to more popular students' surveys (e.g. PISA, TIMMS, PIRLS): it allows the researcher to separate absolute age from relative age. This is possible because the respondents' target age is between 10.5 and 16.5. This feature underlies the main difference between our study and those that studied effects of age at school entry (ASEs; Ponzo & Scoppa, 2014; Mühlenweg et al., 2012; Sprietsma, 2010; Bedard & Dhuey, 2006).

The present study contributes to the previous literature also on a methodological ground, as we are the first to separate the aforementioned relative age effect from the absolute age effect, and to investigate their interaction. All else equal, one would expect the strength of relative age to decrease as absolute age increases. That would mean that gaps in performance and (non)cognitive abilities caused by relative age would decrease with absolute age, and then reflect into smaller well-being gaps. However, there is some evidence that these gaps continue and shape success in adulthood (Gladwell, 2008). Indeed, some studies have investigated the effect of relative age, while controlling for absolute age, on social network (Fumarco & Baert, 2019), on grit and other character skills (Peña & Duckworth, 2018), and on performance (Ponzo & Scoppa, 2014). Other studies have found relative age effects on performance in different age groups (Nam, 2014; Allen & Barnsley, 1993).

To the best of our knowledge, no study in the RAEs literature has investigated how relative age interacts with absolute age yet, while controlling for absolute age. This is a methodologically relevant contribution as it improves the estimation of coefficients and the interpretation of the results. Estimated effects of relative age, while controlling for absolute age, represent average effects across different absolute ages. Estimates of relative age by age group, without controlling for absolute age, are not equivalent to estimates obtained while using a full interaction between relative and absolute age. This is the case as estimates of relative age by age group still incorporate the effect of absolute age, and are similar to analyses where relative age (as well as all the other control variables) is (are) interacted with absolute age. The importance of separating relative age from absolute age, within any age group, is discussed in greater detail in Section 2.4.1. Moreover, controlling for absolute age is importance because of its endogeneity. In Section 2.5. we illustrate how, following Peña and Duckworth (2018) and Fumarco and Baert (2019), we deal with this problem. Differently from Fumarco and Baert (2019), we report these results in full and explain in greater detail the procedure.

The analysis of the interaction between relative and absolute age adds to previous literature also because past studies investigated how subjective well-being varies with absolute age in adolescence (e.g. Currie et al., 2012), while no study has investigated the role of relative age. We thus contribute by filling this gap in the subjective well-being literature as well.

The present work contributes to the scientific literature in a third way. Our analyses of the interaction between relative and absolute age consider the age when the first tracking of students occurs. In adolescence, students are streamed into different educational paths (e.g. academic versus vocational path) based on their perceived skills. At any given absolute age, the probability of being streamed toward a low educational path is higher for relatively young students (Fredriksson & Öckert, 2014; Mühlenweg & Puhani, 2010; Allen & Barnsley, 1993). The threat of being streamed downwards is arguably stressful (Fumarco & Schultze, 2019). Moreover, in countries with early tracking, tracking may occur multiple times before the end of high school. Therefore, we should expect that the effect of this interaction is smaller (or even negative) in countries where tracking occurs at early ages. Ours is the first paper to test this hypothesis.

Many mechanisms can explain the positive RAEs on life-satisfaction: academic performance and self-efficacy (i.e. students' belief in their own academic competence) are certainly two of them,[4] as discussed in Lipperman et al. (2015) and Zi et al. (2015). All else constant, the well-being of (relatively older) students who do better in school should be higher than the one of (relatively younger) students who do worse.

However, while academic performance is largely explored in the RAEs literature, this paper focuses on an important correlate of subjective well-being that has received less attention in the literature: health. Studies from various disciplines mostly focus on mental health, the (over)diagnosis of disorders, and disabilities (Schwandt & Wuppermann, 2016; Patalay et al., 2015; Dhuey & Lipscomb, 2010; Lien et al., 2005). These studies find that relatively old students are less often misdiagnosed with such conditions; this is because they have higher relative age, they are on average more attentive, less hyperactive and less impulsive than their younger peers. Other aspects of health have not been investigated so far. Thus, our fourth contribution to the literature consists in investigating three previously unexplored health outcomes: self-rated general health, frequency of psychosomatic complaints (as a proxy for mental health), and overweight status (as a proxy for physical health). It is important to remark that the study of this third health outcome is among the first ones to provide an objective and visible measure of RAEs on physical health.

Existing literature stresses the importance of a few mechanisms through which relative age affects our three measures of health. Relative age studies find that relatively old students are less frequently misdiagnosed with mental health conditions (Schwandt & Wuppermann, 2016; Patalay et al., 2015; Dhuey & Lipscomb, 2010; Lien et al., 2005). Thus, it is legitimate to expect that, all else equal, their self-rated general health is more frequently higher than relatively younger peers. In addition, psychosomatic complaints (e.g. nervousness, irritability, headaches) are often caused by stressful situations, such as feeling high schoolwork pressure, being bullied, and having weaker social networks (Currie et al., 2012); due to their lower school preparedness and physical development, these stressful situations affect more frequently relatively younger students (Fumarco & Baert, 2019; Fumarco & Schultze, 2019; Ando et al., 2019; Mühlenweg, 2010). Thus, it is legitimate to expect that, all else equal, relatively old students suffer less frequently from psychosomatic complaints than relatively younger peers. Moreover, literature from various disciplines finds that relatively old students engage more frequently in sport activities than their younger peers (Fumarco & Schultze, 2019; Cobley et al., 2009). This result is

[4] We thank an anonymous referee for suggesting this link.

due to the fact that, at any absolute age, competition is tougher for relatively younger peers, who are less physically developed and tend to avoid at higher rates such activities (Cobley et al., 2009; Helsen et al., 1998). Obviously, more frequent participation to sports activities helps fighting overweight problems (Graf et al., 2004).

This investigation of health outcomes is relevant to this paper for three reasons. First, it serves as a robustness check, because of the positive correlation between adolescents' health and subjective well-being (Currie et al., 2008). Second, measures of adolescents' health are important predictors of their subjective well-being and objective health in adulthood (Layard et al., 2014; Currie et al., 2008). Third, adolescents' health—including weight problems—affects labour market outcomes (Lundborg et al., 2014).

A number of studies suggest the possible sign of the impact of relative age on health outcomes. Because of its positive correlation with subjective well-being, we expect a positive association between life satisfaction (our measure of subjective well-being) and relative age. Moreover, self-esteem has a strong positive correlation with life satisfaction (Moksnes & Espnes, 2013)—it could be considered its proxy—and it is positively affected by relative age (Thompson et al., 2004). Furthermore, life satisfaction is negatively correlated with youth suicide, which reflects deep life dissatisfaction and is negatively affected by relative age (Thompson et al. 1999; Matsubayashi & Ueda, 2015).[5] Similarly, we expect relative age to have positive effects on health outcomes. Few reasons can directly explain why the youngest students in a class might suffer from poorer health; in particular, relatively young students have a more sedentary and lonely lifestyle, and they face higher schoolwork strain (Fumarco & Schultze, 2019; Fumarco & Baert, 2019; Cobley et al., 2009).

The remainder of the paper proceeds as follows. Section 2 discusses the data and descriptive statistics. Section 3 discusses the analyses of life satisfaction and health outcomes. Section 4 summaries the results, illustrates policy implications, and provides directions for future research.

[5] We thank an anonymous referee for providing these insights.

2 Data and Descriptive Statistics

The purpose of this section is twofold. First, we discuss the main features of the raw HBSC survey data and how they were prepared for analysis. Second, we discuss the variables used in our analyses and their main descriptive statistics.

2.1 Data

The HBSC survey is an international World Health Organization collaborative study that explores the determinants of young people's health, well-being, and health behaviours. It is administrated by teachers to nationally representative samples of students; the target age is between 10.5 and 16.5, and the smallest sample unit is the class. In this study, we investigate the HBSC survey waves from 2001/2, 2005/6 and 2009/10, as they are the most recent publicly available waves to contain information on adolescents' life satisfaction.

In our data preparation process, we removed observations on students from some countries in two broad cases: first, the case when a precise cutoff date cannot be assigned to a student's country, and second, the case when a country did not collect either students' birthdates, or data about life satisfaction.[6] Information on these characteristics is fundamental to our analyses; more details on this point are discussed below.

Finally, since 'relative age' refers to the difference in age between students in the same class, we excluded students from classes that have been assigned an improper class-identifier. For instance, in some schools, the same class-identifier is clearly assigned to different classes in different grades, so the estimates of RAEs for these classes are meaningless. To reduce the probability of treating students from different classes and grades as if they belonged to the same class, we trimmed the sample using standard boundaries: we excluded students from classes that are in the 95th percentile or above in the class size distribution (i.e. more than 33 students) and students from classes that are in the 5th percentile or below of the class size distribution (i.e. fewer than 8 students).[7]

Our final sample comprises 379,524 students from 32 countries. While Table O.1 in the Online Appendix provides the number of observations by country and wave, and Table O.2 lists the country-specific cutoff dates, which were retrieved from the sources listed in Table O.3.

[6] Refer to Fumarco and Baert (2018) for more details.
[7] Even robustness checks that included these classes would be meaningless.

2.2 Life satisfaction

Life satisfaction is a subjective evaluation of life as a whole. It is different from happiness, which is considered as an emotional measure of subjective well-being. Life satisfaction is a cognitive evaluation and thus it is regarded as a reliable measure of subjective well-being (Diener, 2006). Life satisfaction is measured in the HBSC survey by means of the Cantril ladder (Cantril, 1965), which is a scale from 0 to 10, to indicate possible levels of life satisfaction, 10 being he highest. This scale has been psychometrically demonstrated to be valid, reliable, and sensitive. It is probably the most used scale on life satisfaction, and it is particularly suitable for international comparisons. Table 1 shows that, as usual, the distribution of life satisfaction is left-skewed: on average, adolescents report a life satisfaction of about 7.6.

Table 1. Pairwise correlations and descriptive statistics.

	Pairwise correlations												
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1 Life satisfaction	1												
2 Relative age	-0.019***	1											
3 Female	-0.050***	-0.037	1										
4 Absolute age	-0.182***	0.183***	-0.003*	1									
5 Both parents at home	0.119***	-0.031***	-0.011***	-0.037***	1								
6 Low SES	-0.126***	0.035***	0.033	0.019***	-0.089***	1							
7 Medium SES	-0.007***	0.001	0.010***	-0.001	0.009***	-0.424***	1						
8 High SES	0.112***	-0.030***	-0.038	-0.016***	0.065***	-0.410***	-0.652***	1					
9 Season of birth	-0.008***	-0.218***	0.003***	-0.046***	0.001	0.001	0.001	-0.002	1				
10 ERA	-0.013***	-0.338***	0.001	-0.075***	-0.006***	0.002	0.002	-0.004***	0.548***	1			

11 General health	0.369***	-0.005***	0.123***	-0.119***	0.091***	-0.090***	-0.004**	0.079***	-0.001	-0.008***	1		
12 Index of psychosomatic	-0.372***	0.011***	0.179***	0.122***	-0.084***	0.057***	-0.007***	-0.040***	-0.001	0.004**	-0.328***	1	
13 Overweight	-0.048***	-0.011***	-0.087***	-0.011***	-0.015***	-0.002	0.015***	-0.014***	0.006**	0.010***	-0.090***	0.026***	1
Descriptive statistics													
Mean	7.600	-3.850	0.508	13.543	0.753	0.211	0.403	0.387	5.482	5.494	2.175	7.142	0.126
Standard deviation	1.895	5.436		1.651					3.358	3.369	0.720	5.683	
Min	0	-69	0	9.833	0	0	0	0	0	0	0	0	0
Max	10	60	1	17	1	1	1	1	11	11	3	28	1
N	363,009	368,588	379,524	379,524	377,431	379,524	379,524	379,524	379,524	379,524	367,772	369,449	209,392

Note: 'SES' stands for socio-economic status, 'ERA' stands for expected relative age. *** p<0.01, ** p<0.05, * p<0.1.

2.3 Relative Age

Our explanatory variable of interest is a proxy for relative age, RA_{ic}, which measures the difference between the age (in months) of student i in class c, AGE_{ic}, and that of the oldest regular student in class c, AGE_{Ic}, as in Fumarco and Baert (2019). Thus, this measure varies by class, and a decrease implies that student i is relatively younger. By 'regular student' we mean that the student is in the right class based on his/her age and on the country's cutoff date.[8] Thus, relative age is constructed as in Equation (1):

$$RA_{ic} = AGE_{ic} - \max_{I=1,\dots,n} (AGE_{Ic} \mid I \in R_c) \qquad (1)$$

[8] The Online Appendix of Fumarco and Baert (2019) provides an illustrated description of how the combination of information on students' month and year of birth (their own and that of their classmates) with the country-specific cutoff date allows the identification of regular students.

For regular students *i* in class *c*, $i \in R_c$, this measure should range between -12 months (i.e. there is one year difference between student *i* and the oldest regular student in the class)[9] and 0 months (i.e. student *i* is the oldest regular student in the class and was born on the cutoff date).

Table 1 shows that relative age is right-skewed. The mean is -3.850 (i.e. about four months within-class age difference). Why is the mean of relative age higher than -6 (i.e. six-month age difference)? The seminal paper from Bedard and Dhuey (2006) provides an answer: '…relative age evaluated at any point in the educational process is endogenous' (p.1438). This is the reason that most papers since their study investigate RAEs (or the related topic of the age at school entry) using either instrumental variable techniques or a research discontinuity design (e.g. Fumarco & Baert, 2019; Bahrs & Schumann, 2019; Peña & Duckworth, 2018; Peña, 2017; Matta et al., 2016; Ponzo & Scoppa, 2014; Mühlenweg, 2010; Sprietsma, 2010). Using a research discontinuity design requires a large range of values of the running variable, but such a range is not present in our dataset.[10] Therefore, we cope with the endogeneity of relative age with an instrumental variable technique.

The most important cause of endogeneity is that, based on children's and parents' characteristics, parents can expedite or delay their children's school entry, and children might be retained or skip a grade.[11] For example, parents might decide to postpone their children's school entry if they are expected to be among the youngest students in the class. Some parents from high socio-economic status (SES) in the US do this (Bedard & Dhuey, 2006). Because of endogenetiy, our analyses are conducted with a two-stage least square (2SLS), where we instrument relative age with expected relative age (see Section 2.5). Therefore, because of endogeneity, relative age could have values lower than -12 or values larger than 0. Such values would reflect, in the first case, a student who skipped a grade or entered school earlier, and in the second case, a student who was retained or redshirted and so is older than expected.

Based on this background, the mean of relative age higher than expected is a direct consequence of the fact that there are more retained or redshirted students than students who

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[9] It is actually *almost* -12 months, since exactly -12 months would mean that student *i* was born on the cutoff date of the next academic year.

[10] A research discontinuity design would require knowing the exact day of birth of each student, whereas we have at most the month of birth.

[11] Birth date targeting by parents could be an additional cause of endogeneity of relative age and its instrument, as well as of absolute age and its instrument. However, this cause of endogeneity is ruled out by results of the balance test we discuss in Section 2.5.

entered school earlier than expected or skipped a grade. Table O.4 in the Online Appendix shows that 10% of students in the sample are older than expected (we call them 'Older students' for brevity), while 4% of students are younger than expected (we call them 'Younger students' for brevity).[12]

Table 1 suggests that relative age is negatively associated with life satisfaction. This correlation implies that relatively old adolescents report a lower life satisfaction. This is opposite of what we initially hypothesised. However, the reader should keep in mind that this is not a *ceteris paribus* correlation: a low within-class age gap comes with a high absolute age for student *i*, which the literature suggests is associated with lower life satisfaction. In contrast, our econometric analyses control for absolute age. It is likely that the omission of absolute age in studies of RAEs on life satisfaction would cause a negative bias in the estimated effects of our variable of interest. The importance of separating absolute age (i.e. the age when the survey or test was taken) from relative age (i.e. the age difference between classmates) is discussed in Peña and Duckworth (2018) and in Fumarco and Baert (2019). Moreover, the latter study is based on the same HBSC data as this one, and it compares and discusses estimates obtained with and without controlling for absolute age. Fumarco and Baert provide evidence that the omission of absolute age causes omitted variable bias, and they show that the direction of this bias depends in turn on the correlation of absolute age with the outcome variable (Greene, 2003). This point is discussed in other parts of this study.

[12] Additional statistics show that younger students are on average 2 months younger than expected (i.e. the relative age is about -14), while older students are on average 6 months older than expected (i.e. the relative age is about 6).

2.4 Control Variables

The purpose of this subsection is twofold. First, we discuss the importance of controlling for absolute age and of its interaction with relative age. Second, we discuss other students' demographic characteristics.

2.4.1 Absolute Age

Our econometric analyses account for the student's absolute age, since adolescents' subjective well-being tends to decrease in time (Casas, 2016; Currie et al., 2012; Goldbeck et al., 2007). As is suggested in Table 1, estimates of RAEs would be negatively biased if we did not control for absolute age. Compared to more popular surveys on students (e.g. PISA, TIMMS, PIRLS), the HBSC survey is characterised by large variations in absolute age. This characteristic, country variation in cutoff date, and class-level variation in the relative age, allow us to separate relative from absolute age. However, notice that the latter variable is likely endogenous, for the same reasons as relative age. In Section 2.5, we discuss how we cope with the.

Additionally, in later stages of this analysis, absolute age is interacted with relative age.

One may wonder about the difference in the interpretation of absolute and relative age and about the interpretation of their interaction. The effect of absolute age is the effect of a student *i*'s age, regardless of her classmates' ages, while the effect of relative age is the effect of that student *i*'s age relative to her classmates. Thus, relative age can be intended as a peer effect.

To better see the importance of controlling for absolute age and of how its omission could cause a bias in the estimates of RAEs, we shall proceed with a simplified example. Let us assume for a moment that we focus only on female students from the HBSC survey, with absolute ages between 12 and 13. In this subsample, some relatively older students are about 13 years old and have had menarche already. This is something that we do not observe, but it is positively correlated to absolute age; it does not have anything to do with relative age. On one hand, menarche has a negative impact on these older girls' life satisfaction (Currie et al., 2012). On the other hand, because these same girls are relatively older they enjoy advantages that should provide them with greater life satisfaction than their younger classmates. The effect of relative age on subjective well-being, for this subsample, is likely negatively biased (i.e. lower than the 'real effect') because of the omission of absolute age.

The interaction term between relative and absolute age helps us with the investigation of how the effect of relative age varies over time (and, conversely, of how the effect of absolute age varies depending on students' relative age). This aspect is particularly relevant for the study of our main outcome: adolescents' life satisfaction, Goldbeck et al. (2007) explain that the evolution of life satisfaction in adolescence has to be considered as a developmental phenomenon because of the physical, psychological, and social changes that students experience. Although analyses that control for absolute age separate its effect from that of relative age, they are implicitly assuming that the effect of relative age is constant across different ages, while it is more plausible that it changes.

2.4.2 Other Demographic Characteristics

We control for students' gender because past studies find evidence that female adolescents tend to enjoy lower levels of life satisfaction than male peers (Moksnes & Espnes, 2013). This variable equals 1 for female students and 0 for male students, the reference group.

We control for basic family structure, that is, whether the student lives with both parents, since there is evidence that the presence of both parents at home positively impacts children's life satisfaction (Kwan, 2008).

Moreover, we account for family SES, which is derived from multiple items and is constructed according to the HBSC guidelines (Currie et al., 2008). We create three dummies for High, Medium and Low SES; the latter SES is the reference group. Although intuitively one would expect a positive effect of household SES on adolescents' life satisfaction, the direction of such an effect is a matter of debate (Crede et al., 2014).

Our analyses also account for the fixed-effects of unobservable birthday characteristics, known as 'season-of-birth' effects.[13] The variable for season of birth uses the month of birth within the calendar year (henceforth, calendar month) as a proxy, and it ranges between 0 (January, the reference month) and 11 (December).[14] Season-of-birth effects capture unobservable birthdate characteristics that do not depend on maturity differences but may cause

[13] Class size is thought to be negatively related to school achievements (Krueger 2003). One could thus expect it to be related to life-satisfaction, too. For this reason, it was included in early stages of this investigation, but no statistically significant effect was found in any model specification. This variable has therefore been removed from the analyses.

[14] For illustrative purposes the calendar month is reported in the table in its discrete form. However, the analyses will use one dummy per calendar month to capture non-linear effects.

differences between students born in different periods of the year. If left unaccounted for, season-of-birth effects could cause biased estimates. For instance, Bound and Jaeger (2001) explain that individuals born in winter time are more likely to suffer from multiple health issues, such as mental disabilities and multiple sclerosis, while individuals born in spring are more likely to be shy.

Finally, all the econometric analyses include fixed-effects for country and wave.

The pairwise correlations in Table 1 show that, although statistically significant, the correlation between calendar month and relative age is low; Hinkle et al., (2003) explain that a correlation lower than 0.3 is considered negligible in the behavioral sciences. There are few reasons for this low correlation: the calendar year (January to December) on which the season of birth variable is based is the same for every country, but the academic year (from the month that starts with the cutoff to the month immediately before the cutoff) varies by country (see Table O.2) and by class (see Section 2.3).

Moreover, according to the literature, female and older adolescents tend to be less satisfied with their lives, while an increase in household SES corresponds to higher levels of life satisfaction.

The additional correlations in Table 2 suggest a positive association between (categorical) age at first tracking[15] and life satisfaction.

Table 2. Additional pairwise correlations between: Life satisfaction and age at first tracking, Life satisfaction and relative age as well as absolute age by age at first tracking.

Variables		Age at first tracking, categories		
		<14	14 or 15	>15
	Life satisfaction	Life satisfaction	Life satisfaction	Life satisfaction
	(1)	(2)	(3)	(4)
Age at first tracking	0.007***			
Absolute age	-0.182***	-0.192***	-0.193***	-0.161***
Relative age	-0.019***	-0.029***	-0.017***	-0.001

Note: *** p<0.01, ** p<0.05, * p<0.1.

[15] The original variable on age at first tracking goes from 10 to 16. To facilitate the illustration of the results, we divide this age range into three age groups of similar size: age at first tracking earlier than 14, at 14 or 15, and later than 15. Heterogeneity analyses will be conducted on these same three categories separately.

In countries with later ages at first tracking, students report higher satisfaction with life, and life satisfaction decreases more slowly as absolute age increases. Moreover, there is no correlation between relative age and life satisfaction in countries with the latest age at first tracking. Information on country-specific age at first tracking is in Table O.2 in the Online Appendix.

2.5 Instrumental Variables

The instrument for relative age is expected relative age (ERA). This variable represents the month of birth within the academic year (henceforth, academic month), and it measures the age difference in months between student *i*, if she was a regular student, and the cutoff date (i.e. the hypothetically oldest regular student in the classroom). ERA ranges between 0 and 11, with 0 being the reference month that starts with the cutoff date and 11 being the month that precedes the cutoff date. For example, consider a student born in September in a country with a cutoff date of January 1st. Her ERA would be 8, that is, she was born 8 months after the month that starts with the cutoff date. This instrument is the same as that in Fumarco and Baert (2019), and it is very similar to that used in Peña and Duckworth (2018), Peña (2017), and Datar (2006). The latter studies measure expected relative age as the distance in non-integer years between student *i*'s age—if she was a regular student—and the age of the hypothetically youngest student in the class, who was born right before the cutoff date.

Moreover, we disaggregate ERA into dummies. This transformation is conducted to increase the first stage fit and to test the validity of the instruments using an over-identifying restriction test, which can be conducted because there are 11 instruments for one endogenous variable. If we continue the above example, student *i,* born in September, is expected to be 8 months younger than the hypothetically oldest student in the class, so, for this student, the dummy for academic month of birth 8 equals 1, while dummies for other academic months of birth equal 0.

Although the advantages that come from this disaggregation are not usually exploited, it is worth noting that our approach follows the suggestion in Angrist and Pischke (2008): 'many credible instruments can be thought of as defining categories, such as quarter of birth [or academic month of birth in our study]… any 2SLS estimator using a set of dummy instruments can be understood as a linear combination of all the Wald estimators generated by these instruments one at a time' (pp. 100-103).

Although expected relative age does not vary by class, it still varies by country. Therefore, expected relative age is not highly correlated with season of birth. Consider the example of two children born in September, in the same calendar year t; the difference between them is that one student was born in Poland, where the cutoff is September 1st, and the other student was born in Croatia, where the cutoff is March 1st. This case is illustrated in Figure 1.

Figure 1. Season of birth and expected relative age; example of Polish and Croatian students.

	Cal. year t												Cal. year t+1		
SOB	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
ERA, Poland	4	5	6	7	8	9	10	11	0	1	2	3	4	5	6
ERA, Croatia	9	10	11	0	1	2	3	4	5	6	7	8	9	10	11

Legend: Academic year x-1; Academic year x; Students' birth example 1; Students' birth example 2

Note: 'Cal.' stands for calendar, 'SOB' stands for season of birth, 'ERA' stands for expected relative age.

The Polish student is among the oldest students in her class, being born immediately after the cutoff date (i.e. ERA 0, according to the Polish academic year), while the Croatian student was born later in the academic year (i.e. ERA 5, according to the Croatian academic year). Because of differences in cutoff dates, the correlation between the discrete versions of these two variables is about 0.5. In addition, Table O.5 in the Online Appendix reports the variance inflation factors (VIFs) for expected relative age and for season of birth. The reported values do not suggest multicollinearity in our first stages: all of the factors are below 4, while the rule of thumb suggests that we should worry if VIFs > 10.

The correlation between this instrument and relative age is low as well: -0.338.[16] This low correlation is due to the nature of the two variables. Consider this second example illustrated in Figure 1, about a retained Polish student born in June; this student should have been relatively

[16] The correlation is negative because the ERA ranks months (and thus students) starting from the first month of the academic year, while relative age ranks classmates from the oldest to the youngest for the sake of interpretation of the econometric results. The inversion of expected relative age would not have any impact on our analyses, because of the disaggregation.

young, but she is relatively old because of her past retention. Assume that in her current class her oldest classmate—who has not been retained or redshirted—was born in October. The retained student's ERA is 9 because she was born 10 months after the hypothetically oldest student in her classroom, who was born in September of calendar year x-1. However, her (observed) relative age is about -4, because she is about four months older than the actual oldest regular student in her class.[17]

To create an instrument for absolute age, we follow Peña and Duckworth (2018). We define our instrument as the expected absolute age of classmates who participated in the same survey, are from the same country, and were born in the same quarter of the academic year.

There is one important underlying assumption for using expected relative and absolute age as instruments, which is in common with most of the other literature on relative age (Dickert-Conlin & Elder, 2010): birth date has to be orthogonal to demographic variables. Unconditional and conditional balance tests are conducted to verify the orthogonality of ERA with respect to observable demographic characteristics. The results are reported in the Online Appendix, Tables O.6 and O.7, and they suggest that ERA is randomly distributed with respect to observable characteristics. In particular, it is important to remark that ERA is balanced across the parents' socio-economic statuses. In other words, this result rules out the possibility that parents target certain birth dates depending on their socio-economic status.[18] Note that these results on the unbiased nature of expected relative age, and thus on birth date exogeneity, can be extended to expected absolute age as well.

2.6 Health Outcomes

We investigate three health outcomes. First, we investigate self-rated general health, as a proxy for general health; it is measured on a scale of 0 to 3, for poor, fair, good, and excellent self-rated health.[19] Second, as a proxy for mental health, we investigate complaints about subjective health

[17] We write 'about' because relative age varies by classroom and can be a non-integer number, see Equation 1, while ERA is always an integer.
[18] The existence of birth date targeting is disputed. Studies from the US provide evidence that parents with certain socio-economic status target (more or less willingly) certain birth dates (Buckles & Hungerman, 2013; Clarke et al., 2019), while other studies rule our this possibility (Bedard & Dhuey, 2006; Dickert-Conlin & Elder, 2010). While we are agnostic on this point and thus we conduct balance tests, we agree with the suggestion by Fan et al. (2017) that the validity of instrumental variables such as quarter or month of birth might depend on characteristics of the (sample of the) population being studied.
[19] The original scale goes the other way around; we inverted it so that high values correspond to better health.

distress, that is, psychosomatic complaints. We create an index based on information from a symptoms check-list of seven items: feeling headache and stomach-ache, feeling low, nervous, dizzy and irritable, and having sleep difficulties. All of these outcomes are strongly correlated (Currie et al., 2008) and are measured on the same 1 to 5 scale, for every day, more than once a week, about every week, about every month and rarely or never. We sum the numerical answers across these survey items to obtain an index on a scale from 7 (i.e. 7 different psychosomatic complaints per day) to 35 (i.e. no psychosomatic complaint), and then we subtract the minimum value (i.e. 7) from this index and we invert it.[20] A missing answer in any of the seven items results in a missing value for the index. Third, we investigate a dummy for being overweight, as a proxy for one objective aspect of physical health.[21] This variable is constructed based on body mass index data and on international gender- and age-specific cutoffs (Vidmar et al., 2004; Cole et al., 2000). It positively correlates with overweight and obesity in adulthood, along with weight-related diseases and premature mortality (Currie et al., 2008). Information on body mass index is present only in HBSC survey waves 2001/2 and 2009/10; thus, the analyses on this outcome proceed on a smaller sample.

Table 1 shows that life satisfaction is positively correlated with general health and negatively correlated with both the index of psychosomatic complaints and overweight status. Moreover, relative age negatively correlates with general health and with overweight status, while it positively correlates with the index of psychosomatic complaints. These correlations should be considered with a grain of salt since they consider neither absolute age nor other confounders.

3 Results

This section is composed of two parts. In the first part, we investigate RAEs on life satisfaction and how they vary with absolute age. Then we investigate how this interaction varies by age at first school tracking. In the second part, we investigate RAEs on health outcomes. Then we investigate the interaction effect and how it varies by age at first school tracking.

[20] The original scale goes the other way around; we inverted it so that high levels correspond to more complaints.
[21] Obesity would be an even more interesting outcome. However, there are only about 4,000 obese adolescents in this data set.

3.1 Life Satisfaction

In this subsection, we first study the effects of relative age and of its interaction with life satisfaction. Then we investigate how these effects vary with age at first tracking.

3.1.1 Effects of Relative Age and its Interaction with Absolute Age, using the Entire Sample

We conduct two first stages of the 2SLS, one per endogenous term. We regress the endogenous variables, relative age, *RA*, and absolute age, *AGE*, on their instruments, that is, the vector of dummies for expected relative age, *ERA*, and expected absolute age, *EAA*, respectively. Moreover, we control for demographic characteristics, *X*, which include dummies for the student being female, having both parents at home, Medium SES, and High SES. In addition, there are fixed-effects, *FE*, for season of birth, survey wave, and country. Equation (2) reports the general first stage for the two endogenous variables:

$$Endogenous = \gamma_0 + \gamma_1 IV_i + \gamma_2 X_i + \gamma_3 FE_i + \mu_i \qquad (2)$$

Finally, the second stage regresses life satisfaction on the predicted values of *RA* and *AGE* from their respective first stages, demographic characteristics, *X*, and fixed-effects, *FE.* This model specification is illustrated in Equation (3):

$$Y_i = \beta_0 + \beta_1 \widehat{RA}_{ic} + \beta_2 \widehat{AGE}_i + \beta_3 X_i + \beta_4 FE_i + \varepsilon_i \qquad (3)$$

Y is the outcome variable, in this case life satisfaction, which is standardized to a z-score. Thus, the estimated effects are interpreted in terms of standard deviation. This transformation is conducted so that estimated RAEs could be more easily compared across outcomes, as in Mühlenweg et al. (2012).

The investigation on the evolution of relative age in time is conducted in a similar manner. The only difference is that there is a third first stage, where we regress the *AGE* × *RA* on the interaction *ERA* × *EAA*, and on the same vector of demographic characteristics and fixed-effects as in Equation (4).

$$AGE_i \times RA_{ic} = \gamma_0 + \gamma_1 ERA_i + \gamma_2 ERA_i \times EAA_i + \gamma_3 EAA_i + \gamma_4 X_i + \gamma_5 FE_i + \mu_i \quad (4)$$

The second stage is similar to Equation (3) but includes the predicted interaction between relative age and absolute age, see Equation (5).

$$Y_i = \beta_0 + \beta_1 \widehat{RA}_{ic} + \beta_2 \widehat{AGE}_i + \beta_3 \widehat{AGE_i \times RA_{ic}} + \beta_4 X_i + \beta_5 FE_i + \varepsilon_i \quad (5)$$

All of the analyses include standard errors clustered on class, since the variance of the error term may change by class.

The second stage 2SLS estimates of the main effect of relative age and of its interaction with absolute age are reported in Columns (1) and (2) of Table 3. The table also reports the estimated effects of demographic characteristic. Although they are not the focus of this study, they can be used as comparison tools to assess the economic significance of RAEs. Finally, the table includes sample size, R-squared, along with results from weak-, under-, and over-identification tests. Results from the reduced form and first stage for the analysis without interaction are reported in Table O.8, the equivalent results for the analysis with interaction can be provided upon request.

Table 3. Relative age on standardised life satisfaction; 2SLS second stage results.

Variables	Life satisfaction	Life satisfaction
	(1)	(2)
Relative age	0.014***	0.014***
	(0.001)	(0.001)
Relative age × Absolute age		0.001**
		(0.001)
Absolute age	-0.110***	-0.104***
	(0.001)	(0.003)
Female	-0.079***	-0.078***
	(0.004)	(0.004)
Both parents at home	0.224***	0.224***
	(0.004)	(0.004)
Medium SES	0.200***	0.200***
	(0.005)	(0.005)
High SES	0.334***	0.334***
	(0.006)	(0.005)
Fixed-effects		

Country	X	X
Wave	X	X
Season of birth	X	X
N	344,239	344,239
R-squared	0.073	0.072
2SLS ancillary tests		
Under-identification test:	5141.926	3711.805
Lagrange-Multiplier statistic [p-value]	[0.000]	[0.000]
Weak-identification test: F-statistic	1097.211	337.622
Over-identification test: Hansen J	11.281	17.694
statistic [p-value]	[0.336]	[0. 608]
Relative age × 12	0.168***	0.168***
Relative age × 12 × Absolute age		0.012**

Note: Absolute age is centred. Standard errors clustered on class in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

Column (1) tells us that an increase in relative age of one month increases life satisfaction by 0.014 standard deviations. Are these estimated RAEs economically significant? The last line in Column (1) shows that a twelve-month increase in relative age (i.e. the hypothetical maximum age gap between regular students) increases life satisfaction by 0.168 standard deviations (0.014 × 12), or 0.3 points on the 0 to 10 scale.[22] The magnitude of this result is comparable to changes in the household SES (see Table O.12 in the Online Appendix): it is 25% larger than the effect that a student would enjoy for passing from Low to Medium SES household, it is 16% smaller than the effect for passing from Medium to High SES household, and it is half the magnitude of passing from Low to High SES.

Moreover, while relative age has a positive impact on life satisfaction, absolute age has a negative impact as discussed in the literature (Casas, 2016; Currie et al., 2012; Goldbeck et al., 2007).

Column (2) suggests that gaps in life satisfaction caused by relative age are not constant over time. The life satisfaction gap faced by relatively young students increases with absolute age. With an increase of one year in absolute age, an increase of one month in relative age increases life satisfaction by further 0.001 standard deviations. For a twelve-month increase in relative age, this effect translates into an increase of 0.012 standard deviations in the life satisfaction gap. This result implies that the decline of life satisfaction over time is slower for relatively old students than for relatively younger ones.

[22] Multiply 0.168 by the standard deviation of life-satisfaction from Table 1 (i.e. 1.895).

The three ancillary tests return reassuring results for both 2SLS analyses. The tests for under- and weak-identification reject, respectively, the null hypothesis that the instruments are not correlated with the endogenous variable and that they are only weakly correlated. For the latter test, the F statistic is well beyond critical values suggested in Stock and Yogo (2002). The over-identification test does not reject the null hypothesis that the residuals from the first stage are not correlated with the outcome in the second stage (i.e. the hypothesis that the instruments are valid is not rejected).

It is important to remark that these results are identical to those we would have obtained, had we used a discrete version of expected relative age, instead of a vector of dummies. However, with that specification of expected relative age, we could have not conducted the over-identifying restrictions test. These results can be provided upon request. Moreover, although absolute age is endogenous, we would have obtained very similar estimates for both relative and absolute age had we not instrumented absolute age as well; the results are available upon request.

Table O.8 in the Online Appendix reports the two first stages and the reduced form for the analysis without interaction, in Column (1). There are at least four results worthy of remark. First, understandably, for students born late in the academic year (e.g. ERA 8 to 11), the relative age with respect to the oldest regular student in the class is larger. Moreover, all else being equal, the expected absolute age is positively associated with relative age: the older student i is compared to her classmates, the older she is expected to be in terms of absolute age. Second, returns to expected relative age appear to be non-linear for students born at the extremities of the academic year. This result further supports our choice to disaggregate academic month of birth in dummy variables. These decreasing returns seem to hit a plateau between academic month of birth 8 and 11. Therefore, the monotonicity assumption is more likely to be infringed by students born in the months around the cutoff date. Third, ceteris paribus, expected absolute age is a very good predictor of absolute age. This is something that we expected since about 86% of students in our sample are regular students (see Table O.4 in the Online Appendix).

Finally, the separation of relative age from absolute age is important not only in terms of interpreting results, but also in terms of bias in the estimates. Similarly to Fumarco and Baert (2019), we apply the Frisch-Waugh-Lovell theorem to assess the omitted variable bias, had we omitted absolute age from this analysis on life satisfaction. The results are reported in Table O.13, and they show that the omission of absolute age would have caused a negative bias. This result supports our initial interpretation of the unexpected negative correlation between life satisfaction and relative age.[23]

The small order of magnitude of the interaction between relative and absolute age might hide substantial heterogeneous effects by age at first tracking, which is what we investigate in Section 3.1.2.

3.1.2 Effects of the Interaction between Relative and Absolute Age, by Age at First Tracking

We conduct additional analyses on life satisfaction to investigate how the interaction between relative and absolute age varies by age at first tracking. This information is country-specific and it is displayed in Table O.2 in the Online Appendix.

The analyses replicate those in Section 3.1.1, but they are conducted on three subsamples, based on terciles of the age at first tracking. These subsamples include students from countries where the age at first tracking is lower than 14, is at 14 or 15, or is later than 15. For these analyses, we use the expanded model specification, as by Equations (4) and (5). Table 4 reports only 2SLS estimates of the coefficients of interest.

Table 4. Relative age and its interaction with absolute age on standardised life satisfaction; 2SLS second stage results.

	Age at first tracking		
	<14	14 or 15	>15
Variables	Life satisfaction	Life satisfaction	Life satisfaction
	(1)	(2)	(3)
Relative age	0.014***	0.022***	0.010***
	(0.002)	(0.003)	(0.001)
Relative age × Absolute age	0.001	0.003**	0.001***
	(0.001)	(0.001)	(0.001)
Absolute age	-0.109***	-0.111***	-0.093***
	(0.006)	(0.005)	(0.004)
Demographic control variables	X	X	X
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X

[23] We should keep in mind that the case of positive bias, that is, β̂_(relative age) > β_(relative age), we can have β̂_(relative age) > 0 and β_(relative age) < 0, while in the case of negative bias, that is, β̂_(relative age) < β_(relative age), we can have β̂_(relative age) > 0 and β_(relative age) < 0. It means that in theory, omitted variable bias could cause a change in sign; this is even more likely when we compare the results of a simple bivariate correlation, as in Table 1, with the results from a multivariate regression model.

N	110,847	116,879	116,513
R-squared	0.087	0.056	0.068
2SLS ancillary tests			
Under-identification test:	1303.156	783.230	2433.867
Lagrange-Multiplier statistic [p-value]	[0.000]	[0.000]	[0.000]
Weak-identification test: F-statistic	96.745	55.921	638.493
Over-identification test: Hansen J statistic [p-value]	25.926 [0.168]	16.268 [0.700]	9.471 [0.977]
Relative age × 12	0.168***	0.264***	0.120***
Relative age × 12 × Absolute age	0.012	0.036**	0.012***

Note: Absolute age is centred. Demographic control variables include: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 shows that in the countries where students are tracked only after 15 years of age, the main effect of relative age on life satisfaction declines: it is 28% smaller than the main effects from Table 3. Moreover, Table 4 confirms evidence from Table 3 that there is an interaction effect between relative and absolute age, and it adds that this interaction varies with age at first tracking. However, somehow surprisingly, this positive interaction effect is statistically significant in countries where age at first tracking is 15 or later and in countries where age at first tracking is either 14 or 15.

These results are in line with previous literature (Bedard & Duhey, 2006), which suggests that RAEs are lower when students' tracking occurs later. However, it is important to remark that, even in the countries with late tracking, the life satisfaction gap tends to increase over time, perhaps as a result of the fact that students who face developmental gaps are allowed to lag behind in those countries (Bedard & Duhey, 2006).

Finally, the three ancillary tests return reassuring results for each 2SLS regression.

3.2 Health Outcomes

In this subsection, we first study the effect of relative age on health outcomes, and then we investigate how this effect varies with absolute age and with age at first tracking.

3.2.1 Effects of Relative Age on the Entire Sample

For the study of health outcomes, we use the same econometric approach as for the study of life satisfaction. The only difference is the outcome: we investigate RAEs on self-rated general health, index of psychosomatic complaints, and overweight status.

Even the study of overweight status—which is a binary outcome—can be conducted with a linear model, although in this case, it is more appropriate to speak about linear probability model (LPM). We choose the LPM for two reasons. First, it allows greater flexibility compared to non-linear counterparts and it is more computationally tractable. This is convenient since some models in the remainder of the paper have two endogenous variables that are interacted and include many fixed-effects (2 for wave, 11 for season of birth, 31 for students' country). Second, the LPM allows immediate interpretation and comparability of the RAEs across the multiple outcomes of this paper.[24]

Since the analyses on life satisfaction suggest that the study of the interaction between relative and absolute age is more insightful if age at first tracking is accounted for, the interaction effect is investigated in Section 3.2.2.

Self-rated general health and index of psychosomatic complaints are standardised to a z-score. The results are reported in Table 5, whereas the two first stages and the reduced form, for each analysis, are reported in Tables O.9, O.10, and O.11 in the Online Appendix report.

Table 5. Relative age on standardised self-rated general health, index of psychosomatic complaints, and the dummy for overweight status; 2SLS second stage results.

Variables	2SLS General health	2SLS Index of psychosomatic	2SLS Overweight
	(1)	(2)	(3)
Relative age	0.009***	-0.006***	-0.002***
	(0.001)	(0.001)	(0.001)
Absolute age	-0.070***	0.072***	-0.002***
	(0.001)	(0.001)	(0.001)
Female	-0.231***	0.350***	-0.060***
	(0.003)	(0.003)	(0.001)
Both parents at home	0.126***	-0.164***	-0.012***
	(0.004)	(0.004)	(0.002)
Medium SES	0.123***	-0.079***	-0.006***
	(0.005)	(0.004)	(0.002)
High SES	0.227***	-0.106***	-0.025***
	(0.005)	(0.005)	(0.002)
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X

[24] The application of linear models to the study of causal effects on binary outcomes is increasingly seen as suitable and is discussed in popular undergraduate and graduate econometric manuals such as Wooldridge (2002, 2012) and Angrist and Pischke (2008).

N	349,501	350,523	195,991
R-squared	0.088	0.079	0.019
2SLS ancillary tests			
Under-identification test:	5166.931	5097.705	3257.876
Lagrange-Multiplier statistic [p-value]	[0.000]	[0.000]	[0.000]
Weak-identification test: F-statistic	1121.362	1087.009	609.501
Over-identification test: Hansen J statistic [p-value]	9.112 [0.521]	10.769 [0.376]	16.513 [0.086]
Relative age × 12	0.108***	-0.072***	-0.024***

Note: Absolute age is centred. The analysis on overweight status is conducted on a smaller sample because information on body mass index is present only in waves 2001/2 and 2009/10. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 provides evidence that relative age increases self-rated general health, reduces psychosomatic complaints and reduces the chances of being overweight. A twelve-month increase in relative age increase self-rated general health by 0.108 standard deviations, decreases the index of psychosomatic complaints by 0.072 standard deviations, and decreases the chances of being overweight by 2.4% (-0.024× 100).

These effects acquire greater importance when compared to those of household SES (see Table O.12 in the Online Appendix). The effect of a twelve-month increase in relative age on self-rated general health is close to the effect of passing from Low to Medium SES household as well as from Medium to High SES, while it is half the magnitude of the effect of passing from Low to High SES. The effect of a twelve-month increase in relative age on the index of psychosomatic complaints is close to the effect of passing from Low to Medium SES, but it is about one and a half times as large as the effect of passing from Low to Medium SES, and about 32% smaller than the effect of passing from Low to High SES. Finally, the effect of a twelve-month increase in relative age on the probability of being overweight is three times larger than the effect of passing from Low to Medium SES, it is about 26% larger than the effect of passing from Medium to High SES, and it is about the magnitude of the effect of passing from Low to High SES.

These estimated RAEs are even more interesting when compared to the effect of absolute age. The effect of relative age on general health is positive, as expected, whereas the effect of absolute age is negative as discussed by the literature (Casas, 2016; Currie et al., 2012; Goldbeck et al., 2007). While being relatively older leads to better health, higher absolute age worsens general health. Similarly, we observe the opposite effect for the index of psychosomatic complaints: a twelve-month increase in relative age reduces psychosomatic complaints, which increase with absolute age. Finally, while the point estimates for both relative and absolute age are negative and have the same magnitude, the effect of a twelve-month increase in relative age is more than 10 times larger than a one-year increase in absolute age!

The three ancillary tests return mostly reassuring results. In the analyses of RAEs on overweight status, the over-identification test rejects the null hypothesis that the instruments are uncorrelated with the second-stage error term, albeit only at the 10% significance level; this result casts some doubt on the validity of the instruments.

Also in this case, the results would have been identical, had we used a discrete version of expected relative age, instead of a vector of dummy variables. These results can be provided upon request. Moreover, the estimates for both relative and absolute age would have been non-economically distinguishable from those in Table 5, had we not instrumented absolute age as well; the results are available upon request.

Tables O.9, O.10, and O.11 in the Online Appendix report the two first stages and the reduced form, for each analysis. There are four results worthy of remark. First, the results confirm that the later students are born in the academic year, the larger is their relative age gap with respect to the oldest regular students. Moreover, all else equal, older students have higher expected absolute age. Second, returns to expected relative age are confirmed to be non-linear. Therefore, the monotonicity assumption might be infringed by students born around the cutoff date. Third, we find confirmation that expected absolute age is a very good predictor of absolute age.

How much of the effect of relative age on life satisfaction is carried by health measures? To answer this question, we follow De Neve and Oswald (2012) and conduct multivariate Sobel-Goodman tests, which provide statistically significant evidence of three mediation effects.[25] First, the mediation effect of standardised general health carries about 22% of the total effect of relative age on the standardised life satisfaction. This result confirms that a large part of RAEs passes through health. Second, the mediation effect of the standardised index of psychosomatic complaints carries about 14% of the total effect. Thus, much of the general health effect on life satisfaction caused by relative age might be due to mental health. Third, the mediation effect of

[25] These tests are conducted with the STATA command 'sgmediation' and use predicted relative age as well as predicted absolute age from the first stage regression. This command is no longer available (November 5, 2019).

overweight status carries about 1.5% of the total effect. This mediation effect is smaller than the other two, but it is very specific.

3.2.2 Effects of the Interaction between Relative and Absolute Age, on the Entire Sample and by Age at First Tracking

We briefly discuss the interaction effect between relative and absolute age on health outcomes, and how it varies by age at first tracking. The analyses use the expanded model specification as by Equations (4) and (5), and they investigate the entire sample as well as three subsamples based on terciles of the age at first tracking. Results on general health, index of psychosomatic complaints, and overweight status are reported in Tables O.14, O.15, and O.16, in the Online Appendix.

We observe two relevant results. First, there is no evidence of an interaction effect on health outcomes either when we investigate the entire sample or when we conduct the analyses by age at first tracking. Second, the magnitude of RAEs on health outcomes does not substantially vary by age at first tracking.

4 Conclusions

This study contributes to the literature on adolescents' relative age effects (RAEs), subjective well-being, and health in four ways. First, we investigate RAEs on the subjective well-being of adolescent students. We do that by investigating international survey data from the Health Behaviour in School-Aged Children (HBSC) on European countries. These data present large variation in absolute age and allow us to separate its effect from that of relative age. We find that a twelve-month increase in relative age (i.e. the maximum hypothetical age gap between classmates) reduces life satisfaction (our measure of subjective well-being) by 0.3 points on a 0 to 10 scale. This effect is comparable to that of changes in household socio-economic status and is larger than the effect of absolute age. This result is consistent with the evidence provided by Ando et al. (2019) on a sample of Japanese students.

Second, we investigate whether RAEs on life satisfaction vary with absolute age. Initial estimates do not provide evidence of this interaction effect.

Third, we investigate whether the lack of evidence on this interaction effect might be due to the presence of heterogeneity based on the country-specific rules on age at first formal tracking. We find that RAEs might increase with absolute age where age at first tracking occurs at 14 years of age or later, while they tend to remain stable in countries where tracking occurs at earlier ages.

Fourth, we investigate RAEs on one of the most important correlates of subjective well-being: health. More concretely, we investigate general health (measured by self-rated health), mental health (measured by an index of psychosomatic complaints), and one aspect of physical health, that is, the overweight status. We find that relative age increases general health, reduces psychosomatic complaints, and reduces the chances of being overweight. The negative effect of relative age on overweight status is probably the most interesting result of this paper: the youngest students in a class are more likely to be overweight while controlling for absolute age! One likely reason for this result is that they engage in sport activities less frequently (Fumarco & Schultze, 2019; Cobley et al., 2009). To the best of our knowledge, no paper in any field has documented that the age grouping system that determines the maximum age gap between classmates may affect weight problems, and, thus, might be contributing—at least in part—to the global epidemic of overweight and obesity, that is, 'globesity'—as labelled by the WHO.[26]

We should note two limitations of our study. First, the results on overweight status are obtained from a smaller sample. Thus, the study of the evolution of RAEs with absolute age, by age at first tracking, might be characterised by low statistical power. Second, although the disaggregation of the instrumental variable brings benefits to the analyses, it does not solve one issue. Sprietsma (2010) and Bedard and Dhuey (2006) show that students born at the two extremes of the academic year, that is, around the cutoff date have the greatest chances of being non-regular students. Therefore, the corresponding dummies for expected relative age might still infringe the often-overlooked monotonicity assumption (Barua & Lang, 2016).

We can draw one policy implication from our results. In order to improve the well-being of the youngest students in a class, policymakers could consider postponing the age at first tracking. This policy might improve relatively young students' health as well.

A logical next step is to follow the evolution of negative RAEs on subjective well-being and health outcomes into adulthood. Furthermore, relative age on health outcomes and its variation with age at first tracking should be explored more thoroughly.

[26] https://www.who.int/nutrition/topics/obesity/en/ (March 1st, 2019).

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References

Alesina, A., Di Tella, R., MacCulloch, R. (2004). Inequality and happiness: Are Europeans and Americans different? *Journal of Public Economics, 88*(9), 200-2042.

Allen, J., Barnsley, R. (1993). Streams and Tiers the Interaction of Ability, Maturity, and Training in Systems with Age-Dependent Recursive Selection. *Journal of Human Resources, 28*(3), 649-659.

Ando, S., Usami, S., Matsubayashi, T., Ueda, M., Koike, S., Yamasaki, S., Fujikawa, S., Sasaki, T., Hiraiwa-Hasegawa, M., Patton, G., Kasai, K., Nishida, A. (2019). Age relative to school class peers and emotional well-being in 10-year-olds. *PLoS ONE, 14*(3), E0214359.

Angrist, J., Pischke, J. (2008). *Mostly harmless econometrics.* Princeton, NJ: Princeton University.

Bahrs, M., Schumann, M. (2019). Unlucky to be young? The long-term effects of school starting age on smoking behavior and health. *Journal of Population Economics,* 1-46.

Barnsley, R. H., Thompson, A. H. (1988). Birthdate and Success in Minor Hockey: The Key to the NHL. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement, 20*(2), 167-176.

Barua, R., Lang, K. (2016). School entry, educational attainment, and quarter of birth: A cautionary tale of a local average treatment effect. *Journal of Human Capital, 10*, 347-376.

Bedard, K., Dhuey, E. (2006). The Persistence of Early Childhood Maturity: International Evidence of Long-Run Age Effects. *Quarterly Journal of Economics*, *121*(4), 1437-1472.

Black, S. E., Devereux, P. J., Salvanes, K. G. (2011). Too Young to Leave the Nest? The Effects of School Starting Age. *Review of Economics and Statistics, 93*(2), 455-467.

Blanchflower, D. G., Oswald, A. (2000). The rising well-being of the young. In Youth employment and joblessness in advanced countries (pp. 289-328). University of Chicago Press

Blanchflower, D., Oswald, A. (2004). Money, sex and happiness: An empirical study. *The Scandinavian Journal of Economics, 106*(3), 393-415.

Böckerman, P., Ilmakunnas, P. (2012). The job satisfaction-productivity nexus: A study using matched survey and register data. *ILR Review, 65*(2), 244-262.

Bound, J., Jaeger, D. A. (2001). Do Compulsory School Attendance Laws Alone Explain the Association Between Quarter of Birth and Earnings? *Research in Labor Economics*, *19*, 83-108.

Bruni, L., Porta, P. (2007). *Handbook on the Economics of Happiness.* Cheltenham and Northampton, MA: Edward Elgar Publishing Ltd.

Buckles, K. S., Hungerman, D. M. (2013). Season of Birth and Later Outcomes: Old Questions, New Answers. *Review of Economics and Statistics*, *95*(3), 711-724.

Cantril, H. (1965). *The Pattern of Human Concerns*. New Brunswick, New Jersey: Rutgers University Press.

Casas, F. (2016). Children, Adolescents and Quality of Life: The Social Sciences Perspective Over Two Decades. In F. Maggino (ed.), *A Life Devoted to Quality of Life, festschrift in honor of Alex C. Michalos* (pp. 3-21), Social Indicators Research Series 60. Dordrecht, Netherlands: Springer.

Clark, A. E., D'Ambrosio, C., Ghislandi, S. (2013). Poverty and well-being: Panel evidence from Germany. PSE Working Papers hal-00814659, HAL.

Clark, A. E., Flèche, S., Senik, C. (2012). The great happiness moderation. SOEP papers on Multidisciplinary Panel Data Research 468, DIW Berlin, The German Socio-Economic Panel (SOEP).

Clark, A. E., Flèche, S., Layard, R., Powdthavee, N., Ward, G. (2018). *The Origins of Happiness: The Science of Well-Being over the Life Course*. Princeton, New Jersey: Princeton University Press.

Clarke, D., Oreffice, S., Quintana-Domeque, C. (2019). The demand for season of birth. *Journal of Applied Econometrics, 34*(5), 707-723.

Cobley, S., Baker, J., Wattie, N., McKenna, J. (2009). Annual Age-grouping and Athlete Development: A Meta-analytical Review of Relative Age Effects in Sport. *Sports Medicine, 39*(3), 235-256.

Cole, T. J., Bellizzi, M. C., Flegal, K. M., Dietz, W. H. (2000). Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey. *British Medical Journal (Clinical Research Ed.)*, *320*(1240), 1-6.

Crede, J., Wirthwein, L., McElvany, N., Steinmayr, R. (2015). Adolescents' Academic Achievement and Life Satisfaction: The Role of Parents' Education. *Frontiers in Psychology*, *6*(52), 1-9.

Currie, C., Nic Gabhainn, S., Godeau, E., Roberts, C., Smith, R., Currie, D., Picket, W., Richter, M., Morgan, A., Barnekow, V. B. (2008). *Inequalities in Young People's Health – International Report from the 2005/2006 Survey*. Copenhagen, Denmark: WHO Regional Office for Europe.

Currie, C., Zanotti, C., Morgan, A., Currie, D., de Looze, M., Roberts, C., Samdal, O., Smith, O. R. F., Barnekow, V. (2012). *Social Determinants of Health and Well-Being Among Young People. Health Behaviour in School-aged Children (HBSC) Study: International Report from the 2009/2010 Survey*. Copenhagen, Denmark: WHO Regional Office for Europe.

Datar, A. (2006). Does Delaying Kindergarten Entrance Give Children a Head Start? *Economics of Education Review, 25*(1), pp. 43–62.

De Neve, J. E., Oswald, A. J. (2012). Estimating the Influence of Life Satisfaction and Positive Affect on Later Income Using Sibling Fixed Effects. *Proceedings of the National Academy of Sciences*, *109*(49), 19953-19958.

Dhuey, E., Lipscomb, S. (2008). What Makes a Leader? Relative Age and High School Leadership. *Economics of Education Review, 27*(2), 173-183.

Dhuey, E., Lipscomb, S. (2010). Disabled or Young? Relative Age and Special Education Diagnoses in Schools. *Economics of Education Review, 29*(5), 857-872.

Diener, E. (2006). Guidelines for national indicators of subjective well-being and ill-being. *Journal of Happiness Studies, 7*, 397-404.

Diener, E., Lucas, R., Schimmack, U., Helliwell, J. (2009). *Wellbeing for public policy.* New York: Oxford University Press.

DiMaria, C. H., Peroni, C., Sarracino, F. (2019). Happiness matters: Productivity gains from subjective well-being. *Journal of Happiness Studies*, 1-22.

Di Tella, R., MacCulloch, R. (2008). Gross national happiness as an answer to the Easterlin paradox? *Journal of Development Economics, 86*(1), 22-42.

Elder, T. E., Lubotsky, D. H. (2009). Kindergarten Entrance Age and Children's Achievement: Impacts of State Policies, Family Background, and Peers. *Journal of Human Resources, 44*(3), 641-683.

Fan, E., Liu, J. T., Chen, Y. C. (2017). Is the Quarter of Birth Endogenous? New Evidence from Taiwan, the US, and Indonesia. *Oxford Bulletin of Economics and Statistics*, *79*(6), 1087-1124.

Fredriksson, P., Öckert, B. (2014). Life-cycle Effects of Age at School Start. *Economic Journal, 124*, 977-1004.

Frey, B., Stutzer, A. (2000). Happiness, economy, and institution. *Economic Journal, 110*(466), 918-938.

Frey, B. S., Stutzer, A. (2018). Economics of happiness. Springer International Publishing.

Frijters, P., Johnston, D. W., Shields, M. A. (2014). Does Childhood Predict Adult Life Satisfaction? Evidence from British Cohort Surveys. *Economic Journal*, *124*(580), F688-F719.

Fumarco, L., Schultze, G. (2019). Does Relative Age Make Jack a Dull Student? Evidence from Students' Schoolwork and Playtime. Mimeo.

Fumarco, L., Baert, S. (2019). Relative Age Effect on European Adolescents' Social Network. *Journal of Economic Behavior and Organization.*

Fumarco, L., Baert, S. (2018). Younger and Dissatisfied? Relative Age and Life-satisfaction in Adolescence. *IZA Discussion Paper,11990.*

Funk, B. A., Huebner, E. S., Valois, R. F. (2006). Reliability and validity of a brief life satisfaction scale with a high school sample. *Journal of Happiness Studies*, *7*(1), 41-54.

Gladwell, M. (2008) Outliers: The Story of Success. *New York: Little, Brown and Company.*

Goldbeck, L., Schmitz, T. G., Besier, T., Herschbach, P., Henrich, G. (2007). Life satisfaction decreases during adolescence. *Quality of Life Research, 16*, 969-979.

Gardner, J., Oswald, A. J. (2007). Money and mental wellbeing: A longitudinal study of medium-sized lottery wins. *Journal of Health Economics, 26*(1), 49-60.

Graf, C., Koch, B., Kretschmann-Kandel, E., Falkowski, G., Christ, H., Coburger, S., Lehmacher, W.m Bjarnason-Wehrens, B., Platen, P., Tokarski, W., Predel, H. G., Dordel, S.(2004). Correlation between BMI, leisure habits and motor abilities in childhood (CHILT-project). *International Journal of Obesity, 28*(1), 22-26.

Greene, W. H. (2003). *Econometric Analysis.* Princeton, NJ: Pearson Education.

Gruber, J., Mullainathan, S. (2006). Do cigarette taxes make smokers happier?. *In Ng YK., Ho L.S. (eds). Happiness and Public Policy (pp. 109-146).* Palgrave Macmillan, London.

Haranin, E. C., Huebner, E. S., Suldo, S. M. (2007). Predictive and Incremental Validity of Global and Domain-Based Adolescent Life Satisfaction Reports. *Journal of Psychoeducational Assessment, 25*(2), 127-138.

Harter, J., Schmidt, F., Keyes, C. (2003). Well-being in the workplace and its relationship to business outcomes: A review of the Gallup studies. *In C. Keyes & J. Haidt (Eds.), Flourishing: Positive Psychology and the life well-lived (pp. 205-224)*. Washington, DC: American Psychological Association.

Helsen, W. F., Starkes, J. L., Van Winckel, J. (1998). The Influence of Relative Age on Success and Dropout in Male Soccer Players. *American Journal of Human Biology, 10*(6), 791-798.

Hinkle, D. E., Wiersma, W., Jurs, S. G. (2003). Applied statistics for the behavioral sciences. 5th ed. *Boston: Houghton Mifflin.*

Jovanović, V. (2016) The validity of the Satisfaction with Life Scale in adolescents and a comparison with single-item life satisfaction measures: a preliminary study. *Quality of Life Research , 25*(12), pp 3173–3180.

Kahneman, D., Krueger, A. (2006). Developments in the measurement of subjective well-being. *Journal of Economic Perspectives, 20*, 3–24.

Kristoffersen, I. (2017). The metrics of subjective wellbeing data: An empirical evaluation of the ordinal and cardinal comparability of life satisfaction scores. *Social Indicators Research, 130*(2), 845-865

Krueger, A. B. (2003) Economic Considerations and Class Size. *Economic Journal, 113*(485), F34–F63.

Kwan, Y.-K. (2008). Life Satisfaction and Family Structure Among Adolescents in Hong Kong. *Social Indicators Research, 86*(1), 59-67.

Layard, R. (2005). Happiness: Lessons from a new science. New York: Penguin.

Layard, R., Clark, A. E., Cornaglia, F., Powdthavee, N., Vernoit, J. (2014). What Predicts a Successful Life? A Life-course Model of Well-being. *Economic Journal, 124*(580), F720-F738.

Lien, L., Tambs, K., Oppedal, B., Heyerdahl, S., Bjertness, E. (2005). Is Relatively Young Age within a School Year a Risk Factor for Mental Health Problems and Poor School Performance? A Population-based Cross-sectional Study of Adolescents in Oslo, Norway. *BMC Public Health, 5*(102), 1-8.

Lippman, L. H., Ryberg, R., Terzian, M., Moore, K.A., McIntosh, H., Humble, J. (2014). Positive and Protective Factors in Adolescent Well-being. In B. Asher, F. Casas, I. Frones and J. E. Korbin (Eds.), *Handbook of Child Well-being: Theories, Methods and Policies in Global Perspective* (pp. 2823-2866). Dordrecht, Netherlands: Springer.

Lucas, R. E., Donnellan, M. B. (2012). Estimating the reliability of single-item life satisfaction measures: Results from four national panel studies. *Social Indicators Research, 105*(3), 323-331.

Lundborg, P., Nilsson, A., Rooth, D. O. (2014). Adolescent Health and Adult Labor Market Outcomes. *Journal of Health Economics*, *37*, 25-40.

Matsubayashi, T. & Ueda, M. (2015) Relative age in school and suicide among young individuals in Japan: A regression discontinuity approach. *PLoS One, 10*(8), 1-10

Moksnes, U., Espnes, G. A. (2013). Self-esteem and Life Satisfaction in Adolescents—Gender and Age as Potential Moderators. *Quality of Life Research*, *22*(10), 2921-2928.

Mühlenweg, A. M. (2010). Young and Innocent: International Evidence on Age Effects within Grades on Victimization in Elementary School. *Economics Letters, 109*(3), 157-160.

Mühlenweg, A. M., Puhani, P. A. (2010). The Evolution of School-Entry Age Effect in a School Tracking System. *Journal of Human Resources, 45*(2), 407-438.

Mühlenweg, A. M., Blomeyer, D., Laucht, M. (2012). Effects of Age at School Entry (ASE) on the Development of Non-Cognitive Skills: Evidence from Psychometric Data. *Economics of Education Review, 31*(3), 68-76.

Nam, K. (2014). Until when does the effect of age on academic achievement persist? Evidence from Korean data. *Economics of Education Review, 40*, 106-122.

Ng, Y.-K. (1997). A case for happiness, cardinalism, and interpersonal comparability. *Economic Journal, 107*(445), 1848-1858.

OECD. (2013). OECD guidelines on measuring subjective well-being. Paris: OECD Publishing.

Oswald, A. J., Proto, E., Sgroi, D. (2015). Happiness and productivity. *Journal of Labor Economics, 33*(4), 789-822.

Patalay, P., Belsky, J., Fonagy, P., Vostanis, P., Humprey, N., Deighton, J., Wolpert, M. (2015). The Extent and Specificity of Relative Age Effects on Mental Health and Functioning in Early Adolescence. *Journal of Adolescent Health*, *57*, 475-481.

Peña, A. P., Duckworth, A. L. (2018). The effects of relative age and absolute age in measurement of grit from 9th to 12th grade. *Economics of Education Review, 66*, 183-190.

Peña, A. P. (2017). Creating winners and losers: Date of birth, relative age in school, and outcomes in childhood and adulthood. *Economics of Education Review, 56*, 152-176.

Ponzo, M., Scoppa, V. (2014). The Long-Lasting Effects of School Entry Age: Evidence from Italian Students. *Journal of Policy Modeling*, *36*(3), 578-599.

Powdthavee, N. (2007). Economics of happiness: A review of literature and applications. *Chulalongkorn Journal of Economics, 19*(1), 51-73.

Schimmack, U., Krause, P., Wagner, G., Schupp, J. (2010). Stability and change of well-being: An experimentally enhanced latent state-trait-error analysis. *Social Indicators Research, 95*(1), 19-31.

Schneider, L., Schimmack, U. (2009). Self-informant agreement in well-being ratings: A meta-analysis. *Social Indicators Research, 94*(3), 363-376.

Schwandt, H., Wuppermann, A. (2016). The Youngest Get the Pill: ADHD Misdiagnosis in Germany, Its Regional Correlates and International Comparison. *Labour Economics*, *43*, 72-86.

Schwarz, N., Strack, F. (1999). Reports of subjective well-being: Judgmental processes and their methodological implications. *In D. Kahneman & N. Schwarz (Eds.), Well-being: The foundations of hedonist psychology.* New York: Russell Sage Foundation.

Sprietsma, M. (2010). Effect of Relative Age in the First Grade of Primary School on Long-Term Scholastic Results: International Comparative Evidence Using PISA 2003. *Education Economics*, *18*(1), 1-32.

Stock, J. H., Yogo, M. (2002). Testing for Weak Instruments in Linear IV Regression. *Technical Working Paper, No* 284.

Stutzer, A., Frey, B. S. (2012). Recent developments in the economics of happiness: A selective overview. *IZA Discussion Paper,7078.*

Thompson, A. H., Barnsley, R. H. Dyck. R. J. (1999) A new factor in youth suicide: The relative age effect. *Canadian Journal of Psychiatry, 44*, 82-85.

Thompson, A. H., Barnsley, R. H., Battle, J. (2004) Relative age, school achievement, and mental health: Does the age of entering school affect self-esteem? *Educational Research, 46*, 313-320

van Praag, B., Frijters, P., Ferrer-i Carbonell, A. (2003). The anatomy of subjective well-being. *Journal of Economic Behaviour and Organization*, *51*(1), 29-49.

van Reekum, C., Urry, H., Johnstone, T., Thurow, M., Frye, C., Jackson, C., Schaefer, H. S., Alexander, A. L., Davidson (2007). Individual differences in amygdala and ventromedial prefrontal cortex activity are associated with evaluation speed and psychological well-being. *Journal of Cognitive Neuroscience, 19*(2), 237-248.

Vidmar, S., Carlin, J., Hesketh, K., Cole, T. (2004). Standardizing anthropometric measures in children and adolescents with new functions for egen. *The Stata Journal, 4*(1), 50-55.

Wanous, J., Hudy, M. (2001). Single-item reliability: A replication and extension. *Organizational Research Methods, 4*, 361–375.

Wooldridge, J. (2012). Econometric Analysis of Cross Section and Panel Data. Cambridge: MIT Press.

Wooldridge, J. M. (2002). *Introductory econometrics: A modern approach.* New York: South-Western College Publishing.

Zi, J. N., Huebner, S. E., Hills, K. J. (2015). Life Satisfaction and Academic Performance in Early Adolescents: Evidence for Reciprocal Association. *Journal of School Psychology, 53*, 479-491.

Online Appendix

Additional Raw Data Tables

Table O.1. Number of observations, by country and wave. Source: HBSC data.

	N by Wave			
	2001/2	2005/6	2009/10	
Country	N	N	N	N by country
Austria	4,150	4,771	4,715	13,636
Belgium, Flanders	1,805	3,051	2,956	7,812
Belgium, Wallonia	3,018	3,589	3,113	9,720
Bulgaria	-	4,811	-	4,811
Croatia	4,336	4,779	6,058	15,173
Czech Republic	5,006	-	4,316	9,322
Denmark, mainland	4,474	5,363	3,924	13,761
England	4,082	4,730	3,411	12,223
Estonia	3,345	4,188	4,131	11,664
Finland	5,143	5,143	6,494	16,780
France	7,416	5,710	5,471	18,597
Greece	3,102	-	4,801	7,903
Greenland	-	-	198	198
Hungary	-	3,450	4,569	8,019
Iceland	-	8,494	8,780	17,274
Ireland	1,956	3,716	3,890	9,562
Italy	4,313	3,896	4,734	12,943
Latvia	3,206	4,091	4,053	11,350
Lithuania	5,577	5,574	5,211	16,362
Luxembourg	-	2,886	2,968	5,854
Macedonia	3,704	4,838	3,432	11,974
Netherlands	3,769	3,138	3,206	10,113
Norway	4,943	-	4,050	8,993
Poland	6,239	5,466	4,185	15,890
Scotland	4,381	6,130	6,668	17,179
Slovakia	-	276	4,475	4,751
Slovenia	3,894	5,005	5,320	14,219
Spain	5,418	7,729	3,890	17,037
Sweden	3,778	4,332	6,627	14,737
Switzerland	4,083	4,204	5,694	13,981
Ukraine	3,976	4,859	5,345	14,180
Wales	3,804	4,384	5,355	13,543
Total N	108,918	128,566	142,040	379,524

Note: Flanders and Wallonia as well as Denmark mainland and Greenland hold separate surveys within Belgium and Denmark, respectively.

Table O.2 Cutoff dates and age at first tracking, by country.

Country	Cutoff date	Age at first tracking
Austria	Sep 1st	10
Belgium, Flanders	Jan 1st	14
Belgium, Wallonia	Jan 1st	14
Bulgaria	Jan 1st	14
Croatia	Apr 1st	15
Czech Republic	Sep 1st	11
Denmark	Jan 1st	16
England	Sep 1st	16
Estonia	Oct 1st	16
Finland	Jan 1st	16
France	Jan 1st	15
Greece	Jan 1st	14
Greenland	Jan 1st	16
Hungary	Jul 1st	14
Iceland	Jan 1st	16
Ireland	Jan 1st	15
Italy	Jan 1st	14
Latvia	Jan 1st	13
Lithuania	Jan 1st	11
Luxembourg	Sep 1st	12
Macedonia	Jan 1st	14
Netherlands	Oct 1st	12
Norway	Jan 1st	16
Poland	Sep 1st	15
Scotland	Mar 1st	16
Slovakia	Sep 1st	15
Slovenia	Jan 1st	15
Spain	Jan 1st	15
Sweden	Jan 1st	16
Switzerland	Jul 1st	15
Ukraine	Jan 1st	15
Wales	Sep 1st	16

Table O.3 Educational settings sources.

Country	Source
Croatia	Sakic, M., Burusic, J., Babarovic, T. (2013). The Relation Between School Entrance Age and School Achievement During Primary Schooling: Evidence from Croatian Primary Schools. British Journal of Education Psychology, 83(4), 651-663.
Estonia	Toomela, A., Kikas, E., Mõttus, E. (2006). Ability Grouping in Schools: A Study of Academic Achievements in Five Schools in Estonia. Trames, 10(1), 32-43.
Greenland	Statistics Greenland (2015). Greenland in Figures – 2015. Nuuk, Greenland: Statistics Greenland.
Greenland	Rex, K. F., Larsen, N. H., Rex, H., Niclasen, B., Pedersen, M. L. (2014). A National Study on Weight Classes Among Children in Greenland at School Entry. International Journal of Circumpolar Health, 73, 1-6.
Luxembourg	Ministry of Education correspondence, private correspondence
Multiple	https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Countries
Multiple	http://www.oecd.org/edu/bycountry/
Multiple	http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/eu_press_release/126EN_HI.pdf
Multiple	https://www.nfer.ac.uk/eurydice/compulsory-age-of-starting-school
Netherlands	Plug, E. J. S. (2001). Season of Birth, Schooling and Earnings. Journal of Economic Psychology, *22*(5), 641-660
Norway	Lien et al. (2005)
Norway	Solli, I. F. (2017). Left behind by birth month. Education Economics, *25*(4), 323-346.
Scotland	Gamoran, A. (2002). Standards, Inequality & Ability Grouping in Schools. Mimeo.
Ukrania	https://www.classbase.com/countries/Ukraine/Education-System

Table O.4 Rates of regular, younger, and older students, by country.

Country	Regular students rate	Younger students rate	Older students rate
Austria	0.854	0.027	0.119
Belgium, Flanders	0.800	0.073	0.126
Belgium, Wallonia	0.725	0.074	0.201
Bulgaria	0.935	0.049	0.017
Croatia	0.920	0.023	0.057
Czech Republic	0.800	0.033	0.167
Denmark	0.898	0.022	0.080
England	0.985	0.005	0.010
Estonia	0.807	0.071	0.121
Finland	0.959	0.012	0.029
France	0.728	0.120	0.152
Greece	0.973	0.001	0.026
Greenland	0.347	0.279	0.374
Hungary	0.745	0.011	0.244
Iceland	0.989	0.006	0.005
Ireland	0.523	0.083	0.395
Italy	0.916	0.026	0.057
Latvia	0.868	0.023	0.109
Lithuania	0.826	0.093	0.082
Luxembourg	0.765	0.102	0.134
Macedonia	0.729	0.126	0.145
Netherlands	0.868	0.079	0.053
Norway	0.979	0.007	0.014
Poland	0.986	0.004	0.010
Scotland	0.942	0.005	0.053
Slovakia	0.853	0.038	0.110
Slovenia	0.917	0.048	0.035
Spain	0.766	0.067	0.167
Sweden	0.957	0.017	0.025
Switzerland	0.652	0.036	0.311
Ukraine	0.819	0.015	0.166
Wales	0.989	0.004	0.007
Pooled	0.861	0.040	0.098

Note: Regular students have the expected age in a given class. Younger students are younger than expected in a given class (e.g. they skipped a grade or entered school one year earlier). Older students are older than expected in a given class (e.g. they were retained or redshirted).

Table O.5 Variance inflation factor of expected relative age and of season of birth.

Variables	VIF
Expected relative age dummies	
ERA 1	3.40
ERA 2	3.29
ERA 3	3.42
ERA 4	3.20
ERA 5	3.80
ERA 6	3.09
ERA 7	3.68
ERA 8	2.99
ERA 9	3.21
ERA 10	3.11
ERA 11	3.40
Season of birth dummies	
February	3.37
March	3.36
April	3.43
May	3.20
June	3.82
July	3.07
August	3.65
September	2.98
October	3.21
November	3.10
December	3.43

Note: 'VIF' stands for variance inflation factor.

Balance tests

While the disaggregation allows us to conduct an over-identifying test and thus to establish the orthogonality of ERA with respect to unobservable characteristics, we should still verify whether ERA is orthogonal with respect to observable demographic characteristics as well; therefore, we conduct a few balance tests. For these tests, the information on academic month is summarized by a dummy variable that we call '*Last quarter;*' this variable equals one for students born in the fourth quarter of the academic year and zero otherwise.

Based on this dummy, we split the sample in two groups, and compare the average value of demographic characteristics (i.e. age, gender, parents at home, and SES) between them with t-tests. Additionally, we verify the economic significance of possible imbalances by checking (i) standardized differences, and (ii) variances ratios. Following Linden and Samuels (2013), the reference value for (i) is 0.2—which is a small difference based on the Cohen's d statistics—, and for (ii) it is 1. Table O.5 reports the results.

Table O.6 Unconditional balance t-tests on demographic characteristics, standardized mean differences, variances ratio.

	Last quarter = 1		Last quarter = 0		T-test, absolute mean difference	Standardized mean difference	Variances ratio
	Mean	Variance	Mean	Variance			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Absolute age	13.381	0.236	13.593	2.709	-0.212***	-0.175	0.087
Female	0.509	0.250	0.507	0.250	0.002	0.004	1.000
Both parents at home	0.761	0.181	0.769	0.177	-0.008***	-0.019	1.024
Low SES	0.211	0.167	0.210	0.166	0.001	0.002	1.010
Medium SES	0.403	0.240	0.402	0.240	0.001	0.002	1.000
High SES	0.385	0.236	0.387	0.237	-0.002	-0.004	0.996

Note: 'SES' stands for socio-economic status. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The results reported in Table O.6 are reassuring on the validity of the instrument. T-tests from Column (5) tell us that absolute age and the presence of both parents at home are statistically significantly imbalanced. While the first imbalance is obvious (i.e. students born toward the end of the academic year have a lower absolute age), the second one is not of straightforward interpretation. However, it is important to remark that standardized mean differences and variances ratios, from Columns (6) and (7), tell us that there is no economically significant imbalance.

Additionally, we conduct a naïf conditional balance test with a 2SLS on the dichotomized version of *Last quarter* on control variables. Table O.7 reports the results.

Table O.7 Conditional balance test; 2SLS of the dichotomized expected relative age on demographic characteristics.

Variables	Last quarter	Last quarter	Last quarter
	(1)	(2)	(3)
Absolute age	-0.010***	-0.010***	-0.010***
	(0.001)	(0.001)	(0.001)
Female		-0.001	-0.001
		(0.001)	(0.001)
Both parents at home		-0.007***	-0.007***
		(0.001)	(0.001)
Medium SES			0.001
			(0.002)
High SES			-0.003
			(0.002)
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X
N	379,524	370,715	370,715
R-squared	0.317	0.317	0.317

Note: 'SES' stands for socio-economic status. Standard errors clustered on class are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The magnitude of the estimated coefficients is even smaller than that from the conditional balance t-tests, and confirm the results from the unconditional balance test.

First stages and reduced forms

Table O.8 Life-satisfaction: First stages and reduced form, no interaction.

Variables	First stages		Reduced form
	Relative age	Absolute age	Life-satisfaction
	(1)	(2)	(3)
ERA 1	-0.095*	-0.019***	0.003
	(0.057)	(0.004)	(0.011)
ERA 2	-0.753***	-0.068***	-0.006
	(0.053)	(0.003)	(0.010)
ERA 3	-1.236***	0.046***	-0.035***
	(0.054)	(0.003)	(0.010)
ERA 4	-2.180***	0.002	-0.033***
	(0.052)	(0.003)	(0.010)
ERA 5	-2.803***	-0.042***	-0.048***
	(0.057)	(0.003)	(0.011)
ERA 6	-3.178***	0.042***	-0.037***
	(0.056)	(0.003)	(0.010)
ERA 7	-3.711***	0.017***	-0.061***
	(0.062)	(0.003)	(0.011)
ERA 8	-4.618***	-0.038***	-0.053***
	(0.057)	(0.003)	(0.010)
ERA 9	-4.845***	0.024***	-0.079***
	(0.065)	(0.004)	(0.011)
ERA 10	-4.706***	0.016***	-0.067***
	(0.066)	(0.004)	(0.011)
ERA 11	-4.696***	0.005***	-0.076***
	(0.071)	(0.004)	(0.011)
Expected absolute age	0.190***	0.991***	-0.106***
	(0.010)	(0.000)	(0.001)
Demographic variables	X	X	X
Fized-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X
N	344,239		

Note: Expected absolute age is centred. Demographic control variables include: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.9 General health: First stages and reduced form, no interaction.

Variables	First stages		Reduced form
	Relative age (1)	Absolute age (2)	General health (3)
ERA 1	-0.060	-0.018***	-0.011
	(0.058)	(0.004)	(0.011)
ERA 2	-0.752***	-0.068***	-0.007
	(0.0539	(0.003)	(0.011)
ERA 3	-1.213***	0.047***	-0.029***
	(0.055)	(0.003)	(0.011)
ERA 4	-2.127***	0.003	-0.030***
	(0.052)	(0.003)	(0.010)
ERA 5	-2.744***	-0.041***	-0.023**
	(0.057)	(0.003)	(0.011)
ERA 6	-3.127***	0.041***	-0.026***
	(0.055)	(0.003)	(0.010)
ERA 7	-3.646***	0.017***	-0.043***
	(0.062)	(0.003)	(0.011)
ERA 8	-4.563***	-0.037***	-0.055***
	(0.056)	(0.003)	(0.010)
ERA 9	-4.806***	0.024***	-0.044***
	(0.065)	(0.004)	(0.011)
ERA 10	-4.646***	0.017***	-0.048***
	(0.065)	(0.004)	(0.011)
ERA 11	-4.644***	0.005	-0.053***
	(0.070)	(0.004)	(0.011)
Expected absolute age	0.171***	0.991***	-0.068***
	(0.010)	(0.000)	(0.001)
Demographic variables	X	X	X
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X
N	349,501		

Note: Expected absolute age is centred. Demographic control variables include: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.10 Index of psychosomatic complaints: First stages and reduced form, no interaction.

Variables	First stages		Reduced form
	Relative age	Absolute age	Index of psychosomatic
	(1)	(2)	(3)
ERA 1	-0.072	-0.019***	0.004
	(0.058)	(0.004)	(0.011)
ERA 2	-0.739***	-0.068***	0.006
	(0.053)	(0.003)	(0.011)
ERA 3	-1.215***	0.046***	0.020*
	(0.054)	(0.003)	(0.011)
ERA 4	-2.131***	0.003	0.025**
	(0.052)	(0.003)	(0.010)
ERA 5	-2.757***	-0.041***	0.011
	(0.057)	(0.003)	(0.011)
ERA 6	-3.139***	0.041***	0.009
	(0.055)	(0.003)	(0.010)
ERA 7	-3.663***	0.016***	0.021*
	(0.062)	(0.003)	(0.011)
ERA 8	-4.576***	-0.037***	0.026***
	(0.057)	(0.003)	(0.010)
ERA 9	-4.827***	0.023***	0.032***
	(0.066)	(0.004)	(0.011)
ERA 10	-4.660***	0.018***	0.038***
	(0.066)	(0.004)	(0.011)
ERA 11	-4.666***	0.005	0.036***
	(0.071)	(0.004)	(0.011)
Expected absolute age	0.194***	0.991***	0.071***
	(0.010)	(0.001)	(0.001)
Demographic variables	X	X	X
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X
N	350,523		

Note: Expected absolute age is centred. Demographic control variables include: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.11 Overweight: First stages and reduced form, no interaction.

	First stages		Reduced form
Variables	Relative age (1)	Absolute age (2)	Overweight (3)
ERA 1	-0.026	-0.021***	-0.011**
	(0.078)	(0.005)	(0.005)
ERA 2	-0.622***	-0.071***	-0.002
	(0.073)	(0.004)	(0.005)
ERA 3	-1.085***	0.048***	-0.005
	(0.073)	(0.004)	(0.005)
ERA 4	-2.208***	0.003	0.002
	(0.072)	(0.004)	(0.005)
ERA 5	-2.789***	-0.032***	0.004
	(0.076)	(0.004)	(0.005)
ERA 6	-3.266***	0.034***	0.004
	(0.078)	(0.005)	(0.004)
ERA 7	-3.645***	0.015***	0.000
	(0.085)	(0.005)	(0.005)
ERA 8	-4.397***	-0.025***	0.001
	(0.079)	(0.004)	(0.005)
ERA 9	-4.706***	0.019***	-0.003
	(0.088)	(0.005)	(0.005)
ERA 10	-4.379***	0.015***	0.010*
	(0.091)	(0.005)	(0.005)
ERA 11	-4.223***	(0.011**	0.002
	(0.095)	0.005)	(0.005)
Expected absolute age	0.205***	0.991***	-0.003***
	(0.001)	(0.001)	(0.001)
Demographic variables	X	X	X
Fixed-effects			
Country	X	X	X
Wave	X	X	X
Season of birth	X	X	X
N	195,991		

Note: Expected absolute age is centred. Demographic control variables include: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.12. Points estimates of one-year relative age, and of main demographic variables, by outcome, and their relative magnitude.

Variables	Relative age × 12	Main demographic variables: Low to Medium SES	Medium to High SES	Low to High SES	Absolute age
	(1)	(2)	(3)	(4)	(5)
	Point estimates				
Life satisfaction	0.168	0.134	0.200	0.334	-0.110
General health	0.108	0.123	0.104	0.227	-0.070
Index of psychosomatic	-0.072	-0.079	-0.027	-0.106	0.072
Overweight	-0.024	-0.006	-0.019	-0.025	-0.002
	Relative magnitude of point estimates compared to Relative age × 12				
Life satisfaction		25%	-16%	-50%	Diff. sign
General health		-12%	4%	-52%	Diff. sign
Index of psychosomatic		-9%	167%	-32%	Diff. sign
Overweight		300%	26%	-4%	1150%

Note: 'Diff. sign' stands for different sign. Point estimates of Medium to High SES are obtained by subtracting (2) from (4). Figures in the bottom panel are obtained with this formula [(estimate relative age × 12 - estimate demographic variable) / (estimate relative age × 12)] × 100.

Omitted variable bias computation

Table O.13 Relative age on standardized life satisfaction, general health, and index of psychosomatic, and on the dummy for overweight status. 2SLS estimates of 'true relative age', 'biased relative age', conditional correlation between relative and absolute age, computed bias.

Variables	Life-satisfaction	Life-satisfaction	Absolute age	General health	General health	Absolute age	Index of psychosomatic	Index of psychosomatic	Absolute age	Overweight	Overweight	Absolute age
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Relative age	0.014***	0.006***	0.072***	0.009***	0.004***	0.072***	-0.006***	-0.000	0.071***	-0.002***	-0.002***	0.069***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.026)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)
Absolute age	-0.110***			-0.070***			0.072***			-0.002***		
	(0.001)			(0.001)			(0.001)			(0.001)		
Other demographic control variables	X	X	X	X	X	X	X	X	X			
Fixed-effects	X	X	X	X	X	X	X	X	X			
N	344,239	344,239	344,239	349,501	349,501	349,501	350,523	350,523	350,523	195,991	195,991	195,991
Computed bias caused by the omission of absolute age		-0.0079			-0.0050			0.0051			-0.0001	

Note: Absolute age is centred. Other demographic control variables include: dummy for gender, dummies for having both parents at home, and dummies for Medium and High socio-economic status. Fixed-effects include dummies for country, wave, and season of birth. *** p < 0.01, ** p < 0.05, * p < 0.1.

Health Outcome – Interaction between Relative and Absolute Age, and by Age at First Tracking

Table O.14 Relative age and its interaction with absolute age on standardized general health; 2SLS results (only second stage).

	Pooled sample	Age at first tracking		
		<14	14 or 15	>15
Variables	General health	General health	General health	General health
	(1)	(2)	(3)	(4)
Relative age	0.009***	0.008***	0.010***	0.010***
	(0.001)	(0.002)	(0.003)	(0.001)
Relative age × Absolute age	0.001	-0.001	0.003	0.001
	(0.001)	(0.002)	(0.002)	(0.001)
Absolute age	-0.070***	-0.069***	-0.073***	-0.063***
	(0.003)	(0.006)	(0.005)	(0.004)
Demographic control variables	X	X	X	X
Fixed-effects				
Country	X	X	X	X
Wave	X	X	X	X
Season of birth	X	X	X	X
N	349,501	120,312	111,766	117,423
R-squared	0.088	0.102	0.088	0.061
2SLS ancillary tests				
Under-identification test: Lagrange-Multiplier statistic [p-value]	3757.448 [0.000]	1205.532 [0.000]	759.074[0.000]	2448.165 [0.000]
Weak identification test: F-statistic	339.477	84.853	56.854	646.568
Over-identification test: Hansen J statistic [p-value]	24.386 [0.226]	32.153 [0.047]	15.481 [0.748]	15.474 [0.748]
Relative age estimates in years				
Relative age	0,108***	0.096***	0.120***	0.120***
Relative age × Absolute age	0.012	-0.012	0.036	0.012

Note: Absolute age is centred. The analyses are conducted with the full model specification. Demographic control variables: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.15 Relative age and its interaction with absolute age on standardized index on lack of psychosomatic complaints; 2SLS results (only second stage).

Variables	Pooled sample	Age at first tracking		
		<14	14 or 15	>15
	Lack of psycho-somatic	Lack of psycho-somatic	Lack of psycho-somatic	Lack of psycho-somatic
	(1)	(2)	(3)	(4)
Relative age	-0.005***	-0.004***	-0.005*	-0.006***
	(0.001)	(0.002)	(0.003)	(0.001)
Relative age × Absolute age	0.001	-0.001	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Absolute age	0.073***	0.084***	0.062***	0.072***
	(0.003)	(0.006)	(0.005)	(0.004)
Demographic control variables	X	X	X	X
Fixed-effects				
Country	X	X	X	X
Wave	X	X	X	X
Season of birth	X	X	X	X
N	350,523	118,661	111,766	115,831
R-squared	0.079	0.095	0.076	0.065
2SLS ancillary tests				
Under-identification test:	3655.748	1196.365	785.387	2425.493
Lagrange-Multiplier statistic [p-value]	[0.000]	[0.000]	[0.000]	[0.000]
Weak identification test: F-statistic	327.284	83.667	56.313	642.222
Over-identification test: Hansen	24.232	24.942	29.171	20.556
J statistic [p-value]	[0.232]	[0.204]	[0.084]	[0.424]
Relative age estimates in years				
Relative age	-0.060***	-0.048***	-0.060*	-0.072***
Relative age × Absolute age	0.012	-0.012	-0.012	0.012

Note: Absolute age is centred. The analyses are conducted with the full model specification. Demographic control variables: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table O.16 Relative age and its interaction with absolute age on the dummy for not-overweight status; 2SLS results (only second stage).

Variables	Pooled sample	Age at first tracking		
		<14	14 or 15	>15
	Overweight	Overweight	Overweight	Overweight
	(1)	(2)	(3)	(4)
Relative age	-0.002***	-0.002*	-0.003**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Relative age × Absolute age	0.001	0.001*	-0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Absolute age	-0.001	0.001	-0.004*	0.001
	(0.001)	(0.002)	(0.002)	(0.002)
Demographic control variables	X	X	X	X
Fixed-effects				
Country	X	X	X	X
Wave	X	X	X	X
Season of birth	X	X	X	X
N	195,991	70,042	67,985	57,964
R-squared	0.019	0.025	0.019	0.012
2SLS ancillary tests				
Under-identification test:	2264.927	1007.176	537.124	1186.648
Lagrange-Multiplier statistic [p-value]	[0.000]	[0.000]	[0.000]	[0.000]
Weak identification test: F-statistic	188.077	86.545	34.804	333.179
Over-identification test: Hansen	23.330	16.309	19.964	17.908
J statistic [p-value]	[0.273]	[0.697]	[0.460]	[0.593]
Relative age estimates in years				
Relative age	-0.024***	-0.024***	-0.036**	-0.012
Relative age × Absolute age	0.012	0.012*	-0.012	0.012

Note: Absolute age is centred. The analyses are conducted with the full model specification. Demographic control variables: dummies for being female, for having both parents at home, for Medium and High socio-economic status. Standard errors clustered on class are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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